Solicitation No. **W912ES22B0010**

CONSTRUCTION
DOCUMENTS
FOR

LOCK AND DAM NO 4
LOWER GUIDEWALL END CELL
MISSISSIPPI RIVER
LOCK AND DAM 4
ALMA, WISCONSIN

March 2023

US Army Corps
Of Engineers
St. Paul District

SOLICITATION, OFFER, AND AWARD *(Construction, Alteration, or Repair)*	1. SOLICITATION NO. W912ES22B0010	2. TYPE OF SOLICITATION [X] SEALED BID (IFB) [ ] NEGOTIATED *(RFP)*	3. DATE ISSUED 11-APR-2023	PAGE OF PAGES 1 OF 241

IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO. W81G6730663346	6. PROJECT NO.

7. ISSUED BY CODE W912ES	8. ADDRESS OFFER TO *(If Other Than Item 7)* CODE
CONTRACTING DIVISION USACE - ST PAUL 1332 MINNESOTA STREET SUITE E1500 SAINT PAUL MN 55101-1678	**See Item 7**
TEL:651-290-5414 FAX:	TEL: FAX:

9. FOR INFORMATION CALL:	A. NAME SCOTT E HENDRIX	B. TELEPHONE NO. *(Include area code)* *(NO COLLECT CALLS)* 651-290-5406

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS*(Title, identifying no., date):*

Lock and Dam 4 End Cell Mississippi River Basin Alma, Wisconsin

This solicitation is issued as an Invitation for Bid (IFB) and is 100% set-aside for small business concerns. The anticipated magnitude of this project is between $5,000,000 and $10,000,000. The NAICS code for this procurement is 237990, Other Heavy and Civil Engineering Construction with a size standard of $45,000,000.

Payment and Performance protection is required in accordance with FAR Part 28.

11. The Contractor shall begin performance within 10 calendar days and complete it within _____ calendar days after receiving [ ] award, [X] notice to proceed. This performance period is [X] mandatory, [ ] negotiable. *(See* 52.211-10 Alt1 *.)*

12 A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? *(If "YES," indicate within how many calendar days after award in Item 12B.)* [X] YES [ ] NO	12B. CALENDAR DAYS 10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 1 copies to perform the work required are due at the place specified in Item 8 by 02:00 PM *(hour)* local time 11 MAY 2023 *(date).* If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee [X] is, [ ] is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 60 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

SOLICITATION, OFFER, AND AWARD (Continued)

(Construction, Alteration, or Repair)

OFFER ***(Must be fully completed by offeror)***

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*		15. TELEPHONE NO. *(Include area code)*
		16. REMITTANCE ADDRESS *(Include only if different than Item 14)* **See Item 14**
CODE	FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirements stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)*

AMOUNTS	SEE SCHEDULE OF PRICES

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS

(The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each)

AMENDMENT NO.										
DATE										

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20B. SIGNATURE	20C. OFFER DATE

AWARD ***(To be completed by Government)***

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 copies unless otherwise specified)*	**ITEM**	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c) ☐ 41 U.S.C. 253(c)
26. ADMINISTERED BY CODE		27. PAYMENT WILL BE MADE BY: CODE

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return _____ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.

☐ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation, is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31A. NAME OF CONTRACTING OFFICER *(Type or print)* TEL: EMAIL:
30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY
		31C. AWARD DATE

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SECTION 00 10 00 - SOLICITATION

BID SCHEDULE

Item No.	SUPPLIES/SERVICES	QUANTITY	Unit	Unit Price	Amount
0001	Bonds (Performance & Payment)	1	Job	$	$
0002	Miscellaneous Metals	1	Job	$	$
0003	Mass Concrete	1	Job	$	$
0004	Precast Concrete	1	Job	$	$
0005	Electrical Work	1	Job	$	$
0006	Demolition and Removals	1	Job	$	$
0007	Riprap and Bedding	215	CY	$	$
0008	Steel H Piling	4,407	LF	$	$
0009	PS31 Metal Sheet Piling	3,390	SF	$	$
0010	Z Metal Sheet Piling	2,282	SF	$	$
0011	Gage House	1	Job	$	$
0012	Existing Tie-Back Wall and Interceptor Sewer Wing Wall Concrete Repairs	1	Job	$	$
0013	Erosion Protection Slab	1	Job	$	$
0014	Hydrographic Survey	1	Job	$	$
				TOTAL	

BID SUBMITTAL INSTRUCTIONS

1. **SAM REGISTRATION.** All bidders must register and complete online representations and certifications in the System for Award Management (SAM) at https://sam.gov/content/entity-landing prior to the bid opening. Bidders that have not registered or completed their online representations and certifications may be rejected. Bidders are advised that the initial registration in SAM may take several weeks. The Government will review completed representations and certifications in SAM following the bid opening. Submission of paper copies of completed Representations and Certifications is NOT required with bid submissions.

2. **RESPONSIBILITY DETERMINATION.** In accordance with Federal Acquisition Regulation (FAR) Subpart 9.1, the apparent low bidder will be requested to provide the following information:

A detailed description of the work to be self-performed and resources available to demonstrate the firm is capable of complying with 52.219-14, Limitations on Subcontracting.

Financial Statements, including balance sheets that identify major categories of assets, liabilities, and owner's equity; and profit and loss statements for the past three (3) years.

A Bank Certification of Financial Capability (line of credit).

Bidder qualification information, as referenced in Section 00 73 00 – Supplementary Conditions, must be received by the Contracting Officer **within two (2) business days** after the bid opening. This information will be treated as confidential commercial or financial information to the extent permitted by law under exemption 4 to the Freedom of Information Act, 5 U.S.C. § 552(b)(4). The financial statements should be not over 60 days old. If over 60 days old, a certification should be attached stating that the financial condition of the firm is substantially the same or, if not the same, the changes that have taken place.

3. **BIDDER INQUIRIES.** Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must submit their questions using the ProjNet system at https://www.projnet.org.

Provision 52.214-6 requires that all inquiries be submitted in writing. To submit a new inquiry or to view inquiries submitted by other prospective bidders, users must be registered and signed into the ProjNet system. Bidders may register online at https://www.projnet.org (click on "Register").

The following information will be needed to submit or view bidder inquiries:

Managing Agency: **USACE**

Solicitation Number: **W912ES22B0010**

Bidder Inquiry Key: **86GK4D-92H284**

Bidders shall submit inquiries not later than 10 days prior to bid opening in order to ensure adequate time is allotted to form an appropriate response and amend the solicitation if necessary. Those who submit an inquiry will receive a system-generated email acknowledgement. All answers to inquiries will be posted in ProjNet after they have been reviewed by the USACE technical team. Bidders are advised to review the solicitation in its entirety and to review all previously submitted questions and responses prior to submitting a new inquiry.

4. **IFB EXPENSES AND PRE-CONTRACT COSTS**. This IFB does not commit the Government to pay any costs incurred in the preparation and submission of materials or for any other costs incurred by any firm

submitting materials in response to this solicitation. Finally, the Government will not pay for or subsidize any costs incurred for attendance at the site visit.

5. Any forthcoming amendments will be available on this website: https://sam.gov/content/opportunities. It is recommended that each registered firm check this website periodically for updates.

6. All Quantities are estimated except where unit is given as "EA" (each) or "JOB" (job).

7. FACSIMILE BIDS AND MODIFICATIONS WILL NOT BE ACCEPTED.

8. **Bidders are directed to FAR Clause 52.211-10, COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984) - ALTERNATE I (APR 1984) for completion date requirements.**

BID SUBMISSION & BID OPENING

1. BID SUBMISSION (HAND-CARRIED OR MAIL – authorized transmission methods)

The sealed, hand-carried or mailed, bid envelope containing the bid package must be annotated on the outside of the envelope as follows:

Bidders Name
Bidders Address
Solicitation Number: W912ES22B0010, Lock and Dam 4 End Cell Mississippi River Basin
Bid Receipt Date: 05/11/2023 (or as amended)
Bid Receipt Time: 2:00pm Central

HAND-CARRIED BIDS:
Public access to USACE St. Paul District Headquarters, 332 Minnesota Street, Suite E1500, St. Paul, MN 55101 is through the East tower elevators. Persons delivering hand-carried bids shall go to the Security desk on the 15th floor, between the hours of 8:00am and 3:30pm on 09 and 10 May 2023, and between 8:00am and 2:00pm on 11 May 2023. Someone from the Security Desk will contact a member of Contracting, who will meet you there and accept the bid. Bids shall only be accepted by a member of the Contracting office.

MAILED BIDS: Bids may be mailed to ensure receipt by USACE before the sealed bid due date and time at the following mail address:

Contracting Division
Attn: Ken Eshom (IFB No: W912ES22B0010)
USACE - ST. PAUL
332 Minnesota Street
Suite E1500
Saint Paul, MN 55101-1678

Sealed bids received at the designated location after the required due date and time may be rejected. See Federal Acquisition Regulation Part 14.304.

2. BID OPENING

A public bid opening will be held at the above address on the above date and time (or as amended). Vendors who plan on attending in person should allow enough time to check in at the Security desk on the 15th floor prior to the bid opening time. To participate by telephone, please follow the directions below:

Join by phone

+1-669-234-1177 US Toll
+1-844-800-2712 US Toll Free
Access Code: 2762 705 4843
Attendee ID: #

USACE Contracting will be on the line starting at 1:50pm to take attendance prior to bid opening.

SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS

52.204-7 SYSTEM FOR AWARD MANAGEMENT (OCT 2018)

(a) Definitions. As used in this provision--

Electronic Funds Transfer (EFT) indicator means a four-character suffix to the unique entity identifier. The suffix is assigned at the discretion of the commercial, nonprofit, or Government entity to establish additional System for Award Management records for identifying alternative EFT accounts (see subpart 32.11) for the same entity.

Registered in the System for Award Management (SAM) means that--

(1) The Offeror has entered all mandatory information, including the unique entity identifier and the EFT indicator, if applicable, the Commercial and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see subpart 4.14) into SAM;

(2) The offeror has completed the Core, Assertions, and Representations and Certifications, and Points of Contact sections of the registration in SAM;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The offeror will be required to provide consent for TIN validation to the Government as a part of the SAM registration process; and

(4) The Government has marked the record ``Active".

Unique entity identifier means a number or other identifier used to identify a specific commercial, nonprofit, or Government entity. See www.sam.gov for the designated entity for establishing unique entity identifiers.

(b)(1) An Offeror is required to be registered in SAM when submitting an offer or quotation, and shall continue to be registered until time of award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The Offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation ``Unique Entity Identifier" followed by the unique entity identifier that identifies the Offeror's name and address exactly as stated in the offer. The Offeror also shall enter its EFT indicator, if applicable. The unique entity identifier will be used by the Contracting Officer to verify that the Offeror is registered in SAM.

(c) If the Offeror does not have a unique entity identifier, it should contact the entity designated at www.sam.gov for establishment of the unique entity identifier directly to obtain one. The Offeror should be prepared to provide the following information:

(1) Company legal business name.

(2) Tradestyle, doing business, or other name by which your entity is commonly recognized.

(3) Company physical street address, city, state, and Zip Code.

(4) Company mailing address, city, state and Zip Code (if separate from physical).

(5) Company telephone number.

(6) Date the company was started.

(7) Number of employees at your location.

(8) Chief executive officer/key manager.

(9) Line of business (industry).

(10) Company headquarters name and address (reporting relationship within your entity).

(d) Processing time should be taken into consideration when registering. Offerors who are not registered in SAM should consider applying for registration immediately upon receipt of this solicitation. See https://www.sam.gov for information on registration.

(End of Provision)

52.204-16 COMMERCIAL AND GOVERNMENT ENTITY CODE REPORTING (AUG 2020)

(a) Definition. As used in this provision--

Commercial and Government Entity (CAGE) code means—

(1) An identifier assigned to entities located in the United States or its outlying areas by the Defense Logistics Agency (DLA) Commercial and Government Entity (CAGE) Branch to identify a commercial or government entity by unique location; or

(2) An identifier assigned by a member of the North Atlantic Treaty Organization (NATO) or by the NATO Support and Procurement Agency (NSPA) to entities located outside the United States and its outlying areas that the DLA Commercial and Government Entity (CAGE) Branch records and maintains in the CAGE master file. This type of code is known as a NATO CAGE (NCAGE) code.

(b) The Offeror shall provide its CAGE code with its offer with its name and location address or otherwise include it prominently in its proposal. The CAGE code must be for that name and location address. Insert the word "CAGE" before the number. The CAGE code is required prior to award.

(c) CAGE codes may be obtained via--

(1) Registration in the System for Award Management (SAM) at www.sam.gov. If the Offeror is located in the United States or its outlying areas and does not already have a CAGE code assigned, the DLA Commercial and Government Entity (CAGE) Branch will assign a CAGE code as a part of the SAM registration process. SAM registrants located outside the United States and its outlying areas shall obtain a NCAGE code prior to registration in SAM (see paragraph (c)(3) of this provision).

(2) The DLA Commercial and Government Entity (CAGE) Branch. If registration in SAM is not required for the subject procurement, and the Offeror does not otherwise register in SAM, an Offeror located in the United States or its outlying areas may request that a CAGE code be assigned by submitting a request at https://cage.dla.mil.

(3) The appropriate country codification bureau. Entities located outside the United States and its outlying areas may obtain an NCAGE code by contacting the Codification Bureau in the foreign entity's country if that country is a member of NATO or a sponsored nation. NCAGE codes may be obtained from the NSPA at https://eportal.nspa.nato.int/AC135Public/scage/CageList.aspx if the foreign entity's country is not a member of NATO or a sponsored nation. Points of contact for codification bureaus, as well as additional information on obtaining NCAGE codes, are available at http://www.nato.int/structur/AC/135/main/links/contacts.htm.

(d) Additional guidance for establishing and maintaining CAGE codes is available at https://cage.dla.mil.

(e) When a CAGE code is required for the immediate owner and/or the highest-level owner by Federal Acquisition Regulation (FAR) 52.204-17 or 52.212-3(p), the Offeror shall obtain the respective CAGE code from that entity to supply the CAGE code to the Government.

(f) Do not delay submission of the offer pending receipt of a CAGE code.

(g) If the solicitation includes FAR clause 52.204-2, Security Requirements, a subcontractor requiring access to classified information under a contract shall be identified with a CAGE code on the DD Form 254. The Contractor shall require a subcontractor requiring access to classified information to provide its CAGE code with its name and location address or otherwise include it prominently in the proposal. Each location of subcontractor performance listed on the DD Form 254 is required to reflect a corresponding unique CAGE code for each listed location unless the work is being performed at a Government facility, in which case the agency location code shall be used. The CAGE code must be for that name and location address. Insert the word "CAGE" before the number. The CAGE code is required prior to award.

(End of Provision)

52.209-7 INFORMATION REGARDING RESPONSIBILITY MATTERS (OCT 2018)

(a) Definitions. As used in this provision--

Administrative proceeding means a non-judicial process that is adjudicatory in nature in order to make a determination of fault or liability (e.g., Securities and Exchange Commission Administrative Proceedings, Civilian Board of Contract Appeals Proceedings, and Armed Services Board of Contract Appeals Proceedings). This includes administrative proceedings at the Federal and State level but only in connection with performance of a Federal contract or grant. It does not include agency actions such as contract audits, site visits, corrective plans, or inspection of deliverables.

Federal contracts and grants with total value greater than $10,000,000 means--

(1) The total value of all current, active contracts and grants, including all priced options; and

(2) The total value of all current, active orders including all priced options under indefinite-delivery, indefinite-quantity, 8(a), or requirements contracts (including task and delivery and multiple-award Schedules).

Principal means an officer, director, owner, partner, or a person having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a

division or business segment; and similar positions).

(b) The offeror ( ) has ( ) does not have current active Federal contracts and grants with total value greater than $10,000,000.

(c) If the offeror checked "has" in paragraph (b) of this provision, the offeror represents, by submission of this offer, that the information it has entered in the Federal Awardee Performance and Integrity Information System (FAPIIS) is current, accurate, and complete as of the date of submission of this offer with regard to the following information:

(1) Whether the offeror, and/or any of its principals, has or has not, within the last five years, in connection with the award to or performance by the offeror of a Federal contract or grant, been the subject of a proceeding, at the Federal or State level that resulted in any of the following dispositions:

(i) In a criminal proceeding, a conviction.

(ii) In a civil proceeding, a finding of fault and liability that results in the payment of a monetary fine, penalty, reimbursement, restitution, or damages of $5,000 or more.

(iii) In an administrative proceeding, a finding of fault and liability that results in--

(A) The payment of a monetary fine or penalty of $5,000 or more; or

(B) The payment of a reimbursement, restitution, or damages in excess of $100,000.

(iv) In a criminal, civil, or administrative proceeding, a disposition of the matter by consent or compromise with an acknowledgment of fault by the Contractor if the proceeding could have led to any of the outcomes specified in paragraphs (c)(1)(i), (c)(1)(ii), or (c)(1)(iii) of this provision.

(2) If the offeror has been involved in the last five years in any of the occurrences listed in (c)(1) of this provision, whether the offeror has provided the requested information with regard to each occurrence.

(d) The offeror shall post the information in paragraphs (c)(1)(i) through (c)(1)(iv) of this provision in FAPIIS as required through maintaining an active registration in the System for Award Management, which can be accessed via https://www.sam.gov (see 52.204-7).

(End of provision)

52.214-3 AMENDMENTS TO INVITATIONS FOR BIDS (DEC 2016)

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) (1) Bidders shall acknowledge receipt of any amendment to this solicitation--

(i) By signing and returning the amendment;

(ii) By identifying the amendment number and date in space provided for this purpose on the form for submitting a bid;

(iii) By letter;

(iv) By facsimile, if facsimile bids are authorized in the solicitation; or

(v) By email, if email bids are authorized in the solicitation.

(2) The Government must receive the acknowledgement by the time and at the place specified for receipt of bids.

(End of provision)

52.214-4 FALSE STATEMENTS IN BIDS (APR 1984)

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

(End of provision)

52.214-5 SUBMISSION OF BIDS (DEC 2016)

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages (unless submitted by electronic means) (1) addressed to the office specified in the solicitation, and (2) showing the time and date specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a)(1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Facsimile bids, modifications, or withdrawals, will not be considered unless authorized by the solicitation.

(d) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.

(End of provision)

52.214-6 EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984)

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

(End of provision)

52.214-7 LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (NOV 1999)

(a) Bidders are responsible for submitting bids, and any modifications or withdrawals, so as to reach the Government office designated in the invitation for bids (IFB) by the time specified in the IFB. If no time is specified in the IFB, the time for receipt is 4:30 p.m., local time, for the designated Government office on the date that bids are due.

(b)(1) Any bid, modification, or withdrawal received at the Government office designated in the IFB after the exact time specified for receipt of bids is “late” and will not be considered unless it is received before award is made, the Contracting Officer determines that accepting the late bid would not unduly delay the acquisition; and--

(i) If it was transmitted through an electronic commerce method authorized by the IFB, it was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids; or

(ii) There is acceptable evidence to establish that it was received at the Government installation designated for receipt of bids and was under the Government's control prior to the time set for receipt of bids.

(2) However, a late modification of an otherwise successful bid that makes its terms more favorable to the Government, will be considered at any time it is received and may be accepted.

(c) Acceptable evidence to establish the time of receipt at the Government installation includes the time/date stamp of that installation on the bid wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel.

(d) If an emergency or unanticipated event interrupts normal Government processes so that bids cannot be received at the Government office designated for receipt of bids by the exact time specified in the IFB and urgent Government requirements preclude amendment of the IFB, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

(e) Bids may be withdrawn by written notice received at any time before the exact time set for receipt of bids. If the IFB authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids, subject to the conditions specified in the provision at 52.214-31, Facsimile Bids. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identity of the person requesting withdrawal is established and the person signs a receipt for the bid.

(End of provision)

52.214-18 PREPARATION OF BIDS--CONSTRUCTION (APR 1984)

(a) Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit bid prices for one or more items on various bases, including--

(1) Lump sum bidding;

(2) Alternate prices;

(3) Units of construction; or

(4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

(End of provision)

52.214-19 CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (AUG 1996)

(a) The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

(b) The Government may reject any or all bids, and waive informalities or minor irregularities in bids received.

(c) The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

(d) The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

(End of provision)

52.214-34 SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991)

Offers submitted in response to this solicitation shall be in the English language. Offers received in other than English shall be rejected.

(End of provision)

52.214-35 SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991)

Offers submitted in response to this solicitation shall be in terms of U.S. dollars. Offers received in other than U.S. dollars shall be rejected.

(End of provision)

52.216-1 TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a Firm Fixed-Price contract resulting from this solicitation.

(End of provision)

52.222-5 CONSTRUCTION WAGE RATE REQUIREMENTS--SECONDARY SITE OF THE WORK (MAY 2014)

(a)(1) The offeror shall notify the Government if the offeror intends to perform work at any secondary site of the work, as defined in paragraph (a)(1)(ii) of the FAR clause at 52.222-6, Construction Wage Rate Requirements, of this solicitation.

(2) If the offeror is unsure if a planned work site satisfies the criteria for a secondary site of the work, the offeror shall request a determination from the Contracting Officer.

(b)(1) If the wage determination provided by the Government for work at the primary site of the work is not applicable to the secondary site of the work, the offeror shall request a wage determination from the Contracting Officer.

(2) The due date for receipt of offers will not be extended as a result of an offeror's request for a wage determination for a secondary site of the work.

(End of provision)

52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
0.6%	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the --

(1) Name, address, and telephone number of the subcontractor;

(2) Employer's identification number of the subcontractor;

(3) Estimated dollar amount of the subcontract;

(4) Estimated starting and completion dates of the subcontract; and

(5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Alma, Wisconsin; Buffalo County.

(End of provision)

52.225-10 NOTICE OF BUY AMERICAN REQUIREMENT--CONSTRUCTION MATERIALS (MAY 2014)

(a) Definitions. “Commercially available off-the-shelf (COTS) item,” “construction material,” “domestic construction material,” and “foreign construction material,” as used in this provision, are defined in the clause of this solicitation entitled “Buy American --Construction Materials” (Federal Acquisition Regulation (FAR) clause 52.225-9).

(b) Requests for determinations of inapplicability. An offeror requesting a determination regarding the inapplicability of the Buy American statute should submit the request to the Contracting Officer in time to allow a determination before submission of offers. The offeror shall include the information and applicable supporting data required by paragraphs (c) and (d) of the clause at FAR 52.225-9 in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American statute before submitting its offer, or has not received a response to a previous request, the offeror shall include the information and supporting data in the offer.

(c) Evaluation of offers. (1) The Government will evaluate an offer requesting exception to the requirements of the Buy American statute, based on claimed unreasonable cost of domestic construction material, by adding to the offered price the appropriate percentage of the cost of such foreign construction material, as specified in paragraph (b)(3)(i) of the clause at FAR 52.225-9.

(2) If evaluation results in a tie between an offeror that requested the substitution of foreign construction material based on unreasonable cost and an offeror that did not request an exception, the Contracting Officer will award to the offeror that did not request an exception based on unreasonable cost.

(d) Alternate offers.

(1) When an offer includes foreign construction material not listed by the Government in this solicitation in paragraph (b)(2) of the clause at FAR 52.225-9, the offeror also may submit an alternate offer based on use of equivalent domestic construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of the clause at FAR 52.225-9 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of the clause at FAR 52.225-9 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic construction material, and the offeror shall be required to furnish such domestic construction material. An offer based on use of the foreign construction material for which an exception was requested--

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or

(ii) May be accepted if revised during negotiations.

(End of provision)

52.228-1 BID GUARANTEE (SEP 1996)

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.-

(c) The amount of the bid guarantee shall be 20 percent of the bid price or $3,000,000.00, whichever is less.-

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.-

(e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(End of provision)

52.233-2 SERVICE OF PROTEST (SEP 2006)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from

U. S. Army Corps of Engineers – St. Paul District
ATTN: Ken Eshom, Contracting Officer
332 Minnesota Street; Suite E1500
St. Paul, MN 55101-1323

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

52.236-27 SITE VISIT (CONSTRUCTION) (FEB 1995) – ALTERNATE I (FEB 1995)

(a) The clauses at 52.236-2, Differing Site Conditions, and 52.236-3, Site Investigations and Conditions Affecting the Work, will be included in any contract awarded as a result of this solicitation. Accordingly, offerors or quoters are urged and expected to inspect the site where the work will be performed.

(b) An organized site visit has been scheduled for--
April 20, 2023, at 10:00 am Central Time

(c) Participants will meet at--
Lock and Dam No. 4
Alma, WI 54610

There will be only one site visit offered. Bidders planning to attend are asked to register for the site visit by sending an email to: scott.e.hendrix@usace.army.mil by 1:00pm Central on April 19, 2023.

Site visit attendees must provide the following information via email:

1. Solicitation Number: W912ES22B0010
2. Project Title: Lock and Dam 4 Lower Guide Wall End Cell Project.
3. Name(s) of Individual(s) Attending the site visit.
4. Name of Company.
5. Phone Number of Company

Site visit participants must abide by all local and the Center for Disease Control (CDC) COVID-19 protection guidelines, and the U.S. Army Corps of Engineers Safety and Health Requirements Manual (EM 385-1-1, latest version.) It is the responsibility of the participant to wear personal protective and safety equipment as required by this regulation. Failure to comply could result in denial of access to the site visit location.

The latest version of EM 385-1-1 is available online at:
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM 385-1-1.pdf

(End of provision)

52.252-1 SOLICITATION PROVISIONS INCORPORATED BY REFERENCE (FEB 1998)

This solicitation incorporates one or more solicitation provisions by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. The offeror is cautioned that the listed provisions may include blocks that must be completed by the offeror and submitted with its quotation or offer. In lieu of submitting the full text of those provisions, the offeror may identify the provision by paragraph identifier and provide the appropriate information with its quotation or offer. Also, the full text of a solicitation provision may be accessed electronically at this/these address(es):

FAR: https://www.acquisition.gov/browse/index/far
DFARS: https://www.acquisition.gov/dfars

(End of provision)

52.252-5 AUTHORIZED DEVIATIONS IN PROVISIONS (NOV 2020)

(a) The use in this solicitation of any Federal Acquisition Regulation (48 CFR Chapter 1) provision with an authorized deviation is indicated by the addition of "(DEVIATION)" after the date of the provision.

(b) The use in this solicitation of any Defense Federal Acquisition Regulation Supplement (48 CFR Chapter 2) provision with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of provision)

252.225-7057 PREAWARD DISCLOSURE OF EMPLOYMENT OF INDIVIDUALS WHO WORK IN THE PEOPLE'S REPUBLIC OF CHINA (AUG 2022)

(a) Definitions. As used in this provision--

Covered contract and covered entity have the meaning given in the clause 252.225-7058, Postaward Disclosure of Employment of Individuals Who Work in the People's Republic of China.

(b) Prohibition on award. In accordance with section 855 of the National Defense Authorization Act for Fiscal Year 2022 (Pub. L. 117-81, 10 U.S.C. 4651 note prec.), DoD may not award a contract to the Offeror if it is a covered entity and proposes to employ one or more individuals who will perform work in the People's Republic of China on a covered contract, unless the Offeror has disclosed its use of workforce and facilities in the People's Republic of China.

(c) Preaward disclosure requirement. At the time of submission of an offer for a covered contract, an Offeror that is a covered entity shall provide disclosures to include--

(1) The proposed use of workforce on a covered contract or subcontract, if the Offeror employs one or more individuals who perform work in the People's Republic of China;

(2) The total number of such individuals who will perform work in the People's Republic of China; and

(3) A description of the physical presence, including street address or addresses, in the People's Republic of China, where work on the covered contract will be performed.

(End of provision)

252.236-7008 CONTRACT PRICES - BIDDING SCHEDULES. (DEC 1991)

(a) The Government's payment for the items listed in the Bidding Schedule shall constitute full compensation to the Contractor for --

(1) Furnishing all plant, labor, equipment, appliances, and materials; and

(2) Performing all operations required to complete the work in conformity with the drawings and specifications.

(b) The Contractor shall include in the prices for the items listed in the Bidding Schedule all costs for work in the specifications, whether or not specifically listed in the Bidding Schedule.

SECTION 00 45 00 - REPRESENTATIONS AND CERTIFICATIONS

52.204-8 ANNUAL REPRESENTATIONS AND CERTIFICATIONS (MAR 2023)

(a)

(1) The North American Industry Classification System (NAICS) code for this acquisition is *237990 [insert NAICS code]*.

(2) The small business size standard is *$45.0 Million [insert size standard]*.

(3) The small business size standard for a concern that submits an offer, other than on a construction or service acquisition, but proposes to furnish an end item that it did not itself manufacture, process, or produce is 500 employees, or 150 employees for information technology value-added resellers under NAICS code 541519 if the acquisition—

(i) Is set aside for small business and has a value above the simplified acquisition threshold;

(ii) Uses the HUBZone price evaluation preference regardless of dollar value, unless the offeror waives the price evaluation preference; or

(iii) Is an 8(a), HUBZone, service-disabled veteran-owned, economically disadvantaged women-owned, or women-owned small business set-aside or sole-source award regardless of dollar value.

(b)

(1) If the provision at 52.204-7, System for Award Management, is included in this solicitation, paragraph (d) of this provision applies.

(2) If the provision at 52.204-7, System for Award Management, is not included in this solicitation, and the Offeror has an active registration in the System for Award Management (SAM), the Offeror may choose to use paragraph (d) of this provision instead of completing the corresponding individual representations and certifications in the solicitation. The Offeror shall indicate which option applies by checking one of the following boxes:

(i) □ Paragraph (d) applies.

(ii) □ Paragraph (d) does not apply and the offeror has completed the individual representations and certifications in the solicitation.

(c)

(1) The following representations or certifications in SAM are applicable to this solicitation as indicated:

(i) 52.203-2, Certificate of Independent Price Determination. This provision applies to solicitations when a firm-fixed-price contract or fixed-price contract with economic price adjustment is contemplated, unless–

(A) The acquisition is to be made under the simplified acquisition procedures in part 13;

(B) The solicitation is a request for technical proposals under two-step sealed bidding procedures; or

(C) The solicitation is for utility services for which rates are set by law or regulation.

(ii) 52.203-11, Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions. This provision applies to solicitations expected to exceed $150,000.

(iii) 52.203-18, Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements or Statements-Representation. This provision applies to all solicitations.

(iv) 52.204-3, Taxpayer Identification. This provision applies to solicitations that do not include the provision at 52.204-7, System for Award Management.

(v) 52.204-5, Women-Owned Business (Other Than Small Business). This provision applies to solicitations that-

(A) Are not set aside for small business concerns;

(B) Exceed the simplified acquisition threshold; and

(C) Are for contracts that will be performed in the United States or its outlying areas.

(vi) 52.204-26, Covered Telecommunications Equipment or Services-Representation. This provision applies to all solicitations.

(vii) 52.209-2, Prohibition on Contracting with Inverted Domestic Corporations-Representation.

(viii) 52.209-5, CertificationRegarding Responsibility Matters. This provision applies to solicitations where the contract value is expected to exceed the simplified acquisition threshold.

(ix) 52.209-11, Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law. This provision applies to all solicitations.

(x) 52.214-14, Place of Performance-Sealed Bidding. This provision applies to invitations for bids except those in which the place of performance is specified by the Government.

(xi) 52.215-6, Place of Performance. This provision applies to solicitations unless the place of performance is specified by the Government.

(xii) 52.219-1, Small Business Program Representations (Basic, Alternates I, and II). This provision applies to solicitations when the contract is for supplies to be delivered or services to be performed in the United States or its outlying areas, or when the contracting officer has applied part 19 in accordance with 19.000(b)(1)(ii).

(A) The basic provision applies when the solicitations are issued by other than DoD, NASA, and the Coast Guard.

(B) The provision with its Alternate I applies to solicitations issued by DoD, NASA, or the Coast Guard.

(C) The provision with its Alternate II applies to solicitations that will result in a multiple-award contract with more than one NAICS code assigned.

(xiii) 52.219-2, Equal Low Bids. This provision applies to solicitations when contracting by sealed bidding and the contract is for supplies to be delivered or services to be performed in the United States or its outlying areas, or when the contracting officer has applied part 19 in accordance with 19.000(b)(1)(ii).

(xiv) 52.222-22, Previous Contracts and Compliance Reports. This provision applies to solicitations that include the clause at 52.222-26, Equal Opportunity.

(xv) 52.222-25, Affirmative Action Compliance. This provision applies to solicitations, other than those for construction, when the solicitation includes the clause at 52.222-26, Equal Opportunity.

(xvi) 52.222-38, Compliance with Veterans' Employment Reporting Requirements. This provision applies to solicitations when it is anticipated the contract award will exceed the simplified acquisition threshold and the contract is not for acquisition of commercial products or commercial services.

(xvii) 52.223-1, Biobased Product Certification. This provision applies to solicitations that require the delivery or specify the use of USDA–designated items; or include the clause at 52.223-2, Affirmative Procurement of Biobased Products Under Service and Construction Contracts.

(xviii) 52.223-4, Recovered Material Certification. This provision applies to solicitations that are for, or specify the use of, EPA–designated items.

(xix) 52.223-22, Public Disclosure of Greenhouse Gas Emissions and Reduction Goals-Representation. This provision applies to solicitations that include the clause at 52.204-7.)

(xx) 52.225-2, Buy American Certificate. This provision applies to solicitations containing the clause at 52.225-1.

(xxi) 52.225-4, Buy American-Free Trade Agreements-Israeli Trade Act Certificate. (Basic, Alternates II and III.) This provision applies to solicitations containing the clause at 52.225-3.

(A) If the acquisition value is less than $50,000, the basic provision applies.

(B) If the acquisition value is $50,000 or more but is less than $92,319, the provision with its Alternate II applies.

(C) If the acquisition value is $92,319 or more but is less than $100,000, the provision with its Alternate III applies.

(xxii) 52.225-6, Trade Agreements Certificate. This provision applies to solicitations containing the clause at 52.225-5.

(xxiii) 52.225-20, Prohibition on Conducting Restricted Business Operations in Sudan-Certification. This provision applies to all solicitations.

(xxiv) 52.225-25, Prohibition on Contracting with Entities Engaging in Certain Activities or Transactions Relating to Iran-Representation and Certifications. This provision applies to all solicitations.

(xxv) 52.226-2, Historically Black College or University and Minority Institution Representation. This provision applies to solicitations for research, studies, supplies, or services of the type normally acquired from higher educational institutions.

(2) The following representations or certifications are applicable as indicated by the Contracting Officer:

[*Contracting Officer check as appropriate.*]

__ (i) 52.204-17, Ownership or Control of Offeror.

__ (ii) 52.204-20, Predecessor of Offeror.

__ (iii) 52.222-18, Certification Regarding Knowledge of Child Labor for Listed End Products.

__ (iv) 52.222-48, Exemption from Application of the Service Contract Labor Standards to Contracts for Maintenance, Calibration, or Repair of Certain Equipment- Certification.

__ (v) 52.222-52, Exemption from Application of the Service Contract Labor Standards to Contracts for Certain Services-Certification.

__ (vi) 52.223-9, with its Alternate I, Estimate of Percentage of Recovered Material Content for EPA–Designated Products (Alternate I only).

__ (vii) 52.227-6, Royalty Information.

__ (A) Basic.

__ (B) Alternate I.

__ (viii) 52.227-15, Representation of Limited Rights Data and Restricted Computer Software.

(d) The offeror has completed the annual representations and certifications electronically in SAM website accessed through https://www.sam.gov. After reviewing the SAM information, the offeror verifies by submission of the offer that the representations and certifications currently posted electronically that apply to this solicitation as indicated in paragraph (c) of this provision have been entered or updated within the last 12 months, are current, accurate, complete, and applicable to this solicitation (including the business size standard applicable to the NAICS code referenced for this solicitation), as of the date of this offer and are incorporated in this offer by reference (see FAR 4.1201); except for the changes identified below [*offeror to insert changes, identifying change by clause number, title, date*]. These amended representation(s) and/or certification(s) are also incorporated in this offer and are current, accurate, and complete as of the date of this offer.

FAR Clause # Title Date Change

_____

Any changes provided by the offeror are applicable to this solicitation only, and do not result in an update to the representations and certifications posted on SAM.

(End of provision)

52.204-24 REPRESENTATION REGARDING CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (NOV 2021)

52.204-24 Representation Regarding Certain Telecommunications and Video Surveillance Services or Equipment (NOV 2021)

The Offeror shall not complete the representation at paragraph (d)(1) of this provision if the Offeror has represented that it "does not provide covered telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument" in paragraph (c)(1) in the provision at 52.204-26, Covered Telecommunications Equipment or Services--Representation, or in paragraph (v)(2)(i) of the provision at 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services. The Offeror shall not complete the representation in paragraph (d)(2) of this provision if the Offeror has represented that it "does not use covered telecommunications equipment or services, or any equipment, system, or service that uses covered telecommunications equipment or services" in paragraph (c)(2) of the provision at 52.204-26, or in paragraph (v)(2)(ii) of the provision at 52.212-3.

(a) Definitions. As used in this provision-

Backhaul, covered telecommunications equipment or services, critical technology, interconnection arrangements, reasonable inquiry, roaming, and substantial or essential component have the meanings provided in the clause 52.204-25, Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.

(b) Prohibition.

(1) Section 889(a)(1)(A) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2019, from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. Nothing in the prohibition shall be construed to--

(i) Prohibit the head of an executive agency from procuring with an entity to provide a service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or

(ii) Cover telecommunications equipment that cannot route or redirect user data traffic or cannot permit visibility into any user data or packets that such equipment transmits or otherwise handles.

(2) Section 889(a)(1)(B) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2020, from entering into a contract or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. This prohibition applies to the use of covered telecommunications equipment or services, regardless of whether that use is in performance of work under a Federal contract. Nothing in the prohibition shall be construed to--

(i) Prohibit the head of an executive agency from procuring with an entity to provide a service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or

(ii) Cover telecommunications equipment that cannot route or redirect user data traffic or cannot permit visibility into any user data or packets that such equipment transmits or otherwise handles.

(c) Procedures. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) (https://www.sam.gov) for entities excluded from receiving federal awards for "covered telecommunications equipment or services."

(d) Representations. The Offeror represents that--

(1) It [___] will, [___] will not provide covered telecommunications equipment or services to the Government in the performance of any contract, subcontract or other contractual instrument resulting from this solicitation. The Offeror shall provide the additional disclosure information required at paragraph (e)(1) of this section if the Offeror responds "will" in paragraph (d)(1) of this section; and

(2) After conducting a reasonable inquiry, for purposes of this representation, the Offeror represents that--

It [___] does, [___] does not use covered telecommunications equipment or services, or use any equipment, system, or service that uses covered telecommunications equipment or services. The Offeror shall provide the additional disclosure information required at paragraph (e)(2) of this section if the Offeror responds "does" in paragraph (d)(2) of this section.

(e) Disclosures.

(1) Disclosure for the representation in paragraph (d)(1) of this provision. If the Offeror has responded "will" in the representation in paragraph (d)(1) of this provision, the Offeror shall provide the following information as part of the offer:

(i) For covered equipment--

(A) The entity that produced the covered telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the original equipment manufacturer (OEM) or a distributor, if known);

(B) A description of all covered telecommunications equipment offered (include brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); and

(C) Explanation of the proposed use of covered telecommunications equipment and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(1) of this provision.

(ii) For covered services--

(A) If the service is related to item maintenance: A description of all covered telecommunications services offered (include on the item being maintained: Brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); or

(B) If not associated with maintenance, the Product Service Code (PSC) of the service being provided; and explanation of the proposed use of covered telecommunications services and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(1) of this provision.

(2) Disclosure for the representation in paragraph (d)(2) of this provision. If the Offeror has responded "does" in the representation in paragraph (d)(2) of this provision, the Offeror shall provide the following information as part of the offer:

(i) For covered equipment--

(A) The entity that produced the covered telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the OEM or a distributor, if known);

(B) A description of all covered telecommunications equipment offered (include brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); and

(C) Explanation of the proposed use of covered telecommunications equipment and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(2) of this provision.

(ii) For covered services--

(A) If the service is related to item maintenance: A description of all covered telecommunications services offered (include on the item being maintained: Brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); or

(B) If not associated with maintenance, the PSC of the service being provided; and explanation of the proposed use of covered telecommunications services and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(2) of this provision.

(End of provision)

52.209-13 VIOLATION OF ARMS CONTROL TREATIES OR AGREEMENTS--CERTIFICATION (NOV 2021)

(a) This provision does not apply to acquisitions at or below the simplified acquisition threshold or to acquisitions of commercial products and commercial services as defined in Federal Acquisition Regulation 2.101.

(b) Certification. [Offeror shall check either (1) or (2).]

____ (1) The Offeror certifies that--

(i) It does not engage and has not engaged in any activity that contributed to or was a significant factor in the President's or Secretary of State's determination that a foreign country is in violation of its obligations undertaken in any arms control, nonproliferation, or disarmament agreement to which the United States is a party, or is not adhering to its arms control, nonproliferation, or disarmament commitments in which the United States is a participating state. The determinations are described in the most recent unclassified annual report provided to Congress pursuant to section 403 of the Arms Control and Disarmament Act (22 U.S.C. 2593a). The report is available at https://www.state.gov/bureaus-offices/under-secretary-for-arms-control-and-international-security-affairs/bureau-of-arms-control-verification-and-compliance/; and

(ii) No entity owned or controlled by the Offeror has engaged in any activity that contributed to or was a significant factor in the President's or Secretary of State's determination that a foreign country is in violation of its obligations undertaken in any arms control, nonproliferation, or disarmament agreement to which the United States is a party, or is not adhering to its arms control, nonproliferation, or disarmament commitments in which the United States is a participating state. The determinations are described in the most recent unclassified annual report provided to

Congress pursuant to section 403 of the Arms Control and Disarmament Act (22 U.S.C. 2593a). The report is available at https://www.state.gov/bureaus-offices/under-secretary-for-arms-control-and-international-security-affairs/bureau-of-arms-control-verification-and-compliance/; or

____ (2) The Offeror is providing separate information with its offer in accordance with paragraph (d)(2) of this provision.

(c) Procedures for reviewing the annual unclassified report (see paragraph (b)(1) of this provision). For clarity, references to the report in this section refer to the entirety of the annual unclassified report, including any separate reports that are incorporated by reference into the annual unclassified report.

(1) Check the table of contents of the annual unclassified report and the country section headings of the reports incorporated by reference to identify the foreign countries listed there. Determine whether the Offeror or any person owned or controlled by the Offeror may have engaged in any activity related to one or more of such foreign countries.

(2) If there may have been such activity, review all findings in the report associated with those foreign countries to determine whether or not each such foreign country was determined to be in violation of its obligations undertaken in an arms control, nonproliferation, or disarmament agreement to which the United States is a party, or to be not adhering to its arms control, nonproliferation, or disarmament commitments in which the United States is a participating state. For clarity, in the annual report an explicit certification of non-compliance is equivalent to a determination of violation. However, the following statements in the annual report are not equivalent to a determination of violation:

(i) An inability to certify compliance.

(ii) An inability to conclude compliance.

(iii) A statement about compliance concerns.

(3) If so, determine whether the Offeror or any person owned or controlled by the Offeror has engaged in any activity that contributed to or is a significant factor in the determination in the report that one or more of these foreign countries is in violation of its obligations undertaken in an arms control, nonproliferation, or disarmament agreement to which the United States is a party, or is not adhering to its arms control, nonproliferation, or disarmament commitments in which the United States is a participating state. Review the narrative for any such findings reflecting a determination of violation or non-adherence related to those foreign countries in the report, including the finding itself, and to the extent necessary, the conduct giving rise to the compliance or adherence concerns, the analysis of compliance or adherence concerns, and efforts to resolve compliance or adherence concerns.

(4) The Offeror may submit any questions with regard to this report by email to NDAA1290Cert@state.gov. To the extent feasible, the Department of State will respond to such email inquiries within 3 business days.

(d) Do not submit an offer unless--

(1) A certification is provided in paragraph (b)(1) of this provision and submitted with the offer; or

(2) In accordance with paragraph (b)(2) of this provision, the Offeror provides with its offer information that the President of the United States has--

(i) Waived application under U.S.C. 2593e(d) or (e); or

(ii) Determined under 22 U.S.C. 2593e(g)(2) that the entity has ceased all activities for which measures were imposed under 22 U.S.C.2593e(b).

(e) Remedies. The certification in paragraph (b)(1) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly submitted a false certification, in addition to other remedies available to the Government, such as suspension or debarment, the Contracting Officer may terminate any contract resulting from the false certification.

(End of provision)

252.203-7005 REPRESENTATION RELATING TO COMPENSATION OF FORMER DOD OFFICIALS (SEP 2022)

(a) Definition. Covered DoD official is defined in the clause at 252.203-7000, Requirements Relating to Compensation of Former DoD Officials.

(b) By submission of this offer, the Offeror represents, to the best of its knowledge and belief, that all covered DoD officials employed by or otherwise receiving compensation from the Offeror, and who are expected to undertake activities on behalf of the Offeror for any resulting contract, are presently in compliance with all applicable post-employment restrictions, including those contained in 18 U.S.C. 207, 41 U.S.C. 2101-2107, 5 CFR part 2641, section 1045 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91), and Federal Acquisition Regulation 3.104-2.

(End of provision)

252.204-7007 ALTERNATE A, ANNUAL REPRESENTATIONS AND CERTIFICATIONS (MAY 2021)

Substitute the following paragraphs (b), (d) and (e) for paragraphs (b) and (d) of the provision at FAR 52.204-8:

(b)(1) If the provision at FAR 52.204-7, System for Award Management, is included in this solicitation, paragraph (e) of this provision applies.

(2) If the provision at FAR 52.204-7, System for Award Management, is not included in this solicitation, and the Offeror has an active registration in the System for Award Management (SAM), the Offeror may choose to use paragraph (e) of this provision instead of completing the corresponding individual representations and certifications in the solicitation. The Offeror shall indicate which option applies by checking one of the following boxes:

__ (i) Paragraph (e) applies.

__ (ii) Paragraph (e) does not apply and the Offeror has completed the individual representations and certifications in the solicitation.

(d)(1) The following representations or certifications in the SAM database are applicable to this solicitation as indicated:

(i) 252.204-7016, Covered Defense Telecommunications Equipment or Services--Representation. Applies to all solicitations.

(ii) 252.216-7008, Economic Price Adjustment--Wage Rates or Material Prices Controlled by a Foreign Government. Applies to solicitations for fixed-price supply and service contracts when the contract is to be performed wholly or in part in a foreign country, and a foreign government controls wage rates or material prices and may during contract performance impose a mandatory change in wages or prices of materials.

(iii) 252.225-7042, Authorization to Perform. Applies to all solicitations when performance will be wholly or in part in a foreign country.

(iv) 252.225-7049, Prohibition on Acquisition of Certain Foreign Commercial Satellite Services--Representations. Applies to solicitations for the acquisition of commercial satellite services.

(v) 252.225-7050, Disclosure of Ownership or Control by the Government of a Country that is a State Sponsor of Terrorism. Applies to all solicitations expected to result in contracts of $150,000 or more.

(vi) 252.229-7012, Tax Exemptions (Italy)--Representation. Applies to solicitations when contract performance will be in Italy.

(vii) 252.229-7013, Tax Exemptions (Spain)--Representation. Applies to solicitations when contract performance will be in Spain.

(viii) 252.247-7022, Representation of Extent of Transportation by Sea. Applies to all solicitations except those for direct purchase of ocean transportation services or those with an anticipated value at or below the simplified acquisition threshold.

(2) The following representations or certifications in SAM are applicable to this solicitation as indicated by the Contracting Officer: [Contracting Officer check as appropriate.]

____ (i) 252.209-7002, Disclosure of Ownership or Control by a Foreign Government.

____ (ii) 252.225-7000, Buy American--Balance of Payments Program Certificate.

____ (iii) 252.225-7020, Trade Agreements Certificate.

____ Use with Alternate I.

____ (iv) 252.225-7031, Secondary Arab Boycott of Israel.

____ (v) 252.225-7035, Buy American--Free Trade Agreements--Balance of Payments Program Certificate.

____ Use with Alternate I.

____ Use with Alternate II.

____ Use with Alternate III.

____ Use with Alternate IV.

____ Use with Alternate V.

____ (vi) 252.226-7002, Representation for Demonstration Project for Contractors Employing Persons with Disabilities.

____ (vii) 252.232-7015, Performance-Based Payments--Representation.

(e) The Offeror has completed the annual representations and certifications electronically via the SAM website at https://www.acquisition.gov/. After reviewing the SAM database information, the Offeror verifies by submission of the offer that the representations and certifications currently posted electronically that apply to this solicitation as indicated in FAR 52.204-8(c) and paragraph (d) of this provision have been entered or updated within the last 12 months, are current, accurate, complete, and applicable to this solicitation (including the business size standard applicable to the NAICS code referenced for this solicitation), as of the date of this offer, and are incorporated in this offer by reference (see FAR 4.1201); except for the changes identified below [Offeror to insert changes, identifying change by provision number, title, date____]. These amended representation(s) and/or certification(s) are also incorporated in this offer and are current, accurate, and complete as of the date of this offer.

FAR/DFARS provision No.	Title	Date	Change

Any changes provided by the Offeror are applicable to this solicitation only, and do not result in an update to the representations and certifications located in the SAM database.

(End of provision)

252.204-7008 COMPLIANCE WITH SAFEGUARDING COVERED DEFENSE INFORMATION CONTROLS (OCT 2016)

(a) Definitions. As used in this provision--

Controlled technical information, covered contractor information system, covered defense information, cyber incident, information system, and technical information are defined in clause 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting.

(b) The security requirements required by contract clause 252.204-7012 shall be implemented for all covered defense information on all covered contractor information systems that support the performance of this contract.

(c) For covered contractor information systems that are not part of an information technology service or system operated on behalf of the Government (see 252.204-7012(b)(2))--

(1) By submission of this offer, the Offeror represents that it will implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, ``Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations'' (see http://dx.doi.org/10.6028/NIST.SP.800-171) that are in effect at the time the solicitation is issued or as authorized by the contracting officer not later than December 31, 2017.

(2)(i) If the Offeror proposes to vary from any of the security requirements specified by NIST SP 800-171 that are in effect at the time the solicitation is issued or as authorized by the Contracting Officer, the Offeror shall submit to the Contracting Officer, for consideration by the DoD Chief Information Officer (CIO), a written explanation of—

(A) Why a particular security requirement is not applicable; or

(B) How an alternative but equally effective, security measure is used to compensate for the inability to satisfy a particular requirement and achieve equivalent protection.

(ii) An authorized representative of the DoD CIO will adjudicate offeror requests to vary from NIST SP 800-171 requirements in writing prior to contract award. Any accepted variance from NIST SP 800-171 shall be incorporated into the resulting contract.

(End of provision)

252.204-7017 PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES--REPRESENTATION (MAY 2021)

The Offeror is not required to complete the representation in this provision if the Offeror has represented in the provision at 252.204-7016, Covered Defense Telecommunications Equipment or Services--Representation, that it "does not provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument."

(a) Definitions. Covered defense telecommunications equipment or services, covered mission, critical technology, and substantial or essential component, as used in this provision, have the meanings given in the 252.204-7018 clause, Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services, of this solicitation.

(b) Prohibition. Section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) prohibits agencies from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

(c) Procedures. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

(d) Representation. If in its annual representations and certifications in SAM the Offeror has represented in paragraph (c) of the provision at 252.204-7016, Covered Defense Telecommunications Equipment or Services--Representation, that it "does" provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument, then the Offeror shall complete the following additional representation:

The Offeror represents that it [ ] will [ ] will not provide covered defense telecommunications equipment or services as a part of its offered products or services to DoD in the performance of any award resulting from this solicitation.

(e) Disclosures. If the Offeror has represented in paragraph (d) of this provision that it "will provide covered defense telecommunications equipment or services," the Offeror shall provide the following information as part of the offer:

(1) A description of all covered defense telecommunications equipment and services offered (include brand or manufacturer; product, such as model number, original equipment manufacturer (OEM) number, manufacturer part number, or wholesaler number; and item description, as applicable).

(2) An explanation of the proposed use of covered defense telecommunications equipment and services and any factors relevant to determining if such use would be permissible under the prohibition referenced in paragraph (b) of this provision.

(3) For services, the entity providing the covered defense telecommunications services (include entity name, unique entity identifier, and Commercial and Government Entity (CAGE) code, if known).

(4) For equipment, the entity that produced or provided the covered defense telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the OEM or a distributor, if known).

(End of provision)

252.225-7055 REPRESENTATION REGARDING BUSINESS OPERATIONS WITH THE MADURO REGIME (MAY 2022)

(a) *Definitions*. As used in this provision—

"Agency or instrumentality of the government of Venezuela," "business operations," "government of Venezuela," and "person" have the meaning given in the clause 252.225-7056, Prohibition Regarding Business Operations with the Maduro Regime, of this solicitation.

(b) *Prohibition*. In accordance with section 890 of the National Defense Authorization Act for Fiscal Year 2020 (Pub. L. 116-92), DoD is prohibited from entering into a contract for the procurement of products or services with any person that has business operations with an authority of the government of Venezuela that is not recognized as the legitimate government of Venezuela by the U.S. Government, unless the person has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

(c) *Representation*. By submission of its offer, the Offeror represents that the Offeror is a person that—

(1) Does not have any business operations with an authority of the Maduro regime or the government of Venezuela that is not recognized as the legitimate government of Venezuela by the U.S. Government; or

(2) Has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

(End of provision)

SECTION 00 70 00 - CONDITIONS OF THE CONTRACT

52.202-1 DEFINITIONS (JUN 2020)

When a solicitation provision or contract clause uses a word or term that is defined in the Federal Acquisition Regulation (FAR), the word or term has the same meaning as the definition in FAR 2.101 in effect at the time the solicitation was issued, unless--

(a) The solicitation, or amended solicitation, provides a different definition;

(b) The contracting parties agree to a different definition;

(c) The part, subpart, or section of the FAR where the provision or clause is prescribed provides a different meaning;

(d) The word or term is defined in FAR part 31, for use in the cost principles and procedures; or

(e) The word or term defines an acquisition-related threshold, and if the threshold is adjusted for inflation as set forth in FAR 1.109(a), then the changed threshold applies throughout the remaining term of the contract, unless there is a subsequent threshold adjustment; see FAR 1.109(d).
(End of clause)

52.203-3 GRATUITIES (APR 1984)

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) of this clause, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-5 COVENANT AGAINST CONTINGENT FEES (MAY 2014)

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

(End of clause)

52.203-6 RESTRICTIONS ON SUBCONTRACTOR SALES TO THE GOVERNMENT (JUN 2020)

(a) Except as provided in (b) of this clause, the Contractor shall not enter into any agreement with an actual or prospective subcontractor, nor otherwise act in any manner, which has or may have the effect of restricting sales by such subcontractors directly to the Government of any item or process (including computer software) made or furnished by the subcontractor under this contract or under any follow-on production contract.

(b) The prohibition in (a) of this clause does not preclude the Contractor from asserting rights that are otherwise authorized by law or regulation.

(c) The Contractor agrees to incorporate the substance of this clause, including this paragraph (c), in all subcontracts under this contract which exceed the simplified acquisition threshold, as defined in Federal Acquisition Regulation 2.101 on the date of subcontract award.

(End of Clause)

52.203-7 ANTI-KICKBACK PROCEDURES (JUN 2020)

(a) Definitions.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment, or services of any kind.

"Prime Contractor," as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) 41 U.S.C. chapter 87, Kickbacks, prohibits any person from--

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting, or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c)(1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Attorney General.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States

under the prime contract and/or (ii) direct that the Prime Contractor withhold, from sums owed a subcontractor under the prime contract, the amount of any kickback. The Contracting Officer may order the monies withheld under subdivision (c)(4)(ii) of this clause be paid over to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including this paragraph (c)(5) but excepting paragraph (c)(1) of this clause, in all subcontracts under this contract that exceed the threshold specified in Federal Acquisition Regulation 3.502-2(i) on the date of subcontract award.

(End of Clause)

52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 2014)

(a) If the Government receives information that a contractor or a person has violated 41 U.S.C. 2102-2104, Restrictions on Obtaining and Disclosing Certain Information, the Government may--

(1) Cancel the solicitation, if the contract has not yet been awarded or issued; or

(2) Rescind the contract with respect to which--

(i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct violates 41 U.S.C. 2102 for the purpose of either--

(A) Exchanging the information covered by such subsections for anything of value; or

(B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or

(ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the Contractor or someone acting for the Contractor has engaged in conduct punishable under 41 U.S.C. 2105(a).

(b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.

(c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.

(End of clause)

52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 2014)

(a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract by the amount of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of 41 U.S.C. 2102 or 2103, as implemented in section 3.104 of the Federal Acquisition Regulation.

(b) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or "fee floor" specified in the contract;

(3) For cost-plus-award-fee contracts--

(i) The base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.

(4) For fixed-price-incentive contracts, the Government may--

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or

(ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract. The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed-price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the statute by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 2020)

(a) Definitions. As used in this clause--

Agency means executive agency as defined in Federal Acquisition Regulation (FAR) 2.101.

Covered Federal action means any of the following actions:

(1) Awarding any Federal contract.

(2) Making any Federal grant.

(3) Making any Federal loan.

(4) Entering into any cooperative agreement.

(5) Extending, continuing, renewing, amending, or modifying any Federal contract, grant, loan, or cooperative agreement.

Indian tribe and tribal organization have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450b) and include Alaskan Natives.

Influencing or attempting to influence means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

Local government means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

Officer or employee of an agency includes the following individuals who are employed by an agency:

(1) An individual who is appointed to a position in the Government under Title 5, United States Code, including a position under a temporary appointment.

(2) A member of the uniformed services, as defined in subsection 101(3), Title 37, United States Code.

(3) A special Government employee, as defined in section 202, Title 18, United States Code.

(4) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, Title 5, United States Code, appendix 2.

Person means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization eligible to receive Federal contracts, grants, cooperative agreements, or loans from an agency, but only with respect to expenditures by such tribe or organization that are made for purposes specified in paragraph (b) of this clause and are permitted by other Federal law.

Reasonable compensation means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

Reasonable payment means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

Recipient includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization eligible to receive Federal contracts, grants, cooperative agreements, or loans from an agency, but only with respect to expenditures by such tribe or organization that are made for purposes specified in paragraph (b) of this clause and are permitted by other Federal law.

Regularly employed means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

State means a State of the United States, the District of Columbia, or an outlying area of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) Prohibition. 31 U.S.C. 1352 prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal actions. In accordance with 31 U.S.C. 1352, the Contractor shall not use appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the award of this contractor the extension, continuation, renewal, amendment, or modification of this contract.

(1) The term appropriated funds does not include profit or fee from a covered Federal action.

(2) To the extent the Contractor can demonstrate that the Contractor has sufficient monies, other than Federal appropriated funds, the Government will assume that these other monies were spent for any influencing activities that would be unallowable if paid for with Federal appropriated funds.

(c) Exceptions. The prohibition in paragraph (b) of this clause does not apply under the following conditions:

(1) Agency and legislative liaison by Contractor employees.

(i) Payment of reasonable compensation made to an officer or employee of the Contractor if the payment is for agency and legislative liaison activities not directly related to this contract. For purposes of this paragraph, providing any information specifically requested by an agency or Congress is permitted at any time.

(ii) Participating with an agency in discussions that are not related to a specific solicitation for any covered Federal action, but that concern--

(A) The qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities; or

(B) The application or adaptation of the person's products or services for an agency's use.

(iii) Providing prior to formal solicitation of any covered Federal action any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(iv) Participating in technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(v) Making capability presentations prior to formal solicitation of any covered Federal action by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub.L. 95-507, and subsequent amendments.

(2) Professional and technical services. (i) A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

(ii) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(iii) As used in paragraph (c)(2) of this clause, ``professional and technical services'' are limited to advice and analysis directly applying any professional or technical discipline (for examples, see FAR 3.803(a)(2)(iii)).

(iv) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.

(3) Only those communications and services expressly authorized by paragraphs (c)(1) and (2) of this clause are permitted.

(d) Disclosure. (1) If the Contractor did not submit OMB Standard Form LLL, Disclosure of Lobbying Activities, with its offer, but registrants under the Lobbying Disclosure Act of 1995 have subsequently made a lobbying contact on behalf of the Contractor with respect to this contract, the Contractor shall complete and submit OMB Standard Form LLL to provide the name of the lobbying registrants, including the individuals performing the services.

(2) If the Contractor did submit OMB Standard Form LLL disclosure pursuant to paragraph (d) of the provision at FAR 52.203-11, Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions, and a change occurs that affects Block 10 of the OMB Standard Form LLL (name and address of lobbying registrant or individuals performing services), the Contractor shall, at the end of the calendar quarter in which the change occurs, submit to the Contracting Officer within 30 days an updated disclosure using OMB Standard Form LLL.

(e) Penalties. (1) Any person who makes an expenditure prohibited under paragraph (b) of this clause or who fails to file or amend the disclosure to be filed or amended by paragraph (d) of this clause shall be subject to civil penalties as provided for by 31 U.S.C.1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(2) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(f) Cost allowability. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

(g) Subcontracts.

(1) The Contractor shall obtain a declaration, including the certification and disclosure in paragraphs (c) and (d)

of the provision at FAR 52.203-11, Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions, from each person requesting or receiving a subcontract under this contract that exceeds the threshold

specified in FAR 3.808 on the date of subcontract award. The Contractor or subcontractor that awards the subcontract shall retain the declaration.

(2) A copy of each subcontractor disclosure form (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall, at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor, submit to the Contracting Officer within 30 days a copy of all disclosures. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(3) The Contractor shall include the substance of this clause, including this paragraph (g), in any subcontract that exceeds the threshold specified in FAR 3.808 on the date of subcontract award.

(End of clause)

52.203-13 CONTRACTOR CODE OF BUSINESS ETHICS AND CONDUCT (NOV 2021)

(a) Definitions. As used in this clause--

Agent means any individual, including a director, an officer, an employee, or an independent Contractor, authorized to act on behalf of the organization.

Full cooperation—

(1) Means disclosure to the Government of the information sufficient for law enforcement to identify the nature and extent of the offense and the individuals responsible for the conduct. It includes providing timely and complete response to Government auditors' and investigators' request for documents and access to employees with information;

(2) Does not foreclose any Contractor rights arising in law, the FAR, or the terms of the contract. It does not require--

(i) A Contractor to waive its attorney-client privilege or the protections afforded by the attorney work product doctrine; or

(ii) Any officer, director, owner, or employee of the Contractor, including a sole proprietor, to waive his or her attorney client privilege or Fifth Amendment rights; and

(3) Does not restrict a Contractor from--

(i) Conducting an internal investigation; or

(ii) Defending a proceeding or dispute arising under the contract or related to a potential or disclosed violation.

Principal means an officer, director, owner, partner, or a person having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a division or business segment; and similar positions).

Subcontract means any contract entered into by a subcontractor to furnish supplies or services for performance of a prime contract or a subcontract.

Subcontractor means any supplier, distributor, vendor, or firm that furnished supplies or services to or for a prime contractor or another subcontractor.

United States means the 50 States, the District of Columbia, and outlying areas.

(b) Code of business ethics and conduct. (1) Within 30 days after contract award, unless the Contracting Officer establishes a longer time period, the Contractor shall--

(i) Have a written code of business ethics and conduct;

(ii) Make a copy of the code available to each employee engaged in performance of the contract.

(2) The Contractor shall--

(i) Exercise due diligence to prevent and detect criminal conduct; and

(ii) Otherwise promote an organizational culture that encourages ethical conduct and a commitment to compliance with the law.

(3)(i) The Contractor shall timely disclose, in writing, to the agency Office of the Inspector General (OIG), with a copy to the Contracting Officer, whenever, in connection with the award, performance, or closeout of this contract or any subcontract thereunder, the Contractor has credible evidence that a principal, employee, agent, or subcontractor of the Contractor has committed--

(A) A violation of Federal criminal law involving fraud, conflict of interest, bribery, or gratuity violations found in Title 18 of the United States Code; or

(B) A violation of the civil False Claims Act (31 U.S.C. 3729-3733).

(ii) The Government, to the extent permitted by law and regulation, will safeguard and treat information obtained pursuant to the Contractor's disclosure as confidential where the information has been marked “confidential” or “proprietary” by the company. To the extent permitted by law and regulation, such information will not be released by the Government to the public pursuant to a Freedom of Information Act request, 5 U.S.C. Section 552, without prior notification to the Contractor. The Government may transfer documents provided by the Contractor to any department or agency within the Executive Branch if the information relates to matters within the organization's jurisdiction.

(iii) If the violation relates to an order against a Governmentwide acquisition contract, a multi-agency contract, a multiple-award schedule contract such as the Federal Supply Schedule, or any other procurement instrument intended for use by multiple agencies, the Contractor shall notify the OIG of the ordering agency and the IG of the agency responsible for the basic contract.

(c) Business ethics awareness and compliance program and internal control system. This paragraph (c) does not apply if the Contractor has represented itself as a small business concern pursuant to the award of this contract or if this contract is for the acquisition of a commercial product or commercial service as defined at FAR 2.101. The Contractor shall establish the following within 90 days after contract award, unless the Contracting Officer establishes a longer time period:

(1) An ongoing business ethics awareness and compliance program.

(i) This program shall include reasonable steps to communicate periodically and in a practical manner the Contractor's standards and procedures and other aspects of the Contractor's business ethics awareness and

compliance program and internal control system, by conducting effective training programs and otherwise disseminating information appropriate to an individual's respective roles and responsibilities.

(ii) The training conducted under this program shall be provided to the Contractor's principals and employees, and as appropriate, the Contractor's agents and subcontractors.

(2) An internal control system.

(i) The Contractor's internal control system shall--

(A) Establish standards and procedures to facilitate timely discovery of improper conduct in connection with Government contracts; and

(B) Ensure corrective measures are promptly instituted and carried out.

(ii) At a minimum, the Contractor's internal control system shall provide for the following:

(A) Assignment of responsibility at a sufficiently high level and adequate resources to ensure effectiveness of the business ethics awareness and compliance program and internal control system.

(B) Reasonable efforts not to include an individual as a principal, whom due diligence would have exposed as having engaged in conduct that is in conflict with the Contractor's code of business ethics and conduct.

(C) Periodic reviews of company business practices, procedures, policies, and internal controls for compliance with the Contractor's code of business ethics and conduct and the special requirements of Government contracting, including--

(1) Monitoring and auditing to detect criminal conduct;

(2) Periodic evaluation of the effectiveness of the business ethics awareness and compliance program and internal control system, especially if criminal conduct has been detected; and

(3) Periodic assessment of the risk of criminal conduct, with appropriate steps to design, implement, or modify the business ethics awareness and compliance program and the internal control system as necessary to reduce the risk of criminal conduct identified through this process.

(D) An internal reporting mechanism, such as a hotline, which allows for anonymity or confidentiality, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

(E) Disciplinary action for improper conduct or for failing to take reasonable steps to prevent or detect improper conduct.

(F) Timely disclosure, in writing, to the agency OIG, with a copy to the Contracting Officer, whenever, in connection with the award, performance, or closeout of any Government contract performed by the Contractor or a subcontractor thereunder, the Contractor has credible evidence that a principal, employee, agent, or subcontractor of the Contractor has committed a violation of Federal criminal law involving fraud, conflict of interest, bribery, or gratuity violations found in Title 18 U.S.C. or a violation of the civil False Claims Act (31 U.S.C. 3729-3733).

(1) If a violation relates to more than one Government contract, the Contractor may make the disclosure to the agency OIG and Contracting Officer responsible for the largest dollar value contract impacted by the violation.

(2) If the violation relates to an order against a Governmentwide acquisition contract, a multi-agency contract, a multiple-award schedule contract such as the Federal Supply Schedule, or any other procurement instrument intended for use by multiple agencies, the contractor shall notify the OIG of the ordering agency and the IG of the agency responsible for the basic contract, and the respective agencies' contracting officers.

(3) The disclosure requirement for an individual contract continues until at least 3 years after final payment on the contract.

(4) The Government will safeguard such disclosures in accordance with paragraph (b)(3)(ii) of this clause.

(G) Full cooperation with any Government agencies responsible for audits, investigations, or corrective actions.

(d) Subcontracts.

(1) The Contractor shall include the substance of this clause, including this paragraph (d), in subcontracts that exceed the threshold specified in FAR 3.1004(a) on the date of subcontract award and a performance period of more than 120 days.

(2) In altering this clause to identify the appropriate parties, all disclosures of violation of the civil False Claims Act or of Federal criminal law shall be directed to the agency Office of the Inspector General, with a copy to the Contracting Officer.

(End of clause)

52.203-17 CONTRACTOR EMPLOYEE WHISTLEBLOWER RIGHTS AND REQUIREMENT TO INFORM EMPLOYEES OF WHISTLEBLOWER RIGHTS (JUN 2020)

(a) This contract and employees working on this contract will be subject to the whistleblower rights and remedies in the pilot program on Contractor employee whistleblower protections established at 41 U.S.C. 4712 by section 828 of the National Defense Authorization Act for Fiscal Year 2013 (Pub. L. 112-239) and Federal Acquisition Regulation (FAR) 3.908.

(b) The Contractor shall inform its employees in writing, in the predominant language of the workforce, of employee whistleblower rights and protections under 41 U.S.C. 4712, as described in FAR 3.908.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in all subcontracts over the simplified acquisition threshold, as defined in FAR 2.101 on the date of subcontract award.

(End of clause)

52.203-19 PROHIBITION ON REQUIRING CERTAIN INTERNAL CONFIDENTIALITY AGREEMENTS OR STATEMENTS (JAN 2017)

(a) Definitions. As used in this clause--
Internal confidentiality agreement or statement means a confidentiality agreement or any other written statement that the contractor requires any of its employees or subcontractors to sign regarding nondisclosure of contractor

information, except that it does not include confidentiality agreements arising out of civil litigation or confidentiality agreements that contractor employees or subcontractors sign at the behest of a Federal agency.
Subcontract means any contract as defined in subpart 2.1 entered into by a subcontractor to furnish supplies or services for performance of a prime contract or a subcontract. It includes but is not limited to purchase orders, and changes and modifications to purchase orders.
Subcontractor means any supplier, distributor, vendor, or firm (including a consultant) that furnishes supplies or services to or for a prime contractor or another subcontractor.
(b) The Contractor shall not require its employees or subcontractors to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or subcontractors from lawfully reporting waste, fraud, or abuse related to the performance of a Government contract to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information (e.g., agency Office of the Inspector General).
(c) The Contractor shall notify current employees and subcontractors that prohibitions and restrictions of any preexisting internal confidentiality agreements or statements covered by this clause, to the extent that such prohibitions and restrictions are inconsistent with the prohibitions of this clause, are no longer in effect.
(d) The prohibition in paragraph (b) of this clause does not contravene requirements applicable to Standard Form 312 (Classified Information Nondisclosure Agreement), Form 4414 (Sensitive Compartmented Information Nondisclosure Agreement), or any other form issued by a Federal department or agency governing the nondisclosure of classified information.
(e) In accordance with section 743 of Division E, Title VII, of the Consolidated and Further Continuing Appropriations Act, 2015, (Pub. L. 113-235), and its successor provisions in subsequent appropriations acts (and as extended in continuing resolutions) use of funds appropriated (or otherwise made available) is prohibited, if the Government determines that the Contractor is not in compliance with the provisions of this clause.
(f) The Contractor shall include the substance of this clause, including this paragraph (f), in subcontracts under such contracts.

(End of clause)

52.204-4 PRINTED OR COPIED DOUBLE-SIDED ON POSTCONSUMER FIBER CONTENT PAPER (MAY 2011)

(a) Definitions. As used in this clause--

Postconsumer fiber means—

(1) Paper, paperboard, and fibrous materials from retail stores, office buildings, homes, and so forth, after they have passed through their end-usage as a consumer item, including: used corrugated boxes; old newspapers; old magazines; mixed waste paper; tabulating cards; and used cordage; or

(2) All paper, paperboard, and fibrous materials that enter and are collected from municipal solid waste; but not

(3) Fiber derived from printers' over-runs, converters' scrap, and over-issue publications.

(b) The Contractor is required to submit paper documents, such as offers, letters, or reports that are printed or copied double-sided on paper containing at least 30 percent postconsumer fiber, whenever practicable, when not using electronic commerce methods to submit information or data to the Government.

(End of clause)

52.204-9 PERSONAL IDENTITY VERIFICATION OF CONTRACTOR PERSONNEL (JAN 2011)

(a) The Contractor shall comply with agency personal identity verification procedures identified in the contract that implement Homeland Security Presidential Directive-12 (HSPD-12), Office of Management and Budget (OMB) guidance M-05-24, and Federal Information Processing Standards Publication (FIPS PUB) Number 201.

(b) The Contractor shall account for all forms of Government-provided identification issued to the Contractor employees in connection with performance under this contract. The Contractor shall return such identification to the issuing agency at the earliest of any of the following, unless otherwise determined by the Government:

(1) When no longer needed for contract performance.

(2) Upon completion of the Contractor employee's employment.

(3) Upon contract completion or termination.

(c) The Contracting Officer may delay final payment under a contract if the Contractor fails to comply with these requirements.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in all subcontracts when the subcontractor`s employees are required to have routine physical access to a Federally-controlled facility and/or routine access to a Federally-controlled information system. It shall be the responsibility of the prime Contractor to return such identification to the issuing agency in accordance with the terms set forth in paragraph (b) of this section, unless otherwise approved in writing by the Contracting Officer.

(End of Clause)

52.204-10 REPORTING EXECUTIVE COMPENSATION AND FIRST-TIER SUBCONTRACT AWARDS (JUN 2020)

(a) Definitions. As used in this clause:

Executive means officers, managing partners, or any other employees in management positions.

First-tier subcontract means a subcontract awarded directly by the Contractor for the purpose of acquiring supplies or services (including construction) for performance of a prime contract. It does not include the Contractor's supplier agreements with vendors, such as long-term arrangements for materials or supplies that benefit multiple contracts and/or the costs of which are normally applied to a Contractor's general and administrative expenses or indirect costs.

Month of award means the month in which a contract is signed by the Contracting Officer or the month in which a first-tier subcontract is signed by the Contractor.

Total compensation means the cash and noncash dollar value earned by the executive during the Contractor's preceding fiscal year and includes the following (for more information see 17 CFR 229.402(c)(2)):

(1) Salary and bonus.

(2) Awards of stock, stock options, and stock appreciation rights. Use the dollar amount recognized for financial statement reporting purposes with respect to the fiscal year in accordance with the Financial Accounting Standards Board's Accounting Standards Codification (FASB ASC) 718, Compensation-Stock Compensation.

(3) Earnings for services under non-equity incentive plans. This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.

(4) Change in pension value. This is the change in present value of defined benefit and actuarial pension plans.

(5) Above-market earnings on deferred compensation which is not tax-qualified.

(6) Other compensation, if the aggregate value of all such other compensation (e.g., severance, termination payments, value of life insurance paid on behalf of the employee, perquisites or property) for the executive exceeds $10,000.

(b) Section 2(d)(2) of the Federal Funding Accountability and Transparency Act of 2006 (Pub. L. 109-282), as amended by section 6202 of the Government Funding Transparency Act of 2008 (Pub. L. 110-252), requires the Contractor to report information on subcontract awards. The law requires all reported information be made public, therefore, the Contractor is responsible for notifying its subcontractors that the required information will be made public.

(c) Nothing in this clause requires the disclosure of classified information.

(d)(1) Executive compensation of the prime contractor. As a part of its annual registration requirement in the System for Award Management (SAM) (Federal Acquisition Regulation FAR provision 52.204-7), the Contractor shall report the names and total compensation of each of the five most highly compensated executives for its preceding completed fiscal year, if—

(i) In the Contractor's preceding fiscal year, the Contractor received—

(A) 80 percent or more of its annual gross revenues from Federal contracts (and subcontracts), loans, grants (and subgrants), cooperative agreements, and other forms of Federal financial assistance; and

(B) $25,000,000 or more in annual gross revenues from Federal contracts (and subcontracts), loans, grants (and subgrants), cooperative agreements, and other forms of Federal financial assistance; and

(ii) The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at http://www.sec.gov/answers/execomp.htm.).

(2) First-tier subcontract information. Unless otherwise directed by the Contracting Officer, or as provided in paragraph (g) of this clause, by the end of the month following the month of award of a first-tier subcontract valued at or above the threshold specified in FAR 4.1403(a) on the date of subcontract award, the Contractor shall report the following information at http://www.fsrs.gov for that first-tier subcontract. (The Contractor shall follow the instructions at http://www.fsrs.gov to report the data.)

(i) Unique entity identifier for the subcontractor receiving the award and for the subcontractor's parent company, if the subcontractor has a parent company.

(ii) Name of the subcontractor.

(iii) Amount of the subcontract award.

(iv) Date of the subcontract award.

(v) A description of the products or services (including construction) being provided under the subcontract, including the overall purpose and expected outcomes or results of the subcontract.

(vi) Subcontract number (the subcontract number assigned by the Contractor).

(vii) Subcontractor's physical address including street address, city, state, and country. Also include the nine-digit zip code and congressional district.

(viii) Subcontractor's primary performance location including street address, city, state, and country. Also include the nine-digit zip code and congressional district.

(ix) The prime contract number, and order number if applicable.

(x) Awarding agency name and code.

(xi) Funding agency name and code.

(xii) Government contracting office code.

(xiii) Treasury account symbol (TAS) as reported in FPDS.

(xiv) The applicable North American Industry Classification System code (NAICS).

(3) Executive compensation of the first-tier subcontractor. Unless otherwise directed by the Contracting Officer, by the end of the month following the month of award of a first-tier subcontract valued at or above the threshold specified in FAR 4.1403(a) on the date of subcontract award, and annually thereafter calculated from the prime contract award date), the Contractor shall report the names and total compensation of each of the five most highly compensated executives for that first-tier subcontractor for the first-tier subcontractor's preceding completed fiscal year at http://www.fsrs.gov, if—

(i) In the subcontractor's preceding fiscal year, the subcontractor received—

(A) 80 percent or more of its annual gross revenues from Federal contracts (and subcontracts), loans, grants (and subgrants), cooperative agreements, and other forms of Federal financial assistance; and

(B) $25,000,000 or more in annual gross revenues from Federal contracts (and subcontracts), loans, grants (and subgrants), cooperative agreements, and other forms of Federal financial assistance; and

(ii) The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if thepublic has access to the compensation information, see the U.S. Security and Exchange Commission
total compensation filings at http://www.sec.gov/answers/execomp.htm.)

(e) The Contractor shall not split or break down first-tier subcontract awards to a value below the threshold specified in FAR 4.1403(a), on the date of subcontract award, to avoid the reporting requirements in paragraph (d) of this clause.

(f) The Contractor is required to report information on a first-tier subcontract covered by paragraph (d) when the subcontract is awarded. Continued reporting on the same subcontract is not required unless one of the reported data elements changes during the performance of the subcontract. The Contractor is not required to make further reports after the first-tier subcontract expires.

(g)(1) If the Contractor in the previous tax year had gross income, from all sources, under $300,000, the Contractor is exempt from the requirement to report subcontractor awards.

(2) If a subcontractor in the previous tax year had gross income from all sources under $300,000, the Contractor does not need to report awards for that subcontractor.

(h) The FSRS database at http://www.fsrs.gov will be prepopulated with some information from SAM and the FPDS database. If FPDS information is incorrect, the contractor should notify the contracting officer. If the SAM information is incorrect, the contractor is responsible for correcting this information.

(End of clause)

52.204-13 SYSTEM FOR AWARD MANAGEMENT MAINTENANCE (OCT 2018)

(a) Definitions. As used in this clause--

Electronic Funds Transfer (EFT) indicator means a four-character suffix to the unique entity identifier. The suffix is assigned at the discretion of the commercial, nonprofit, or Government entity to establish additional System for Award Management (SAM) records for identifying alternative EFT accounts (see subpart 32.11) for the same entity.

Registered in the System for Award Management (SAM) means that--

(1) The Contractor has entered all mandatory information, including the unique entity identifier and the EFT indicator (if applicable), the Commercial and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see subpart 4.14), into SAM;

(2) The Contractor has completed the Core, Assertions, Representations and Certifications, and Points of Contact sections of the registration in SAM;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The Contractor will be required to provide consent for TIN validation to the Government as a part of the SAM registration process; and

(4) The Government has marked the record ``Active".

System for Award Management (SAM) means the primary Government repository for prospective Federal awardee and Federal awardee information and the centralized Government system for certain contracting, grants, and other assistance-related processes. It includes—

(1) Data collected from prospective Federal awardees required for the conduct of business with the Government;

(2) Prospective contractor-submitted annual representations and certifications in accordance with FAR subpart 4.12; and

(3) Identification of those parties excluded from receiving Federal contracts, certain subcontracts, and certain types of Federal financial and non-financial assistance and benefits.

Unique entity identifier means a number or other identifier used to identify a specific commercial, nonprofit, or Government entity. See www.sam.gov for the designated entity for establishing unique entity identifiers.

(b) If the solicitation for this contract contained the provision 52.204-7 with its Alternate I, and the Contractor was unable to register prior to award, the Contractor shall be registered in SAM within 30 days after award or before three days prior to submission of the first invoice, whichever occurs first.

(c) The Contractor shall maintain registration in SAM during contract performance and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement. The Contractor is responsible for the currency, accuracy and completeness of the data within SAM, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in SAM after the initial registration, the Contractor is required to review and update on an annual basis, from the date of initial registration or subsequent updates, its information in SAM to ensure it is current, accurate and complete. Updating information in SAM does not alter the terms and conditions of this contract and is not a substitute for a properly executed contractual document.

(d)(1)(i) If a Contractor has legally changed its business name or ``doing business as'' name (whichever is shown on the contract), or has transferred the assets used in performing the contract, but has not completed the necessary requirements regarding novation and change-of-name agreements in subpart 42.12, the Contractor shall provide the responsible Contracting Officer a minimum of one business day's written notification of its intention to--

(A) Change the name in SAM;

(B) Comply with the requirements of subpart 42.12 of the FAR; and

(C) Agree in writing to the timeline and procedures specified by the responsible Contracting Officer. The Contractor shall provide with the notification sufficient documentation to support the legally changed name.

(ii) If the Contractor fails to comply with the requirements of paragraph (d)(1)(i) of this clause, or fails to perform the agreement at paragraph (d)(1)(i)(C) of this clause, and, in the absence of a properly executed novation or change-of-name agreement, the SAM information that shows the Contractor to be other than the Contractor indicated in the contract will be considered to be incorrect information within the meaning of the ``Suspension of Payment'' paragraph of the electronic funds transfer (EFT) clause of this contract.

(2) The Contractor shall not change the name or address for EFT payments or manual payments, as appropriate, in the SAM record to reflect an assignee for the purpose of assignment of claims (see FAR subpart 32.8, Assignment of Claims). Assignees shall be separately registered in SAM. Information provided to the Contractor's SAM record that indicates payments, including those made by EFT, to an ultimate recipient other than that Contractor will be considered to be incorrect information within the meaning of the ``Suspension of Payment'' paragraph of the EFT clause of this contract.

(3) The Contractor shall ensure that the unique entity identifier is maintained with the entity designated at www.sam.gov for establishment of the unique entity identifier throughout the life of the contract. The Contractor shall communicate any change to the unique entity identifier to the Contracting Officer within 30 days after the

change, so an appropriate modification can be issued to update the data on the contract. A change in the unique entity identifier does not necessarily require a novation be accomplished.

(e) Contractors may obtain additional information on registration and annual confirmation requirements at https://www.sam.gov.

(End of clause)

52.204-18 COMMERCIAL AND GOVERNMENT ENTITY CODE MAINTENANCE (AUG 2020)

(a) Definition. As used in this clause--

Commercial and Government Entity (CAGE) code means--

(1) An identifier assigned to entities located in the United States or its outlying areas by the Defense Logistics Agency (DLA) Commercial and Government Entity (CAGE) Branch to identify a commercial or government entity by unique location; or

(2) An identifier assigned by a member of the North Atlantic Treaty Organization (NATO) or by the NATO Support and Procurement Agency (NSPA) to entities located outside the United States and its outlying areas that the DLA Commercial and Government Entity (CAGE) Branch records and maintains in the CAGE master file. This type of code is known as a NATO CAGE (NCAGE) code.

(b) Contractors shall ensure that the CAGE code is maintained throughout the life of the contract for each location of contract, including subcontract, performance. For contractors registered in the System for Award Management (SAM), the DLA Commercial and Government Entity (CAGE) Branch shall only modify data received from SAM in the CAGE master file if the contractor initiates those changes via update of its SAM registration. Contractors undergoing a novation or change-of-name agreement shall notify the contracting officer in accordance with subpart 42.12. The contractor shall communicate any change to the CAGE code to the contracting officer within 30 days after the change, so that a modification can be issued to update the CAGE code on the contract.

(c) Contractors located in the United States or its outlying areas that are not registered in SAM shall submit written change requests to the DLA Commercial and Government Entity (CAGE) Branch. Requests for changes shall be provided at https://cage.dla.mil. Change requests to the CAGE master file are accepted from the entity identified by the code.

(d) Contractors located outside the United States and its outlying areas that are not registered in SAM shall contact the appropriate National Codification Bureau (points of contact available at http://www.nato.int/structur/AC/135/main/links/contacts.htm) or NSPA at https://eportal.nspa.nato.int/AC135Public/scage/CageList.aspx to request CAGE changes.

(e) Additional guidance for maintaining CAGE codes is available at https://cage.dla.mil.

(f) If the contract includes Federal Acquisition Regulation clause 52.204-2, Security Requirements, the contractor shall ensure that subcontractors maintain their CAGE code(s) throughout the life of the contract.

(End of Clause)

52.204-19 INCORPORATION BY REFERENCE OF REPRESENTATIONS AND CERTIFICATIONS (DEC 2014)

The Contractor's representations and certifications, including those completed electronically via the System for Award Management (SAM), are incorporated by reference into the contract.

(End of clause)

52.204-21 BASIC SAFEGUARDING OF COVERED CONTRACTOR INFORMATION SYSTEMS (NOV 2021)

(a) Definitions. As used in this clause--

Covered contractor information system means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.

Federal contract information means information, not intended for public release, that is provided by or generated for the Government under a contract to develop or deliver a product or service to the Government, but not including information provided by the Government to the public (such as on public websites) or simple transactional information, such as necessary to process payments.

Information means any communication or representation of knowledge such as facts, data, or opinions, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual (Committee on National Security Systems Instruction (CNSSI) 4009).

Information system means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information (44 U.S.C. 3502).

Safeguarding means measures or controls that are prescribed to protect information systems.

(b) Safeguarding requirements and procedures.

(1) The Contractor shall apply the following basic safeguarding requirements and procedures to protect covered contractor information systems. Requirements and procedures for basic safeguarding of covered contractor information systems shall include, at a minimum, the following security controls:

(i) Limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems).

(ii) Limit information system access to the types of transactions and functions that authorized users are permitted to execute.

(iii) Verify and control/limit connections to and use of external information systems.

(iv) Control information posted or processed on publicly accessible information systems.

(v) Identify information system users, processes acting on behalf of users, or devices.

(vi) Authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to
organizational information systems.

(vii) Sanitize or destroy information system media containing Federal Contract Information before disposal or release for reuse.

(viii) Limit physical access to organizational information systems, equipment, and the respective operating environments to authorized individuals.

(ix) Escort visitors and monitor visitor activity; maintain audit logs of physical access; and control and manage physical access devices.

(x) Monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems.

(xi) Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.

(xii) Identify, report, and correct information and information system flaws in a timely manner.

(xiii) Provide protection from malicious code at appropriate locations within organizational information systems.

(xiv) Update malicious code protection mechanisms when new
releases are available.

(xv) Perform periodic scans of the information system and real-time scans of files from external sources as files are downloaded, opened, or executed.

(2) Other requirements. This clause does not relieve the Contractor of any other specific safeguarding requirements specified by Federal agencies and departments relating to covered contractor information systems generally or other Federal safeguarding requirements for controlled unclassified information (CUI) as established by Executive Order 13556.

(c) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (c), in subcontracts under this contract (including subcontracts for the acquisition of commercial products or commercial services, other than commercially available off-the-shelf items), in which the subcontractor may have Federal contract information residing in or transiting through its information system.

(End of clause)

52.204-23 PROHIBITION ON CONTRACTING FOR HARDWARE, SOFTWARE, AND SERVICES DEVELOPED OR PROVIDED BY KASPERSKY LAB AND OTHER COVERED ENTITIES (NOV 2021)

(a) Definitions. As used in this clause--

Covered article means any hardware, software, or service that--

(1) Is developed or provided by a covered entity;

(2) Includes any hardware, software, or service developed or provided in whole or in part by a covered entity; or

(3) Contains components using any hardware or software developed in whole or in part by a covered entity.

Covered entity means--

(1) Kaspersky Lab;

(2) Any successor entity to Kaspersky Lab;

(3) Any entity that controls, is controlled by, or is under common control with Kaspersky Lab; or

(4) Any entity of which Kaspersky Lab has a majority ownership.

(b) Prohibition. Section 1634 of Division A of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) prohibits Government use of any covered article. The Contractor is prohibited from--

(1) Providing any covered article that the Government will use on or after October 1, 2018; and

(2) Using any covered article on or after October 1, 2018, in the development of data or deliverables first produced in the performance of the contract.

(c) Reporting requirement.

(1) In the event the Contractor identifies a covered article provided to the Government during contract performance, or the Contractor is notified of such by a subcontractor at any tier or any other source, the Contractor shall report, in writing, to the Contracting Officer or, in the case of the Department of Defense, to the website at https://dibnet.dod.mil. For indefinite delivery contracts, the Contractor shall report to the Contracting Officer for the indefinite delivery contract and the Contracting Officer(s) for any affected order or, in the case of the Department of Defense, identify both the indefinite delivery contract and any affected orders in the report provided at https://dibnet.dod.mil.

(2) The Contractor shall report the following information pursuant to paragraph (c)(1) of this clause:

(i) Within 1 business day from the date of such identification or notification: The contract number; the order number(s), if applicable; supplier name; brand; model number (Original Equipment Manufacturer (OEM) number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

(ii) Within 10 business days of submitting the report pursuant to paragraph (c)(1) of this clause: Any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of a covered article, any reasons that led to the use or submission of the covered article, and any additional efforts that will be incorporated to prevent future use or submission of covered articles.

(d) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (d), in all subcontracts including subcontracts for the acquisition of commercial products or commercial services.

(End of clause)

52.204-25 PROHIBITION ON CONTRACTING FOR CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (NOV 2021)

(a) Definitions. As used in this clause--

Backhaul means intermediate links between the core network, or backbone network, and the small subnetworks at the edge of the network (e.g., connecting cell phones/towers to the core telephone network). Backhaul can be wireless (e.g., microwave) or wired (e.g., fiber optic, coaxial cable, Ethernet).

Covered foreign country means The People's Republic of China.

Covered telecommunications equipment or services means--

(1) Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities);

(2) For the purpose of public safety, security of Government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities);

(3) Telecommunications or video surveillance services provided by such entities or using such equipment; or

(4) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

Critical technology means--

(1) Defense articles or defense services included on the United States Munitions List set forth in the International Traffic in Arms Regulations under subchapter M of chapter I of title 22, Code of Federal Regulations;

(2) Items included on the Commerce Control List set forth in Supplement No. 1 to part 774 of the Export Administration Regulations under subchapter C of chapter VII of title 15, Code of Federal Regulations, and controlled--

(i) Pursuant to multilateral regimes, including for reasons relating to national security, chemical and biological weapons proliferation, nuclear nonproliferation, or missile technology; or

(ii) For reasons relating to regional stability or surreptitious listening;

(3) Specially designed and prepared nuclear equipment, parts and components, materials, software, and technology covered by part 810 of title 10, Code of Federal Regulations (relating to assistance to foreign atomic energy activities);

(4) Nuclear facilities, equipment, and material covered by part 110 of title 10, Code of Federal Regulations (relating to export and import of nuclear equipment and material);

(5) Select agents and toxins covered by part 331 of title 7, Code of Federal Regulations, part 121 of title 9 of such Code, or part 73 of title 42 of such Code; or

(6) Emerging and foundational technologies controlled pursuant to section 1758 of the Export Control Reform Act of 2018 (50 U.S.C. 4817).

Interconnection arrangements means arrangements governing the physical connection of two or more networks to allow the use of another's network to hand off traffic where it is ultimately delivered (e.g., connection of a customer of telephone provider A to a customer of telephone company B) or sharing data and other information resources.

Reasonable inquiry means an inquiry designed to uncover any information in the entity's possession about the identity of the producer or provider of covered telecommunications equipment or services used by the entity that excludes the need to include an internal or third-party audit.

Roaming means cellular communications services (e.g., voice, video, data) received from a visited network when unable to connect to the facilities of the home network either because signal coverage is too weak or because traffic is too high.

Substantial or essential component means any component necessary for the proper function or performance of a piece of equipment, system, or service.

(b) Prohibition.

(1) Section 889(a)(1)(A) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2019, from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. The Contractor is prohibited from providing to the Government any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless an exception at paragraph (c) of this clause applies or the covered telecommunication equipment or services are covered by a waiver described in FAR 4.2104.

(2) Section 889(a)(1)(B) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2020, from entering into a contract, or extending or renewing a contract, with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless an exception at paragraph (c) of this clause applies or the covered telecommunication equipment or services are covered by a waiver described in FAR 4.2104. This prohibition applies to the use of covered telecommunications equipment or services, regardless of whether that use is in performance of work under a Federal contract.

(c) Exceptions. This clause does not prohibit contractors from providing--

(1) A service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or

(2) Telecommunications equipment that cannot route or redirect user data traffic or permit visibility into any user data or packets that such equipment transmits or otherwise handles.

(d) Reporting requirement.

(1) In the event the Contractor identifies covered telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, or the Contractor is notified of such by a subcontractor at any tier or by any other source, the Contractor shall report the information in paragraph (d)(2) of this clause to the Contracting Officer, unless elsewhere in this contract are established procedures for reporting the information; in the case of the Department of Defense, the Contractor shall report to the website at https://dibnet.dod.mil. For indefinite delivery contracts, the Contractor shall report to the Contracting Officer for the indefinite delivery contract and the Contracting Officer(s) for any affected order or, in the case of the Department of Defense, identify both the indefinite delivery contract and any affected orders in the report provided at https://dibnet.dod.mil.

(2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:

(i) Within one business day from the date of such identification or notification: The contract number; the order number(s), if applicable; supplier name; supplier unique entity identifier (if known); supplier Commercial and Government Entity (CAGE) code (if known); brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

(ii) Within 10 business days of submitting the information in paragraph (d)(2)(i) of this clause: Any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of covered telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.

(e) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (e) and excluding paragraph (b)(2), in all subcontracts and other contractual instruments, including subcontracts for the acquisition of commercial products or commercial services.

(End of clause)

52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (NOV 2021)

(a) Definition. Commercially available off-the-shelf (COTS) item, as used in this clause--

(1) Means any item of supply (including construction material) that is--

(i) A commercial product (as defined in paragraph (1) of the definition of "commercial product" in Federal Acquisition Regulation (FAR) 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, under a contract or subcontract at any tier, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4), such as agricultural products and petroleum products.

(b) The Government suspends or debars Contractors to protect the Government's interests. Other than a subcontract for a commercially available off-the-shelf item, the Contractor shall not enter into any subcontract, in excess of the

threshold specified in FAR 9.405-2(b) on the date of subcontract award, with a Contractor that is debarred, suspended, or proposed for debarment by any executive agency unless there is a compelling reason to do so.

(c) The Contractor shall require each proposed subcontractor whose subcontract will exceed the threshold specified in FAR 9.405-2(b) on the date of subcontract award, other than a subcontractor providing a commercially available off-the-shelf item, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principals, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(d) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party (other than a subcontractor providing a commercially available off-the-shelf item) that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the System for Award Management (SAM) Exclusions). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor's knowledge of the reasons for the subcontractor being listed with an exclusion in SAM.

(3) The compelling reason(s) for doing business with the subcontractor notwithstanding its being listed with an exclusion in SAM.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(e) Subcontracts. Unless this is a contract for the acquisition of commercial products or commercial services, the Contractor shall include the requirements of this clause, including this paragraph (e) (appropriately modified for the identification of the parties), in each subcontract that--

(1) Exceeds the threshold specified in FAR 9.405-2(b) on the date of subcontract award; and

(2) Is not a subcontract for commercially available off-the-shelf items.

(End of clause)

52.209-9 UPDATES OF PUBLICLY AVAILABLE INFORMATION REGARDING RESPONSIBILITY MATTERS (OCT 2018)

(a) The Contractor shall update the information in the Federal Awardee Performance and Integrity Information System (FAPIIS) on a semi-annual basis, throughout the life of the contract, by posting the required information in the System for Award Management via https://www.sam.gov.

(b) As required by section 3010 of the Supplemental Appropriations Act, 2010 (Pub. L. 111-212), all information posted in FAPIIS on or after April 15, 2011, except past performance reviews, will be publicly available. FAPIIS consists of two segments--

(1) The non-public segment, into which Government officials and the Contractor post information, which can only be viewed by--

(i) Government personnel and authorized users performing business on behalf of the Government; or

(ii) The Contractor, when viewing data on itself; and

(2) The publicly-available segment, to which all data in the non-public segment of FAPIIS is automatically transferred after a waiting period of 14 calendar days, except for--

(i) Past performance reviews required by subpart 42.15;

(ii) Information that was entered prior to April 15, 2011; or

(iii) Information that is withdrawn during the 14-calendar-day waiting period by the Government official who posted it in accordance with paragraph (c)(1) of this clause.

(c) The Contractor will receive notification when the Government posts new information to the Contractor's record.

(1) If the Contractor asserts in writing within 7 calendar days, to the Government official who posted the information, that some of the information posted to the non-public segment of FAPIIS is covered by a disclosure exemption under the Freedom of Information Act, the Government official who posted the information must within 7 calendar days remove the posting from FAPIIS and resolve the issue in accordance with agency Freedom of Information procedures, prior to reposting the releasable information. The contractor must cite 52.209-9 and request removal within 7 calendar days of the posting to FAPIIS.

(2) The Contractor will also have an opportunity to post comments regarding information that has been posted by the Government. The comments will be retained as long as the associated information is retained, i.e., for a total period of 6 years. Contractor comments will remain a part of the record unless the Contractor revises them.

(3) As required by section 3010 of Pub. L. 111-212, all information posted in FAPIIS on or after April 15, 2011, except past performance reviews, will be publicly available.

(d) Public requests for system information posted prior to April 15, 2011, will be handled under Freedom of Information Act procedures, including, where appropriate, procedures promulgated under E.O. 12600.

(End of clause)

52.209-10 PROHIBITION ON CONTRACTING WITH INVERTED DOMESTIC CORPORATIONS. (NOV 2015)

(a) Definitions. As used in this clause--

Inverted domestic corporation means a foreign incorporated entity that meets the definition of an inverted domestic corporation under 6 U.S.C. 395(b), applied in accordance with the rules and definitions of 6 U.S.C. 395(c).

Subsidiary means an entity in which more than 50 percent of the entity is owned--

(1) Directly by a parent corporation; or

(2) Through another subsidiary of a parent corporation.

(b) If the contractor reorganizes as an inverted domestic corporation or becomes a subsidiary of an inverted domestic corporation at any time during the period of performance of this contract, the Government may be prohibited from paying for Contractor activities performed after the date when it becomes an inverted domestic corporation or subsidiary. The Government may seek any available remedies in the event the Contractor fails to perform in accordance with the terms and conditions of the contract as a result of Government action under this clause.

(c) Exceptions to this prohibition are located at 9.108-2.

(d) In the event the Contractor becomes either an inverted domestic corporation, or a subsidiary of an inverted domestic corporation during contract performance, the Contractor shall give written notice to the Contracting Officer within five business days from the date of the inversion event.

(End of clause)

52.210-1 MARKET RESEARCH (NOV 2021)

(a) Definition. As used in this clause-

Commercial product, commercial service, and nondevelopmental item have the meaning contained in Federal Acquisition Regulation (FAR) 2.101.

(b) Before awarding subcontracts for other than commercial acquisitions, where the subcontracts are over the simplified acquisition threshold, as defined in FAR 2.101 on the date of subcontract award, the Contractor shall conduct market research to--

(1) Determine if commercial products, commercial services, or, to the extent commercial products suitable to meet the agency's needs are not available, nondevelopmental items are available that--

(i) Meet the agency's requirements;

(ii) Could be modified to meet the agency's requirements; or

(iii) Could meet the agency's requirements if those requirements were modified to a reasonable extent; and

(2) Determine the extent to which commercial products, commercial services, or nondevelopmental items could be incorporated at the component level.

(End of clause)

52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984) - ALTERNATE I (APR 1984)

The Contractor shall be required to (a) commence work under this contract within 10 calendar days after the date the

Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than December 31, 2024. The time stated for completion shall include final cleanup of the premises.

The completion date is based on the assumption that the successful offeror will receive the notice to proceed by July 31, 2023. The completion date will be extended by the number of calendar days after the above date that the Contractor receives the notice to proceed, except to the extent that the delay in issuance of the notice to proceed results from the failure of the Contractor to execute the contract and give the required performance and payment bonds within the time specified in the offer.

(End of clause)

52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)

(a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of 1,525.00 for each calendar day of delay until the work is completed or accepted.

(b) If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.

(End of clause)

52.211-18 VARIATION IN ESTIMATED QUANTITY (APR 1984)

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the date of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgement of the Contracting Officer, is justified.

(End of clause)

52.214-26 AUDIT AND RECORDS--SEALED BIDDING (JUN 2020)

(a) As used in this clause, records includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) Certified cost or pricing data. If the Contractor has been required to submit certified cost or pricing data in connection with the pricing of any modification to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the certified cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

(1) The proposal for the modification;

(2) The discussions conducted on the proposal(s), including those related to negotiating;

(3) Pricing of the modification; or

(4) Performance of the modification.

(c) Comptroller General. In the case of pricing any modification, the Comptroller General of the United States, or an authorized representative, shall have the same rights as specified in paragraph (b) of this clause and also the right to interview any current employee regarding such transactions.

(d) Availability. The Contractor shall make available at its office at all reasonable times the materials described in reproduction, until 3 years after final payment under this contract, or for any other period specified in Subpart 4.7 of the Federal Acquisition Regulation (FAR). FAR Subpart 4.7, Contractor Records Retention, in effect on the data of this contract, is incorporated by reference in its entirety and made a part of this contract.

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement.

(2) Records pertaining to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to the performance of this contract shall be made available until disposition of such appeals, litigation, or claims.

(e) Subcontracts. The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (e), in all subcontracts expected to exceed the threshold for submission of certified cost or pricing data in FAR 15.403-4(a)(1) on the date of subcontract award.

(End of clause)

52.214-27 PRICE REDUCTION FOR DEFECTIVE CERTIFIED COST OR PRICING DATA - MODIFICATIONS - SEALED BIDDING. (JUN 2020)

(a) This clause shall become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for the submission of certified cost or pricing data in Federal Acquisition Regulation (FAR) 15.403-4(a)(1) on the date of execution of the modification, except that this clause does not apply to a modification if an exception under FAR 15.403-1(b) applies.

(b) If any price, including profit, negotiated in connection with any modification under this clause, was increased by any significant amount because

(1) the Contractor or a subcontractor furnished certified cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data;

(2) a subcontractor or prospective subcontractor furnished the Contractor certified cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data; or

(3) any of these parties furnished data of any description that were not accurate, the price shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) above.

(c) Any reduction in the contract price under paragraph (b) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which:

(1) the actual subcontract; or

(2) the actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective certified cost or pricing data.

(d) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made:

(1) the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current certified cost or pricing data had been submitted;

(ii) The Contracting Officer should have known that the certified cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer;

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract; or

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2) Except as prohibited by subdivision (d)(2)(ii) of this clause:

(i) an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if:

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the certified cost or pricing data were available before the date of agreement on the price of the contract (or price of the modification) and that the data were not submitted before such date.

(ii) An offset shall not be allowed if:

(A) The understated data was known by the Contractor to be understated when the Certificate of Current Cost or Pricing Data was signed; or (B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data had been submitted before the date of agreement on price.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid:

(1) Interest compounded daily, as required by 26 U.S.C. 6622, on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted certified cost or pricing data which were incomplete, inaccurate, or noncurrent.

(End of clause)

52.214-28 SUBCONTRACTOR CERTIFIED COST OR PRICING DATA - MODIFICATIONS - SEALED BIDDING. (JUN 2020)

(a) The requirements of paragraphs (b) and (c) of this clause shall—

(1) Become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of certified cost or pricing data in Federal Acquisition Regulation (FAR) 15.403-4(a)(1) on the date of execution of the modification; and

(2) Be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of certified cost or pricing data in FAR 15.403-4(a)(1), on the date of agreement on price or the date of award, whichever is later, or before pricing any subcontract modifications involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of certified cost or pricing data in FAR 15.403-4(a)(1), the Contractor shall require the subcontractor to submit certified cost or pricing data (actually or by specific identification in writing), as part of the subcontractor's proposal in accordance with FAR 15.408, Table 15-2 (to include any information reasonably required to explain the subcontractor's estimating process such as the judgmental factors applied and the mathematical or other methods used in the estimate, including those used in projecting from known data, and the nature and amount of any contingencies included in the price), unless an exception under FAR 15.403-1(b) applies. If the threshold for submission of certified cost or pricing data specified in FAR 15.403-4(a)(1) is adjusted for inflation as set forth in FAR 1.109(a), then pursuant to FAR 1.109(d) the changed threshold applies throughout the remaining term of the contract, unless there is a subsequent threshold adjustment.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in FAR subsection 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (b) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that, when entered into, exceeds the threshold for submission of certified cost or pricing data in FAR 15.403-4(a)(1).

(End of clause)

52.219-6 NOTICE OF TOTAL SMALL BUSINESS SET-ASIDE (NOV 2020)

(a) Definition. Small business concern, as used in this clause—

(1) Means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the size standards in this solicitation.

(2) Affiliates, as used in paragraph (a)(1) of this clause, means business concerns, one of whom directly or indirectly controls or has the power to control the others, or a third party or parties control or have the power to control the others. In determining whether affiliation exists, consideration is given to all appropriate factors including common ownership, common management, and contractual relationships. SBA determines affiliation based on the factors set forth at 13 CFR 121.103.

(b) Applicability. This clause applies only to-

(1) Contracts that have been totally set aside for small business concerns; and

(2) Orders set aside for small business concerns under multiple-award contracts as described in 8.405-5 and 16.505(b)(2)(i)(F).

(c) General. (1) Offers are solicited only from small business concerns. Offers received from concerns that are not small business concerns shall be considered nonresponsive and will be rejected.
(2) Any award resulting from this solicitation will be made to a small business concern.

(End of clause)

52.219-14 LIMITATIONS ON SUBCONTRACTING (DEVIATION 2021-O0008) (SEP 2021)

(a) This clause does not apply to the unrestricted portion of a partial set-aside.
(b) Definition. "Similarly situated entity," as used in this clause, means a first-tier subcontractor, including an independent contractor, that—
(1) Has the same small business program status as that which qualified the prime contractor for the award (e.g., for a small business set-aside contract, any small business concern, without regard to its socioeconomic status); and
(2) Is considered small for the size standard under the North American Industry Classification System (NAICS) code the prime contractor assigned to the subcontract.
(c) Applicability. This clause applies only to—
(1) Contracts that have been set aside for any of the small business concerns identified in 19.000(a)(3);
(2) Part or parts of a multiple-award contract that have been set aside for any of the small business concerns identified in 19.000(a)(3);
(3) Contracts that have been awarded on a sole-source basis in accordance with subparts 19.8, 19.13, 19.14, and 19.15;
(4) Orders expected to exceed the simplified acquisition threshold and that are—

(i) Set aside for small business concerns under multiple-award contracts, as described in 8.405-5 and 16.505(b)(2)(i)(F); or
(ii) Issued directly to small business concerns under multiple-award contracts as described in 19.504(c)(1)(ii);
(5) Orders, regardless of dollar value, that are—
(i) Set aside in accordance with subparts 19.8, 19.13, 19.14, or 19.15 under multiple-award contracts, as described in 8.405-5 and 16.505(b)(2)(i)(F); or
(ii) Issued directly to concerns that qualify for the programs described in subparts 19.8, 19.13, 19.14, or 19.15 under multiple-award contracts, as described in 19.504(c)(1)(ii); and
(6) Contracts using the HUBZone price evaluation preference to award to a HUBZone small business concern unless the concern waived the evaluation preference.
(d) Independent contractors. An independent contractor shall be considered a subcontractor.
(e) Limitations on subcontracting. By submission of an offer and execution of a contract, the Contractor agrees that in performance of a contract assigned a North American Industry Classification System (NAICS) code for—
(1) Services (except construction), it will not pay more than 50 percent of the amount paid by the Government for contract performance, excluding certain other direct costs and certain work performed outside the United States (see paragraph (e)(1)(i)), to subcontractors that are not similarly situated entities. Any work that a similarly situated entity further subcontracts will count towards the prime contractor's 50 percent subcontract amount that cannot be exceeded. When a contract includes both services and supplies, the 50 percent limitation shall apply only to the service portion of the contract. The following services may be excluded from the 50 percent limitation:
(i) Other direct costs, to the extent they are not the principal purpose of the acquisition and small business concerns do not provide the service. Examples include airline travel, work performed by a transportation or disposal entity under a contract assigned the environmental remediation NAICS code 562910), cloud computing services, or mass media purchases.
(ii) Work performed outside the United States on awards made pursuant to the Foreign Assistance Act of 1961, or work performed outside the United States required to be performed by a local contractor.
(2) Supplies (other than procurement from a nonmanufacturer of such supplies), it will not pay more than 50 percent of the amount paid by the Government for contract performance, excluding the cost of materials, to subcontractors that are not similarly situated entities. Any work that a similarly situated entity further subcontracts will count towards the prime contractor's 50 percent subcontract amount that cannot be exceeded. When a contract includes both supplies and services, the 50 percent limitation shall apply only to the supply portion of the contract;
(3) General construction, it will not pay more than 85 percent of the amount paid by the Government for contract performance, excluding the cost of materials, to subcontractors that are not similarly situated entities. Any work that a similarly situated entity further subcontracts will count towards the prime contractor's 85 percent subcontract amount that cannot be exceeded; or
(4) Construction by special trade contractors, it will not pay more than 75 percent of the amount paid by the Government for contract performance, excluding the cost of materials, to subcontractors that are not similarly situated entities. Any work that a similarly situated entity further subcontracts will count towards the prime contractor's 75 percent subcontract amount that cannot be exceeded.
(f) The Contractor shall comply with the limitations on subcontracting as follows:
(1) For contracts, in accordance with paragraphs (c)(1), (2), (3) and (6) of this clause –
[Contracting Officer check as appropriate.]
XXX By the end of the base term of the contract and then by the end of each subsequent option period; or
___ By the end of the performance period for each order issued under the contract.
(2) For orders, in accordance with paragraphs (c)(4) and (5) of this clause, by the end of the performance period for the order.
(g) A joint venture agrees that, in the performance of the contract, the applicable percentage specified in paragraph (e) of this clause will be performed by the aggregate of the joint venture participants.
(End of clause)

52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (OCT 2022)

(a) Definitions. As used in this contract--

HUBZone small business concern means a small business concern that meets the requirements described in 13 CFR 126.200, certified by the Small Business Administration (SBA) and designated by SBA as a HUBZone small business concern in the Dynamic Small Business Search (DSBS) and SAM.

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

Small business concern means a concern, including its affiliates, that is independently owned and operated, not dominant in its field of operation and qualified as a small business under the criteria and size standards in 13 CFR part 121, including the size standard that corresponds to the NAICS code assigned to the contract or subcontract.

Small disadvantaged business concern, consistent with 13 CFR 124.1002, means a small business concern under the size standard applicable to the acquisition, that--

(1) Is at least 51 percent unconditionally and directly owned (as defined at 13 CFR 124.105) by--

(i) One or more socially disadvantaged (as defined at 13 CFR 124.103) and economically disadvantaged (as defined at 13 CFR 124.104) individuals who are citizens of the United States; and

(ii) Each individual claiming economic disadvantage has a net worth not exceeding $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(2) The management and daily business operations of which are controlled (as defined at 13.CFR 124.106) by individuals, who meet the criteria in paragraphs (1)(i) and (ii) of this definition.

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern--

(1) That is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.
(b) It is the policy of the United States that small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns.

(c)(1) A joint venture qualifies as a small business concern if--

(i) Each party to the joint venture qualifies as small under the size standard for the solicitation; or

(ii) The protege is small under the size standard for the solicitation in a joint venture comprised of a mentor and protege with an approved mentor-protege agreement under a SBA mentor-protege program.

(2) A joint venture qualifies as--

(i) A service-disabled veteran-owned small business concern if it complies with the requirements in 13 CFR part 125; or

(ii) A HUBZone small business concern if it complies with the requirements in 13 CFR 126.616(a) through (c).

(d) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

(e)(1) The Contractor may accept a subcontractor's written representations of its size and socioeconomic status as a small business, small disadvantaged business, veteran-owned small business, service-disabled veteran-owned small business, or a women-owned small business if the subcontractor represents that the size and socioeconomic status representations with its offer are current, accurate, and complete as of the date of the offer for the subcontract.

(2) The Contractor may accept a subcontractor's representations of its size and socioeconomic status as a small business, small disadvantaged business, veteran-owned small business, service-disabled veteran-owned small business, or a women-owned small business in the System for Award Management (SAM) if--

(i) The subcontractor is registered in SAM; and

(ii) The subcontractor represents that the size and socioeconomic status representations made in SAM are current, accurate and complete as of the date of the offer for the subcontract.

(3) The Contractor may not require the use of SAM for the purposes of representing size or socioeconomic status in connection with a subcontract.

(4) In accordance with 13 CFR 121.411, 124.1015, 125.29, 126.900, and 127.700, a contractor acting in good faith is not liable for misrepresentations made by its subcontractors regarding the subcontractor's size or socioeconomic status.

(5) The Contractor shall confirm that a subcontractor representing itself as a HUBZone small business concern is certified by SBA as a HUBZone small business concern by accessing SAM or by accessing DSBS at https://web.sba.gov/pro-net/search/dsp_dsbs.cfm. If the subcontractor is a joint venture, the Contractor shall confirm that at least one party to the joint venture is certified by SBA as a HUBZone small business concern. The Contractor may confirm the representation by accessing SAM.

(End of clause)

52.219-28 POST-AWARD SMALL BUSINESS PROGRAM REREPRESENTATION (MAR 2023)

(a) *Definitions*. As used in this clause—

Long-term contract means a contract of more than five years in duration, including options. However, the term does not include contracts that exceed five years in duration because the period of performance has been extended for a cumulative period not to exceed six months under the clause at 52.217-8, Option to Extend Services, or other appropriate authority.

Small business concern—

(1) Means a concern, including its affiliates, that is independently owned and operated, not dominant in its field of operation, and qualified as a small business under the criteria in 13 CFR part 121 and the size standard in paragraph (d) of this clause.

(2) *Affiliates*, as used in this definition, means business concerns, one of whom directly or indirectly controls or has the power to control the others, or a third party or parties control or have the power to control the others. In determining whether affiliation exists, consideration is given to all appropriate factors including common ownership, common management, and contractual relationships. SBA determines affiliation based on the factors set forth at 13 CFR 121.103.

(b) If the Contractor represented that it was any of the small business concerns identified in 19.000(a)(3) prior to award of this contract, the Contractor shall rerepresent its size and socioeconomic status according to paragraph (f) of this clause or, if applicable, paragraph (h) of this clause, upon occurrence of any of the following:

(1) Within 30 days after execution of a novation agreement or within 30 days after modification of the contract to include this clause, if the novation agreement was executed prior to inclusion of this clause in the contract.

(2) Within 30 days after a merger or acquisition that does not require a novation or within 30 days after modification of the contract to include this clause, if the merger or acquisition occurred prior to inclusion of this clause in the contract.

(3) For long-term contracts-

(i) Within 60 to 120 days prior to the end of the fifth year of the contract; and

(ii) Within 60 to 120 days prior to the date specified in the contract for exercising any option thereafter.

(c) If the Contractor represented that it was any of the small business concerns identified in 19.000(a)(3) prior to award of this contract, the Contractor shall rerepresent its size and socioeconomic status according to paragraph (f) of this clause or, if applicable, paragraph (h) of this clause, when the Contracting Officer explicitly requires it for an order issued under a multiple-award contract.

(d) The Contractor shall rerepresent its size status in accordance with the size standard in effect at the time of this rerepresentation that corresponds to the North American Industry Classification System (NAICS) code(s) assigned to this contract. The small business size standard corresponding to this NAICS code(s) can be found at https://www.sba.gov/document/support--table-size-standards.

(e) The small business size standard for a Contractor providing an end item that it does not manufacture, process, or produce itself, for a contract other than a construction or service contract, is 500 employees, or 150 employees for information technology value-added resellers under NAICS code 541519, if the acquisition—

(1) Was set aside for small business and has a value above the simplified acquisition threshold;

(2) Used the HUBZone price evaluation preference regardless of dollar value, unless the Contractor waived the price evaluation preference; or

(3) Was an 8(a), HUBZone, service-disabled veteran-owned, economically disadvantaged women-owned, or women-owned small business set-aside or sole-source award regardless of dollar value.

(f) Except as provided in paragraph (h) of this clause, the Contractor shall make the representation(s) required by paragraph (b) and (c) of this clause by validating or updating all its representations in the Representations and Certifications section of the System for Award Management (SAM) and its other data in SAM, as necessary, to ensure that they reflect the Contractor's current status. The Contractor shall notify the contracting office in writing within the timeframes specified in paragraph (b) of this clause, or with its offer for an order (see paragraph (c) of this clause), that the data have been validated or updated, and provide the date of the validation or update.

(g) If the Contractor represented that it was other than a small business concern prior to award of this contract, the Contractor may, but is not required to, take the actions required by paragraphs (f) or (h) of this clause.

(h) If the Contractor does not have representations and certifications in SAM, or does not have a representation in SAM for the NAICS code applicable to this contract, the Contractor is required to complete the following rerepresentation and submit it to the contracting office, along with the contract number and the date on which the rerepresentation was completed:

(1) The Contractor represents that it □ is, □ is not a small business concern under *NAICS Code* _____ assigned to *contract number* _____.

(2) [*Complete only if the Contractor represented itself as a small business concern in paragraph (h)(1) of this clause*.] The Contractor represents that it □ is, □ is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) [*Complete only if the Contractor represented itself as a small business concern in paragraph (h)(1) of this clause.*] The Contractor represents that it □ is, □ is not a women-owned small business concern.

(4) Women-owned small business (WOSB) joint venture eligible under the WOSB Program. The Contractor represents that it □ is, □ is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [*The Contractor shall enter the name and unique entity identifier of each party to the joint venture:* __.]

(5) Economically disadvantaged women-owned small business (EDWOSB) joint venture. The Contractor represents that it □ is, □ is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [*The Contractor shall enter the name and unique entity identifier of each party to the joint venture:* __ .]

(6) [*Complete only if the Contractor represented itself as a small business concern in paragraph (h)(1) of this clause.*] The Contractor represents that it □ is, □ is not a veteran-owned small business concern.

(7) [*Complete only if the Contractor represented itself as a veteran-owned small business concern in paragraph (h)(6) of this clause.*] The Contractor represents that it □ is, □ is not a service-disabled veteran-owned small business concern.

(8) [*Complete only if the Contractor represented itself as a small business concern in paragraph (h)(1) of this clause.*] The Contractor represents that—

(i) It □ is, □ is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material changes in ownership and control, principal office, or HUBZone employee percentage have occurred since it was certified in accordance with 13 CFR part 126; and

(ii) It □ is, □ is not a HUBZone joint venture that complies with the requirements of 13 CFR part 126, and the representation in paragraph (h)(8)(i) of this clause is accurate for each HUBZone small business concern participating in the HUBZone joint venture. *[The Contractor shall enter the names of each of the HUBZone small business concerns participating in the HUBZone joint venture: .]* Each HUBZone small business concern participating in the HUBZone joint venture shall submit a separate signed copy of the HUBZone representation.

[*Contractor to sign and date and insert authorized signer's name and title.*_____]

52.222-1 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997)

If the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediately give notice, including all relevant information, to the Contracting Officer.

(End of clause)

52.222-3 CONVICT LABOR (JUN 2003)

(a) Except as provided in paragraph (b) of this clause, the Contractor shall not employ in the performance of this contract any person undergoing a sentence of imprisonment imposed by any court of a State, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, or the U.S. Virgin Islands.

(b) The Contractor is not prohibited from employing persons--

(1) On parole or probation to work at paid employment during the term of their sentence;

(2) Who have been pardoned or who have served their terms; or

(3) Confined for violation of the laws of any of the States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, or the U.S. Virgin Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

(i) The worker is paid or is in an approved work training program on a voluntary basis;

(ii) Representatives of local union central bodies or similar labor union organizations have been consulted;

(iii) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services;

(iv) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and

(v) The Attorney General of the United States has certified that the work-release laws or **regulations** of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

(End of clause)

52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS - OVERTIME COMPENSATION (MAY 2018)

(a) Overtime requirements. No Contractor or subcontractor employing laborers or mechanics (see Federal Acquisition Regulation 22.300) shall require or permit them to work over 40 hours in any workweek unless they are paid at least 1 and 1/2 times the basic rate of pay for each hour worked over 40 hours.

(b) Violation; liability for unpaid wages; liquidated damages. The responsible Contractor and subcontractor are liable for unpaid wages if they violate the terms in paragraph (a) of this clause. In addition, the Contractor and subcontractor are liable for liquidated damages payable to the Government. The Contracting Officer will assess liquidated damages at the rate specified at 29 CFR 5.5(b)(2) per affected employee for each calendar day on which the employer required

or permitted the employee to work in excess of the standard workweek of 40 hours without paying overtime wages required by the Contract Work Hours and Safety Standards statute (found at 40 U.S.C. chapter 37). In accordance with the Federal Civil Penalties Inflation Adjustment Act of 1990 (28 U.S.C. 2461 Note), the Department of Labor adjusts this civil monetary penalty for inflation no later than January 15 each year.

(c) Withholding for unpaid wages and liquidated damages. The Contracting Officer will withhold from payments due under the contract sufficient funds required to satisfy any Contractor or subcontractor liabilities for unpaid wages and liquidated damages. If amounts withheld under the contract are insufficient to satisfy Contractor or subcontractor liabilities, the Contracting Officer will withhold payments from other Federal or Federally assisted contracts held by the same Contractor that are subject to the Contract Work Hours and Safety Standards statute.

(d) Payrolls and basic records.

(1) The Contractor and its subcontractors shall maintain payrolls and basic payroll records for all laborers and mechanics working on the contract during the contract and shall make them available to the Government until 3 years after contract completion. The records shall contain the name and address of each employee, social security number, labor classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. The records need not duplicate those required for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Construction Wage Rate Requirements statute.

(2) The Contractor and its subcontractors shall allow authorized representatives of the Contracting Officer or the Department of Labor to inspect, copy, or transcribe records maintained under paragraph (d)(1) of this clause. The Contractor or subcontractor also shall allow authorized representatives of the Contracting Officer or Department of Labor to interview employees in the workplace during working hours.

(e) Subcontracts. The Contractor shall insert the provisions set forth in paragraphs (a) through (d) of this clause in subcontracts that may require or involve the employment of laborers and mechanics and require subcontractors to include these provisions in any such lower tier subcontracts. The Contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the provisions set forth in paragraphs (a) through (d) of this clause.

(End of clause)

52.222-6 CONSTRUCTION WAGE RATE REQUIREMENTS (AUG 2018)

(a) Definition.—"Site of the work"—

(1) Means—

(i) The primary site of the work. The physical place or places where the construction called for in the contract will remain when work on it is completed; and

(ii) The secondary site of the work, if any. Any other site where a significant portion of the building or work is constructed, provided that such site is—

(A) Located in the United States; and

(B) Established specifically for the performance of the contract or project;

(2) Except as provided in paragraph (3) of this definition, includes any fabrication plants, mobile factories, batch plants, borrow pits, job headquarters, tool yards, etc., provided—

(i) They are dedicated exclusively, or nearly so, to performance of the contract or project; and

(ii) They are adjacent or virtually adjacent to the "primary site of the work" as defined in paragraph (a)(1)(i), or the "secondary site of the work" as defined in paragraph (a)(1)(ii) of this definition;

(3) Does not include permanent home offices, branch plant establishments, fabrication plants, or tool yards of a Contractor or subcontractor whose locations and continuance in operation are determined wholly without regard to a

particular Federal contract or project. In addition, fabrication plants, batch plants, borrow pits, job headquarters, yards, etc., of a commercial or material supplier which are established by a supplier of materials for the project before opening of bids and not on the Project site, are not included in the "site of the work." Such permanent, previously established facilities are not a part of the "site of the work" even if the operations for a period of time may be dedicated exclusively or nearly so, to the performance of a contract.

(b)(1) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, or as may be incorporated for a secondary site of the work, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Any wage determination incorporated for a secondary site of the work shall be effective from the first day on which work under the contract was performed at that site and shall be incorporated without any adjustment in contract price or estimated cost. Laborers employed by the construction Contractor or construction subcontractor that are transporting portions of the building or work between the secondary site of the work and the primary site of the work shall be paid in accordance with the wage determination applicable to the primary site of the work.

(2) Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Construction Wage Rate Requirements statute on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (e) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period.

(3) Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.

(4) The wage determination (including any additional classifications and wage rates conformed under paragraph (c) of this clause) and the Construction Wage Rate Requirements statute poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the primary site of the work and the secondary site of the work, if any, in a prominent and accessible place where it can be easily seen by the workers.

(c)(1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount

designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the:
Wage and Hour Division
U.S. Department of Labor
Washington, DC 20210
The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to paragraphs (c)(2) and (c)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(d) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(e) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Construction Wage Rate Requirements statute have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.
(End of clause)

52.222-7 WITHHOLDING OF FUNDS (MAY 2014)

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Construction Wage Rate Requirements statute prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(End of clause)

52.222-8 PAYROLLS AND BASIC RECORDS (JUL 2021)

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 40 U.S.C. 3141(2)(B) (Construction Wage Rate Requirement statute)), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Construction Wage Rate Requirements, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in 40 U.S.C. 3141(2)(B), the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b)(1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph(a) of this clause, except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be obtained from the U.S. Department of Labor Wage and Hour Division website at https://www.dol.gov/agencies/whd/forms. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the Contracting Officer, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a Prime Contractor to require a subcontractor to provide addresses and social security numbers to the Prime Contractor for its own records, without weekly submission to the Contracting Officer.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2)

of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(End of clause)

52.222-9 APPRENTICES AND TRAINEES (JUL 2005)

(a) Apprentices. (1) An apprentice will be permitted to work at less than the predetermined rate for the work performed when employed--

(i) Pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer, and Labor Services (OATELS) or with a State Apprenticeship Agency recognized by the OATELS; or

(ii) In the first 90 days of probationary employment as an apprentice in such an apprenticeship program, even though not individually registered in the program, if certified by the OATELS or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

(2) The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program.

(3) Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in paragraph (a)(1) of this clause, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(4) Where a Contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination.

(5) Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

(6) In the event OATELS, or a State Apprenticeship Agency recognized by OATELS, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) Trainees.

(1) Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer, and Labor Services (OATELS). The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by OATELS.

(2) Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the OATELS shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed.

(3) In the event OATELS withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

52.222-11 SUBCONTRACTS (LABOR STANDARDS) (MAY 2014)

(a) Definition. Construction, alteration or repair, as used in this clause, means all types of work done by laborers and mechanics employed by the construction Contractor or construction subcontractor on a particular building or work at the site thereof, including without limitation--

(1) Altering, remodeling, installation (if appropriate) on the site of the work of items fabricated off-site;

(2) Painting and decorating;

(3) Manufacturing or furnishing of materials, articles, supplies, or equipment on the site of the building or work;

(4) Transportation of materials and supplies between the site of the work within the meaning of paragraphs (a)(1)(i) and (ii) of the ``site of work'' as defined in the FAR clause at 52.222-6, Construction Wage Rate Requirements of this contract, and a facility which is dedicated to the construction of the building or work and is deemed part of the site of the work within the meaning of paragraph (2) of the ``site of work'' definition; and

(5) Transportation of portions of the building or work between a secondary site where a significant portion of the building or work is constructed, which is part of the ``site of work'' definition in paragraph (a)(1)(ii) of the FAR clause at 52.222-6, Construction Wage Rate Requirements, and the physical place or places where the building or work will remain (paragraph (a)(1)(i) of the FAR clause at 52.222-6, in the ``site of the work'' definition).

(b) The Contractor shall insert in any subcontracts for construction, alterations and repairs within the United States the clauses entitled--

(1) Construction Wage Rate Requirements;

(2) Contract Work Hours and Safety Standards--Overtime Compensation (if the clause is included in this contract);

(3) Apprentices and Trainees;

(4) Payrolls and Basic Records;

(5) Compliance with Copeland Act Requirements;

(6) Withholding of Funds;

(7) Subcontracts (Labor Standards);

(8) Contract Termination--Debarment;

(9) Disputes Concerning Labor Standards;

(10) Compliance with Construction Wage Rate Requirements and Related Regulations; and

(11) Certification of Eligibility.

(c) The prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor performing construction within the United States with all the contract clauses cited in paragraph (b).

(d)(1) Within 14 days after award of the contract, the Contractor shall deliver to the Contracting Officer a completed Standard Form (SF) 1413, Statement and Acknowledgment, for each subcontract for construction within the United States, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (b) of this clause have been included in the subcontract.

(2) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(e) The Contractor shall insert the substance of this clause, including this paragraph (e) in all subcontracts for construction within the United States.

(End of clause)

52.222-12 CONTRACT TERMINATION--DEBARMENT (MAY 2014)

A breach of the contract clauses entitled Construction Wage Rate Requirements, Contract Work Hours and Safety Standards--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Construction Wage Rate Requirements and Related Regulations, or Certification of Eligibility may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

(End of clause)

52.222-13 COMPLIANCE WITH CONSTRUCTION WAGE RATE REQUIREMENTS AND RELATED REGULATIONS (MAY 2014)

All rulings and interpretations of the Construction Wage Rate Requirements and related statutes contained in 29 CFR parts 1, 3, and 5 are hereby incorporated by reference in this contract.

(End of clause)

52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(End of clause)

52.222-15 CERTIFICATION OF ELIGIBILITY (MAY 2014)

(a) By entering into this contract, the Contractor certifies that neither it nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of 40 U.S.C. 3144(b)(2) or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of 40 U.S.C. 3144(b)(2) or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

52.222-21 PROHIBITION OF SEGREGATED FACILITIES (APR 2015)

(a) Definitions. As used in this clause--

Gender identity has the meaning given by the Department of Labor's Office of Federal Contract Compliance Programs, and is found at www.dol.gov/ofccp/LGBT/LGBT_FAQs.html.

Segregated facilities means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

Sexual orientation has the meaning given by the Department of Labor's Office of Federal Contract Compliance Programs, andis found at www.dol.gov/ofccp/LGBT/LGBT_FAQs.html.

(b) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

(End of clause)

52.222-26 EQUAL OPPORTUNITY (SEPT 2016)

(a) Definitions. As used in this clause--

Compensation means any payments made to, or on behalf of, an employee or offered to an applicant as remuneration for employment, including but not limited to salary, wages, overtime pay, shift differentials, bonuses, commissions, vacation and holiday pay, allowances, insurance and other benefits, stock options and awards, profit sharing, and retirement.

Compensation information means the amount and type of compensation provided to employees or offered to applicants, including, but not limited to, the desire of the Contractor to attract and retain a particular employee for the value the employee is perceived to add to the Contractor's profit or productivity; the availability of employees with like skills in the marketplace; market research about the worth of similar jobs in the relevant marketplace; job analysis, descriptions, and evaluations; salary and pay structures; salary surveys; labor union agreements; and

Contractor decisions, statements and policies related to setting or altering employee compensation.

Essential job functions means the fundamental job duties of the employment position an individual holds. A job function may be considered essential if--

(1) The access to compensation information is necessary in order to perform that function or another routinely assigned business task; or

(2) The function or duties of the position include protecting and maintaining the privacy of employee personnel records, including compensation information.

Gender identity has the meaning given by the Department of Labor's Office of Federal Contract Compliance Programs, and is found at www.dol.gov/ofccp/LGBT/LGBT_FAQs.html.

Sexual orientation has the meaning given by the Department of Labor's Office of Federal Contract Compliance Programs, and is found at www.dol.gov/ofccp/LGBT/LGBT_FAQs.html.

United States means the 50 States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, the U.S. Virgin Islands, and Wake Island.

(b)(1) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of $10,000, the Contractor shall comply with this clause, except for work performed outside the United States by employees who were not recruited within the United States. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.

(2) If the Contractor is a religious corporation, association, educational institution, or society, the requirements of this clause do not apply with respect to the employment of individuals of a particular religion to perform work connected with the carrying on of the Contractor's activities (41 CFR 60-1.5).

(c) (1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. However, it shall not be a violation of this clause for the Contractor to extend a publicly announced preference in employment to Indians living on or near an Indian reservation, in connection with employment opportunities on or near an Indian reservation, as permitted by 41 CFR 60-1.5.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(5)(i) The Contractor shall not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This prohibition against discrimination does

not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such

disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the Contractor's legal duty to furnish information.

(ii) The Contractor shall disseminate the prohibition on discrimination in paragraph (c)(5)(i) of this clause, using language prescribed by the Director of the Office of Federal Contract Compliance Programs (OFCCP), to employees and applicants by--

(A) Incorporation into existing employee manuals or handbooks; and

(B) Electronic posting or by posting a copy of the provision in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(7) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(8) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. The Contractor shall also file Standard Form 100 (EEO-1), or any successor form, as prescribed in 41 CFR part 60-1. Unless the Contractor has filed within the 12 months preceding the date of contract award, the Contractor shall, within 30 days after contract award, apply to either the regional Office of Federal Contract Compliance Programs (OFCCP) or the local office of the Equal Employment Opportunity Commission for the necessary forms.

(9) The Contractor shall permit access to its premises, during normal business hours, by the contracting agency or the OFCCP for the purpose of conducting on-site compliance evaluations and complaint investigations. The Contractor shall permit the Government to inspect and copy any books, accounts, records (including computerized records), and other material that may be relevant to the matter under investigation and pertinent to compliance with Executive Order 11246, as amended, and rules and regulations that implement the Executive Order.

(10) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended; in the rules, regulations, and orders of the Secretary of Labor; or as otherwise provided by law.

(11) The Contractor shall include the terms and conditions of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(12) The Contractor shall take such action with respect to any subcontract or purchase order as the Director of OFCCP may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(d) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR part 60-1.

(End of clause)

52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (APR 2015)

(a) Definitions. "Covered area" means the geographical area described in the solicitation for this contract.

"Deputy Assistant Secretary" means the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, or a designee.

"Employer's identification number" means the Federal Social Security number used on the employer's quarterly Federal tax return, U.S. Treasury Department Form 941.

"Gender identity" has the meaning given by the Department of Labor's Office of Federal Contract Compliance Programs, and is found at www.dol.gov/ofccp/LGBT/LGBT_FAQs.html .

"Minority" means --

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

"Sexual orientation" has the meaning given by the Department of Labor's Office of Federal Contract Compliance Programs, and is found at www.dol.gov/ofccp/LGBT/LGBT_FAQs.html .

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of $10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in

which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations, and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Deputy Assistant Secretary when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The

Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) of this clause.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all on-site supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for, through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user rest rooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business

associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16) of this clause. The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participant may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16) of this clause, provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Makes a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) of this clause, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Deputy Assistant Secretary shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

(o) Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(End of clause)

52.222-35 EQUAL OPPORTUNITY FOR VETERANS (JUN 2020)

(a) Definitions. As used in this clause--

"Active duty wartime or campaign badge veteran," "Armed Forces service medal veteran," "disabled veteran," "protected veteran," "qualified disabled veteran," and "recently separated veteran" have the meanings given at Federal Acquisition Regulation (FAR) 22.1301.

(b) Equal opportunity clause. The Contractor shall abide by the requirements of the equal opportunity clause at 41 CFR 60-300.5(a), as of March 24, 2014. This clause prohibits discrimination against qualified protected veterans, and requires affirmative action by the Contractor to employ and advance in employment qualified protected veterans.

(c) Subcontracts. The Contractor shall insert the terms of this clause in subcontracts valued at or above the threshold specified in FAR 22.1303(a) on the date of subcontract award, unless exempted by rules, regulations, or orders of the Secretary of Labor. The Contractor shall act as specified by the Director, Office of Federal Contract Compliance Programs, to enforce the terms, including action for noncompliance. Such necessary changes in language may be made as shall be appropriate to identify properly the parties and their undertakings.

(End of clause)

52.222-36 EQUAL OPPORTUNITY FOR WORKERS WITH DISABILITIES (JUN 2020)

(a) Equal opportunity clause. The Contractor shall abide by the requirements of the equal opportunity clause at 41 CFR 60-741.5(a), as of March 24, 2014. This clause prohibits discrimination against qualified individuals on the basis of disability, and requires affirmative action by the Contractor to employ and advance in employment qualified individuals with disabilities.

(b) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of the threshold specified in Federal Acquisition Regulation (FAR) 22.1408(a) on the date of subcontract award, unless exempted by rules, regulations, or orders of the Secretary, so that such provisions will be binding upon each subcontractor or vendor. The Contractor shall act as specified by the Director, Office of Federal Contract

Compliance Programs of the U.S. Department of Labor, to enforce the terms, including action for noncompliance. Such necessary changes in language may be made as shall be appropriate to identify properly the parties and their undertakings.

(End of clause)

52.222-37 EMPLOYMENT REPORTS ON VETERANS (JUN 2020)

(a) Definitions. As used in this clause, "active duty wartime or campaign badge veteran," "Armed Forces service medal veteran," "disabled veteran," "protected veteran," and "recently separated veteran," have the meanings given in Federal Acquisition Regulation (FAR) 22.1301.

(b) Unless the Contractor is a State or local government agency, the Contractor shall report at least annually, as required by the Secretary of Labor, on--

(1) The total number of employees in the contractor's workforce, by job category and hiring location, who are protected veterans (i.e., active duty wartime or campaign badge veterans, Armed Forces service medal veterans, disabled veterans, and recently separated veterans);

(2) The total number of new employees hired during the period covered by the report, and of the total, the number of protected veterans (i.e., active duty wartime or campaign badge veterans, Armed Forces service medal veterans, disabled veterans, and recently separated veterans); and

(3) The maximum number and minimum number of employees of the Contractor or subcontractor at each hiring location during the period covered by the report.

(c) The Contractor shall report the above items by filing the VETS-4212 "Federal Contractor Veterans' Employment Report" (see "VETS-4212 Federal Contractor Reporting" and "Filing Your VETS-4212 Report" at http://www.dol.gov/vets/vets4212.htm).

(d) The Contractor shall file VETS-4212 Reports no later than September 30 of each year.

(e) The employment activity report required by paragraphs (b)(2) and (b)(3) of this clause shall reflect total new hires, and maximum and minimum number of employees, during the most recent 12-month period preceding the ending date selected for the report. Contractors may select an ending date--

(1) As of the end of any pay period between July 1 and August 31 of the year the report is due; or

(2) As of December 31, if the Contractor has prior written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(f) The number of veterans reported must be based on data known to the contractor when completing the VETS-4212. The contractor's knowledge of veterans status may be obtained in a variety of ways, including an invitation to applicants to self-identify (in accordance with 41 CFR 60-300.42), voluntary self-disclosure by employees, or actual knowledge of veteran status by the contractor. This paragraph does not relieve an employer of liability for discrimination under 38 U.S.C. 4212.

(g) The Contractor shall insert the terms of this clause in subcontracts valued at or above the threshold specified in FAR 22.1303(a) on the date of subcontract award, unless exempted by rules, regulations, or orders of the Secretary of Labor.

(End of clause)

52.222-40 NOTIFICATION OF EMPLOYEE RIGHTS UNDER THE NATIONAL LABOR RELATIONS ACT (DEC 2010)

(a) During the term of this contract, the Contractor shall post an employee notice, of such size and in such form, and containing such content as prescribed by the Secretary of Labor, in conspicuous places in and about its plants and offices where employees covered by the National Labor Relations Act engage in activities relating to the performance of the contract, including all places where notices to employees are customarily posted both physically and electronically, in the languages employees speak, in accordance with 29 CFR 471.2(d) and (f).

(1) Physical posting of the employee notice shall be in conspicuous places in and about the Contractor's plants and offices so that the notice is prominent and readily seen by employees who are covered by the National Labor Relations Act and engage in activities related to the performance of the contract.

(2) If the Contractor customarily posts notices to employees electronically, then the Contractor shall also post the required notice electronically by displaying prominently, on any Web site that is maintained by the Contractor and is customarily used for notices to employees about terms and conditions of employment, a link to the Department of Labor's Web site that contains the full text of the poster. The link to the Department's Web site, as referenced in (b)(3) of this section, must read, ``Important Notice about Employee Rights to Organize and Bargain Collectively with Their Employers."

(b) This required employee notice, printed by the Department of Labor, may be--

(1) Obtained from the Division of Interpretations and Standards, Office of Labor-Management Standards, U.S. Department of Labor, 200 Constitution Avenue, NW., Room N-5609, Washington, DC 20210, (202) 693-0123, or from any field office of the Office of Labor-Management Standards or Office of Federal Contract Compliance Programs;

(2) Provided by the Federal contracting agency if requested;

(3) Downloaded from the Office of Labor-Management Standards Web site at http://www.dol.gov/olms/regs/compliance/EO13496.htm; or

(4) Reproduced and used as exact duplicate copies of the Department of Labor's official poster.

(c) The required text of the employee notice referred to in this clause is located at Appendix A, Subpart A, 29 CFR Part 471.

(d) The Contractor shall comply with all provisions of the employee notice and related rules, regulations, and orders of the Secretary of Labor.

(e) In the event that the Contractor does not comply with the requirements set forth in paragraphs (a) through (d) of this clause, this contract may be terminated or suspended in whole or in part, and the Contractor may be suspended

or debarred in accordance with 29 CFR 471.14 and subpart 9.4. Such other sanctions or remedies may be imposed as are provided by 29 CFR part 471, which implements Executive Order 13496 or as otherwise provided by law.

(f) Subcontracts. (1) The Contractor shall include the substance of this clause, including this paragraph (f), in every subcontract that exceeds $10,000 and will be performed wholly or partially in the United States, unless exempted by the rules, regulations, or orders of the Secretary of Labor issued pursuant to section 3 of Executive Order 13496 of January 30, 2009, so that such provisions will be binding upon each subcontractor.

(2) The Contractor shall not procure supplies or services in a way designed to avoid the applicability of Executive Order 13496 or this clause.

(3) The Contractor shall take such action with respect to any such subcontract as may be directed by the Secretary of Labor as a means of enforcing such provisions, including the imposition of sanctions for noncompliance.

(4) However, if the Contractor becomes involved in litigation with a subcontractor, or is threatened with such involvement, as a result of such direction, the Contractor may request the United States, through the Secretary of Labor, to enter into such litigation to protect the interests of the United States.

(End of clause)

52.222-50 COMBATING TRAFFICKING IN PERSONS (NOV 2021)

(a) Definitions. As used in this clause--

Agent means any individual, including a director, an officer, an employee, or an independent contractor, authorized to act on behalf of the organization.

Coercion means--

(1) Threats of serious harm to or physical restraint against any person;

(2) Any scheme, plan, or pattern intended to cause a person to believe that failure to perform an act would result in serious harm to or physical restraint against any person; or

(3) The abuse or threatened abuse of the legal process.

Commercially available off-the-shelf (COTS) item--

(1) Means any item of supply (including construction material) that is-

(i) A commercial product (as defined in paragraph (1) of the definition of "commercial product" at Federal Acquisition Regulation (FAR) 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, under a contract or subcontract at any tier, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4), such as agricultural products and petroleum products.

Commercial sex act means any sex act on account of which anything of value is given to or received by any person.

Debt bondage means the status or condition of a debtor arising from a pledge by the debtor of his or her personal services or of those of a person under his or her control as a security for debt, if the value of those services as reasonably assessed is not applied toward the liquidation of the debt or the length and nature of those services are not respectively limited and defined.

Employee means an employee of the Contractor directly engaged in the performance of work under the contract who has other than a minimal impact or involvement in contract performance.

Forced Labor means knowingly providing or obtaining the labor or services of a person--

(1) By threats of serious harm to, or physical restraint against, that person or another person;

(2) By means of any scheme, plan, or pattern intended to cause the person to believe that, if the person did not perform such labor or services, that person or another person would suffer serious harm or physical restraint; or

(3) By means of the abuse or threatened abuse of law or the legal process.

Involuntary servitude includes a condition of servitude induced by means of--

(1) Any scheme, plan, or pattern intended to cause a person to believe that, if the person did not enter into or continue in such conditions, that person or another person would suffer serious harm or physical restraint; or

(2) The abuse or threatened abuse of the legal process.

Recruitment fees means fees of any type, including charges, costs, assessments, or other financial obligations, that are associated with the recruiting process, regardless of the time, manner, or location of imposition or collection of the fee.

(1) Recruitment fees include, but are not limited to, the following fees (when they are associated with the recruiting process) for--

(i) Soliciting, identifying, considering, interviewing, referring, retaining, transferring, selecting, training, providing orientation to, skills testing, recommending, or placing employees or potential employees;

(ii) Advertising;

(iii) Obtaining permanent or temporary labor certification, including any associated fees;

(iv) Processing applications and petitions;

(v) Acquiring visas, including any associated fees;

(vi) Acquiring photographs and identity or immigration documents, such as passports, including any associated fees;

(vii) Accessing the job opportunity, including required medical examinations and immunizations; background, reference, and security clearance checks and examinations; and additional certifications;

(viii) An employer's recruiters, agents or attorneys, or other notary or legal fees;

(ix) Language interpretation or translation, arranging for or accompanying on travel, or providing other advice to employees or potential employees;

(x) Government-mandated fees, such as border crossing fees, levies, or worker welfare funds;

(xi) Transportation and subsistence costs--

(A) While in transit, including, but not limited to, airfare or costs of other modes of transportation, terminal fees, and travel taxes associated with travel from the country of origin to the country of performance and the return journey upon the end of employment; and

(B) From the airport or disembarkation point to the worksite;

(xii) Security deposits, bonds, and insurance; and

(xiii) Equipment charges.

(2) A recruitment fee, as described in the introductory text of this definition, is a recruitment fee, regardless of whether the payment is--

(i) Paid in property or money;

(ii) Deducted from wages;

(iii) Paid back in wage or benefit concessions;

(iv) Paid back as a kickback, bribe, in-kind payment, free labor, tip, or tribute; or

(v) Collected by an employer or a third party, whether licensed or unlicensed, including, but not limited to--

(A) Agents;

(B) Labor brokers;

(C) Recruiters;

(D) Staffing firms (including private employment and placement firms);

(E) Subsidiaries/affiliates of the employer;

(F) Any agent or employee of such entities; and

(G) Subcontractors at all tiers.

Severe forms of trafficking in persons means--

(1) Sex trafficking in which a commercial sex act is induced by force, fraud, or coercion, or in which the person induced to perform such act has not attained 18 years of age; or

(2) The recruitment, harboring, transportation, provision, or obtaining of a person for labor or services, through the use of force, fraud, or coercion for the purpose of subjection to involuntary servitude, peonage, debt bondage, or slavery.

Sex trafficking means the recruitment, harboring, transportation, provision, or obtaining of a person for the purpose of a commercial sex act.

Subcontract means any contract entered into by a subcontractor to furnish supplies or services for performance of a prime contract or a subcontract.

Subcontractor means any supplier, distributor, vendor, or firm that furnishes supplies or services to or for a prime contractor or another subcontractor.

United States means the 50 States, the District of Columbia, and outlying areas.

(b) Policy. The United States Government has adopted a policy prohibiting trafficking in persons including the trafficking-related activities of this clause. Contractors, contractor employees, and their agents shall not--

(1) Engage in severe forms of trafficking in persons during the period of performance of the contract;

(2) Procure commercial sex acts during the period of performance of the contract;

(3) Use forced labor in the performance of the contract;

(4) Destroy, conceal, confiscate, or otherwise deny access by an employee to the employee's identity or immigration documents, such as passports or drivers' licenses, regardless of issuing authority;

(5)(i) Use misleading or fraudulent practices during the recruitment of employees or offering of employment, such as failing to disclose, in a format and language understood by the employee or potential employee, basic information or making material misrepresentations during the recruitment of employees regarding the key terms and conditions of employment, including wages and fringe benefits, the location of work, the living conditions, housing and associated costs (if employer or agent provided or arranged), any significant costs to be charged to the employee or potential employee, and, if applicable, the hazardous nature of the work;

(ii) Use recruiters that do not comply with local labor laws of the country in which the recruiting takes place;

(6) Charge employees or potential employees recruitment fees;

(7)(i) Fail to provide return transportation or pay for the cost of return transportation upon the end of employment--

(A) For an employee who is not a national of the country in which the work is taking place and who was brought into that country for the purpose of working on a U.S. Government contract or subcontract (for portions of contracts performed outside the United States); or

(B) For an employee who is not a United States national and who was brought into the United States for the purpose of working on a U.S. Government contract or subcontract, if the payment of such costs is required under existing temporary worker programs or pursuant to a written agreement with the employee (for portions of contracts performed inside the United States); except that--

(ii) The requirements of paragraphs (b)(7)(i) of this clause shall not apply to an employee who is--

(A) Legally permitted to remain in the country of employment and who chooses to do so; or

(B) Exempted by an authorized official of the contracting agency from the requirement to provide return transportation or pay for the cost of return transportation;

(iii) The requirements of paragraph (b)(7)(i) of this clause are modified for a victim of trafficking in persons who is seeking victim services or legal redress in the country of employment, or for a witness in an enforcement action related to trafficking in persons. The contractor shall provide the return transportation or pay the cost of return transportation in a way that does not obstruct the victim services, legal redress, or witness activity. For example, the contractor shall not only offer return transportation to a witness at a time when the witness is still needed to testify. This paragraph does not apply when the exemptions at paragraph (b)(7)(ii) of this clause apply.

(8) Provide or arrange housing that fails to meet the host country housing and safety standards; or

(9) If required by law or contract, fail to provide an employment contract, recruitment agreement, or other required work document in writing. Such written work document shall be in a language the employee understands. If the employee must relocate to perform the work, the work document shall be provided to the employee at least five days prior to the employee relocating. The employee's work document shall include, but is not limited to, details about work description, wages, prohibition on charging recruitment fees, work location(s), living accommodations and associated costs, time off, roundtrip transportation arrangements, grievance process, and the content of applicable laws and regulations that prohibit trafficking in persons.

(c) Contractor requirements. The Contractor shall--

(1) Notify its employees and agents of--

(i) The United States Government's policy prohibiting trafficking in persons, described in paragraph (b) of this clause; and

(ii) The actions that will be taken against employees or agents for violations of this policy. Such actions for employees may include, but are not limited to, removal from the contract, reduction in benefits, or termination of employment; and

(2) Take appropriate action, up to and including termination, against employees, agents, or subcontractors that violate the policy in paragraph (b) of this clause.

(d) Notification.

(1) The Contractor shall inform the Contracting Officer and the agency Inspector General immediately of--

(i) Any credible information it receives from any source (including host country law enforcement) that alleges a Contractor employee, subcontractor, subcontractor employee, or their agent has engaged in conduct that violates the policy in paragraph (b) of this clause (see also 18 U.S.C. 1351, Fraud in Foreign Labor Contracting, and 52.203-13(b)(3)(i)(A), if that clause is included in the solicitation or contract, which requires disclosure to the agency Office of the Inspector General when the Contractor has credible evidence of fraud); and

(ii) Any actions taken against a Contractor employee, subcontractor, subcontractor employee, or their agent pursuant to this clause.

(2) If the allegation may be associated with more than one contract, the Contractor shall inform the contracting officer for the contract with the highest dollar value.

(e) Remedies. In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraphs (c), (d), (g), (h), or (i) of this clause may result
in--

(1) Requiring the Contractor to remove a Contractor employee or employees from the performance of the contract;

(2) Requiring the Contractor to terminate a subcontract;

(3) Suspension of contract payments until the Contractor has taken appropriate remedial action;

(4) Loss of award fee, consistent with the award fee plan, for the performance period in which the Government determined Contractor non-compliance;

(5) Declining to exercise available options under the contract;

(6) Termination of the contract for default or cause, in accordance with the termination clause of this contract; or

(7) Suspension or debarment.

(f) Mitigating and aggravating factors. When determining remedies, the Contracting Officer may consider the following:

(1) Mitigating factors. The Contractor had a Trafficking in Persons compliance plan or an awareness program at the time of the violation, was in compliance with the plan, and has taken appropriate remedial actions for the violation, that may include reparation to victims for such violations.

(2) Aggravating factors. The Contractor failed to abate an alleged violation or enforce the requirements of a compliance plan, when directed by the Contracting Officer to do so.

(g) Full cooperation. (1) The Contractor shall, at a minimum--

(i) Disclose to the agency Inspector General information sufficient to identify the nature and extent of an offense and the individuals responsible for the conduct;

(ii) Provide timely and complete responses to Government auditors' and investigators' requests for documents;

(iii) Cooperate fully in providing reasonable access to its facilities and staff (both inside and outside the U.S.) to allow contracting agencies and other responsible Federal agencies to conduct audits, investigations, or other actions to ascertain compliance with the Trafficking Victims Protection Act of 2000 (22 U.S.C. chapter 78), E.O. 13627, or any other applicable law or regulation establishing restrictions on trafficking in persons, the procurement of commercial sex acts, or the use of forced labor; and

(iv) Protect all employees suspected of being victims of or witnesses to prohibited activities, prior to returning to the country from which the employee was recruited, and shall not prevent or hinder the ability of these employees from cooperating fully with Government authorities.

(2) The requirement for full cooperation does not foreclose any Contractor rights arising in law, the FAR, or the terms of the contract. It does not--

(i) Require the Contractor to waive its attorney-client privilege or the protections afforded by the attorney work product doctrine;

(ii) Require any officer, director, owner, employee, or agent of the Contractor, including a sole proprietor, to waive his or her attorney client privilege or Fifth Amendment rights; or

(iii) Restrict the Contractor from--

(A) Conducting an internal investigation; or

(B) Defending a proceeding or dispute arising under the contract or related to a potential or disclosed violation.

(h) Compliance plan. (1) This paragraph (h) applies to any portion of the contract that--

(i) Is for supplies, other than commercially available off-the-shelf items, acquired outside the United States, or services to be performed outside the United States; and

(ii) Has an estimated value that exceeds $550,000.

(2) The Contractor shall maintain a compliance plan during the performance of the contract that is appropriate--

(i) To the size and complexity of the contract; and

(ii) To the nature and scope of the activities to be performed for the Government, including the number of non-United States citizens expected to be employed and the risk that the contract or subcontract will involve services or supplies susceptible to trafficking in persons.

(3) Minimum requirements. The compliance plan must include, at a minimum, the following:

(i) An awareness program to inform contractor employees about the Government's policy prohibiting trafficking-related activities described in paragraph (b) of this clause, the activities prohibited, and the actions that will be taken against the employee for violations. Additional information about Trafficking in Persons and examples of awareness programs can be found at the Web site for the Department of State's Office to Monitor and Combat Trafficking in Persons at http://www.state.gov/j/tip/.

(ii) A process for employees to report, without fear of retaliation, activity inconsistent with the policy prohibiting trafficking in persons, including a means to make available to all employees and potential employees the hotline phone number of the Global Human Trafficking Hotline at 1-844-888-FREE and its email address at help@befree.org.

(iii) A recruitment and wage plan that only permits the use of recruitment companies with trained employees, prohibits charging recruitment fees to the employee or potential employee, and ensures that wages meet applicable host-country legal requirements or explains any variance.

(iv) A housing plan, if the Contractor or subcontractor intends to provide or arrange housing, that ensures that the housing meets host-country housing and safety standards.

(v) Procedures to prevent agents and subcontractors at any tier and at any dollar value from engaging in trafficking in persons (including activities in paragraph (b) of this clause) and to monitor, detect, and terminate any agents, subcontracts, or subcontractor employees that have engaged in such activities.

(4) Posting.

(i) The Contractor shall post the relevant contents of the compliance plan, no later than the initiation of contract performance, at the workplace (unless the work is to be performed in the field or not in a fixed location) and on the

Contractor's Web site (if one is maintained). If posting at the workplace or on the Web site is impracticable, the Contractor shall provide the relevant contents of the compliance plan to each worker in writing.

(ii) The Contractor shall provide the compliance plan to the Contracting Officer upon request.

(5) Certification. Annually after receiving an award, the Contractor shall submit a certification to the Contracting Officer that--

(i) It has implemented a compliance plan to prevent any prohibited activities identified at paragraph (b) of this clause and to monitor, detect, and terminate any agent, subcontract or subcontractor employee engaging in prohibited activities; and

(ii) After having conducted due diligence, either--

(A) To the best of the Contractor's knowledge and belief, neither it nor any of its agents, subcontractors, or their agents is engaged in any such activities; or

(B) If abuses relating to any of the prohibited activities identified in paragraph (b) of this clause have been found, the Contractor or subcontractor has taken the appropriate remedial and referral actions.

(i) Subcontracts. (1) The Contractor shall include the substance of this clause, including this paragraph (i), in all subcontracts and in all contracts with agents. The requirements in paragraph (h) of this clause apply only to any portion of the subcontract that--

(i) Is for supplies, other than commercially available off-the-shelf items, acquired outside the United States, or services to be performed outside the United States; and

(ii) Has an estimated value that exceeds $550,000.

(2) If any subcontractor is required by this clause to submit a certification, the Contractor shall require submission prior to the award of the subcontract and annually thereafter. The certification shall cover the items in paragraph (h)(5) of this clause.

(End of clause)

52.222-54 EMPLOYMENT ELIGIBILITY VERIFICATION (MAY 2022)

(a) Definitions. As used in this clause--Commercially available off-the-shelf (COTS) item—

(1) Means any item of supply that is--

(i) A commercial product (as defined in paragraph (1) of the definition of "commercial product" at Federal Acquisition Regulation (FAR) 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4), such as agricultural products and petroleum products. Per 46 CFR 525.1(c)(2), "bulk cargo" means cargo that is loaded and carried in bulk onboard ship without mark or count, in a loose unpackaged form, having homogenous characteristics. Bulk cargo loaded into intermodal equipment, except LASH or Seabee barges, is subject to mark and count and, therefore, ceases to be bulk cargo.

Employee assigned to the contract means an employee who was hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), who is directly performing work, in the United States, under a contract that is required to include the clause prescribed at 22.1803. An employee is not considered to be directly performing work under a contract if the employee--

(1) Normally performs support work, such as indirect or overhead functions; and

(2) Does not perform any substantial duties applicable to the contract.

Subcontract means any contract, as defined in 2.101, entered into by a subcontractor to furnish supplies or services for performance of a prime contract or a subcontract. It includes but is not limited to purchase orders, and changes and modifications to purchase orders.

Subcontractor means any supplier, distributor, vendor, or firm that furnishes supplies or services to or for a prime Contractor or another subcontractor.

United States, as defined in 8 U.S.C. 1101(a)(38), means the 50 States, the District of Columbia, Puerto Rico, Guam, the Commonwealth of the Northern Mariana Islands, and the U.S. Virgin Islands.

(b) Enrollment and verification requirements.

(1) If the Contractor is not enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall--

(i) Enroll. Enroll as a Federal Contractor in the E-Verify program within 30 calendar days of contract award;

(ii) Verify all new employees. Within 90 calendar days of enrollment in the E-Verify program, begin to use E-Verify to initiate verification of employment eligibility of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within 3 business days after the date of hire (but see paragraph (b)(3) of this section); and

(iii) Verify employees assigned to the contract. For each employee assigned to the contract, initiate verification within 90 calendar days after date of enrollment or within 30 calendar days of the employee's assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section).

(2) If the Contractor is enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall use E-Verify to initiate verification of employment eligibility of--

(i) All new employees. (A) Enrolled 90 calendar days or more. The Contractor shall initiate verification of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within 3 business days after the date of hire (but see paragraph (b)(3) of this section); or

(B) Enrolled less than 90 calendar days. Within 90 calendar days after enrollment as a Federal Contractor in E-Verify, the Contractor shall initiate verification of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within 3 business days after the date of hire (but see paragraph (b)(3) of this section); or

(ii) Employees assigned to the contract. For each employee assigned to the contract, the Contractor shall initiate verification within 90 calendar days after date of contract award or within 30 days after assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section).

(3) If the Contractor is an institution of higher education (as defined at 20 U.S.C. 1001(a)); a State or local government or the government of a Federally recognized Indian tribe; or a surety performing under a takeover agreement entered into with a Federal agency pursuant to a performance bond, the Contractor may choose to verify only employees assigned to the contract, whether existing employees or new hires. The Contractor shall follow the applicable verification requirements at (b)(1) or (b)(2), respectively, except that any requirement for verification of new employees applies only to new employees assigned to the contract.

(4) Option to verify employment eligibility of all employees. The Contractor may elect to verify all existing employees hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), rather than just those employees assigned to the contract. The Contractor shall initiate verification for each existing employee working in the United States who was hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), within 180 calendar days of--

(i) Enrollment in the E-Verify program; or

(ii) Notification to E-Verify Operations of the Contractor's decision to exercise this option, using the contact information provided in the E-Verify program Memorandum of Understanding (MOU).

(5) The Contractor shall comply, for the period of performance of this contract, with the requirements of the E-Verify program MOU.

(i) The Department of Homeland Security (DHS) or the Social Security Administration (SSA) may terminate the Contractor's MOU and deny access to the E-Verify system in accordance with the terms of the MOU. In such case, the Contractor will be referred to a suspension or debarment official.

(ii) During the period between termination of the MOU and a decision by the suspension or debarment official whether to suspend or debar, the Contractor is excused from its obligations under paragraph (b) of this clause. If the suspension or debarment official determines not to suspend or debar the Contractor, then the Contractor must reenroll in E-Verify.

(c) Web site. Information on registration for and use of the E-Verify program can be obtained via the Internet at the Department of Homeland Security Web site: https://www.e-Verify.gov.

(d) Individuals previously verified. The Contractor is not required by this clause to perform additional employment verification using E-Verify for any employee--

(1) Whose employment eligibility was previously verified by the Contractor through the E-Verify program;

(2) Who has been granted and holds an active U.S. Government security clearance for access to confidential, secret, or top secret information in accordance with the National Industrial Security Program Operating Manual; or

(3) Who has undergone a completed background investigation and been issued credentials pursuant to Homeland Security Presidential Directive (HSPD)-12, Policy for a Common Identification Standard for Federal Employees and Contractors.

(e) Subcontracts. The Contractor shall include the requirements of this clause, including this paragraph (e) (appropriately modified for identification of the parties), in each subcontract that--

(1) Is for—

(i) Services (except for commercial services that are part of the purchase of a COTS item (or an item that would be a COTS item, but for minor modifications), performed by the COTS provider, and are normally provided for that COTS item); or

(ii) Construction;

(2) Has a value of more than $3,500; and

(3) Includes work performed in the United States.

(End of clause)

52.222-55 MINIMUM WAGES FOR CONTRACTOR WORKERS UNDER EXECUTIVE ORDER 14026 (JAN 2022)

(a) Definitions. As used in this clause--

"United States" means the 50 states, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, the U.S. Virgin Islands, Johnston Island, Wake Island, and the outer Continental Shelf as defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331, et seq.).

"Worker"--

(1) (i) Means any person engaged in performing work on, or in connection with, a contract covered by Executive Order 14026, and --

(A) Whose wages under such contract are governed by the Fair Labor Standards Act (29 U.S.C. chapter 8), the Service Contract Labor Standards statute (41 U.S.C. chapter 67), or the Wage Rate Requirements (Construction) statute (40 U.S.C. chapter 31, subchapter IV);

(B) Other than individuals employed in a bona fide executive, administrative, or professional capacity, as those terms are defined in 29 CFR part 541;

(C) Regardless of the contractual relationship alleged to exist between the individual and the employer.

(ii) Includes workers performing on, or in connection with, the contract whose wages are calculated pursuant to special certificates issued under 29 U.S.C. 214(c).

(iii) Also includes any person working on, or in connection with, the contract and individually registered in a bona fide apprenticeship or training program registered with the Department of Labor's Employment and Training Administration, Office of Apprenticeship, or with a State Apprenticeship Agency recognized by the Office of Apprenticeship.

(2)(i) A worker performs on a contract if the worker directly performs the specific services called for by the contract; and

(ii) A worker performs in connection with a contract if the worker's work activities are necessary to the performance of a contract but are not the specific services called for by the contract.

(b) Executive Order minimum wage rate.

(1) The Contractor shall pay to workers, while performing in the United States, and performing on, or in connection with, this contract, a minimum hourly wage rate of $15.00 per hour beginning January 30, 2022.

(2) The Contractor shall adjust the minimum wage paid, if necessary, beginning January 1, 2023, and annually thereafter, to meet the applicable annual E.O. minimum wage. The Administrator of the Department of Labor's Wage and Hour Division (the Administrator) will publish annual determinations in the Federal Register no later than 90 days before the effective date of the new E.O. minimum wage rate. The Administrator will also publish the applicable E.O. minimum wage on https://www.sam.gov (or any successor Web site), and a general notice on all wage determinations issued under the Service Contract Labor Standards statute or the Wage Rate Requirements (Construction) statute, that will provide information on the E.O. minimum wage and how to obtain annual updates. The applicable published E.O. minimum wage is incorporated by reference into this contract.

(3)(i) The Contractor may request a price adjustment only after the effective date of the new annual E.O. minimum wage determination. Prices will be adjusted only for increased labor costs (including subcontractor labor costs) as a result of an increase in the annual E.O. minimum wage, and for associated labor costs (including those for subcontractors). Associated labor costs shall include increases or decreases that result from changes in social security and unemployment taxes and workers' compensation insurance, but will not otherwise include any amount for general and administrative costs, overhead, or profit.

(ii) Subcontractors may be entitled to adjustments due to the new minimum wage, pursuant to paragraph (b)(2). Contractors shall consider any subcontractor requests for such price adjustment.

(iii) The Contracting Officer will not adjust the contract price under this clause for any costs other than those identified in paragraph (b)(3)(i) of this clause, and will not provide duplicate price adjustments with any price adjustment under clauses implementing the Service Contract Labor Standards statute or the Wage Rate Requirements (Construction) statute.

(4) The Contractor warrants that the prices in this contract do not include allowance for any contingency to cover increased costs for which adjustment is provided under this clause.

(5) A pay period under this clause may not be longer than semi-monthly, but may be shorter to comply with any applicable law or other requirement under this contract establishing a shorter pay period. Workers shall be paid no later than one pay period following the end of the regular pay period in which such wages were earned or accrued.

(6) The Contractor shall pay, unconditionally to each worker, all wages due free and clear without subsequent rebate or kickback. The Contractor may make deductions that reduce a worker's wages below the E.O. minimum wage rate only if done in accordance with 29 CFR 23.230, Deductions.

(7) The Contractor shall not discharge any part of its minimum wage obligation under this clause by furnishing fringe benefits or, with respect to workers whose wages are governed by the Service Contract Labor Standards statute, the cash equivalent thereof.

(8) Nothing in this clause shall excuse the Contractor from compliance with any applicable Federal or State prevailing wage law or any applicable law or municipal ordinance or any applicable contract establishing a minimum wage higher than the E.O. 14026 minimum wage. However, wage increases under such other laws or municipal ordinances are not subject to price adjustment under this subpart.

(9) The Contractor shall pay the E.O. minimum wage rate whenever it is higher than any applicable collective bargaining agreement(s) wage rate.

(10) The Contractor shall follow the policies and procedures in 29 CFR 23.240(b) and 23.280 for treatment of workers engaged in an occupation in which they customarily and regularly receive more than $30 a month in tips.

(c)(1) This clause applies to workers as defined in paragraph (a). As provided in that definition--

(i) Workers are covered regardless of the contractual relationship alleged to exist between the contractor or subcontractor and the worker;

(ii) Workers with disabilities whose wages are calculated pursuant to special certificates issued under 29 U.S.C. 214(c) are covered; and

(iii) Workers who are registered in a bona fide apprenticeship program or training program registered with the Department of Labor's Employment and Training Administration, Office of Apprenticeship, or with a State Apprenticeship Agency recognized by the Office of Apprenticeship, are covered.

(2) This clause does not apply to--

(i) Fair Labor Standards Act (FLSA)-covered individuals performing in connection with contracts covered by the E.O., i.e. those individuals who perform duties necessary to the performance of the contract, but who are not directly engaged in performing the specific work called for by the contract, and who spend less than 20 percent of their hours worked in a particular workweek performing in connection with such contracts;

(ii) Individuals exempted from the minimum wage requirements of the FLSA under 29 U.S.C. 213(a) and 214(a) and (b), unless otherwise covered by the Service Contract Labor Standards statute, or the Wage Rate Requirements (Construction) statute. These individuals include but are not limited to--

(A) Learners, apprentices, or messengers whose wages are calculated pursuant to special certificates issued under 29 U.S.C. 214(a);

(B) Students whose wages are calculated pursuant to special certificates issued under 29 U.S.C. 214(b); and

(C) Those employed in a bona fide executive, administrative, or professional capacity (29 U.S.C. 213(a)(1) and 29 CFR part 541).

(d) Notice. The Contractor shall notify all workers performing work on, or in connection with, this contract of the applicable E.O. minimum wage rate under this clause. With respect to workers covered by the Service Contract Labor Standards statute or the Wage Rate Requirements (Construction) statute, the Contractor may meet this requirement by posting, in a prominent and accessible place at the worksite, the applicable wage determination under those statutes. With respect to workers whose wages are governed by the FLSA, the Contractor shall post notice, utilizing the poster provided by the Administrator, which can be obtained at www.dol.gov/agencies/whd/government-contracts, in a prominent and accessible place at the worksite. Contractors that customarily post notices to workers electronically may post the notice electronically provided the electronic posting is displayed prominently on any Web site that is maintained by the contractor, whether external or internal, and customarily used for notices to workers about terms and conditions of employment.

(e) Payroll Records. (1) The Contractor shall make and maintain records, for three years after completion of the work, containing the following information for each worker:

(i) Name, address, and social security number;

(ii) The worker's occupation(s) or classification(s);

(iii) The rate or rates of wages paid;

(iv) The number of daily and weekly hours worked by each worker;

(v) Any deductions made; and

(vi) Total wages paid.

(2) The Contractor shall make records pursuant to paragraph (e)(1) of this clause available for inspection and transcription by authorized representatives of the Administrator. The Contractor shall also make such records available upon request of the Contracting Officer.

(3) The Contractor shall make a copy of the contract available, as applicable, for inspection or transcription by authorized representatives of the Administrator.

(4) Failure to comply with this paragraph (e) shall be a violation of 29 CFR 23.260 and this contract. Upon direction of the Administrator or upon the Contracting Officer's own action, payment shall be withheld until such time as the noncompliance is corrected.

(5) Nothing in this clause limits or otherwise modifies the Contractor's payroll and recordkeeping obligations, if any, under the Service Contract Labor Standards statute, the Wage Rate Requirements (Construction) statute, the Fair Labor Standards Act, or any other applicable law.

(f) Access. The Contractor shall permit authorized representatives of the Administrator to conduct investigations, including interviewing workers at the worksite during normal working hours.

(g) Withholding. The Contracting Officer, upon his or her own action or upon written request of the Administrator, will withhold funds or cause funds to be withheld, from the Contractor under this or any other Federal contract with the same Contractor, sufficient to pay workers the full amount of wages required by this clause.

(h) Disputes. Department of Labor has set forth in 29 CFR 23.510, Disputes concerning contractor compliance, the procedures for resolving disputes concerning a contractor's compliance with Department of Labor regulations at 29 CFR part 23. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. These disputes include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the Department of Labor, or the workers or their representatives.

(i) Antiretaliation. The Contractor shall not discharge or in any other manner discriminate against any worker because such worker has filed any complaint or instituted or caused to be instituted any proceeding under or related to compliance with the E.O. or this clause, or has testified or is about to testify in any such proceeding.

(j) Subcontractor compliance. The Contractor is responsible for subcontractor compliance with the requirements of this clause and may be held liable for unpaid wages due subcontractor workers.

(k) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (k) in all subcontracts, regardless of dollar value, that are subject to the Service Contract Labor Standards statute or the Wage Rate Requirements (Construction) statute, and are to be performed in whole or in part in the United States.

(End of clause)

52.222-62 PAID SICK LEAVE UNDER EXECUTIVE ORDER 13706 (JAN 2022)

(a) Definitions. As used in this clause (in accordance with 29 CFR 13.2)--

Child, domestic partner, and domestic violence have the meaning given in 29 CFR 13.2.

Employee--(1)(i) Means any person engaged in performing work on or in connection with a contract covered by Executive Order (E.O.) 13706; and

(A) Whose wages under such contract are governed by the Service Contract Labor Standards statute (41 U.S.C. chapter 67), the Wage Rate Requirements (Construction) statute (40 U.S.C. chapter 31, subchapter IV), or the Fair Labor Standards Act (29 U.S.C. chapter 8);

(B) Including employees who qualify for an exemption from the Fair Labor Standards Act's minimum wage and overtime provisions;

(C) Regardless of the contractual relationship alleged to exist between the individual and the employer; and

(ii) Includes any person performing work on or in connection with the contract and individually registered in a bona fide apprenticeship or training program registered with the Department of Labor's Employment and Training Administration, Office of Apprenticeship, or with a State Apprenticeship Agency recognized by the Office of Apprenticeship.

(2)(i) An employee performs "on" a contract if the employee directly performs the specific services called for by the contract; and

(ii) An employee performs "in connection with" a contract if the employee's work activities are necessary to the performance of a contract but are not the specific services called for by the contract.

Individual related by blood or affinity whose close association with the employee is the equivalent of a family relationship has the meaning given in 29 CFR 13.2.

Multiemployer plan means a plan to which more than one employer is required to contribute and which is maintained pursuant to one or more collective bargaining agreements between one or more employee organizations and more than one employer.

Paid sick leave means compensated absence from employment that is required by E.O. 13706 and 29 CFR part 13.

Parent, sexual assault, spouse, and stalking have the meaning given in 29 CFR 13.2.

United States means the 50 States and the District of Columbia.

(b) Executive Order 13706. (1) This contract is subject to E.O. 13706 and the regulations issued by the Secretary of Labor in 29 CFR part 13 pursuant to the E.O.

(2) If this contract is not performed wholly within the United States, this clause only applies with respect to that part of the contract that is performed within the United States.

(c) Paid sick leave. The Contractor shall--

(1) Permit each employee engaged in performing work on or in connection with this contract to earn not less than 1 hour of paid sick leave for every 30 hours worked;

(2) Allow accrual and use of paid sick leave as required by E.O. 13706 and 29 CFR part 13;

(3) Comply with the accrual, use, and other requirements set forth in 29 CFR 13.5 and 13.6, which are incorporated by reference in this contract;

(4) Provide paid sick leave to all employees when due free and clear and without subsequent deduction (except as otherwise provided by 29 CFR 13.24), rebate, or kickback on any account;

(5) Provide pay and benefits for paid sick leave used no later than one pay period following the end of the regular pay period in which the paid sick leave was taken; and

(6) Be responsible for the compliance by any subcontractor with the requirements of E.O. 13706, 29 CFR part 13, and this clause.

(d) Contractors may fulfill their obligations under E.O. 13706 and 29 CFR part 13 jointly with other contractors through a multiemployer plan, or may fulfill their obligations through an individual fund, plan, or program (see 29 CFR 13.8).

(e) Withholding. The Contracting Officer will, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this or any other Federal contract with the same Contractor, so much of the accrued payments or advances as may be considered necessary to pay employees the full amount owed to compensate for any violation of the requirements of E.O. 13706, 29 CFR part 13, or this clause, including--

(1) Any pay and/or benefits denied or lost by reason of the violation;

(2) Other actual monetary losses sustained as a direct result of the violation; and

(3) Liquidated damages.

(f) Payment suspension/contract termination/contractor debarment. (1) In the event of a failure to comply with E.O. 13706, 29 CFR part 13, or this clause, the contracting agency may, on its own action or after authorization or by direction of the Department of Labor and written notification to the Contractor take action to cause suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(2) Any failure to comply with the requirements of this clause may be grounds for termination for default or cause.

(3) A breach of the contract clause may be grounds for debarment as a contractor and subcontractor as provided in 29 CFR 13.52.

(g) The paid sick leave required by E.O. 13706, 29 CFR part 13, and this clause is in addition to the Contractor's obligations under the Service Contract Labor Standards statute and Wage Rate Requirements (Construction) statute, and the Contractor may not receive credit toward its prevailing wage or fringe benefit obligations under those Acts for any paid sick leave provided in satisfaction of the requirements of E.O. 13706 and 29 CFR part 13.

(h) Nothing in E.O. 13706 or 29 CFR part 13 shall excuse noncompliance with or supersede any applicable Federal or State law, any applicable law or municipal ordinance, or a collective bargaining agreement requiring greater paid sick leave or leave rights than those established under E.O. 13706 and 29 CFR part 13.

(i) Recordkeeping. (1) The Contractor shall make and maintain, for no less than three (3) years from the completion of the work on the contract, records containing the following information for each employee, which the Contractor shall make available upon request for inspection, copying, and transcription by authorized representatives of the Administrator of the Wage and Hour Division of the Department of Labor:

(i) Name, address, and social security number of each employee.

(ii) The employee's occupation(s) or classification(s).

(iii) The rate or rates of wages paid (including all pay and benefits provided).

(iv) The number of daily and weekly hours worked.

(v) Any deductions made.

(vi) The total wages paid (including all pay and benefits provided) each pay period.

(vii) A copy of notifications to employees of the amount of paid sick leave the employee has accrued, as required under 29 CFR 13.5(a)(2).

(viii) A copy of employees' requests to use paid sick leave, if in writing, or, if not in writing, any other records reflecting such employee requests.

(ix) Dates and amounts of paid sick leave taken by employees (unless the Contractor's paid time off policy satisfies the requirements of E.O. 13706 and 29 CFR part 13 as described in 29 CFR 13.5(f)(5), leave shall be designated in records as paid sick leave pursuant to E.O. 13706).

(x) A copy of any written responses to employees' requests to use paid sick leave, including explanations for any denials of such requests, as required under 29 CFR 13.5(d)(3).

(xi) Any records reflecting the certification and documentation the Contractor may require an employee to provide under 29 CFR 13.5(e), including copies of any certification or documentation provided by an employee.

(xii) Any other records showing any tracking of or calculations related to an employee's accrual or use of paid sick leave.

(xiii) The relevant contract.

(xiv) The regular pay and benefits provided to an employee for each use of paid sick leave.

(xv) Any financial payment made for unused paid sick leave upon a separation from employment intended, pursuant to 29 CFR 13.5(b)(5), to relieve the Contractor from the obligation to reinstate such paid sick leave as otherwise required by 29 CFR 13.5(b)(4).

(2)(i) If the Contractor wishes to distinguish between an employee's covered and noncovered work, the Contractor shall keep records or other proof reflecting such distinctions. Only if the Contractor adequately segregates the employee's time will time spent on noncovered work be excluded from hours worked counted toward the accrual of paid sick leave. Similarly, only if the Contractor adequately segregates the employee's time may the Contractor properly refuse an employee's request to use paid sick leave on the ground that the employee was scheduled to perform noncovered work during the time he or she asked to use paid sick leave.

(ii) If the Contractor estimates covered hours worked by an employee who performs work in connection with contracts covered by the E.O. pursuant to 29 CFR 13.5(a)(1)(i) or (iii), the Contractor shall keep records or other proof of the verifiable information on which such estimates are reasonably based. Only if the Contractor relies on an estimate that is reasonable and based on verifiable information will an employee's time spent in connection with noncovered work be excluded from hours worked counted toward the accrual of paid sick leave. If the Contractor estimates the amount of time an employee spends performing in connection with contracts covered by the E.O., the Contractor shall permit the employee to use his or her paid sick leave during any work time for the Contractor.

(3) In the event the Contractor is not obligated by the Service Contract Labor Standards statute, the Wage Rate Requirements (Construction) statute, or the Fair Labor Standards Act to keep records of an employee's hours worked, such as because the employee is exempt from the Fair Labor Standards Act's minimum wage and overtime requirements, and the Contractor chooses to use the assumption permitted by 29 CFR 13.5(a)(1)(iii), the Contractor is excused from the requirement in paragraph (i)(1)(iv) of this clause and 29 CFR 13.25(a)(4) to keep records of the employee's number of daily and weekly hours worked.

(4)(i) Records relating to medical histories or domestic violence, sexual assault, or stalking, created for purposes of E.O. 13706, whether of an employee or an employee's child, parent, spouse, domestic partner, or other individual related by blood or affinity whose close association with the employee is the equivalent of a family relationship, shall be maintained as confidential records in separate files/records from the usual personnel files.

(ii) If the confidentiality requirements of the Genetic Information Nondiscrimination Act of 2008 (GINA), section 503 of the Rehabilitation Act of 1973, and/or the Americans with Disabilities Act (ADA) apply to records or documents created to comply with the recordkeeping requirements in this contract clause, the records and documents shall also be maintained in compliance with the confidentiality requirements of the GINA, section 503 of the Rehabilitation Act of 1973, and/or ADA as described in 29 CFR 1635.9, 41 CFR 60-741.23(d), and 29 CFR 1630.14(c)(1), respectively.

(iii) The Contractor shall not disclose any documentation used to verify the need to use 3 or more consecutive days of paid sick leave for the purposes listed in 29 CFR 13.5(c)(1)(iv) (as described in 29 CFR 13.5(e)(1)(ii)) and shall maintain confidentiality about any domestic abuse, sexual assault, or stalking, unless the employee consents or when disclosure is required by law.

(5) The Contractor shall permit authorized representatives of the Wage and Hour Division to conduct interviews with employees at the worksite during normal working hours.

(6) Nothing in this contract clause limits or otherwise modifies the Contractor's recordkeeping obligations, if any, under the Service Contract Labor Standards statute, the Wage Rate Requirements (Construction) statute, the Fair Labor Standards Act, the Family and Medical Leave Act, E.O. 14026, their respective implementing regulations, or any other applicable law.

(j) Interference/discrimination.

(1) The Contractor shall not in any manner interfere with an employee's accrual or use of paid sick leave as required by E.O. 13706 or 29 CFR part 13. Interference includes, but is not limited to--

(i) Miscalculating the amount of paid sick leave an employee has accrued;

(ii) Denying or unreasonably delaying a response to a proper request to use paid sick leave;

(iii) Discouraging an employee from using paid sick leave;

(iv) Reducing an employee's accrued paid sick leave by more than the amount of such leave used;

(v) Transferring an employee to work on contracts not covered by the E.O. to prevent the accrual or use of paid sick leave;

(vi) Disclosing confidential information contained in certification or other documentation provided to verify the need to use paid sick leave; or

(vii) Making the use of paid sick leave contingent on the employee's finding a replacement worker or the fulfillment of the Contractor's operational needs.

(2) The Contractor shall not discharge or in any other manner discriminate against any employee for--

(i) Using, or attempting to use, paid sick leave as provided for under E.O. 13706 and 29 CFR part 13;

(ii) Filing any complaint, initiating any proceeding, or otherwise asserting any right or claim under E.O. 13706 and 29 CFR part 13;

(iii) Cooperating in any investigation or testifying in any proceeding under E.O. 13706 and 29 CFR part 13; or

(iv) Informing any other person about his or her rights under E.O. 13706 and 29 CFR part 13.

(k) Notice. The Contractor shall notify all employees performing work on or in connection with a contract covered by the E.O. of the paid sick leave requirements of E.O. 13706, 29 CFR part 13, and this clause by posting a notice provided by the Department of Labor in a prominent and accessible place at the worksite so it may be readily seen by employees. Contractors that customarily post notices to employees electronically may post the notice electronically, provided such electronic posting is displayed prominently on any Web site that is maintained by the Contractor, whether external or internal, and customarily used for notices to employees about terms and conditions of employment.

(l) Disputes concerning labor standards. Disputes related to the application of E.O. 13706 to this contract shall not be subject to the general disputes clause of the contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR part 13. Disputes within the meaning of this contract clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the Department of Labor, or the employees or their representatives.

(m) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (m), in all subcontracts, regardless of dollar value, that are subject to the Service Contract Labor Standards statute or the Wage Rate Requirements (Construction) statute, and are to be performed in whole or in part in the United States.

(End of clause)

52.223-2 AFFIRMATIVE PROCUREMENT OF BIOBASED PRODUCTS UNDER SERVICE AND CONSTRUCTION CONTRACTS (SEP 2013)

(a) In the performance of this contract, the contractor shall make maximum use of biobased products that are United States Department of Agriculture (USDA)-designated items unless--

(1) The product cannot be acquired--

(i) Competitively within a time frame providing for compliance with the contract performance schedule;

(ii) Meeting contract performance requirements; or

(iii) At a reasonable price.

(2) The product is to be used in an application covered by a USDA categorical exemption (see 7 CFR 3201.3(e)). For example, all USDA-designated items are exempt from the preferred procurement requirement for the following:

(i) Spacecraft system and launch support equipment.

(ii) Military equipment, i.e., a product or system designed or procured for combat or combat-related missions.

(b) Information about this requirement and these products is available at http://www.biopreferredgov.

(c) In the performance of this contract, the Contractor shall--

(1) Report to http://www.sam.gov, with a copy to the Contracting Officer, on the product types and dollar value of any USDA-designated biobased products purchased by the Contractor during the previous Government fiscal year, between October 1 and September 30; and

(2) Submit this report no later than--

(i) October 31 of each year during contract performance; and

(ii) At the end of contract performance.

(End of clause)

52.223-5 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (MAY 2011)

(a) Definitions. As used in this clause--

“Toxic chemical means a chemical or chemical category listed in 40 CFR 372.65.”

(b) Federal facilities are required to comply with the provisions of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11001-11050), and the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13101-13109).

(c) The Contractor shall provide all information needed by the Federal facility to comply with the following:

(1) The emergency planning reporting requirements of section 302 of EPCRA.

(2) The emergency notice requirements of section 304 of EPCRA.

(3) The list of Material Safety Data Sheets, required by section 311 of EPCRA.

(4) The emergency and hazardous chemical inventory forms of section 312 of EPCRA.

(5) The toxic chemical release inventory of section 313 of EPCRA, which includes the reduction and recycling information required by section 6607 of PPA.

(6) The toxic chemical and hazardous substance release and use reduction goals of section 2(e) of Executive Order 13423 and of Executive Order 13514.

(End of clause)

52.223-6 DRUG-FREE WORKPLACE (MAY 2001)

(a) Definitions. As used in this clause --

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to deter- mine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession, or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the Contractor in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall-- within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) though (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

52.223-17 AFFIRMATIVE PROCUREMENT OF EPA-DESIGNATED ITEMS IN SERVICE AND CONSTRUCTION CONTRACTS (AUG 2018)

(a) In the performance of this contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired—

(1) Competitively within a timeframe providing for compliance with the contract performance schedule;

(2) Meeting contract performance requirements; or

(3) At a reasonable price.

(b) Information about this requirement is available at EPA's Comprehensive Procurement Guidelines web site, https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program. The list of EPA-designated items is available at https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program.

(End of clause)

52.223-18 ENCOURAGING CONTRACTOR POLICIES TO BAN TEXT MESSAGING WHILE DRIVING (JUN 2020)

(a) Definitions. As used in this clause--

Driving—

(1) Means operating a motor vehicle on an active roadway with the motor running, including while temporarily stationary because of traffic, a traffic light, stop sign, or otherwise.

(2) Does not include operating a motor vehicle with or without the motor running when one has pulled over to the side of, or off, an active roadway and has halted in a location where one can safely remain stationary.

Text messaging means reading from or entering data into any handheld or other electronic device, including for the purpose of short message service texting, e-mailing, instant messaging, obtaining navigational information, or engaging in any other form of electronic data retrieval or electronic data communication. The term does not include glancing at or listening to a navigational device that is secured in a commercially designed holder affixed to the vehicle, provided that the destination and route are programmed into the device either before driving or while stopped in a location off the roadway where it is safe and legal to park.

(b) This clause implements Executive Order 13513, Federal Leadership on Reducing Text Messaging while Driving, dated October 1, 2009.

(c) The Contractor is encouraged to--

(1) Adopt and enforce policies that ban text messaging while driving--

(i) Company-owned or -rented vehicles or Government-owned vehicles; or

(ii) Privately-owned vehicles when on official Government business or when performing any work for or on behalf of the Government.

(2) Conduct initiatives in a manner commensurate with the size of the business, such as--

(i) Establishment of new rules and programs or re-evaluation of existing programs to prohibit text messaging while driving; and

(ii) Education, awareness, and other outreach to employees about the safety risks associated with texting while driving.

(d) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (d), in all subcontracts that exceed the micro-purchase threshold, as defined in Federal Acquisition Regulation 2.101 on the date of subcontract award.

(End of clause)

52.223-21 FOAMS (JUN 2016)

(a) Definitions. As used in this clause--

Global warming potential means how much a given mass of a chemical contributes to global warming over a given time period compared to the same mass of carbon dioxide. Carbon dioxide's global warming potential is defined as 1.0.

High global warming potential hydrofluorocarbons means any hydrofluorocarbons in a particular end use for which EPA's Significant New Alternatives Policy (SNAP) program has identified other acceptable alternatives that have lower global warming potential. The SNAP list of alternatives is found at 40 CFR part 82, subpart G, with supplemental tables of alternatives available at http://www.epa.gov/snap/.

Hydrofluorocarbons means compounds that contain only hydrogen,
fluorine, and carbon.

(b) Unless otherwise specified in the contract, the Contractor shall reduce its use, release, and emissions of high global warming potential hydrofluorocarbons and refrigerant blends containing hydrofluorocarbons, when feasible, from foam blowing agents, under this contract. When determining feasibility of using a particular alternative, the Contractor shall consider environmental, technical, and economic factors such as--

(1) In-use emission rates, energy efficiency, and safety;

(2) Ability to meet performance requirements; and

(3) Commercial availability at a reasonable cost.

(c) The Contractor shall refer to EPA's SNAP program to identify alternatives. The SNAP list of alternatives is found at 40 CFR part 82, subpart G, with supplemental tables available at http://www.epa.gov/snap/.

(End of clause)

52.225-9 BUY AMERICAN—CONSTRUCTION MATERIALS (OCT 2022)

(a) *Definitions*. As used in this clause—

Commercially available off-the-shelf (COTS) item—

(1) Means any item of supply (including construction material) that is–

(i) A commercial product (as defined in paragraph (1) of the definition of “commercial product” at Federal Acquisition Regulation (FAR) 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, under a contract or subcontract at any tier, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4), such as agricultural products and petroleum products.

"Construction material" means an article, material, or supply brought to the construction site by the Contractor or a subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

Cost of components means—

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the construction material.

Critical component means a component that is mined, produced, or manufactured in the United States and deemed critical to the U.S. supply chain. The list of critical components is at FAR 25.105.

Critical item means a domestic construction material or domestic end product that is deemed critical to U.S. supply chain resiliency. The list of critical items is at FAR 25.105.

Domestic construction material means—

(1) For construction material that does not consist wholly or predominantly of iron or steel or a combination of both-

(i) An unmanufactured construction material mined or produced in the United States; or

(ii) A construction material manufactured in the United States, if–

(A)The cost of its components mined, produced, or manufactured in the United States exceeds 60 percent of the cost of all its components, except that the percentage will be 65 percent for items delivered in calendar years 2024 through 2028 and 75 percent for items delivered starting in calendar year 2029. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic. Components of unknown origin are treated as foreign; or

(B) The construction material is a COTS item; or

(2) For construction material that consists wholly or predominantly of iron or steel or a combination of both, a construction material manufactured in the United States if the cost of foreign iron and steel constitutes less than 5 percent of the cost of all components used in such construction material. The cost of foreign iron and steel includes but is not limited to the cost of foreign iron or steel mill products (such as bar, billet, slab, wire, plate, or sheet), castings, or forgings utilized in the manufacture of the construction material and a good faith estimate of the cost of all foreign iron or steel components excluding COTS fasteners. Iron or steel components of unknown origin are treated as foreign. If the construction material contains multiple components, the cost of all the materials used in such construction material is calculated in accordance with the definition of "cost of components".

Fastener means a hardware device that mechanically joins or affixes two or more objects together. Examples of fasteners are nuts, bolts, pins, rivets, nails, clips, and screws.

Foreign construction material means a construction material other than a domestic construction material.

Foreign iron and steel means iron or steel products not produced in the United States. Produced in the United States means that all manufacturing processes of the iron or steel must take place in the United States, from the initial melting stage through the application of coatings, except metallurgical processes involving refinement of steel additives. The origin of the elements of the iron or steel is not relevant to the determination of whether it is domestic or foreign.

Predominantly of iron or steel or a combination of both means that the cost of the iron and steel content exceeds 50 percent of the total cost of all its components. The cost of iron and steel is the cost of the iron or steel mill products (such as bar, billet, slab, wire, plate, or sheet), castings, or forgings utilized in the manufacture of the product and a good faith estimate of the cost of iron or steel components excluding COTS fasteners.

Steel means an alloy that includes at least 50 percent iron, between 0.02 and 2 percent carbon, and may include other elements.

"United States" means the 50 States, the District of Columbia, and outlying areas.

(b) Domestic preference.

(1) This clause implements 41 U.S.C.chapter 83, Buy American, by providing a preference for domestic construction material. In accordance with 41 U.S.C. 1907, the domestic content test of the Buy American statute is waived for construction material that is a COTS item, except that for construction material that consists wholly or predominantly of iron or steel or a combination of both, the domestic content test is applied only to the iron and steel content of the construction materials, excluding COTS fasteners. (See FAR 12.505(a)(2)). The Contractor shall use only domestic construction material in performing this contract, except as provided in paragraphs (b)(2) and (b)(3) of this clause.

(2) This requirement does not apply to information technology that is a commercial product or to the construction materials or components listed by the Government as follows:

_____*[Contracting Officer to list applicable excepted materials or indicate "none"]*

(3) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(2) of this clause if the Government determines that-

(i)The cost of domestic construction material would be unreasonable.

(A) *For domestic construction material that is not a critical item or does not contain critical components*.

(1)The cost of a particular domestic construction material *subject to the requirements of the Buy American statute is unreasonable when the cost of such material exceeds the cost of foreign material by more than 20 percent;*

(2)For construction *material that is not a COTS item and does not consist wholly or* predominantly of iron or steel or a combination of both*, if the cost of a particular* domestic construction material *is determined to be unreasonable or there is no domestic* offer *received, and the low* offer *is for* foreign construction material *that is manufactured in the* United States *and does not exceed 55 percent domestic content, the* Contracting Officer *will treat the lowest* offer *of* foreign construction material *that exceeds 55 percent domestic content as a domestic* offer *and determine whether the cost of that* offer *is unreasonable by applying the evaluation factor listed in paragraph (b)(3)(i)(A)(1) of this clause.*

(3)The procedures in paragraph (b)(3)(i)(A)(2) of this clause will no longer apply as of January 1, 2030.

(B) *For domestic construction material that is a critical item or contains critical components*.

(1)The cost of a particular domestic construction material *that is a* critical item *or contains* critical components*, subject to the requirements of the Buy American statute, is unreasonable when the cost of such material exceeds the cost of foreign material by more than 20 percent plus the additional preference factor identified for the* critical item *or* construction *material containing* critical components *listed at FAR 25.105*.

(2)For construction *material that does not consist wholly or* predominantly of iron or steel or a combination of both*, if the cost of a particular* domestic construction material *is determined to be unreasonable or there is no domestic* offer *received, and the low* offer *is for* foreign construction material *that does not exceed 55 percent domestic content, the* Contracting Officer *will treat the lowest foreign* offer *of* construction *material that is manufactured in the* United States *and exceeds 55 percent domestic content as a domestic* offer*, and determine whether the cost of that* offer *is unreasonable by applying the evaluation factor listed in paragraph (b)(3)(i)(B)(1) of this clause.*

(3)The procedures in paragraph (b)(3)(i)(B)(2) of this clause will no longer apply as of January 1, 2030.

(ii) The application of the restriction of the Buy American statute to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) Request for determination of inapplicability of the Buy American statute.

(1)

(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(3) of this clause shall include adequate information for Government evaluation of the request, including-

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American statute applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(3)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American statute applies, use of foreign construction material is noncompliant with the Buy American statute.

(d) *Data*. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

Foreign and Domestic Construction Materials Price Comparison

Construction Material Description	Unit of Measure	Quantity	Price (dollars)*
Item1:			
Foreign construction material	_____	_____	_____

Domestic construction material	_____	_____	_____
Item2:	_____	_____	_____
Foreign construction material	_____	_____	_____
Domestic construction material			

[* *Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued)*].
[*List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.*]
[*Include other applicable supporting information.*]

(End of clause)

52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (FEB 2021)

(a) Except as authorized by the Office of Foreign Assets Control (OFAC) in the Department of the Treasury, the Contractor shall not acquire, for use in the performance of this contract, any supplies or services if any proclamation, Executive order, or statute administered by OFAC, or if OFAC's implementing regulations at 31 CFR ChapterV, would prohibit such a transaction by a person subject to the jurisdiction of the United States.

(b) Except as authorized by OFAC, most transactions involving Cuba, Iran, and Sudan are prohibited, as are most imports from Burma or North Korea, into the United States or its outlying areas. Lists of entities and individuals subject to economic sanctions are included in OFAC's List of Specially Designated Nationals and Blocked Persons at https://home.treasury.gov/policy-issues/financial-sanctions/specially-designated-nationals-and-blocked-persons-list-sdn-human-readable-lists. More information about these restrictions, as well as updates, is available in the OFAC's regulations at 31 CFR ChapterV and/or on OFAC's website at https://home.treasury.gov/policy-issues/office-of-foreign-assets-control-sanctions-programs-and-information.

(c) The Contractor shall insert this clause, including this paragraph (c), in all subcontracts.

(End of clause)

52.227-1 AUTHORIZATION AND CONSENT (JUN 2020)

(a) The Government authorizes and consents to all use and manufacture, in performing this contract or any subcontract at any tier, of any invention described in and covered by a United States patent--

(1) Embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract; or

(2) Used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with (i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a United States patent shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor shall include the substance of this clause, including this paragraph (b), in all subcontracts that are expected to exceed the simplified acquisition threshold, as defined in Federal Acquisition Regulation (FAR) 2.101 on the date of subcontract award. However, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, as defined in FAR 2.101 on the date of subcontract award, does not affect this authorization and consent.

(End of clause)

52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (JUN 2020)

(a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail, each notice or claim of patent or copyright infringement based on the performance of this contract of which the Contractor has knowledge.

(b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed under this contract, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in the Contractor's possession pertaining to such claim or suit. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.

(c) The Contractor shall include the substance of this clause, including this paragraph (c), in all subcontracts that are expected to exceed the simplified acquisition threshold, as defined in Federal Acquisition Regulation (FAR) 2.101 on the date of subcontract award.

(End of clause)

52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (DEC 2007)

Except as otherwise provided, the Contractor shall indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement of any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order

under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

(End of clause)

52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

(a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government.

(b) Any surety fails to furnish reports on its financial condition as required by the Government;

(c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or

(d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting officer has the right to immediately draw on the ILC.

(End of clause)

52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997)

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract, at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(b) Before commencing work under this contract, the Contractor shall notify the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

(End of clause)

52.228-11 INDIVIDUAL SURETY—PLEDGE OF ASSETS (FEB 2021) (DEVIATION 2020-O0016)

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond –

(1) Pledge of assets; and

(2) Standard Form 28, Affidavit of Individual Surety**,** except that the words "being duly sworn, depose and say" on the Standard Form 28 are replaced with the word "affirm" and the Standard Form 28 is not required to be sworn and notarized in block 12.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of—

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form); and/or

(2) A recorded lien on real estate. The offeror will be required to provide—

(i) A mortgagee title insurance policy, in an insurance amount equal to the amount of the lien, or other evidence of title that is consistent with the requirements of Section 2 of the United States Department of Justice Title Standards at *https://www.justice.gov/enrd/page/file/922431/download*. This title evidence must show fee simple title vested in the surety along with any concurrent owners; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

(End of clause)

52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (DEC 2022)

In accordance with section 806(a)(3) of Pub. L. 102-190, as amended by sections 2091 and 8105 of Pub. L. 103-355 (10 U.S.C. 4601 note prec.), upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to 40 U.S.C. chapter 31, subchapter III, Bonds, the Contractor shall promptly provide a copy of such payment bond to the requester.

(End of clause)

52.228-14 IRREVOCABLE LETTER OF CREDIT (NOV 2014)

(a) "Irrevocable letter of credit" (ILC), as used in this clause, means a written commitment by a federally insured financial institution to pay all or part of a stated amount of money, until the expiration date of the letter, upon presentation by the Government (the beneficiary) of a written demand therefor. Neither the financial institution nor the offeror/Contractor can revoke or condition the letter of credit.

(b) If the offeror intends to use an ILC in lieu of a bid bond, or to secure other types of bonds such as performance and payment bonds, the letter of credit and letter of confirmation formats in paragraphs (e) and (f) of this clause shall be used.

(c) The letter of credit shall be irrevocable, shall require presentation of no document other than a written demand and the ILC (including confirming letter, if any), shall be issued/confirmed by an acceptable federally insured financial institution as provided in paragraph (d) of this clause, and--

(1) If used as a bid guarantee, the ILC shall expire no earlier than 60 days after the close of the bid acceptance period;

(2) If used as an alternative to corporate or individual sureties as security for a performance or payment bond, the offeror/Contractor may submit an ILC with an initial expiration date estimated to cover the entire period for which financial security is required or may submit an ILC with an initial expiration date that is a minimum period of one year from the date of issuance. The ILC shall provide that, unless the issuer provides the beneficiary written notice of non-renewal at least 60 days in advance of the current expiration date, the ILC is automatically extended without amendment for one year from the expiration date, or any future expiration date, until the period of required coverage is completed and the Contracting Officer provides the financial institution with a written statement waiving the right to payment. The period of required coverage shall be:

(i) For contracts subject to 40 U.S.C. chapter 31, subchapter III, Bonds, the later of--

(A) One year following the expected date of final payment;

(B) For performance bonds only, until completion of any warranty period; or

(C) For payment bonds only, until resolution of all claims filed against the payment bond during the one-year period following final payment.

(ii) For contracts not subject to the Miller Act, the later of--

(A) 90 days following final payment; or

(B) For performance bonds only, until completion of any warranty period.

(d)(1) Only federally insured financial institutions rated investment grade by a commercial rating service shall issue or confirm the ILC.

(2) Unless the financial institution issuing the ILC had letter of credit business of at least $25 million in the past year, ILCs over $5 million must be confirmed by another acceptable financial institution that had letter of credit business of at least $25 million in the past year.

(3) The Offeror/Contractor shall provide the Contracting Officer a credit rating that indicates the financial institutions have the required credit rating as of the date of issuance of the ILC.

(4) The current rating for a financial institution is available through any of the following rating services registered with the U.S. Securities and Exchange Commission (SEC) as a Nationally Recognized Statistical Rating Organization (NRSRO). NRSRO's can be located at the Web site http://www.sec.gov/answers/nrsro.htm maintained by the SEC.

(e) The following format shall be used by the issuing financial institution to create an ILC:

___
[Issuing Financial Institution's Letterhead or Name and Address]

Issue Date _ ___

IRREVOCABLE LETTER OF CREDIT NO. ___

Account party's name ___ _

Account party's address ___ _

For Solicitation No. ___ _(for reference only)

TO: [___ U.S. Government agency]

[___ U.S. Government agency's address]

1. We hereby establish this irrevocable and transferable Letter of Credit in your favor for one or more drawings up to United States $ ___ . This Letter of Credit is payable at [issuing financial institution's and, if any, confirming financial institution's] office at [___ issuing financial institution's address and, if any, confirming financial institution's address] and expires with our close of business on ___ , or any automatically extended expiration date.

2. We hereby undertake to honor your or the transferee's sight draft(s) drawn on the issuing or, if any, the confirming financial institution, for all or any part of this credit if presented with this Letter of Credit and confirmation, if any, at the office specified in paragraph 1 of this Letter of Credit on or before the expiration date or any automatically extended expiration date.

3. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this Letter of Credit that it is deemed to be automatically extended without amendment for one year from the expiration date hereof, or any future expiration date, unless at least 60 days prior to any expiration date, we notify you or the transferee by registered mail, or other receipted means of delivery, that we elect not to consider this Letter of Credit renewed for any such additional period. At the time we notify you, we also agree to notify the account party (and confirming financial institution, if any) by the same means of delivery.

4. This Letter of Credit is transferable. Transfers and assignments of proceeds are to be effected without charge to either the beneficiary or the transferee/assignee of proceeds. Such transfer or assignment shall be only at the written direction of the Government (the beneficiary) in a form satisfactory to the issuing financial institution and the confirming financial institution, if any.

5. This Letter of Credit is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, International Chamber of Commerce Publication No. ___ -- (Insert version in effect at the time of ILC issuance, e.g., ``Publication 600, 2006 edition") and to the extent not inconsistent therewith, to the laws of ___ --[State of confirming financial institution, if any, otherwise State of issuing financial institution].

6. If this credit expires during an interruption of business of this financial institution as described in Article 17 of the UCP, the financial institution specifically agrees to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

___

[___ Issuing financial institution]

(f) The following format shall be used by the financial institution to confirm an ILC:

___ [Confirming Financial Institution's Letterhead or Name and Address]

(Date) ___

Our Letter of Credit Advice Number ___

Beneficiary: ___ [U.S. Government agency]

Issuing Financial Institution: ___

Issuing Financial Institution's LC No.: ___

Gentlemen:

1. We hereby confirm the above indicated Letter of Credit, the original of which is attached, issued by ___ [name of issuing financial institution] for drawings of up to United States dollars ___ _/U.S. $ ___ and expiring with our close of business on ___ [the expiration date], or any automatically extended expiration date.

2. Draft(s) drawn under the Letter of Credit and this Confirmation are payable at our office located at ___ _.

3. We hereby undertake to honor sight draft(s) drawn under and presented with the Letter of Credit and this Confirmation at our offices as specified herein.

4. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this confirmation that it be deemed automatically extended without amendment for one year from the expiration date hereof, or any automatically extended expiration date, unless:

(a) At least 60 days prior to any such expiration date, we shall notify the Contracting Officer, or the transferee and the issuing financial institution, by registered mail or other receipted means of delivery, that we elect not to consider this confirmation extended for any such additional period; or

(b) The issuing financial institution shall have exercised its right to notify you or the transferee, the account party, and ourselves, of its election not to extend the expiration date of the Letter of Credit.

5. This confirmation is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, International Chamber of Commerce Publication No. ___ -- (Insert version in effect at the time of ILC issuance, e.g., ``Publication 600, 2006 edition") and to the extent not inconsistent therewith, to the laws of ___ --[State of confirming financial institution].

6. If this confirmation expires during an interruption of business of this financial institution as described in Article 17 of the UCP, we specifically agree to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

___

[Confirming financial institution]

(g) The following format shall be used by the Contracting Officer for a sight draft to draw on the Letter of Credit:

SIGHT DRAFT

___
[City, State]

(Date) ___

[Name and address of financial institution]

Pay to the order of ___ [Beneficiary Agency] ___ the sum of United States ___ This draft is drawn under Irrevocable Letter of Credit No. ___

___ [Beneficiary Agency]

By: ___

(End of clause)

52.228-15 PERFORMANCE AND PAYMENT BONDS-CONSTRUCTION (JUN 2020) (DEVIATION 2020-O0016)

(a) *Definitions.* As used in this clause—

Original contract price means the award price of the contract; or, for requirements contracts, the price payable for the estimated total quantity; or, for indefinite-quantity contracts, the price payable for the specified minimum quantity. Original contract price does not include the price of any options, except those options exercised at the time of contract award.

(b) *Amount of required bonds.* Unless the resulting contract price is valued at or below the threshold specified in Federal Acquisition Regulation 28.102-1(a) on the date of award of this contract, the successful offeror shall furnish performance and payment bonds to the Contracting Officer as follows:

(1) *Performance bonds* (Standard Form 25, except that no seal is required). The penal amount of performance bonds at the time of contract award shall be 100 percent of the original contract price.

(2) *Payment bonds* (Standard Form 25A**,** except that no seal is required). The penal amount of payment bonds at the time of contract award shall be 100 percent of the original contract price.

(3) *Additional bond protection*.

(i) The Government may require additional performance and payment bond protection if the contract price is increased. The increase in protection generally will equal 100 percent of the increase in contract price.

(ii) The Government may secure the additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.
(c) *Furnishing executed bonds.* The Contractor shall furnish all executed bonds, including any necessary reinsurance agreements, to the Contracting Officer, within the time period specified in the Bid Guarantee provision of the solicitation, or otherwise specified by the Contracting Officer, but in any event, before starting work.

(d) *Surety or other security for bonds.* The bonds shall be in the form of firm commitment, supported by corporate sureties whose names appear on the list contained in Treasury Department Circular 570, individual sureties, or by other acceptable security such as postal money order, certified check, cashier's check, irrevocable letter of credit, or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. Treasury Circular 570 is published in the *Federal Register* or may be obtained from the U.S. Department of the Treasury, Financial Management Service, Surety Bond Branch, 3700 East West Highway, Room 6F01, Hyattsville, MD 20782. Or via the internet at *http://www.fms.treas.gov/c570/.*

(e) *Notice of subcontractor waiver of protection (40 U.S.C. 3133(c)).* Any waiver of the right to sue on the payment bond is void unless it is in writing, signed by the person whose right is waived, and executed after such person has first furnished labor or material for use in the performance of the contract.

(End of clause)

52.229-3 FEDERAL, STATE, AND LOCAL TAXES (FEB 2013)

(a) As used in this clause—

“After-imposed Federal tax” means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.

“After-relieved Federal tax” means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

“All applicable Federal, State, and local taxes and duties” means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"Contract date" means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification.

"Local taxes" includes taxes imposed by a possession or territory of the United States, Puerto Rico, or the Northern Mariana Islands, if the contract is performed wholly or partly in any of those areas.

(b)(1) The contract price includes all applicable Federal, State, and local taxes and duties, except as provided in subparagraph (b)(2)(i) of this clause.

(2) Taxes imposed under 26 U.S.C. 5000C may not be—

(i) Included in the contract price; nor

(ii) Reimbursed.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds $250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption. (End of clause)

52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 2014)

(a) Payment of price. The Government shall pay the Contractor the contract price as provided in this contract.

(b) Progress payments. The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the total amount of each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) Contractor certification. Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) All payments due to subcontractors and suppliers from previous payments received under the contract have been made, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code;

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

_____

(Name)

_____

(Title)

_____

(Date)

(d) Refund of unearned amounts. If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the 8th day after the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) Retainage. If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) Title, liability, and reservation of rights. All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) Reimbursement for bond premiums. In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) Final payment. The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 6305).

(i) Limitation because of undefinitized work. Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) Interest computation on unearned amounts. In accordance with 31 U.S.C. 3903(c)(1), the amount payable under

subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

(End of clause)

52.232-17 INTEREST (MAY 2014)

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Certified Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in 41 U.S.C. 7109, which is applicable to the period in which the amount becomes due, as provided in paragraph (e) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid.

(b) The Government may issue a demand for payment to the Contractor upon finding a debt is due under the contract.

(c) Final Decisions. The Contracting Officer will issue a final decision as required by 33.211 if--

(1) The Contracting Officer and the Contractor are unable to reach agreement on the existence or amount of a debt in a timely manner;

(2) The Contractor fails to liquidate a debt previously demanded by the Contracting Officer within the timeline specified in the demand for payment unless the amounts were not repaid because the Contractor has requested an installment payment agreement; or

(3) The Contractor requests a deferment of collection on a debt previously demanded by the Contracting Officer (see 32.607-2).

(d) If a demand for payment was previously issued for the debt, the demand for payment included in the final decision shall identify the same due date as the original demand for payment.

(e) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment, including any demand for payment resulting from a default termination.

(f) The interest charge shall be computed for the actual number of calendar days involved beginning on the due date and ending on--

(1) The date on which the designated office receives payment from the Contractor;

(2) The date of issuance of a Government check to the Contractor from which an amount otherwise payable has been withheld as a credit against the contract debt; or

(3) The date on which an amount withheld and applied to the contract debt would otherwise have become payable to the Contractor.

(g) The interest charge made under this clause may be reduced under the procedures prescribed in 32.608-2 of the Federal Acquisition Regulation in effect on the date of this contract.

(End of clause)

52.232-23 ASSIGNMENT OF CLAIMS (MAY 2-14) - ALTERNATE I (APR 1984)

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 6305 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence. Unless otherwise stated in this contract, payments to an assignee of any amounts due or to become due under this contract shall not, to the extent specified in the Act, be subject to reduction or setoff.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

(End of clause)

52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JAN 2017)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer. Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) Invoice payments--(1) Types of invoice payments. For purposes of this clause, there are several types of invoice payments that may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project.

(A) The due date for making such payments is 14 days after the designated billing office receives a proper payment request. If the designated billing office fails to annotate the payment request with the actual date of receipt at the

time of receipt, the payment due date is the 14th day after the date of the Contractor's payment request, provided the designated billing office receives a proper payment request and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, is as specified in the contract or, if not specified, 30 days after approval by the Contracting Officer for release to the Contractor.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract).

(A) The due date for making such payments is the later of the following two events:

(1) The 30th day after the designated billing office receives a proper invoice from the Contractor.

(2) The 30th day after Government acceptance of the work or services completed by the Contractor. For a final invoice when the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance is deemed to occur on the effective date of the contract settlement.

(B) If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) Contractor's invoice. The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(xi) of this clause. If the invoice does not comply with these requirements, the designated billing office must return it within 7 days after receipt, with the reasons why it is not a proper invoice. When computing any interest penalty owed the Contractor, the Government will take into account if the Government notifies the Contractor of an improper invoice in an untimely manner.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor should date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., discount for prompt payment terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(x) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFT banking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (e.g., 52.232-38, Submission of Electronic Funds Transfer Information with Offer), contract clause (e.g., 52.232-33, Payment by Electronic Funds Transfer--System for Award Management, or 52.232-34, Payment by Electronic Funds Transfer--Other Than System for Award Management), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by EFT.

(xi) Any other information or documentation required by the contract.

(3) Interest penalty. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) Computing penalty amount. The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in paragraph (a)(1)(ii) of this clause, Government acceptance or approval is deemed to occur constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. If actual acceptance or approval occurs within the constructive acceptance or approval period, the Government will base the determination of an interest penalty on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the

terms of the contract. The Government and the Contractor shall resolve claims involving disputes, and any interest that may be payable in accordance with the clause at FAR 52.233-1, Disputes.

(5) Discounts for prompt payment. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(6) Additional interest penalty. (i) The designated payment office will pay a penalty amount, calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if--

(A) The Government owes an interest penalty of $1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible--

(1) The designated payment office that receives the demand will annotate it with the date of receipt provided the demand is received on or before the 40th day after payment was made; or

(2) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(b) Contract financing payments. If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) Subcontract clause requirements. The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) Prompt payment for subcontractors. A payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) Interest for subcontractors. An interest penalty clause that obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under 41 U.S.C. 7109 in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) Subcontractor clause flowdown. A clause requiring each subcontractor to use:

(i) Include a payment clause and an interest penalty clause conforming to the standards set forth in paragraphs (c)(1) and (c)(2) of this clause in each of its subcontracts; and

(ii) Require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) Subcontract clause interpretation. The clauses required by paragraph (c) of this clause shall not be construed to impair the right of the Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) Retainage permitted. Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) Withholding permitted. Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) Withholding requirements. Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) The Contractor furnishes to the Contracting Officer a copy of any notice issued by a Contractor pursuant to paragraph (d)(3)(i) of this clause.

(e) Subcontractor withholding procedures. If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) Subcontractor notice. Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) Contracting Officer notice. Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to paragraph (e)(1) of this clause;

(3) Subcontractor progress payment reduction. Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (e)(1) of this clause;

(4) Subsequent subcontractor payment. Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under paragraph (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under 41 U.S.C. 7109 in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) Notice to Contracting Officer. Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under paragraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) Interest to Government. Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under paragraph (e)(5)(i) of this clause.

(f) Third-party deficiency reports—

(1) Withholding from subcontractor. If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a “second-tier subcontractor”) a written notice in accordance with 40 U.S.C. 3133, asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under paragraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) Subsequent payment or interest charge. As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall--

(i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or

(ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of 41 U.S.C. 7109 in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) Written notice of subcontractor withholding. The Contractor shall issue a written notice of any withholding to a subcontractor (with a copy furnished to the Contracting Officer), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) Subcontractor payment entitlement. The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) Prime-subcontractor disputes. A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the Government is a party. The Government may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) Preservation of prime-subcontractor rights. Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) Non-recourse for prime contractor interest penalty. The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the Government for such interest penalty. A cost-reimbursement claim may not include any amount for reimbursement of such interest penalty.

(l) Overpayments. If the Contractor becomes aware of a duplicate contract financing or invoice payment or that the Government has otherwise overpaid on a contract financing or invoice payment, the Contractor shall--

(1) Remit the overpayment amount to the payment office cited in the contract along with a description of the overpayment including the--

(i) Circumstances of the overpayment (e.g., duplicate payment, erroneous payment, liquidation errors, date(s) of overpayment);

(ii) Affected contract number and delivery order number if applicable;

(iii) Affected line item or subline item, if applicable; and

(iv) Contractor point of contact.

(2) Provide a copy of the remittance and supporting documentation to the Contracting Officer.

(End of clause)

52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—SYSTEM FOR AWARD MANAGEMENT (OCT 2018)

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) of this clause. As used in this clause, the term "EFT" refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either--

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (d) of this clause).

(b) Contractor's EFT information. The Government shall make payment to the Contractor using the EFT information contained in the System for Award Management (SAM). In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to SAM.

(c) Mechanisms for EFT payment. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fedwire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) Suspension of payment. If the Contractor's EFT information in SAM is incorrect, then the Government need not make payment to the Contractor under this contract until correct EFT information is entered into SAM; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(e) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government used the Contractor's EFT information incorrectly, the Government remains responsible for--

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and

(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and--

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (d) of this clause shall apply.

(f) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(g) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall register separately in SAM and shall be paid by EFT in accordance with the terms of this clause. Notwithstanding any other requirement of this contract, payment to an ultimate recipient other than the Contractor, or a financial institution properly recognized under an assignment of claims pursuant to subpart 32.8, is not permitted. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (d) of this clause.

(h) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(i) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in SAM.

(End of Clause)

52.232-39 UNENFORCEABILITY OF UNAUTHORIZED OBLIGATIONS (JUN 2013)

(a) Except as stated in paragraph (b) of this clause, when any supply or service acquired under this contract is subject to any End User License Agreement (EULA), Terms of Service (TOS), or similar legal instrument or agreement, that includes any clause requiring the Government to indemnify the Contractor or any person or entity for damages, costs, fees, or any other loss or liability that would create an Anti-Deficiency Act violation (31 U.S.C. 1341), the following shall govern:

(1) Any such clause is unenforceable against the Government.

(2) Neither the Government nor any Government authorized end user shall be deemed to have agreed to such clause by virtue of it appearing in the EULA, TOS, or similar legal instrument or agreement. If the EULA, TOS, or similar legal instrument or agreement is invoked through an ``I agree'' click box or other comparable mechanism (e.g., ``click-wrap'' or ``browse-wrap'' agreements), execution does not bind the Government or any Government authorized end user to such clause.

(3) Any such clause is deemed to be stricken from the EULA, TOS, or similar legal instrument or agreement.

(b) Paragraph (a) of this clause does not apply to indemnification by the Government that is expressly authorized by statute and specifically authorized under applicable agency regulations and procedures.

(End of clause)

52.232-40 PROVIDING ACCELERATED PAYMENTS TO SMALL BUSINESS SUBCONTRACTORS (MAR 2023)

(a)(1) In accordance with 31 U.S.C. 3903 and 10 U.S.C. 3801, within 15 days after receipt of accelerated payments from the Government, the Contractor shall make accelerated payments to its small business subcontractors under this contract, to the maximum extent practicable and prior to when such payment is otherwise required under the applicable contract or subcontract, after receipt of a proper invoice and all other required documentation from the small business subcontractor.

(2) The Contractor agrees to make such payments to its small business subcontractors without any further consideration from or fees charged to the subcontractor.

(b) The acceleration of payments under this clause does not provide any new rights under the Prompt Payment Act.

(c) Include the substance of this clause, including this paragraph (c), in all subcontracts with small business concerns, including subcontracts with small business concerns for the acquisition of commercial products or commercial services.

(End of clause)

52.233-1 DISPUTES. (MAY 2014)

(a) This contract is subject to 41 U.S.C. chapter 71, Contract Disputes.

(b) Except as provided in 41 U.S.C. chapter 71, all disputes arising under or relating to this contract shall be resolved under this clause.

(c) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding $100,000 is not a claim under the Act until certified. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under 41 U.S.C. chapter 71. The submission may be converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2)(i) The Contractor shall provide the certification specified in paragraph (d)(2)(iii) of this clause when submitting any claim exceeding $100,000.

(ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.

(iii) The certification shall state as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am authorized to certify the claim on behalf of the Contractor."

(3) The certification may be executed by any person authorized to bind the Contractor with respect to the claim.

(e) For Contractor claims of $100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over $100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in 41 U.S.C. chapter 71.

(g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use alternative dispute resolution (ADR). If the Contractor refuses an offer for ADR, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the offer.

(h) The Government shall pay interest on the amount found due and unpaid from (1) the date that the Contracting Officer receives the claim (certified, if required); or (2) the date that payment otherwise would be due, if that date is later, until the date of payment. With regard to claims having defective certifications, as defined in FAR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claims shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

(End of clause)

52.233-3 PROTEST AFTER AWARD (AUG. 1996)

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the

Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; provided, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

(End of clause)

52.233-4 APPLICABLE LAW FOR BREACH OF CONTRACT CLAIM (OCT 2004)

United States law will apply to resolve any claim of breach of this contract.

(End of clause)

52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of

(1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or

(2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for,

performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to

(1) conditions bearing upon transportation, disposal, handling, and storage of materials;

(2) the availability of labor, water, electric power, and roads;

(3) uncertainties of weather, river stages, tides, or similar physical conditions at the site;

(4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

(End of clause)

52.236-4 PHYSICAL DATA (APR 1984)

Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) The indications of physical conditions on the drawings and in the specifications are the result of site investigations by surveys and subsurface exploration. The subsurface exploration included soil boring and soils testing, as noted on the boring logs. Graphic logs of borings located within the area of work

under this contract are included in the specifications. The borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches. Variations in the stratigraphy and characteristics of the soil are known to occur between borings. Normal variations in site geology will not be considered as differing materially within the purview of Contract Clause FAR 52.236-2, Differing Site Conditions. Groundwater elevations measured in borings are not constant and will fluctuate.

(b) Weather conditions Bidders should satisfy themselves before submitting bids as to the hazards from weather conditions. Complete weather records and reports may be obtained from the local U.S. Weather Service.

(c) Transportation facilities. Before submitting a bid, Bidders should obtain necessary data as to highway, railroad, and marine facilities.

(d) River Conditions: Hydrographs of the river stages are indicated on the drawings. Actual water levels may vary from those indicated on the historic hydrographs.

(End of clause)

52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

(End of clause)

52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to

the Contracting Officer and has authority to act for the Contractor.

(End of clause)

52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

(End of clause)

52.236-8 OTHER CONTRACTS (APR 1984)

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

(End of clause)

52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities

(1) at or near the work site, and

(2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(End of clause)

52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

(End of clause)

52.236-12 CLEANING UP (APR 1984)

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

(End of clause)

52.236-13 ACCIDENT PREVENTION (NOV 1991)

(a) The Contractor shall provide and maintain work environments and procedures which will

(1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities;

(2) avoid interruptions of Government operations and delays in project completion dates; and

(3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall-

(1) Provide appropriate safety barricades, signs, and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.

(c) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.

(d) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

(e) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontracts.

(End of clause)

52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including

acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately deliver three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

(End of clause)

52.236-17 LAYOUT OF WORK (APR 1984)

The Contractor shall lay out its work from Government established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(End of clause)

52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997) - ALTERNATE I (APR 1984

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by," or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown," as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place," that is "furnished and installed".

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements, and (2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor. Upon completing the work under this contract, the Contractor shall furnish a complete set of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the equipment is completed and accepted.

(End of clause)

52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

(End of clause)

52.242-13 BANKRUPTCY (JUL 1995)

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

(End of clause)

52.242-14 SUSPENSION OF WORK (APR 1984)

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract.

(c) A claim under this clause shall not be allowed—

(1) For any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order); and

(2) Unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

(End of clause)

52.243-4 CHANGES (JUN 2007)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

(1) In the specifications (including drawings and designs);

(2) In the method or manner of performance of the work;

(3) In the Government-furnished property or services; or

(4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating

(1) the date, circumstances, and source of the order and

(2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after

(1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

52.244-6 SUBCONTRACTS FOR COMMERCIAL PRODUCTS AND COMMERCIAL SERVICES (MAR 2023)

(a) Definitions. As used in this clause--

Commercial product, commercial service, and commercially available off-the-shelf item have the meanings contained in Federal Acquisition Regulation (FAR) 2.101.

Subcontract includes a transfer of commercial products or commercial services between divisions, subsidiaries, or affiliates of the Contractor or subcontractor at any tier.

(b) To the maximum extent practicable, the Contractor shall incorporate, and require its subcontractors at all tiers to incorporate, commercial products, commercial services, or non-developmental items as components of items to be supplied under this contract.

(c)(1) The Contractor shall insert the following clauses in subcontracts for commercial products or commercial services:

(i) 52.203-13, Contractor Code of Business Ethics and Conduct (NOV 2021) (41 U.S.C. 3509), if the subcontract exceeds the threshold specified in FAR 3.1004(a) on the date of subcontract award, and has a performance period of more than 120 days. In altering this clause to identify the appropriate parties, all disclosures of violation of the civil False Claims Act or of Federal criminal law shall be directed to the agency Office of the Inspector General, with a copy to the Contracting Officer.

(ii) 52.203-15, Whistleblower Protections Under the American Recovery and Reinvestment Act of 2009 (JUN 2010) (Section 1553 of Pub. L. 111-5), if the subcontract is funded under the Recovery Act.

(iii) 52.203-19, Prohibition on Requiring Certain Internal Confidentiality Agreements or Statements (JAN 2017).

(iv) 52.204-21, Basic Safeguarding of Covered Contractor Information Systems (NOV 2021), other than subcontracts for commercially available off-the-shelf items, if flow down is required in accordance with paragraph (c) of FAR clause 52.204-21.

(v) 52.204-23, Prohibition on Contracting for Hardware, Software, and Services Developed or Provided by Kaspersky Lab and Other Covered Entities (NOV 2021) (Section 1634 of Pub. L. 115-91).

(vi) 52.204-25, Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment. (NOV 2021) (Section 889(a)(1)(A) of Pub. L. 115-232)

(vii) 52.219-8, Utilization of Small Business Concerns (OCT 2022) (15 U.S.C. 637(d)(2) and (3)), if the subcontract offers further subcontracting opportunities. If the subcontract (except subcontracts to small business concerns) exceeds the applicable threshold specified in FAR 19.702(a) on the date of subcontract award, the subcontractor must include 52.219-8 in lower tier subcontracts that offer subcontracting opportunities.

(viii) 52.222-21, Prohibition of Segregated Facilities (APR 2015).

(ix) 52.222-26, Equal Opportunity (SEP 2016) (E.O. 11246).

(x) 52.222-35, Equal Opportunity for Veterans (JUN 2020) (38 U.S.C. 4212(a)).

(xi) 52.222-36, Equal Opportunity for Workers with Disabilities (JUN 2020) (29 U.S.C. 793).

(xii) 52.222-37, Employment Reports on Veterans (JUN 2020) (38 U.S.C. 4212).

(xiii) 52.222-40, Notification of Employee Rights Under the National Labor Relations Act (DEC 2010) (E.O. 13496), if flow down is required in accordance with paragraph (f) of FAR clause 52.222-40.

(xiv)(A) 52.222-50, Combating Trafficking in Persons (NOV 2021) (22 U.S.C. chapter 78 and E.O. 13627).

(B) Alternate I (MAR 2015) of 52.222-50 (22 U.S.C. chapter 78 and E.O. 13627).

(xv) 52.222-55, Minimum Wages for Contractor Workers under Executive Order 14026 (JAN 2022), if flowdown is required in accordance with paragraph (k) of FAR clause 52.222-55.

(xvi) 52.222-62, Paid Sick Leave Under Executive Order 13706 (JAN 2022) (E.O. 13706), if flow down is required in accordance with paragraph (m) of FAR clause 52.222-62.

(xvii)(A) 52.224-3, Privacy Training (JAN 2017) (5 U.S.C. 552a) if flow down is required in accordance with 52.224-3(f).

(B) Alternate I (JAN 2017) of 52.224-3, if flow down is required in accordance with 52.224-3(f) and the agency specifies that only its agency-provided training is acceptable).

(xviii) 52.225-26, Contractors Performing Private Security Functions Outside the United States (OCT 2016) (Section 862, as amended, of the National Defense Authorization Act for Fiscal Year 2008; 10 U.S.C. Subtitle A, Part V, Subpart G Note).

(xix) 52.232-40, Providing Accelerated Payments to Small Business Subcontractors (MAR 2023), if flow down is required in accordance with paragraph (c) of FAR clause 52.232-40.

(xx) 52.247-64, Preference for Privately Owned U.S.-Flag Commercial Vessels (NOV 2021) (46 U.S.C. 55305 and 10 U.S.C. 2631), if flow down is required in accordance with paragraph (d) of FAR clause 52.247-64).

(2) While not required, the Contractor may flow down to subcontracts for commercial products or commercial services a minimal number of additional clauses necessary to satisfy its contractual obligations.

(d) The Contractor shall include the terms of this clause, including this paragraph (d), in subcontracts awarded under this contract.

(End of clause)

52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)

(a) Definition. "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

(1) Relieve the Contractor of responsibility for providing adequate quality control measures;

(2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

(3) Constitute or imply acceptance; or

(4) Affect the continuing rights of the Government after acceptance of the completed work under paragraph (i) of this section.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, at no increase in contract price, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or (2) terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make an equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.

(End of clause)

52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)

(a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

(e) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.

(f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(j) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

(End of clause)

52.248-3 VALUE ENGINEERING--CONSTRUCTION (OCT 2020)

(a) General. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) Definitions. "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP)" means a proposal that--

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; provided, that it does not involve a change--

(i) In deliverable end item quantities only; or

(ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in subparagraphs(c) (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for

(i) the affected portions of the existing contract requirement and

(ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submission. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) Government action.

(1) The Contracting Officer will notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer will notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

If the VECP is not accepted, the Contracting Officer will notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the

Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The decision to accept or reject all or part of any VECP is a unilateral decision made solely at the discretion of the Contracting Officer.

(f) Sharing.

(1) Rates. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by

(i) 45 percent for fixed-price contracts or

(ii) 75 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) Collateral savings. If a VECP is accepted, the Contracting Officer will increase the instant contract amount by 20 percent of any projected collateral savings determined to be realized in a typical year of use after subtracting any Government costs not previously offset. However, the Contractor's share of collateral savings will not exceed the contract's firm-fixed-price or estimated cost, at the time the VECP is accepted, or $100,000, whichever is greater. The Contracting Officer is the sole determiner of the amount of collateral savings.

(h) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of $75,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; provided, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(i) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering-- Construction clause of contract . . . . . , shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations." If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract

modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(End of clause)

52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (APR 2012) - ALTERNATE I (SEP 1996)

(a) The Government may terminate performance of work under this contract in whole or, from time to time, in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination, and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

(1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b)(6) of this clause; provided, however, that the Contractor (i) is not required to extend credit to any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.

(d) After expiration of the plant clearance period as defined in Subpart 49.001 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any, due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid or remaining to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (g) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be modified, and the Contractor paid the agreed amount. Paragraph (g) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and Contracting Officer fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value as determined by the Contracting Officer, for the loss of the Government property.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal or request for equitable adjustment within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is no right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m)(1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

(End of clause)

52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the Government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if—

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include—

(i) Acts of God or of the public enemy,

(ii) Acts of the Government in either its sovereign or contractual capacity,

(iii) Acts of another Contractor in the performance of a contract with the Government,

(iv) Fires,

(v) Floods,

(vi) Epidemics,

(vii) Quarantine restrictions,

(viii) Strikes,

(ix) Freight embargoes,

(x) Unusually severe weather, or

(xi) Delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

(d) The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.
(End of clause)

52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es):

FAR: https://www.acquisition.gov/browse/index/far
DFARS: https://www.acquisition.gov/dfars

(End of clause)

52.252-6 AUTHORIZED DEVIATIONS IN CLAUSES (NOV 2020)

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the date of the clause.

(b) The use in this solicitation or contract of any Defense Federal Acquisition Regulation Supplement (48 CFR 2) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of clause)

52.253-1 COMPUTER GENERATED FORMS (JAN 1991)

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, provided there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition date.

(i) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

252.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)

(a) "Definition. Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the contracting officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a contracting officer's representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the contracting officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

252.203-7000 REQUIREMENTS RELATING TO COMPENSATION OF FORMER DOD OFFICIALS (SEP 2011)

(a) Definition. Covered DoD official, as used in this clause, means an individual that--

(1) Leaves or left DoD service on or after January 28, 2008; and

(2)(i) Participated personally and substantially in an acquisition as defined in 41 U.S.C. 131 with a value in excess of $10 million, and serves or served--

(A) In an Executive Schedule position under subchapter II of chapter 53 of Title 5, United States Code;

(B) In a position in the Senior Executive Service under subchapter VIII of chapter 53 of Title 5, United States Code; or

(C) In a general or flag officer position compensated at a rate of pay for grade O-7 or above under section 201 of Title 37, United States Code; or

(ii) Serves or served in DoD in one of the following positions: Program manager, deputy program manager, procuring contracting officer, administrative contracting officer, source selection authority, member of the source selection evaluation board, or chief of a financial or technical evaluation team for a contract in an amount in excess of $10 million.

(b) The Contractor shall not knowingly provide compensation to a covered DoD official within 2 years after the official leaves DoD service, without first determining that the official has sought and received, or has not received after 30 days of seeking, a written opinion from the appropriate DoD ethics counselor regarding the applicability of post-employment restrictions to the activities that the official is expected to undertake on behalf of the Contractor.

(c) Failure by the Contractor to comply with paragraph (b) of this clause may subject the Contractor to rescission of this contract, suspension, or debarment in accordance with 41 U.S.C. 2105(c).

(End of clause)

252.203-7001 PROHIBITION ON PERSONS CONVICTED OF FRAUD OR OTHER DEFENSE-CONTRACT-RELATED FELONIES (JAN 2023)

(a) Definitions. As used in this clause—

(1) "Arising out of a contract with the DoD" means any act in connection with—

(i) Attempting to obtain;

(ii) Obtaining, or

(iii) Performing a contract or first-tier subcontract of any agency, department, or component of the Department of Defense (DoD).

(2) "Conviction of fraud or any other felony" means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of nolo contendere, for which sentence has been imposed.

(3) "Date of conviction" means the date judgment was entered against the individual.

(b) Any individual who is convicted after September 29, 1988, of fraud or any other felony arising out of a contract with the DoD is prohibited from serving--

(1) In a management or supervisory capacity on this contract;

(2) On the board of directors of the Contractor;

(3) As a consultant, agent, or representative for the Contractor; or

(4) In any other capacity with the authority to influence, advise, or control the decisions of the Contractor with regard to this contract.

(c) Unless waived, the prohibition in paragraph (b) of this clause applies for not less than 5 years from the date of conviction.

(d) 10 U.S.C. 4656 provides that the Contractor shall be subject to a criminal penalty of not more than $500,000 if convicted of knowingly--

(1) Employing a person under a prohibition specified in paragraph (b) of this clause; or

(2) Allowing such a person to serve on the board of directors of the contractor or first-tier subcontractor.

(e) In addition to the criminal penalties contained in 10 U.S.C. 4656, the Government may consider other available remedies, such as—

(1) Suspension or debarment;

(2) Cancellation of the contract at no cost to the Government; or

(3) Termination of the contract for default.

(f) The Contractor may submit written requests for waiver of the prohibition in paragraph (b) of this clause to the Contracting Officer. Requests shall clearly identify—

(1) The person involved;

(2) The nature of the conviction and resultant sentence or punishment imposed;

(3) The reasons for the requested waiver; and

(4) An explanation of why a waiver is in the interest of national security.

(g) Subcontracts. The Contractor agrees to include the substance of this clause, appropriately modified to reflect the identity and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition threshold in Part 2 of the Federal Acquisition Regulation, except those for commercial products, commercial services, or commercial components.

(h) Pursuant to 10 U.S.C. 4656(c), defense contractors and subcontractors may obtain information as to whether a particular person has been convicted of fraud or any other felony arising out of a contract with the DoD by contacting The Office of Justice Programs, The Denial of Federal Benefits Office, U.S. Department of Justice, telephone 301-937-1542; www.ojp.usdoj.gov/BJA/grant/DPFC.html".

(End of clause)

252.203-7002 REQUIREMENT TO INFORM EMPLOYEES OF WHISTLEBLOWER RIGHTS (DEC 2022)

(a) The Contractor shall inform its employees in writing, in the predominant native language of the workforce, of contractor employee whistleblower rights and protections under 10 U.S.C. 4701, as described in subpart 203.9 of the Defense Federal Acquisition Regulation Supplement.

(b) The Contractor shall include the substance of this clause, including this paragraph (b), in all subcontracts.

(End of clause)

252.203-7003 AGENCY OFFICE OF THE INSPECTOR GENERAL (AUG 2019)

The agency office of the Inspector General referenced in paragraphs (c) and (d) of FAR clause 52.203-13, Contractor Code of Business Ethics and Conduct, is the DoD Office of Inspector General at the following address:

Department of Defense Office of Inspector General, Administrative Investigations, Contractor Disclosure Program, 4800 Mark Center Drive, Suite 14L25, Alexandria, VA 22350-1500.

Toll Free Telephone: 866-429-8011. Website: https://www.dodig.mil/Programs/Contractor-Disclosure-Program/.

(End of clause)

252.203-7004 DISPLAY OF HOTLINE POSTERS (JAN 2023)

(a) Definition. As used in this clause--

United States means the 50 States, the District of Columbia, and outlying areas.

(b) Display of hotline poster(s).

(1)(i) The Contractor shall display prominently the DoD fraud, waste, and abuse hotline poster prepared by the DoD Office of the Inspector General, in effect at time of contract award, in common work areas within business segments performing work under Department of Defense (DoD) contracts.

(ii) For contracts performed outside the United States, when security concerns can be appropriately demonstrated, the contracting officer may provide the contractor the option to publicize the program to contractor personnel in a manner other than public display of the poster, such as private employee written instructions and briefings.

(2) If the contract is funded, in whole or in part, by Department of Homeland Security (DHS) disaster relief funds and the work is to be performed in the United States, the DHS fraud hotline poster shall be displayed in addition to the DoD hotline poster. If a display of a DHS fraud hotline poster is required, the Contractor may obtain such poster from—

(i) DHS Office of Inspector General/MAIL STOP 0305, Attn: Office of Investigations – Hotline, 245 Murray Lane SW, Washington, DC 20528-0305; or

(ii) Via the internet at https://www.oig.dhs.gov/assets/Hotline/DHS_OIG_Hotline-optimized.jpg.

(c)(1) The DoD hotline poster may be obtained from: Defense Hotline, The Pentagon, Washington, D.C. 20301-1900, or is also available via the internet at https://www.dodig.mil/Resources/Posters-and-Brochures/.

(2) If a significant portion of the employee workforce does not speak English, then the poster is to be displayed in the foreign languages that a significant portion of the employees speak.

(3) Additionally, if the Contractor maintains a company website as a method of providing information to employees, the Contractor shall display an electronic version of the required poster at the website.

(d) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (d), in all subcontracts that exceed the threshold specified in Defense Federal Acquisition Regulation Supplement 203.1004(b)(2)(ii) on the date of subcontract award, except when the subcontract is for the acquisition of a commercial product or commercial service.

(End of clause)

252.204-7003 CONTROL OF GOVERNMENT PERSONNEL WORK PRODUCT (APR 1992)

The Contractor's procedures for protecting against unauthorized disclosure of information shall not require Department of Defense employees or members of the Armed Forces to relinquish control of their work products, whether classified or not, to the contractor.

(End of clause)

252.204-7004 LEVEL I ANTITERRORISM AWARENESS TRAINING FOR CONTRACTORS (JAN 2023)

(a) Definition. As used in this clause--

Military installation means a base, camp, post, station, yard, center, or other activity under the jurisdiction of the Secretary of a military department or, in the case of an activity in a foreign country, under the operational control of the Secretary of a military department or the Secretary of Defense (see 10 U.S.C. 2801(c)(4)).

(b) Training. Contractor personnel who require routine physical access to a Federally-controlled facility or military installation shall complete Level I antiterrorism awareness training within 30 days of requiring access and annually thereafter. In accordance with Department of Defense Instruction O-2000.16 Volume 1, DoD Antiterrorism (AT) Program Implementation: DoD AT Standards, Level I antiterrorism awareness training shall be completed--

(1) Through a DoD-sponsored and certified computer or web-based distance learning instruction for Level I antiterrorism awareness; or

(2) Under the instruction of a Level I antiterrorism awareness instructor.

(c) Additional information. Information and guidance pertaining to DoD antiterrorism awareness training is available at https://jko.jten.mil/ or as otherwise identified in the performance work statement.

(d) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (d), in subcontracts, including subcontracts for commercial products and commercial services, when subcontractor performance requires routine physical access to a Federally-controlled facility or military installation.

(End of clause)

252.204-7012 SAFEGUARDING COVERED DEFENSE INFORMATION AND CYBER INCIDENT REPORTING (JAN 2023)

(a) Definitions. As used in this clause--

Adequate security means protective measures that are commensurate with the consequences and probability of loss, misuse, or unauthorized access to, or modification of information.

Compromise means disclosure of information to unauthorized persons, or a violation of the security policy of a system, in which unauthorized intentional or unintentional disclosure, modification, destruction, or loss of an object, or the copying of information to unauthorized media may have occurred.

Contractor attributional/proprietary information means information that identifies the contractor(s), whether directly or indirectly, by the grouping of information that can be traced back to the contractor(s) (e.g., program description, facility locations), personally identifiable information, as well as trade secrets, commercial or financial information, or other commercially sensitive information that is not customarily shared outside of the company.

Controlled technical information means technical information with military or space application that is subject to controls on the access, use, reproduction, modification, performance, display, release, disclosure, or dissemination. Controlled technical information would meet the criteria, if disseminated, for distribution statements B through F

using the criteria set forth in DoD Instruction 5230.24, Distribution Statements on Technical Documents. The term does not include information that is lawfully publicly available without restrictions.

Covered contractor information system means an unclassified information system that is owned, or operated by or for, a contractor and that processes, stores, or transmits covered defense information.

Covered defense information means unclassified controlled technical information or other information, as described in the Controlled Unclassified Information (CUI) Registry at http://www.archives.gov/cui/registry/category-list.html, that requires safeguarding or dissemination controls pursuant to and consistent with law, regulations, and Governmentwide policies, and is--

(1) Marked or otherwise identified in the contract, task order, or delivery order and provided to the contractor by or on behalf of DoD in support of the performance of the contract; or

(2) Collected, developed, received, transmitted, used, or stored by or on behalf of the contractor in support of the performance of the contract.

Cyber incident means actions taken through the use of computer networks that result in a compromise or an actual or potentially adverse effect on an information system and/or the information residing therein.

Forensic analysis means the practice of gathering, retaining, and analyzing computer-related data for investigative purposes in a manner that maintains the integrity of the data.

Information system means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information.

Malicious software means computer software or firmware intended to perform an unauthorized process that will have adverse impact on the confidentiality, integrity, or availability of an information system. This definition includes a virus, worm, Trojan horse, or other code-based entity that infects a host, as well as spyware and some forms of adware.

Media means physical devices or writing surfaces including, but is not limited to, magnetic tapes, optical disks, magnetic disks, large-scale integration memory chips, and printouts onto which covered defense information is recorded, stored, or printed within a covered contractor information system.

Operationally critical support means supplies or services designated by the Government as critical for airlift, sealift, intermodal transportation services, or logistical support that is essential to the mobilization, deployment, or sustainment of the Armed Forces in a contingency operation.

Rapidly report means within 72 hours of discovery of any cyber incident.

Technical information means technical data or computer software, as those terms are defined in the clause at DFARS 252.227-7013, Rights in Technical Data--Other Than Commercial Products and Commercial Services, regardless of whether or not the clause is incorporated in this solicitation or contract. Examples of technical information include research and engineering data, engineering drawings, and associated lists, specifications, standards, process sheets, manuals, technical reports, technical orders, catalog-item identifications, data sets, studies and analyses and related information, and computer software executable code and source code.

(b) Adequate security. The Contractor shall provide adequate security on all covered contractor information systems. To provide adequate security, the Contractor shall implement, at a minimum, the following information security protections:

(1) For covered contractor information systems that are part of an information technology (IT) service or system operated on behalf of the Government, the following security requirements apply:

(i) Cloud computing services shall be subject to the security requirements specified in the clause 252.239-7010, Cloud Computing Services, of this contract.

(ii) Any other such IT service or system (i.e., other than cloud computing) shall be subject to the security requirements specified elsewhere in this contract.

(2) For covered contractor information systems that are not part of an IT service or system operated on behalf of the Government and therefore are not subject to the security requirement specified at paragraph (b)(1) of this clause, the following security requirements apply:

(i) Except as provided in paragraph (b)(2)(ii) of this clause, the covered contractor information system shall be subject to the security requirements in National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, "Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations" (available via the internet at http://dx.doi.org/10.6028/NIST.SP.800-171) in effect at the time the solicitation is issued or as authorized by the Contracting Officer.

(ii)(A) The Contractor shall implement NIST SP 800-171, as soon as practical, but not later than December 31, 2017. For all contracts awarded prior to October 1, 2017, the Contractor shall notify the DoD Chief Information Officer (CIO), via email at osd.dibcsia@mail.mil, within 30 days of contract award, of any security requirements specified by NIST SP 800-171 not implemented at the time of contract award.

(B) The Contractor shall submit requests to vary from NIST SP 800-171 in writing to the Contracting Officer, for consideration by the DoD CIO. The Contractor need not implement any security requirement adjudicated by an authorized representative of the DoD CIO to be nonapplicable or to have an alternative, but equally effective, security measure that may be implemented in its place.

(C) If the DoD CIO has previously adjudicated the contractor's requests indicating that a requirement is not applicable or that an alternative security measure is equally effective, a copy of that approval shall be provided to the Contracting Officer when requesting its recognition under this contract.

(D) If the Contractor intends to use an external cloud service provider to store, process, or transmit any covered defense information in performance of this contract, the Contractor shall require and ensure that the cloud service provider meets security requirements equivalent to those established by the Government for the Federal Risk and Authorization Management Program (FedRAMP) Moderate baseline (https://www.fedramp.gov/resources/documents/) and that the cloud service provider complies with requirements in paragraphs (c) through (g) of this clause for cyber incident reporting, malicious software, media preservation and protection, access to additional information and equipment necessary for forensic analysis, and cyber incident damage assessment.

(3) Apply other information systems security measures when the Contractor reasonably determines that information systems security measures, in addition to those identified in paragraphs (b)(1) and (2) of this clause, may be required to provide adequate security in a dynamic environment or to accommodate special circumstances (e.g., medical devices) and any individual, isolated, or temporary deficiencies based on an assessed risk or vulnerability. These measures may be addressed in a system security plan.

(c) Cyber incident reporting requirement.

(1) When the Contractor discovers a cyber incident that affects a covered contractor information system or the covered defense information residing therein, or that affects the contractor's ability to perform the requirements of the contract that are designated as operationally critical support and identified in the contract, the Contractor shall--

(i) Conduct a review for evidence of compromise of covered defense information, including, but not limited to, identifying compromised computers, servers, specific data, and user accounts. This review shall also include analyzing covered contractor information system(s) that were part of the cyber incident, as well as other information systems on the Contractor's network(s), that may have been accessed as a result of the incident in order to identify compromised covered defense information, or that affect the Contractor's ability to provide operationally critical support; and

(ii) Rapidly report cyber incidents to DoD at https://dibnet.dod.mil.

(2) Cyber incident report. The cyber incident report shall be treated as information created by or for DoD and shall include, at a minimum, the required elements at https://dibnet.dod.mil.

(3) Medium assurance certificate requirement. In order to report cyber incidents in accordance with this clause, the Contractor or subcontractor shall have or acquire a DoD-approved medium assurance certificate to report cyber incidents. For information on obtaining a DoD-approved medium assurance certificate, see https://public.cyber.mil/eca/.

(d) Malicious software. When the Contractor or subcontractors discover and isolate malicious software in connection with a reported cyber incident, submit the malicious software to DoD Cyber Crime Center (DC3) in accordance with instructions provided by DC3 or the Contracting Officer. Do not send the malicious software to the Contracting Officer.

(e) Media preservation and protection. When a Contractor discovers a cyber incident has occurred, the Contractor shall preserve and protect images of all known affected information systems identified in paragraph (c)(1)(i) of this clause and all relevant monitoring/packet capture data for at least 90 days from the submission of the cyber incident report to allow DoD to request the media or decline interest.

(f) Access to additional information or equipment necessary for forensic analysis. Upon request by DoD, the Contractor shall provide DoD with access to additional information or equipment that is necessary to conduct a forensic analysis.

(g) Cyber incident damage assessment activities. If DoD elects to conduct a damage assessment, the Contracting Officer will request that the Contractor provide all of the damage assessment information gathered in accordance with paragraph (e) of this clause.

(h) DoD safeguarding and use of contractor attributional/proprietary information. The Government shall protect against the unauthorized use or release of information obtained from the contractor (or derived from information obtained from the contractor) under this clause that includes contractor attributional/proprietary information, including such information submitted in accordance with paragraph (c). To the maximum extent practicable, the Contractor shall identify and mark attributional/proprietary information. In making an authorized release of such information, the Government will implement appropriate procedures to minimize the contractor attributional/proprietary information that is included in such authorized release, seeking to include only that information that is necessary for the authorized purpose(s) for which the information is being released.

(i) Use and release of contractor attributional/proprietary information not created by or for DoD. Information that is obtained from the contractor (or derived from information obtained from the contractor) under this clause that is not created by or for DoD is authorized to be released outside of DoD--

(1) To entities with missions that may be affected by such information;

(2) To entities that may be called upon to assist in the diagnosis, detection, or mitigation of cyber incidents;

(3) To Government entities that conduct counterintelligence or law enforcement investigations;

(4) For national security purposes, including cyber situational awareness and defense purposes (including with Defense Industrial Base (DIB) participants in the program at 32 CFR part 236); or

(5) To a support services contractor ("recipient") that is directly supporting Government activities under a contract that includes the clause at 252.204-7009, Limitations on the Use or Disclosure of Third-Party Contractor Reported Cyber Incident Information.

(j) Use and release of contractor attributional/proprietary information created by or for DoD. Information that is obtained from the contractor (or derived from information obtained from the contractor) under this clause that is created by or for DoD (including the information submitted pursuant to paragraph (c) of this clause) is authorized to be used and released outside of DoD for purposes and activities authorized by paragraph (i) of this clause, and for any other lawful Government purpose or activity, subject to all applicable statutory, regulatory, and policy based restrictions on the Government's use and release of such information.

(k) The Contractor shall conduct activities under this clause in accordance with applicable laws and regulations on the interception, monitoring, access, use, and disclosure of electronic communications and data.

(l) Other safeguarding or reporting requirements. The safeguarding and cyber incident reporting required by this clause in no way abrogates the Contractor's responsibility for other safeguarding or cyber incident reporting pertaining to its unclassified information systems as required by other applicable clauses of this contract, or as a result of other applicable U.S. Government statutory or regulatory requirements.

(m) Subcontracts. The Contractor shall--

(1) Include this clause, including this paragraph (m), in subcontracts, or similar contractual instruments, for operationally critical support, or for which subcontract performance will involve covered defense information, including subcontracts for commercial products or commercial services, without alteration, except to identify the parties. The Contractor shall determine if the information required for subcontractor performance retains its identity as covered defense information and will require protection under this clause, and, if necessary, consult with the Contracting Officer; and

(2) Require subcontractors to--

(i) Notify the prime Contractor (or next higher-tier subcontractor) when submitting a request to vary from a NIST SP 800-171 security requirement to the Contracting Officer, in accordance with paragraph (b)(2)(ii)(B) of this clause; and

(ii) Provide the incident report number, automatically assigned by DoD, to the prime Contractor (or next higher-tier subcontractor) as soon as practicable, when reporting a cyber incident to DoD as required in paragraph (c) of this clause.

(End of clause)

252.204-7015 NOTICE OF AUTHORIZED DISCLOSURE OF INFORMATION FOR LITIGATION SUPPORT (JAN 2023)

(a) Definitions. As used in this clause--

Computer software means computer programs, source code, source code listings, object code listings, design details, algorithms, processes, flow charts, formulae, and related material that would enable the software to be reproduced, recreated, or recompiled. Computer software does not include computer data bases or computer software documentation.

Litigation support means administrative, technical, or professional services provided in support of the Government during or in anticipation of litigation.

Litigation support contractor means a contractor (including its experts, technical consultants, subcontractors, and suppliers) providing litigation support under a contract that contains the clause at 252.204-7014, Limitations on the Use or Disclosure of Information by Litigation Support Contractors.

Sensitive information means controlled unclassified information of a commercial, financial, proprietary, or privileged nature. The term includes technical data and computer software, but does not include information that is lawfully, publicly available without restriction.

Technical data means recorded information, regardless of the form or method of the recording, of a scientific or technical nature (including computer software documentation). The term does not include computer software or data incidental to contract administration, such as financial and/or management information.

(b) Notice of authorized disclosures. Notwithstanding any other provision of this solicitation or contract, the Government may disclose to a litigation support contractor, for the sole purpose of litigation support activities, any information, including sensitive information, received—

(1) Within or in connection with a quotation or offer; or

(2) In the performance of or in connection with a contract.

(c) Subcontracts. Include the substance of this clause, including this paragraph (c), in all subcontracts, including subcontracts for commercial products or commercial services.

(End of clause)

252.204-7018 PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES (JAN 2023)

(a) Definitions. As used in this clause--

Covered defense telecommunications equipment or services means--

(1) Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation, or any subsidiary or affiliate of such entities;

(2) Telecommunications services provided by such entities or using such equipment; or

(3) Telecommunications equipment or services produced or provided by an entity that the Secretary of Defense reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

Covered foreign country means--

(1) The People's Republic of China; or

(2) The Russian Federation.

Covered missions means--

(1) The nuclear deterrence mission of DoD, including with respect to nuclear command, control, and communications, integrated tactical warning and attack assessment, and continuity of Government; or

(2) The homeland defense mission of DoD, including with respect to ballistic missile defense.

Critical technology means--

(1) Defense articles or defense services included on the United States Munitions List set forth in the International Traffic in Arms Regulations under subchapter M of chapter I of title 22, Code of Federal Regulations;

(2) Items included on the Commerce Control List set forth in Supplement No. 1 to part 774 of the Export Administration Regulations under subchapter C of chapter VII of title 15, Code of Federal Regulations, and controlled--

(i) Pursuant to multilateral regimes, including for reasons relating to national security, chemical and biological weapons proliferation, nuclear nonproliferation, or missile technology; or

(ii) For reasons relating to regional stability or surreptitious listening;

(3) Specially designed and prepared nuclear equipment, parts and components, materials, software, and technology covered by part 810 of title 10, Code of Federal Regulations (relating to assistance to foreign atomic energy activities);

(4) Nuclear facilities, equipment, and material covered by part 110 of title 10, Code of Federal Regulations (relating to export and import of nuclear equipment and material);

(5) Select agents and toxins covered by part 331 of title 7, Code of Federal Regulations, part 121 of title 9 of such Code, or part 73 of title 42 of such Code; or

(6) Emerging and foundational technologies controlled pursuant to section 1758 of the Export Control Reform Act of 2018 (50 U.S.C. 4817).

Substantial or essential component means any component necessary for the proper function or performance of a piece of equipment, system, or service.

(b) Prohibition. In accordance with section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91), the contractor shall not provide to the Government any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless the covered defense telecommunication equipment or services are covered by a waiver described in Defense Federal Acquisition Regulation Supplement 204.2104.

(c) Procedures. The Contractor shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service, to carry out covered missions, that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

(d) Reporting.

(1) In the event the Contractor identifies covered defense telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, the Contractor shall report at https://dibnet.dod.mil the information in paragraph (d)(2) of this clause.

(2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:

(i) Within 3 business days from the date of such identification or notification: The contract number; the order number(s), if applicable; supplier name; brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

(ii) Within 30 business days of submitting the information in paragraph (d)(2)(i) of this clause: Any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of a covered defense telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.

(e) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (e), in all subcontracts and other contractual instruments, including subcontracts for the acquisition of commercial products or commercial services.

(End of clause)

252.205-7000 PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991)

(a) Definition.

"Cooperative agreement holder" means a State or local government; a private, nonprofit organization; a tribal organization (as defined in section 4(c) of the Indian Self-Determination and Education Assistance Act (Pub. L. 93-268; 25 U.S.C. 450 (c))); or an economic enterprise (as defined in section 3(e) of the Indian Financing Act of 1974 (Pub. L. 93-362; 25 U.S.C. 1452(e))) whether such economic enterprise is organized for profit or nonprofit purposes; which has an agreement with the Defense Logistics Agency to furnish procurement technical assistance to business entities.

(b) The Contractor shall provide cooperative agreement holders, upon their request, with a list of those appropriate employees or offices responsible for entering into subcontracts under defense contracts. The list shall include the business address, telephone number, and area of responsibility of each employee or office.

(c) The Contractor need not provide the listing to a particular cooperative agreement holder more frequently than once a year.

(End of clause)

252.209-7004 SUBCONTRACTING WITH FIRMS THAT ARE OWNED OR CONTROLLED BY THE GOVERNMENT OF A COUNTRY THAT IS A STATE SPONSOR OF TERRORISM (MAY 2019)

(a) Unless the Government determines that there is a compelling reason to do so, the Contractor shall not enter into any subcontract in excess of the threshold specified in Federal Acquisition Regulation 9.405-2(b) on the date of subcontract award with a firm, or a subsidiary of a firm, that is identified in the Exclusions section of the System for Award Management System (SAM Exclusions) as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a country that is a state sponsor of terrorism.

(b) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is identified, in SAM Exclusions, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a country that is a state sponsor of terrorism. The notice must include the name of the proposed subcontractor and the compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion in SAM Exclusions.

(End of clause)

252.222-7006 RESTRICTIONS ON THE USE OF MANDATORY ARBITRATION AGREEMENTS (JAN 2023)

(a) Definitions. As used in this clause--

Covered subcontractor means any entity that has a subcontract valued in excess of $1 million, except a subcontract for the acquisition of commercial products or commercial services, including commercially available off-the-shelf items.

Subcontract means any contract, as defined in Federal Acquisition Regulation subpart 2.1, to furnish supplies or services for performance of this contract or a higher-tier subcontract thereunder.

(b) The Contractor--

(1) Agrees not to--

(i) Enter into any agreement with any of its employees or independent contractors that requires, as a condition of employment, that the employee or independent contractor agree to resolve through arbitration-

(A) Any claim under title VII of the Civil Rights Act of 1964; or

(B) Any tort related to or arising out of sexual assault or harassment, including assault and battery, intentional infliction of emotional distress, false imprisonment, or negligent hiring, supervision, or retention; or

(ii) Take any action to enforce any provision of an existing agreement with an employee or independent contractor that mandates that the employee or independent contractor resolve through arbitration--

(A) Any claim under title VII of the Civil Rights Act of 1964; or

(B) Any tort related to or arising out of sexual assault or harassment, including assault and battery, intentional infliction of emotional distress, false imprisonment, or negligent hiring, supervision, or retention; and

(2) Certifies, by signature of the contract, that it requires each covered subcontractor to agree not to enter into, and not to take any action to enforce, any provision of any existing agreements, as described in paragraph (b)(1) of this clause, with respect to any employee or independent contractor performing work related to such subcontract.

(c) The prohibitions of this clause do not apply with respect to a contractor's or subcontractor's agreements with employees or independent contractors that may not be enforced in a court of the United States.

(d) The Secretary of Defense may waive the applicability of the restrictions of paragraph (b) of this clause in accordance with Defense Federal Acquisition Regulation Supplement 222.7404.

(End of clause)

252.223-7004 DRUG-FREE WORK FORCE (SEP 1988)

(a) Definitions.

(1) "Employee in a sensitive position," as used in this clause, means an employee who has been granted access to classified information; or employees in other positions that the Contractor determines involve national security; health or safety, or functions other than the foregoing requiring a high degree of trust and confidence.

(2) "Illegal drugs," as used in this clause, means controlled substances included in Schedules I and II, as defined by section 802(6) of title 21 of the United States Code, the possession of which is unlawful under chapter 13 of that Title. The term "illegal drugs" does not mean the use of a controlled substance pursuant to a valid prescription or other uses authorized by law.

(b) The Contractor agrees to institute and maintain a program for achieving the objective of a drug-free work force. While this clause defines criteria for such a program, contractors are encouraged to implement alternative approaches comparable to the criteria in paragraph (c) that are designed to achieve the objectives of this clause.

(c) Contractor programs shall include the following, or appropriate alternatives:

(1) Employee assistance programs emphasizing high level direction, education, counseling, rehabilitation, and coordination with available community resources;

(2) Supervisory training to assist in identifying and addressing illegal drug use by Contractor employees;

(3) Provision for self-referrals as well as supervisory referrals to treatment with maximum respect for individual confidentiality consistent with safety and security issues;

(4) Provision for identifying illegal drug users, including testing on a controlled and carefully monitored basis. Employee drug testing programs shall be established taking account of the following:

(i) The Contractor shall establish a program that provides for testing for the use of illegal drugs by employees in sensitive positions. The extent of and criteria for such testing shall be determined by the Contractor based on considerations that include the nature of the work being performed under the contract, the employee's duties, and efficient use of Contractor resources, and the risks to health, safety, or national security that could result from the failure of an employee adequately to discharge his or her position.

(ii) In addition, the Contractor may establish a program for employee drug testing--

(A) When there is a reasonable suspicion that an employee uses illegal drugs; or

(B) When an employees has been involved in an accident or unsafe practice;

(C) As part of or as a follow-up to counseling or rehabilitation for illegal drug use;

(D) As part of a voluntary employee drug testing program.

(iii) The Contractor may establish a program to test applicants for employment for illegal drug use.

(iv) For the purpose of administering this clause, testing for illegal drugs may be limited to those substances for which testing is prescribed by section 2..1 of subpart B of the "Mandatory Guidelines for Federal Workplace Drug Testing Programs" (53 FR 11980 (April 11, 1988), issued by the Department of Health and Human Services.

(d) Contractors shall adopt appropriate personnel procedures to deal with employees who are found to be using drugs illegally. Contractors shall not allow any employee to remain on duty or perform in a sensitive position who is found to use illegal drugs until such times as the Contractor, in accordance with procedures established by the Contractor, determines that the employee may perform in such a position.

(e) The provisions of this clause pertaining to drug testing program shall not apply to the extent that are inconsistent with state or local law, or with an existing collective bargaining agreement; provided that with respect to the latter, the Contractor agrees those issues that are in conflict will be a subject of negotiation at the next collective bargaining session.

(End of clause)

252.223-7006 PROHIBITION ON STORAGE, TREATMENT, AND DISPOSAL OF TOXIC OR HAZARDOUS MATERIALS--BASIC (SEP 2014)

(a) Definitions. As used in this clause--

Storage means a non-transitory, semi-permanent or permanent holding, placement, or leaving of material. It does not include a temporary accumulation of a limited quantity of a material used in or a waste generated or resulting from authorized activities, such as servicing, maintenance, or repair of Department of Defense (DoD) items, equipment, or facilities.

Toxic or hazardous materials means--

(i) Materials referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601(14)) and materials designated under section 102 of CERCLA (42 U.S.C. 9602) (40 CFR Part 302);

(ii) Materials that are of an explosive, flammable, or pyrotechnic nature; or

(iii) Materials otherwise identified by the Secretary of Defense as specified in DoD regulations.

(b) In accordance with 10 U.S.C. 2692, the Contractor is prohibited from storing, treating, or disposing of toxic or hazardous materials not owned by DoD on a DoD installation, except to the extent authorized by a statutory exception to 10 U.S.C. 2692 or as authorized by the Secretary of Defense. A charge may be assessed for any storage or disposal authorized under any of the exceptions to 10 U.S.C. 2692. If a charge is to be assessed, then such assessment shall be identified elsewhere in the contract with payment to the Government on a reimbursable cost basis.

(c) The Contractor shall include the substance of this clause, including this paragraph (c), in all subcontracts that require, may require, or permit a subcontractor access to a DoD installation, at any subcontract tier.

(End of clause)

252.223-7008 PROHIBITION OF HEXAVALENT CHROMIUM (JAN 2023)

(a) Definitions. As used in this clause--

Homogeneous material means a material that cannot be mechanically disjointed into different materials and is of uniform composition throughout.

(1) Examples of homogeneous materials include individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins, and surface coatings.

(2) Homogeneous material does not include conversion coatings that chemically modify the substrate.

Mechanically disjointed means that the materials can, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding, and abrasive processes.

(b) Prohibition.

(1) Unless otherwise specified by the Contracting Officer, the Contractor shall not provide any deliverable or construction material under this contract that--

(i) Contains hexavalent chromium in a concentration greater than 0.1 percent by weight in any homogenous material; or

(ii) Requires the removal or reapplication of hexavalent chromium materials during subsequent sustainment phases of the deliverable or construction material.

(2) This prohibition does not apply to hexavalent chromium produced as a by-product of manufacturing processes.

(c) If authorization for incorporation of hexavalent chromium in a deliverable or construction material is required, the Contractor shall submit a request to the Contracting Officer.

(d) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (d), in all subcontracts, including subcontracts for commercial products or commercial services, that are for supplies, maintenance and repair services, or construction materials.

(End of clause)

252.225-7012 PREFERENCE FOR CERTAIN DOMESTIC COMMODITIES (APR 2022)

(a) Definitions. As used in this clause--

Component means any item supplied to the Government as part of an end product or of another component.

End product means supplies delivered under a line item of this contract.

Qualifying country means a country with a reciprocal defense procurement memorandum of understanding or international agreement with the United States in which both countries agree to remove barriers to purchases of supplies produced in the other country or services performed by sources of the other country, and the memorandum or agreement complies, where applicable, with the requirements of section 36 of the Arms Export Control Act (22 U.S.C. 2776) and with 10 U.S.C. 2457. Accordingly, the following are qualifying countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Egypt
Estonia
Finland
France
Germany
Greece
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
Norway
Poland
Portugal
Slovenia
Spain

Sweden
Switzerland
Turkey
United Kingdom of Great Britain and Northern Ireland.

Structural component of a tent--

(i) Means a component that contributes to the form and stability of the tent (e.g., poles, frames, flooring, guy ropes, pegs);

(ii) Does not include equipment such as heating, cooling, or lighting.

United States means the 50 States, the District of Columbia, and outlying areas.

U.S.-flag vessel means a vessel of the United States or belonging to the United States, including any vessel registered or having national status under the laws of the United States.

(b) The Contractor shall deliver under this contract only such of the following items, either as end products or components, that have been grown, reprocessed, reused, or produced in the United States:

(1) Food.

(2) Clothing and the materials and components thereof, other than sensors, electronics, or other items added to, and not normally associated with, clothing and the materials and components thereof. Clothing includes items such as outerwear, headwear, underwear, nightwear, footwear, hosiery, handwear, belts, badges, and insignia.

(3) (i) Tents and structural components of tents;

(ii) Tarpaulins; or

(iii) Covers.

(4) Cotton and other natural fiber products.

(5) Woven silk or woven silk blends.

(6) Spun silk yarn for cartridge cloth.

(7) Synthetic fabric, and coated synthetic fabric, including all textile fibers and yarns that are for use in such fabrics.

(8) Canvas products.

(9) Wool (whether in the form of fiber or yarn or contained in fabrics, materials, or manufactured articles).

(10) Any item of individual equipment (Federal Supply Class 8465) manufactured from or containing fibers, yarns, fabrics, or materials listed in this paragraph (b).

(c) This clause does not apply--

(1) To items listed in section 25.104(a) of the Federal Acquisition Regulation (FAR), or other items for which the Government has determined that a satisfactory quality and sufficient quantity cannot be acquired as and when needed at U.S. market prices;

(2) To incidental amounts of cotton, other natural fibers, or wool incorporated in an end product, for which the estimated value of the cotton, other natural fibers, or wool--

(i) Is not more than 10 percent of the total price of the end product; and (ii) Does not exceed the simplified acquisition threshold in FAR part 2;

(3) To waste and byproducts of cotton or wool fiber for use in the production of propellants and explosives;

(4) To foods, other than fish, shellfish, or seafood, that have been manufactured or processed in the United States, regardless of where the foods (and any component if applicable) were grown or produced. Fish, shellfish, or seafood manufactured or processed in the United States and fish, shellfish, or seafood contained in foods manufactured or processed in the United States shall be provided in accordance with paragraph (d) of this clause;

(5) To chemical warfare protective clothing produced in a qualifying country; or

(6) To fibers and yarns that are for use in synthetic fabric or coated synthetic fabric (but does apply to the synthetic or coated synthetic fabric itself), if--

(i) The fabric is to be used as a component of an end product that is not a textile product. Examples of textile products, made in whole or in part of fabric, include--

(A) Draperies, floor coverings, furnishings, and bedding (Federal Supply Group 72, Household and Commercial Furnishings and Appliances);

(B) Items made in whole or in part of fabric in Federal Supply Group 83, Textile/leather/furs/apparel/findings/ tents/flags, or Federal Supply Group 84, Clothing, Individual Equipment and Insignia;

(C) Upholstered seats (whether for household, office, or other use); and

(D) Parachutes (Federal Supply Class 1670); or

(ii) The fibers and yarns are para-aramid fibers and continuous filament para-aramid yarns manufactured in a qualifying country.

(d)(1) Fish, shellfish, and seafood delivered under this contract, or contained in foods delivered under this contract--

(i) Shall be taken from the sea by U.S.-flag vessels; or

(ii) If not taken from the sea, shall be obtained from fishing within the United States; and

(2) Any processing or manufacturing of the fish, shellfish, or seafood shall be performed on a U.S.-flag vessel or in the United States.

(End of clause)

252.225-7048 EXPORT-CONTROLLED ITEMS (JUNE 2013)

(a) Definition. ``Export-controlled items," as used in this clause, means items subject to the Export Administration Regulations (EAR) (15 CFR Parts 730-774) or the International Traffic in Arms Regulations (ITAR) (22 CFR Parts 120-130). The term includes--

(1) ``Defense items," defined in the Arms Export Control Act, 22 U.S.C. 2778(j)(4)(A), as defense articles, defense services, and related technical data, and further defined in the ITAR, 22 CFR Part 120; and

(2) ``Items," defined in the EAR as ``commodities", ``software", and ``technology," terms that are also defined in the EAR, 15 CFR 772.1.

(b) The Contractor shall comply with all applicable laws and regulations regarding export-controlled items, including, but not limited to, the requirement for contractors to register with the Department of State in accordance with the ITAR. The Contractor shall consult with the Department of State regarding any questions relating to compliance with the ITAR and shall consult with the Department of Commerce regarding any questions relating to compliance with the EAR.

(c) The Contractor's responsibility to comply with all applicable laws and regulations regarding export-controlled items exists independent of, and is not established or limited by, the information provided by this clause.

(d) Nothing in the terms of this contract adds, changes, supersedes, or waives any of the requirements of applicable Federal laws, Executive orders, and regulations, including but not limited to—

(1) The Export Administration Act of 1979, as amended (50 U.S.C. App. 2401, et seq.);

(2) The Arms Export Control Act (22 U.S.C. 2751, et seq.);

(3) The International Emergency Economic Powers Act (50 U.S.C. 1701, et seq.);

(4) The Export Administration Regulations (15 CFR Parts 730-774);

(5) The International Traffic in Arms Regulations (22 CFR Parts 120-130); and

(6) Executive Order 13222, as extended.

(e) The Contractor shall include the substance of this clause, including this paragraph (e), in all subcontracts.

(End of clause)

252.225-7052 RESTRICTION ON THE ACQUISITION OF CERTAIN MAGNETS, TANTALUM, AND TUNGSTEN (JAN 2023)

(a) Definitions. As used in this clause--

Assembly means an item forming a portion of a system or subsystem that--

(1) Can be provisioned and replaced as an entity; and

(2) Incorporates multiple, replaceable parts.

Commercially available off-the-shelf item--

(1) Means any item of supply that is--

(i) A commercial product (as defined in paragraph (1) of the definition of "commercial product" in section 2.101 of the Federal Acquisition Regulation);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, under this contract or a subcontract at any tier, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4), such as agricultural products and petroleum products.

Component means any item supplied to the Government as part of an end item or of another component.

Covered country means--

(1) The Democratic People's Republic of North Korea;

(2) The People's Republic of China;

(3) The Russian Federation; or

(4) The Islamic Republic of Iran.

Covered material means--

(1) Samarium-cobalt magnets;

(2) Neodymium-iron-boron magnets;

(3) Tantalum metals and alloys;

(4) Tungsten metal powder; and

(5) Tungsten heavy alloy or any finished or semi-finished component containing tungsten heavy alloy.

Electronic device means an item that operates by controlling the flow of electrons or other electrically charged particles in circuits, using interconnections such as resistors, inductors, capacitors, diodes, switches, transistors, or integrated circuits.

End item means the final production product when assembled or completed and ready for delivery under a line item of this contract.

Subsystem means a functional grouping of items that combine to perform a major function within an end item, such as electrical power, attitude control, and propulsion.

Tungsten heavy alloy means a tungsten base pseudo alloy that--

(1) Meets the specifications of ASTM B777 or SAE-AMS-T-21014 for a particular class of tungsten heavy alloy; or

(2) Contains at least 90 percent tungsten in a matrix of other metals (such as nickel-iron or nickel-copper) and has density of at least 16.5 g/cm3).

(b) Restriction.

(1) Except as provided in paragraph (c) of this clause, the Contractor shall not deliver under this contract any covered material melted or produced in any covered country, or any end item, manufactured in any covered country, that contains a covered material (10 U.S.C. 4872).

(2) (i) For samarium-cobalt magnets and neodymium iron-boron magnets, this restriction includes--

(A) Melting samarium with cobalt to produce the samarium-cobalt alloy or melting neodymium with iron and boron to produce the neodymium-iron-boron alloy; and

(B) All subsequent phases of production of the magnets, such as powder formation, pressing, sintering or bonding, and magnetization.

(ii) The restriction on melting and producing of samarium-cobalt magnets is in addition to any applicable restrictions on melting of specialty metals if the clause at 252.225-7009, Restriction on Acquisition of Certain Articles Containing Specialty Metals, is included in the contract.

(3) For production of tantalum metals of any kind and alloys, this restriction includes the reduction or melting of any form of tantalum to create tantalum metal including unwrought, powder, mill products, and alloys. The restriction also covers all subsequent phases of production of tantalum metals and alloys.

(4) For production of tungsten metal powder and tungsten heavy alloy, this restriction includes--

(i) Atomization;

(ii) Calcination and reduction into powder;

(iii) Final consolidation of non-melt derived metal powders; and

(iv) All subsequent phases of production of tungsten metal powder, tungsten heavy alloy, or any finished or semi-finished component containing tungsten heavy alloy.

(c) Exceptions. This clause does not apply--

(1) To an end item containing a covered material that is--

(i) A commercially available off-the-shelf item, other than--

(A) A commercially available off-the-shelf item that is 50 percent or more tungsten by weight; or

(B) A tantalum metal, tantalum alloy, or tungsten heavy alloy mill product, such as bar, billet, slab, wire, cube, sphere, block, blank, plate, or sheet, that has not been incorporated into an end item, subsystem, assembly, or component;

(ii) An electronic device, unless otherwise specified in the contract; or

(iii) A neodymium-iron-boron magnet manufactured from recycled material if the milling of the recycled material and sintering of the final magnet takes place in the United States.

(2) If the authorized agency official concerned has made a nonavailability determination, in accordance with section 225.7018-4 of the Defense Federal Acquisition Regulation Supplement, that compliant covered materials of satisfactory quality and quantity, in the required form, cannot be procured as and when needed at a reasonable price.

(i) For tantalum metal, tantalum alloy, or tungsten heavy alloy, the term "required form" refers to the form of the mill product, such as bar, billet, wire, slab, plate, or sheet, in the grade appropriate for the production of a finished end item to be delivered to the Government under this contract; or a finished component assembled into an end item to be delivered to the Government under the contract.

(ii) For samarium-cobalt magnets or neodymium-iron-boron magnets, the term "required form" refers to the form and properties of the magnets.

(d) Subcontracts. The Contractor shall insert the substance of this clause, including this paragraph (d), in subcontracts and other contractual instruments that are for items containing a covered material, including subcontracts and other contractual instruments for commercial products, unless an exception in paragraph (c) of this clause applies. The Contractor shall not alter this clause other than to identify the appropriate parties.

(End of clause)

252.225-7056 PROHIBITION REGARDING BUSINESS OPERATIONS WITH THE MADURO REGIME (MAY 2022)

(a) *Definitions*. As used in this clause—

"Agency or instrumentality of the government of Venezuela" means an agency or instrumentality of a foreign state as defined in 28 U.S.C. 1603(b), with each reference in section 1603(b) to a foreign state deemed to be a reference to Venezuela.

"Business operations" means engaging in commerce in any form, including acquiring, developing, maintaining, owning, selling, possessing, leasing, or operating equipment, facilities, personnel, products, services, personal property, real property, or any other apparatus of business or commerce.

"Government of Venezuela" means the government of any political subdivision of Venezuela, and any agency or instrumentality of the government of Venezuela.

"Person" means—

(1) A natural person, corporation, company, business association, partnership, society, trust, or any other nongovernmental entity, organization, or group;

(2) Any governmental entity or instrumentality of a government, including a multilateral development institution (as defined in section 1701(c)(3) of the International Financial Institutions Act (22 U.S.C. 262r(c)(3)); and

(3) Any successor, subunit, parent entity, or subsidiary of, or any entity under common ownership or control with, any entity described in paragraph (1) or (2) of this definition.

(b) *Prohibition*. In accordance with section 890 of the National Defense Authorization Act for Fiscal Year 2020 (Pub. L. 116-92), DoD is prohibited from entering into a contract for the procurement of products or services with

any person that has business operations with an authority of the government of Venezuela that is not recognized as the legitimate government of Venezuela by the U.S. Government, unless the person has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

(c) The Contractor shall—

(1) Not have any business operations with an authority of the Maduro regime or the government of Venezuela that is not recognized as the legitimate government of Venezuela by the U.S. Government; or

(2) Have a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

(d) *Subcontracts*. The Contractor shall insert the substance of this clause, including this paragraph (d), in all subcontracts, including subcontracts for the acquisition of commercial items.

(End of clause)

252.225-7058 POSTAWARD DISCLOSURE OF EMPLOYMENT OF INDIVIDUALS WHO WORK IN THE PEOPLE'S REPUBLIC OF CHINA (JAN 2023)

(a) Definitions. As used in this clause--

Covered contract means any DoD contract or subcontract with a value in excess of $5 million, not including contracts for commercial products and commercial services.

Covered entity means any corporation, company, limited liability company, limited partnership, business trust, business association, or other similar entity, including any subsidiary thereof, performing work on a covered contract in the People's Republic of China, including by leasing or owning real property used in the performance of the covered contract in the People's Republic of China.

(b) Disclosure requirement.

(1) In accordance with section 855 of the National Defense Authorization Act for Fiscal Year 2022 (Pub. L. 117-81, 10 U.S.C. 4651 note prec.), DoD may not award, extend, or exercise an option on a covered contract with a covered entity unless such covered entity submits each required disclosure of its use of workforce and facilities in the People's Republic of China, if it employs one or more individuals who perform work in the People's Republic of China on a covered contract.

(2) If the Contractor is a covered entity, the Contractor shall disclose for the Government's fiscal years 2023 and 2024, the Contractor's employment of one or more individuals who perform work in the People's Republic of China on any covered contract. The disclosures shall include--

(i) The total number of such individuals who perform work in the People's Republic of China on the covered contracts funded by DoD; and

(ii) A description of the physical presence, including street address or addresses in the People's Republic of China, where work on the covered contract is performed.

(c) Subcontracts. The Contractor shall insert this clause, including this paragraph (c), without alteration other than to identify the appropriate parties, in all subcontracts that meet the definition of a covered contract.

(End of clause)

252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

252.232-7003 ELECTRONIC SUBMISSION OF PAYMENT REQUESTS AND RECEIVING REPORTS (DEC 2018)

(a) Definitions. As used in this clause--

Contract financing payment means an authorized Government disbursement of monies to a contractor prior to acceptance of supplies or services by the Government.

(1) Contract financing payments include--

(i) Advance payments;

(ii) Performance-based payments;

(iii) Commercial advance and interim payments;

(iv) Progress payments based on cost under the clause at Federal Acquisition Regulation (FAR) 52.232-16, Progress Payments;

(v) Progress payments based on a percentage or stage of completion (see FAR 32.102(e)), except those made under the clause at FAR 52.232-5, Payments Under Fixed-Price Construction Contracts, or the clause at FAR 52.232-10, Payments Under Fixed-Price Architect-Engineer Contracts; and

(vi) Interim payments under a cost reimbursement contract, except for a cost reimbursement contract for services when Alternate I of the clause at FAR 52.232-25, Prompt Payment, is used.

(2) Contract financing payments do not include--

(i) Invoice payments;

(ii) Payments for partial deliveries; or

(iii) Lease and rental payments.

Electronic form means any automated system that transmits information electronically from the initiating system to affected systems.

Invoice payment means a Government disbursement of monies to a contractor under a contract or other authorization for supplies or services accepted by the Government.

(1) Invoice payments include--

(i) Payments for partial deliveries that have been accepted by the Government;

(ii) Final cost or fee payments where amounts owed have been settled between the Government and the contractor;

(iii) For purposes of subpart 32.9 only, all payments made under the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, and the clause at 52.232-10, Payments Under Fixed-Price Architect-Engineer Contracts; and

(iv) Interim payments under a cost-reimbursement contract for services when Alternate I of the clause at 52.232-25, Prompt Payment, is used.

(2) Invoice payments do not include contract financing payments.

Payment request means any request for contract financing payment or invoice payment submitted by the Contractor under this contract or task or delivery order.

Receiving report means the data prepared in the manner and to the extent required by Appendix F, Material Inspection and Receiving Report, of the Defense Federal Acquisition Regulation Supplement.

(b) Except as provided in paragraph (d) of this clause, the Contractor shall submit payment requests and receiving reports in electronic form using Wide Area WorkFlow (WAWF). The Contractor shall prepare and furnish to the Government a receiving report at the time of each delivery of supplies or services under this contract or task or delivery order.

(c) Submit payment requests and receiving reports to WAWF in one of the following electronic formats:

(1) Electronic Data Interchange.

(2) Secure File Transfer Protocol.

(3) Direct input through the WAWF website.

(d) The Contractor may submit a payment request and receiving report using methods other than WAWF only when--

(1) The Contractor has requested permission in writing to do so, and the Contracting Officer has provided instructions for a temporary alternative method of submission of payment requests and receiving reports in the contract administration data section of this contract or task or delivery order;

(2) DoD makes payment for commercial transportation services provided under a Government rate tender or a contract for transportation services using a DoD-approved electronic third party payment system or other exempted vendor payment/invoicing system (e.g., PowerTrack, Transportation Financial Management System, and Cargo and Billing System);

(3) DoD makes payment on a contract or task or delivery order for rendered health care services using the TRICARE Encounter Data System; or

(4) The Governmentwide commercial purchase card is used as the method of payment, in which case submission of only the receiving report in WAWF is required.

(e) Information regarding WAWF is available at https://wawf.eb.mil/.

(f) In addition to the requirements of this clause, the Contractor shall meet the requirements of the appropriate payment clauses in this contract when submitting payment requests.

(End of clause)

252.232-7004 DOD PROGRESS PAYMENT RATES (MAR 2020) (DEVIATION 2020-O0010)

If the Contractor is a small business concern, the Progress Payments clause of this contract is modified to change each mention of the progress payment rate and liquidation rate (excepting paragraph (k), Limitations on Undefinitized Contract Actions) to 95 percent.

(End of clause)

252.232-7010 LEVIES ON CONTRACT PAYMENTS (DEC 2006)

(a) 26 U.S.C. 6331(h) authorizes the Internal Revenue Service (IRS) to continuously levy up to 100 percent of contract payments, up to the amount of tax debt.

(b) When a levy is imposed on a payment under this contract and the Contractor believes that the levy may result in an inability to perform the contract, the Contractor shall promptly notify the Procuring Contracting Officer in writing, with a copy to the Administrative Contracting Officer, and shall provide--

(1) The total dollar amount of the levy;

(2) A statement that the Contractor believes that the levy may result in an inability to perform the contract, including rationale and adequate supporting documentation; and

(3) Advice as to whether the inability to perform may adversely affect national security, including rationale and adequate supporting documentation.

(c) DoD shall promptly review the Contractor's assessment, and the Procuring Contracting Officer shall provide a written notification to the Contractor including--

(1) A statement as to whether DoD agrees that the levy may result in an inability to perform the contract; and

(2)(i) If the levy may result in an inability to perform the contract and the lack of performance will adversely affect national security, the total amount of the monies collected that should be returned to the Contractor; or

(ii) If the levy may result in an inability to perform the contract but will not impact national security, a recommendation that the Contractor promptly notify the IRS to attempt to resolve the tax situation.

(d) Any DoD determination under this clause is not subject to appeal under the Contract Disputes Act.

(End of clause)

252.232-7017 ACCELERATING PAYMENTS TO SMALL BUSINESS SUBCONTRACTORS--PROHIBITION ON FEES AND CONSIDERATION (JAN 2023)

(a) Definition. Accelerated payment, as used in this clause, means a payment made to a small business subcontractor as quickly as possible, with a goal of 15 days or less after receipt of payment from the Government or receipt of a proper invoice from the subcontractor, whichever is later.

(b) In accordance with 10 U.S.C. 3801(b)(2), the Contractor shall not require any further consideration from or charge fees to the small business subcontractor when making accelerated payments, as defined in paragraph (a) of this clause, to subcontractors under the clause at FAR 52.232-40, Providing Accelerated Payments to Small Business Subcontractors.

(c) Subcontracts. Include the substance of this clause, including this paragraph (c), in all subcontracts with small business concerns, including those for the acquisition of commercial products or commercial services.

(End of clause)

252.236-7000 MODIFICATION PROPOSALS - PRICE BREAKDOWN. (DEC 1991)

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown --

(1) Must include sufficient detail to permit an analysis of profit, and of all costs for --

(i) Material;

(ii) Labor;

(iii) Equipment;

(iv) Subcontracts; and

(v) Overhead; and

(2) Must cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor's proposal shall include a justification for any time extension proposed.

252.236-7001 CONTRACT DRAWINGS AND SPECIFICATIONS (AUG 2000)

(a) The Government will provide to the Contractor, without charge, one set of contract drawings and specifications, except publications incorporated into the technical provisions by reference, in electronic or paper media as chosen by the Contracting Officer.

(b) The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies;

(4) Be responsible for any errors that might have been avoided by complying with this paragraph (b); and

(5) Reproduce and print contract drawings and specifications as needed.

(c) In general--

(1) Large-scale drawings shall govern small-scale drawings; and

(2) The Contractor shall follow figures marked on drawings in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work that are manifestly necessary to carry out the intent of the drawings and specifications, or that are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work. The Contractor shall perform such details as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

G-003 DRAWING INDEX, REFERENCE DRAWING INDEX AND LEGEND

(End of clause)

252.236-7002 OBSTRUCTION OF NAVIGABLE WATERWAYS. (DEC 1991)

(a) The Contractor shall --

(1) Promptly recover and remove any material, plant, machinery, or appliance which the contractor loses, dumps, throws overboard, sinks, or misplaces, and which, in the opinion of the Contracting Officer, may be dangerous to or obstruct navigation;

(2) Give immediate notice, with description and locations of any such obstructions, to the Contracting Officer; and

(3) When required by the Contracting Officer, mark or buoy such obstructions until the same are removed.

(b) The Contracting Officer may --

(1) Remove the obstructions by contract or otherwise should the Contractor refuse, neglect, or delay compliance with paragraph (a) of this clause; and

(2) Deduct the cost of removal from any monies due or to become due to the Contractor; or

(3) Recover the cost of removal under the Contractor's bond.

(c) The Contractor's liability for the removal of a vessel wrecked or sunk without fault or negligence is limited to that provided in sections 15, 19, and 20 of the River and Harbor Act of March 3, 1899 (33 U.S.C. 410 et. seq.).

252.242-7006 ACCOUNTING SYSTEM ADMINISTRATION (FEB 2012)

(a) Definitions. As used in this clause--

(1) Acceptable accounting system means a system that complies with the system criteria in paragraph (c) of this clause to provide reasonable assurance that--

(i) Applicable laws and regulations are complied with;

(ii) The accounting system and cost data are reliable;

(iii) Risk of misallocations and mischarges are minimized; and

(iv) Contract allocations and charges are consistent with billing procedures.

(2) Accounting system means the Contractor's system or systems for accounting methods, procedures, and controls established to gather, record, classify, analyze, summarize, interpret, and present accurate and timely financial data for reporting in compliance with applicable laws, regulations, and management decisions, and may include subsystems for specific areas such as indirect and other direct costs, compensation, billing, labor, and general information technology.

(3) Significant deficiency means a shortcoming in the system that materially affects the ability of officials of the Department of Defense to rely upon information produced by the system that is needed for management purposes.

(b) General. The Contractor shall establish and maintain an acceptable accounting system. Failure to maintain an acceptable accounting system, as defined in this clause, shall result in the withholding of payments if the contract includes the clause at 252.242-7005, Contractor Business Systems, and also may result in disapproval of the system.

(c) System criteria. The Contractor's accounting system shall provide for--

(1) A sound internal control environment, accounting framework, and organizational structure;

(2) Proper segregation of direct costs from indirect costs;

(3) Identification and accumulation of direct costs by contract;

(4) A logical and consistent method for the accumulation and allocation of indirect costs to intermediate and final cost objectives;

(5) Accumulation of costs under general ledger control;

(6) Reconciliation of subsidiary cost ledgers and cost objectives to general ledger;

(7) Approval and documentation of adjusting entries;

(8) Management reviews or internal audits of the system to ensure compliance with the Contractor's established policies, procedures, and accounting practices;

(9) A timekeeping system that identifies employees' labor by intermediate or final cost objectives;

(10) A labor distribution system that charges direct and indirect labor to the appropriate cost objectives;

(11) Interim (at least monthly) determination of costs charged to a contract through routine posting of books of account;

(12) Exclusion from costs charged to Government contracts of amounts which are not allowable in terms of Federal Acquisition Regulation (FAR) part 31, Contract Cost Principles and Procedures, and other contract provisions;

(13) Identification of costs by contract line item and by units (as if each unit or line item were a separate contract), if required by the contract;

(14) Segregation of preproduction costs from production costs, as applicable;

(15) Cost accounting information, as required--

(i) By contract clauses concerning limitation of cost (FAR 52.232-20), limitation of funds (FAR 52.232-22), or allowable cost and payment (FAR 52.216-7); and

(ii) To readily calculate indirect cost rates from the books of accounts;

(16) Billings that can be reconciled to the cost accounts for both current and cumulative amounts claimed and comply with contract terms;

(17) Adequate, reliable data for use in pricing follow-on acquisitions; and

(18) Accounting practices in accordance with standards promulgated by the Cost Accounting Standards Board, if applicable, otherwise, Generally Accepted Accounting Principles.

(d) Significant deficiencies.

(1) The Contracting Officer will provide an initial determination to the Contractor, in writing, on any significant deficiencies. The initial determination will describe the deficiency in sufficient detail to allow the Contractor to understand the deficiency.

(2) The Contractor shall respond within 30 days to a written initial determination from the Contracting Officer that identifies significant deficiencies in the Contractor's accounting system. If the Contractor disagrees with the initial determination, the Contractor shall state, in writing, its rationale for disagreeing.

(3) The Contracting Officer will evaluate the Contractor's response and notify the Contractor, in writing, of the Contracting Officer's final determination concerning--

(i) Remaining significant deficiencies;

(ii) The adequacy of any proposed or completed corrective action; and

(iii) System disapproval, if the Contracting Officer determines that one or more significant deficiencies remain.

(e) If the Contractor receives the Contracting Officer's final determination of significant deficiencies, the Contractor shall, within 45 days of receipt of the final determination, either correct the significant deficiencies or submit an acceptable corrective action plan showing milestones and actions to eliminate the significant deficiencies.

(f) Withholding payments. If the Contracting Officer makes a final determination to disapprove the Contractor's accounting system, and the contract includes the clause at 252.242-7005, Contractor Business Systems, the Contracting Officer will withhold payments in accordance with that clause.

(End of clause)

252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR part 31 and DFARS part 231, in effect on the date of this contract, apply.

(End of clause)

252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (DEC 2022)

(a) The amount of any request for equitable adjustment to contract terms shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(b) In accordance with 10 U.S.C. 3862(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:

I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of my knowledge and belief.

(Official's Name)

(Title)

(c) The certification in paragraph (b) of this clause requires full disclosure of all relevant facts, including--

(1) Certified cost or pricing data if required in accordance with subsection 15.403-4 of the Federal Acquisition Regulation (FAR); and

(2) Data other than certified cost or pricing data, in accordance with subsection 15.403-3 of the FAR, including actual cost data and data to support any estimated costs, even if certified cost or pricing data are not required.

(d) The certification requirement in paragraph (b) of this clause does not apply to----

(1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or

(2) Final adjustment under an incentive provision of the contract.

(End of clause)

252.244-7000 SUBCONTRACTS FOR COMMERCIAL PRODUCTS OR COMMERCIAL SERVICES (JAN 2023)

(a) The Contractor is not required to flow down the terms of any Defense Federal Acquisition Regulation Supplement (DFARS) clause in subcontracts for commercial products or commercial services at any tier under this contract, unless so specified in the particular clause.

(b) While not required, the Contractor may flow down to subcontracts for commercial products or commercial services a minimal number of additional clauses necessary to satisfy its contractual obligation.

(c)(1) In accordance with 10 U.S.C. 3457(c), the Contractor shall treat as commercial products any items valued at less than $10,000 per item that were purchased by the Contractor for use in the performance of multiple contracts with the Department of Defense and other parties and are not identifiable to any particular contract when purchased.

(2) The Contractor shall ensure that any items to be used in performance of this contract, that are treated as commercial products pursuant to paragraph (c)(1) of this clause, meet all terms and conditions of this contract that are applicable to commercial products in accordance with the clause at Federal Acquisition Regulation 52.244-6 and paragraph (a) of this clause.

(d) The Contractor shall include the terms of this clause, including this paragraph (d), in subcontracts awarded under this contract, including subcontracts for the acquisition of commercial products or commercial services.

(End of clause)

252.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (JAN 2023)

(a) Definitions. As used in this clause --

"Components" means articles, materials, and supplies incorporated directly into end products at any level of manufacture, fabrication, or assembly by the Contractor or any subcontractor.

"Department of Defense" (DoD) means the Army, Navy, Air Force, Marine Corps, and defense agencies.

"Foreign-flag vessel" means any vessel that is not a U.S.-flag vessel.

"Ocean transportation" means any transportation aboard a ship, vessel, boat, barge, or ferry through international waters.

"Subcontractor" means a supplier, materialman, distributor, or vendor at any level below the prime contractor whose contractual obligation to perform results from, or is conditioned upon, award of the prime contract and who is performing any part of the work or other requirement of the prime contract.

"Supplies" means all property, except land and interests in land, that is clearly identifiable for eventual use by or owned by the DoD at the time of transportation by sea.

(i) An item is clearly identifiable for eventual use by the DoD if, for example, the contract documentation contains a reference to a DoD contract number or a military destination.

(ii) "Supplies" includes (but is not limited to) public works; buildings and facilities; ships; floating equipment and vessels of every character, type, and description, with parts, subassemblies, accessories, and equipment; machine tools; material; equipment; stores of all kinds; end items; construction materials; and components of the foregoing.

"U.S.-flag vessel" means a vessel of the United States or belonging to the United States, including any vessel registered or having national status under the laws of the United States.

(b)(1) The Contractor shall use U.S.-flag vessels when transporting any supplies by sea under this contract.

(2) A subcontractor transporting supplies by sea under this contract shall use U.S.-flag vessels if--

(i) This contract is a construction contract; or

(ii) The supplies being transported are--

(A) Other than commercial products; or

(B) Commercial products that--

(1) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it contracts for f.o.b. destination shipment);

(2) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(3) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(c) The Contractor and its subcontractors may request that the Contracting Officer authorize shipment in foreign-flag vessels, or designate available U.S.-flag vessels, if the Contractor or a subcontractor believes that --

(1) U.S.-flag vessels are not available for timely shipment;

(2) The freight charges are inordinately excessive or unreasonable; or

(3) Freight charges are higher than charges to private persons for transportation of like goods.

(d) The Contractor must submit any request for use of foreign-flag vessels in writing to the Contracting Officer at least 45 days prior to the sailing date necessary to meet its delivery schedules. The Contracting Officer will process requests submitted after such date(s) as expeditiously as possible, but the Contracting Officer's failure to grant approvals to meet the shipper's sailing date will not of itself constitute a compensable delay under this or any other clause of this contract. Requests shall contain at a minimum --

(1) Type, weight, and cube of cargo;

(2) Required shipping date;

(3) Special handling and discharge requirements;

(4) Loading and discharge points;

(5) Name of shipper and consignee;

(6) Prime contract number; and

(7) A documented description of efforts made to secure U.S.-flag vessels, including points of contact (with names and telephone numbers) with at least two U.S.-flag carriers contacted. Copies of telephone notes, telegraphic and facsimile message or letters will be sufficient for this purpose.

(e) The Contractor shall, within 30 days after each shipment covered by this clause, provide the Contracting Officer and the Maritime Administration, Office of Cargo Preference, U.S. Department of Transportation, 400 Seventh Street SW., Washington, DC 20590, one copy of the rated on board vessel operating carrier's ocean bill of lading, which shall contain the following information:

(1) Prime contract number;

(2) Name of vessel;

(3) Vessel flag of registry;

(4) Date of loading;

(5) Port of loading;

(6) Port of final discharge;

(7) Description of commodity;

(8) Gross weight in pounds and cubic feet if available;

(9) Total ocean freight in U.S. dollars; and

(10) Name of the steamship company.

(f) If this contract exceeds the simplified acquisition threshold, the Contractor shall provide with its final invoice under this contract a representation that to the best of its knowledge and belief--

(1) No ocean transportation was used in the performance of this contract;

(2) Ocean transportation was used and only U.S.-flag vessels were used for all ocean shipments under the contract;

(3) Ocean transportation was used, and the Contractor had the written consent of the Contracting Officer for all foreign-flag ocean transportation; or

(4) Ocean transportation was used and some or all of the shipments were made on foreign-flag vessels without the written consent of the Contracting Officer. The Contractor shall describe these shipments in the following format:

ITEM DESCRIPTION	CONTRACT LINE ITEMS	QUANTITY

TOTAL_____

(g) If this contract exceeds the simplified acquisition threshold and the final invoice does not include the required representation, the Government will reject and return it to the Contractor as an improper invoice for the purposes of the Prompt Payment clause of this contract. In the event there has been unauthorized use of foreign-flag vessels in the performance of this contract, the Contracting Officer is entitled to equitably adjust the contract, based on the unauthorized use.

(h) If the Contractor has indicated by the response to the solicitation provision, Representation of Extent of Transportation by Sea, that it did not anticipate transporting by sea any supplies; however, after the award of this contract, the Contractor learns that supplies will be transported by sea, the Contractor--

(1) Shall notify the Contracting Officer of that fact; and

(2) Hereby agrees to comply with all the terms and conditions of this clause.

(i) Subcontracts. In the award of subcontracts for the types of supplies described in paragraph (b)(2) of this clause, including subcontracts for commercial products, the Contractor shall flow down the requirements of this clause as follows:

(1) The Contractor shall insert the substance of this clause, including this paragraph (i), in subcontracts that exceed the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(2) The Contractor shall insert the substance of paragraphs (a) through (e) of this clause, and this paragraph (i), in subcontracts that are at or below the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(End of clause)

SECTION 00 73 00 - SUPPLEMENTARY CONDITIONS

CONTRACTOR SUPPLY and USE OF ELECTRONIC SOFTWARE FOR PROCESSING DAVIS-BACON ACT CERTIFIED LABOR PAYROLLS

The contractor is encouraged to use a commercially-available electronic system to process and submit certified payrolls electronically to the Government. The requirements for preparing, processing and providing certified labor payrolls are established by the Davis-Bacon Act as stated in FAR 52.222-8, PAYROLLS AND BASIC RECORDS and FAR 52.222-13, COMPLIANCE WITH CONSTRUCTION WAGE RATE REQUIREMENTS AND RELATED REGULATIONS.

If the contractor elects to use an electronic Davis-Bacon payroll processing system, then the contractor shall be responsible for obtaining and providing for all access, licenses, and other services required to provide for receipt, processing, certifying, electronically transmitting to the Government, and storing weekly payrolls and other data required for the contractor to comply with Davis-Bacon and related Act regulations. When the contractor uses an electronic Davis-Bacon payroll system, the electronic payroll service shall be used by the contractor to prepare, process, and maintain the relevant payrolls and basic records during all work under this construction contract and the electronic payroll service shall be capable of preserving these payrolls and related basic records for the required 3 years after contract completion. If the contractor chooses to use an electronic Davis-Bacon payroll system, then the contractor shall obtain and provide electronic system access to the Government, as required to comply with the Davis-Bacon and related Act regulations over the duration of this construction contract. The access shall include electronic review access by the Government contract administration office to the electronic payroll processing system used by the contractor.

The contractor's provision and use of an electronic payroll processing system shall meet the following basic functional criteria: commercially available; compliant with appropriate Davis Bacon Act payroll provisions in the FAR; able to accommodate the required numbers of employees and subcontractors planned to be employed under the contract; capable of producing an Excel spreadsheet-compatible electronic output of weekly payroll records (format at http://www.rmssupport.com/guides.aspx) for export in an Excel spreadsheet to be imported into the contractor's Quality Control System (QCS) version of Resident Management System (RMS), that in turn shall export payroll data to the Government's Resident Management System (RMS); demonstrated security of data and data entry rights; ability to produce contractor-certified electronic versions of weekly payroll data; ability to identify erroneous entries and track the data/time of all versions of the certified Davis Bacon payrolls submitted to the government over the life of the contract; capable of generating a durable record copy, that is, a CD or DVD and PDF file record of data from the system database at end of the contract closeout. This durable record copy of data from the electronic Davis-Bacon payroll processing system shall be provided to the Government during contract closeout.

All contractor-incurred costs related to the contractor's provision and use of an electronic payroll processing service shall be included in the contractor's price for the overall work under the contract. The costs for Davis-Bacon Act compliance using electronic payroll processing services shall not be a separately bid/proposed or reimbursed item under this contract.

AT/OPSEC SECURITY REQUIREMENTS

Access and General Protection/Security Policy and Procedures:
"All contractor and all associated sub-contractors employees shall comply with applicable installation, facility and area commander installation/facility access and local security policies and procedures (provided by government representative). The contractor shall also provide all information required for background checks to meet

installation/facility access requirements to be accomplished by installation Provost Marshal Office, Director of Emergency Services or Security Office. Contractor workforce must comply with all personal identity verification requirements (FAR clause 52.204-9, Personal Identity Verification of Contractor Personnel) as directed by DOD, HQDA and/or local policy. In addition to the changes otherwise authorized by the changes clause of this contract, should the Force Protection Condition (FPCON) at any installation or facility change, the Government may require changes in contractor security matters or processes."

For contractors who do not require CAC, but require access to a DoD facility or installation. **Proposed language**: Contractor and all associated sub-contractors employees shall comply with adjudication standards and procedures using the National Crime Information Center Interstate Identification Index (NCIC-III) and Terrorist Screening Database (TSDB) (Army Directive 2014-05 / AR 190-13), applicable installation, facility and area commander installation/facility access and local security policies and procedures (provided by government representative, as NCIC and TSDB are
available), or, at OCONUS locations, in accordance with status of forces agreements and other theater regulations.

Suspicious Activity Reporting Training (e.g. iWATCH, CorpsWatch, or See Something, Say Something**).** "The contractor and all associated sub-contractors shall receive a brief/training (provided by the RA) on the local suspicious activity reporting program. This locally developed training will be used to inform employees of the types of behavior to watch for and instruct employees to report suspicious activity to the project manager, security representative or law enforcement entity. This training shall be completed within 30 calendar days of contract award and within 30 calendar days of new employees commencing performance with the results reported to the COR NLT 5 calendar days after the completion of the training.

Will be escorted in areas where they may be exposed to classified and/or sensitive materials and/or sensitive or restricted areas.
"All contract employees, including subcontractor employees who are not in possession of the appropriate security clearance or access privileges, will be escorted in areas where they may be exposed to classified and/or sensitive materials and/or sensitive or restricted areas."

Pre-screen candidates using E-Verify Program.
"The Contractor must pre-screen Candidates using the E-verify Program (http://www.uscis.gov/e-verify) website to meet the established employment eligibility requirements. The Vendor must ensure that the Candidate has two valid forms of Government issued identification prior to enrollment to ensure the correct information is entered into the E-verify system. An initial list of verified/eligible Candidates must be provided to the COR no later than 3 business days after the initial contract award."

PARTNERING

The Government proposes to form a partnering relationship with the contractor. This partnering relationship will strive to facilitate communication and draw on the strengths of each organization in an effort to achieve a quality project, within budget, and on schedule. Participation will be totally voluntary. Partnering will not alter or supersede any provision of this contract nor will it provide either party with any additional contractual rights or obligations. Participation in partnering will not affect award of this contract. Any cost associated with this partnering will be agreed to by both parties and will be shared equally, with no change in contract price.

BIDDER'S QUALIFICATIONS

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding their previous experience in performing comparable work, the business and technical organization, financial resources, and plant available to be used in performing the work.

TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

a. This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the CONTRACT CLAUSES: DEFAULT (FIXED-PRICE CONSTRUCTION). In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The weather station selected for this analysis was Alma Dam 4, MN US which has a period of record of 81 years (1940 - 2020). The analysis was produced for another Lock and Dam 4 project in August 2021 and is unchanged from then. Data shown is for precipitation of 0.1 inch or more and maximum daily temperatures less than 32 degrees Fahrenheit. The actual numbers have been multiplied by 5/7 to account for the workweek. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORKDAYS BASED ON (5) DAY WORKWEEK.

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Days	16	11	6	5	6	6	5	5	5	4	5	13

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled workday. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph b, above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the CONTRACT CLAUSES: DEFAULT (FIXED-PRICE CONSTRUCTION).

ALL OR NONE QUALIFICATIONS

A vendor must provide a price on all items in this solicitation to be eligible for award. The Government will award on an “All or None” basis. Evaluation of bids/offers will be based upon only the total price included on the pricing schedule for all items. If options are included in the pricing schedule the evaluation will be conducted in accordance with the applicable option clause in the solicitation.

APPARENT CLERICAL MISTAKES

(a) For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of bidding schedule as submitted by the bidder:

(1) Obviously misplaced decimal points will be corrected;
(2) Discrepancy between unit price and extended price, the unit price will govern;
(3) Apparent errors in extension of unit prices will be corrected;
(4) Apparent errors in addition of lump sum and extended prices will be corrected.

(b) For the purpose of bid evaluation, the Government will proceed on the assumption that the bidder intends it's bid to be evaluated on the basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

WORK PERFORMED BY THE CONTRACTOR

The successful bidder must furnish the Contracting Officer within 10 days after the award, the items of work which he will perform with their own forces, the percentage of the total work this represents, and the estimated cost thereof.

INSURANCE

As referenced in Contract Clause: INSURANCE--WORK ON A GOVERNMENT INSTALLATION, the following types and amounts of insurance are required under this contract.

Type	Amount
Worker's Compensation and Employer's Liability Insurance:	
Coverage A Worker's Compensation	Compliance with State of Wisconsin Worker's Compensation Law
Coverage B Employer's Liability	$ 100,000
General Liability Insurance:	
Bodily Injury	$1,000,000 per occurrence
Property Damage	Not Required
Automobile Liability Insurance (Comprehensive Policy Form):	
Bodily Injury	$ 500,000 per person and $1,000,000 per occurrence
Property Damage	$ 100,000 per occurrence

REQUIREMENT FOR BID GUARANTEE

Each bidder shall submit with its bid a Bid Bond (current version of Standard Form 24) with good and sufficient surety or sureties acceptable to the Government or other security as provided in the clause BID GUARANTEE in the form of twenty percent (20%) of the bid price or $3,000,000 whichever is lesser. The bid bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents.

EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

(a) This clause does not apply to terminations. See FAR 49.206-2, Basis for Settlement of Proposals.

(b) Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region IV. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the contracting officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time the work was performed shall apply.

(c) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

(d) When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet.

INVOICE PROCEDURES

In accordance with CONTRACT CLAUSE titled "PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS", the contractor shall submit invoices as follows:

a. In order to qualify for a periodic payment, the Contractor must submit a proper invoice (request for payment) to the Contracting Officer's Representative (COR) and a determination must be made that supplies or services conform to the contract requirements. This determination will be made for the sole purpose of processing progress payments and will not constitute formal acceptance. The due date for making progress payments shall be as stated in the contract clause: PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS.

b. The submitted request for payment must be accompanied with documentation adequate to substantiate the amount requested. Substantiation shall be consistent will the clauses in the solicitation titled Quantity Surveys, Purchase Orders, Invoices, etc. satisfactory to the COR.

c. The Contractor must also include with the payment request a certification as described in the Clause "PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS".

d. Payment requests will be reviewed for propriety by the COR. Defective invoices will be returned to the Contractor for resolution with defects identified. Along with the returned invoice, the COR may include, at its option, an ENG FORM 93-PAYMENT ESTIMATE reflecting the substantiated and uncontested payment amount. The Contractor will then be given the option of signing and returning the FORM 93 for payment along with the original invoice and certification or resubmitting a revised invoice and certification. To expedite payment, the Contractor may request in writing that the COR retain the defective invoice and immediately process the payment request at the amount determined to be acceptable to the Government.

UNAVAILABILITY OF UTILITY SERVICES

The responsibility shall be upon the Contractor to provide and maintain at its expense, adequate utilities for its use for construction and domestic consumption, and to install and maintain necessary connections and lines for same, but only at such locations and in such manner as may be approved by the Contracting Officer. Before final acceptance, temporary connections and lines installed by the Contractor shall be removed in a manner satisfactory to the Contracting Officer.

SAFETY AND HEALTH REQUIREMENTS MANUAL INTERIM CHANGES, EM 385-1-1

This paragraph applies to contracts and purchase orders that require the contractor to comply with EM 385-1-1 (e.g., contracts that include the Accident Prevention clause at FAR 52.236-13 and/or other safety provisions). EM 385-1-1 and its changes are available at http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf. The Contractor shall be responsible for complying with the current edition and all changes posted on the web as of the effective date of this solicitation.

MATERIAL SOURCES

a. Concrete aggregate and stone protection materials meeting the requirements of these specifications can be produced from the sources listed in Section 35 31 19.00 13.

b. Materials may be furnished from any of the listed sources or at the option of the Contractor may be furnished from any other sources designated by the Contractor and approved by the Contracting Officer, subject to the conditions hereinafter stated.

c. After the award of the contract, the Contractor shall designate in writing only one source for each type of material or one combination of sources from which he proposes to furnish the materials. If the Contractor proposes to furnish materials from a source or from sources not listed, he may designate only a single source for each type of material or single combination of sources for materials. Samples for acceptance testing shall be provided as required by the TECHNICAL PROVISIONS. If a source for materials so designated by the Contractor is not

approved for use by the Contracting Officer, the Contractor may not submit for approval other sources but shall furnish the materials from approved sources selected from the list at no additional cost to the Government.

d. Approval of a source of materials is not to be construed as approval of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels, when such materials are unsuitable as determined by the Contracting Officer. Materials produced from an approved source shall meet all the requirements of the TECHNICAL PROVISIONS of these specifications.

FLOATING PLANT EQUIPMENT

When mechanized equipment is operated on floating plant, the contractor shall provide positive and acceptable means of preventing this equipment from moving or falling into the water. The type of equipment addressed by this clause includes front-end loaders, bulldozers, trucks (both on and off-road), backhoes, track hoes, and similar equipment. If the Contractor plans to use such equipment on floating plant, an activity hazard analysis must be developed for this feature of work. The plan must include a detailed explanation of the type or types of physical barriers, curbs, structures, etc., which will be incorporated to protect the operator and prevent the equipment from entering the water. Nonstructural warning devices may be considered for situations where the use of structural barriers is determined to be impracticable. The activity hazard analysis must thoroughly address the procedure and be submitted to the Corps of engineers for review and acceptance prior to start of this feature of work.

OBSTRUCTION OF CHANNEL

The Government will not undertake to keep the channel free from vessels or other obstructions, except to the extent of such regulations, if any, as may be prescribed by the Secretary of the Army, in accordance with the Provisions of Section 7 of the River and Harbor Act approved August 8, 1917. The Contractor will be required to conduct the work in such manner as to obstruct navigation as little as possible. The Contractor shall consult with the appropriate Coast Guard office to determine whether a Notice to Mariners will need to be issued for construction-related activities that might interfere with navigation or be interfered with by such navigation. (Point of Contact: Sector Upper Mississippi River, St. Louis, Missouri, 24 hour #314-269-2332). If the Contractor's plant so obstructs the channel as to make difficult or endanger the passage of vessels, said plant shall be promptly moved on the approach of any vessel to such an extent as may be necessary to afford a practicable passage. Upon the completion of the work the Contractor shall promptly remove his plant, including ranges, buoys, piles, and other marks placed by him under the contract whether in navigable waters or on shore.

SIGNAL LIGHTS

The Contractor shall display signal lights and conduct his operations in accordance with the General Regulation of the Department of the Army and the Coast Guard governing lights and day signals to be displayed by towing vessels with tows on which no signals can be displayed, vessels working on wrecks, dredges, and vessels engaged in laying cables or pipe or in submarine or bank protection operations, lights to be displayed on dredge pipe lines, and day signals to be displayed by vessels of more than 65 feet in length moored or anchored in a fairway or channel, and the passing by other vessels or floating plant working in navigable channels, as set forth in Commandant U.S. Coast Guard instruction M16672.2B, navigation rules: International-Inland (COMDTINST) M16672.2B, or 33 CFR 81 Appendix A (International) and 33 CFR 84 through 33 CFR (Inland) as applicable.

RADIO

The Contractor shall maintain a staff that is knowledgeable about radio communications to advise oncoming navigation of appropriate passing directions while the Contractor's floating plant is in the navigation channel. In particular, the Contractor shall monitor Marine Band Channel 13 for commercial navigation and Channel 16 for emergency communication.

BASIS FOR SETTLEMENT OF PROPOSALS

"Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a terminations settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for unallowable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate."

VETERANS EMPLOYMENT EMPHASIS FOR U.S. ARMY CORPS OF ENGINEERS CONTRACTS

In addition to complying with the requirements outlined in FAR Part 22.13, FAR Provision 52.222-38, FAR Clause 52.222-35, FAR Clause 52.222-37, DFARS 222.13 and Department of Labor regulations, U.S. Army Corps of Engineers (USACE) contractors and subcontractors at all tiers are encouraged to promote the training and employment of U.S. veterans while performing under a USACE contract. While no set-aside, evaluation preference, or incentive applies to the solicitation or performance under the resultant contract, USACE contractors are encouraged to seek out highly qualified veterans to perform services under this contract. The following resources are available to assist USACE contractors in their outreach efforts:

- U.S. Department of Labor Veterans' Employment and Training Service (VETS): https://www.dol.gov/vets/
- Federal Veteran Employment Information: https://www.fedshirevets.gov/
- Veterans Opportunity to Work (VOW) Program: https://www.benefits.va.gov/vow/
- U.S. Army Warrior Transition Command Employment Index: https://wct.army.mil/modules/employers/index.html
- Hiring Our Heroes: https://www.uschamberfoundation.org/hiring-our-heroes

DAVIS-BACON WAGE DETERMINATION

"General Decision Number: WI20230015 04/07/2023

Superseded General Decision Number: WI20220015

State: Wisconsin

Construction Type: Heavy

Counties: Wisconsin Statewide.

HEAVY CONSTRUCTION PROJECTS (Excluding Tunnel, Sewer, and Water Lines).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2023
1	01/13/2023
2	01/20/2023
3	03/31/2023
4	04/07/2023

BOIL0107-001 01/01/2021

	Rates	Fringes
BOILERMAKER		
Boilermaker	$ 39.52	31.50
Small Boiler Repair (under 25,000 lbs/hr)	$ 26.91	16.00

BRWI0001-002 06/01/2022

CRAWFORD, JACKSON, JUNEAU, LA CROSSE, MONROE, TREMPEALEAU, AND VERNON COUNTIES

	Rates	Fringes
BRICKLAYER	$ 37.96	25.13

BRWI0002-002 06/01/2022

ASHLAND, BAYFIELD, DOUGLAS, AND IRON COUNTIES

	Rates	Fringes
BRICKLAYER	$ 45.87	23.91

BRWI0002-005 06/01/2022

ADAMS, ASHLAND, BARRON, BROWN, BURNETT, CALUMET, CHIPPEWA, CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC, FOREST, GREEN LAKE, IRON, JEFFERSON, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE,

OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST CROIX, SAUK, SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 38.81	23.94

BRWI0003-002 06/01/2021

BROWN, DOOR, FLORENCE, KEWAUNEE, MARINETTE, AND OCONTO COUNTIES

	Rates	Fringes
BRICKLAYER	$ 37.03	24.95

BRWI0004-002 06/01/2022

KENOSHA, RACINE, AND WALWORTH COUNTIES

	Rates	Fringes
BRICKLAYER	$ 42.53	26.01

BRWI0006-002 06/01/2022

ADAMS, CLARK, FOREST, LANGLADE, LINCOLN, MARATHON, MENOMINEE, ONEIDA, PORTAGE, PRICE, TAYLOR, VILAS AND WOOD COUNTIES

	Rates	Fringes
BRICKLAYER	$ 38.26	24.83

BRWI0007-002 06/01/2022

GREEN, LAFAYETTE, AND ROCK COUNTIES

	Rates	Fringes
BRICKLAYER	$ 39.26	25.52

BRWI0008-002 06/01/2022

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
BRICKLAYER	$ 44.08	24.42

BRWI0009-001 06/01/2022

GREEN LAKE, MARQUETTE, OUTAGAMIE, SHAWANO, WAUPACA, WASHARA, AND WINNEBAGO COUNTIES

	Rates	Fringes
BRICKLAYER	$ 38.00	25.09

BRWI0011-002 06/01/2022

CALUMET, FOND DU LAC, MANITOWOC, AND SHEBOYGAN COUNTIES

	Rates	Fringes
BRICKLAYER	$ 38.00	25.09

BRWI0013-002 06/01/2022

DANE, GRANT, IOWA, AND RICHLAND COUNTIES

	Rates	Fringes
BRICKLAYER	$ 39.56	25.22

BRWI0019-002 06/01/2022

BARRON, BUFFALO, BURNETT, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN, PIERCE, POLK, RUSK, ST. CROIX, SAWYER AND WASHBURN COUNTIES

	Rates	Fringes
BRICKLAYER	$ 37.36	25.73

BRWI0021-002 06/01/2022

DODGE AND JEFFERSON COUNTIES

	Rates	Fringes
BRICKLAYER	$ 38.49	26.27

BRWI0034-002 06/01/2022

COLUMBIA AND SAUK COUNTIES

	Rates	Fringes
BRICKLAYER	$ 39.56	25.22

CARP0068-011 05/02/2022

BURNETT (W. of Hwy 48), PIERCE (W. of Hwy 29), POLK (W. of Hwys
35, 48 & 65), AND ST. CROIX (W. of Hwy 65) COUNTIES

	Rates	Fringes
Carpenter & Piledrivermen.....	$ 41.19	27.05

CARP0264-003 06/01/2016

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WAUKESHA, AND WASHINGTON
COUNTIES

	Rates	Fringes
CARPENTER.....	$ 35.78	22.11

CARP0310-002 06/05/2022

Ashland, Bayfield, Forest, Iron, Langlade, Lincoln, Marathon,
Oneida, Shawano, Taylor and Vilas

	Rates	Fringes
CARPENTER.....	$ 36.80	26.12
Piledriver.....	$ 37.37	25.96

CARP0314-001 06/05/2022

Columbia, Dane, Dodge, Grant, Green, Iowa, Jefferson,
Lafayette, Richland, Rock, Sauk and Walworth

	Rates	Fringes
CARPENTER.....	$ 36.80	26.12
Piledriver.....	$ 37.37	25.96

CARP0361-004 05/01/2018

BAYFIELD (West of Hwy 63) AND DOUGLAS COUNTIES

	Rates	Fringes
CARPENTER.....	$ 36.15	20.43

CARP0731-002 06/05/2022

Calumet (Eastern portion of the County), Fond Du Lac, Manitowoc

and Sheboygan

	Rates	Fringes
CARPENTER	$ 36.80	26.12
Piledriver	$ 37.37	25.96

CARP0804-001 06/05/2022

Adams, Juneau, Portage and Wood

	Rates	Fringes
CARPENTER	$ 36.80	26.12
Piledriver	$ 37.37	25.96

CARP0955-002 06/01/2022

Calumet (western portion of County), Fond Du Lac, Green Lake, Marquette, Outagamie and Winnebago

	Rates	Fringes
CARPENTER	$ 36.80	26.12
PILEDRIVER	$ 37.37	25.96

CARP1056-002 06/05/2022

	Rates	Fringes
MILLWRIGHT	$ 38.00	26.78

CARP1074-002 06/01/2022

Barron, Burnett, Chippewa, Clark, Dunn, Eau Claire, Pepin, Pierce, Polk, Rusk, Sawyer, St. Croix and Washburn

	Rates	Fringes
CARPENTER	$ 36.80	26.12
PILEDRIVER	$ 37.37	25.96

CARP1143-002 06/01/2022

Crawford, Jackson, La Crosse, Monroe, Trempealeau and Vernon

	Rates	Fringes
CARPENTER	$ 36.80	26.12

PILEDRIVER.....$ 37.37 25.96

CARP1146-002 06/01/2022

Brown, Door, Florence, Kewaunee, Marinette, Menominee and Shawano

	Rates	Fringes
CARPENTER	$ 36.80	26.12
PILEDRIVER	$ 37.37	25.96

CARP2337-001 06/01/2016

ZONE A: MILWAUKEE, OZAUKEE, WAUKESHA AND WASHINGTON

ZONE B: KENOSHA & RACINE

	Rates	Fringes
PILEDRIVERMAN		
Zone A	$ 31.03	22.69
Zone B	$ 31.03	22.69

CARP2337-003 06/01/2019

	Rates	Fringes
MILLWRIGHT		
Zone A	$ 33.58	21.53
Zone B	$ 33.58	21.53

ZONE DEFINITIONS

ZONE A: MILWAUKEE, OZAUKEE, WAUKESHA AND WASHINGTON COUNTIES

ZONE B: KENOSHA & RACINE COUNTIES

ELEC0014-002 12/25/2022

ASHLAND, BARRON, BAYFIELD, BUFFALO, BURNETT, CHIPPEWA, CLARK (except Maryville, Colby, Unity, Sherman, Fremont, Lynn & Sherwood), CRAWFORD, DUNN, EAU CLAIRE, GRANT, IRON, JACKSON, LA CROSSE, MONROE, PEPIN, PIERCE, POLK, PRICE, RICHLAND, RUSK, ST CROIX, SAWYER, TAYLOR, TREMPEALEAU, VERNON, AND WASHBURN COUNTIES

	Rates	Fringes

Electricians:.....$ 39.25 22.34

ELEC0014-007 05/29/2022

REMAINING COUNTIES

	Rates	Fringes
Teledata System Installer		
Installer/Technician.....	$ 29.63	3%+16.18

Low voltage construction, installation, maintenance and removal of teledata facilities (voice, data, and video) including outside plant, telephone and data inside wire, interconnect, terminal equipment, central offices, PABX, fiber optic cable and equipment, micro waves, V-SAT, bypass, CATV, WAN (wide area networks), LAN (local area networks), and ISDN (integrated systems digital network).

ELEC0127-002 06/01/2021

KENOSHA COUNTY

	Rates	Fringes
Electricians:.....	$ 43.16	30%+12.70

ELEC0158-002 05/30/2021

BROWN, DOOR, KEWAUNEE, MANITOWOC (except Schleswig), MARINETTE(Wausuakee and area South thereof), OCONTO, MENOMINEE (East of a ine 6 miles West of the West boundary of Oconto County), SHAWANO (Except Area North of Townships of Aniwa and Hutchins) COUNTIES

	Rates	Fringes
ELECTRICIAN.....	$ 36.14	29.75%+10.26

ELEC0159-003 05/30/2021

COLUMBIA, DANE, DODGE (Area West of Hwy 26, except Chester and Emmet Townships), GREEN, LAKE (except Townships of Berlin, Seneca, and St. Marie), IOWA, MARQUETTE (except Townships of Neshkoka, Crystal Lake, Newton, and Springfield), and SAUK COUNTIES

	Rates	Fringes

ELECTRICIAN.....$ 43.38 23.13

ELEC0219-004 06/01/2019

FLORENCE COUNTY (Townships of Aurora, Commonwealth, Fern, Florence and Homestead) AND MARINETTE COUNTY (Township of Niagara)

	Rates	Fringes
Electricians:		
Electrical contracts over $180,000	$ 33.94	21.80
Electrical contracts under $180,000	$ 31.75	21.73

ELEC0242-005 05/30/2021

DOUGLAS COUNTY

	Rates	Fringes
Electricians:	$ 41.37	69.25%

ELEC0388-002 05/30/2021

ADAMS, CLARK (Colby, Freemont, Lynn, Mayville, Sherman, Sherwood, Unity), FOREST, JUNEAU, LANGLADE, LINCOLN, MARATHON, MARINETTE (Beecher, Dunbar, Goodman & Pembine), MENOMINEE (Area West of a line 6 miles West of the West boundary of Oconto County), ONEIDA, PORTAGE, SHAWANO (Aniwa and Hutchins), VILAS AND WOOD COUNTIES

	Rates	Fringes
Electricians:	$ 36.22	26%+11.24

ELEC0430-002 06/01/2022

RACINE COUNTY (Except Burlington Township)

	Rates	Fringes
Electricians:	$ 45.02	24.35

ELEC0494-005 06/01/2022

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Electricians:.....	$ 46.38	25.86

ELEC0494-006 06/01/2021

CALUMET (Township of New Holstein), DODGE (East of Hwy 26 including Chester Township), FOND DU LAC, MANITOWOC (Schleswig), and SHEBOYGAN COUNTIES

	Rates	Fringes
Electricians:.....	$ 37.91	22.74

ELEC0494-013 05/29/2022

DODGE (East of Hwy 26 including Chester Twp, excluding Emmet Twp), FOND DU LAC (Except Waupuin), MILWAUKEE, OZAUKEE, MANITOWOC (Schleswig), WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Sound & Communications		
Installer.....	$ 22.39	18.80
Technician.....	$ 33.19	21.12

Installation, testing, maintenance, operation and servicing of all sound, intercom, telephone interconnect, closed circuit TV systems, radio systems, background music systems, language laboratories, electronic carillion, antenna distribution systems, clock and program systems and low-voltage systems such as visual nurse call, audio/visual nurse call systems, doctors entrance register systems. Includes all wire and cable carrying audio, visual, data, light and radio frequency signals. Includes the installation of conduit, wiremold, or raceways in existing structures that have been occupied for six months or more where required for the protection of the wire or cable, but does not mean a complete conduit or raceway system. work covered does not include the installation of conduit, wiremold or any raceways in any new construction, or the installation of power supply outlets by means of which external electric power is supplied to any of the foregoing equipment or products

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* ELEC0577-003 06/01/2022

CALUMET (except Township of New Holstein), GREEN LAKE (N. part including Townships of Berlin, St Marie, and Seneca), MARQUETTE

(N. part including Townships of Crystal Lake, Neshkoro, Newton,
and Springfield), OUTAGAMIE, WAUPACA, WAUSHARA, AND WINNEBAGO
COUNTIES

	Rates	Fringes
Electricians:	$ 37.41	29.50%+10.00

ELEC0890-003 06/01/2022

DODGE (Emmet Township only), GREEN, JEFFERSON, LAFAYETTE,
RACINE (Burlington Township), ROCK AND WALWORTH COUNTIES

	Rates	Fringes
Electricians:	$ 40.70	25.95%+11.26

ELEC0953-001 06/02/2019

	Rates	Fringes
Line Construction:		
(1) Lineman	$ 47.53	21.43
(2) Heavy Equipment Operator	$ 42.78	19.80
(3) Equipment Operator	$ 38.02	18.40
(4) Heavy Groundman Driver	$ 33.27	16.88
(5) Light Groundman Driver	$ 30.89	16.11
(6) Groundsman	$ 26.14	14.60

ENGI0139-001 06/01/2022

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WASHINGTON, AND WAUKESHA
COUNTIES

	Rates	Fringes
Power Equipment Operator		
Group 1	$ 49.01	25.30
Group 2	$ 48.51	25.30
Group 3	$ 48.01	25.30
Group 4	$ 47.17	25.30
Group 5	$ 43.39	25.30
Group 6	$ 38.24	25.30

HAZARDOUS WASTE PREMIUMS:
EPA Level ""A"" Protection: $3.00 per hour
EPA Level ""B"" Protection: $2.00 per hour
EPA Level ""C"" Protection: $1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes, Pedestal Tower Cranes and Derricks with or w/o attachments with a lifting capacity of over 100 tons; or Cranes, Tower Cranes, Pedestal Tower Cranes and Derricks with boom, leads, and/or jib lengths measuring 176 feet or longer; Self-Erecting Tower Cranes over 4000 lbs lifting capacity; All Cranes with Boom Dollies; Boring Machines (directional); Master Mechanic. $0.50 additional per hour per 100 tons or 100 ft of boom over 200 ft or lifting capacity of crane over 200 tons to a maximum of 300 tons or 300 ft. Thereafter an increase of $0.01 per ft or ton, whichever is greater.

GROUP 2: Cranes, Tower Cranes, Pedestal Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or less; or Cranes, Tower Cranes Portable Tower Cranes, Pedestal Tower Cranes and Derricks with boom, leadsand/or jib lengths measuring 175 feet or less; Backhoes (excavators) 130,000 lbs and over; Caisson Rigs; Pile Drivers; Boring Machines (vertical or horizontal), Versi-Lift, Tri-Lift, Gantry 20,000 lbs & over.

GROUP 3: Backhoe (excavator) under 130,000 lbs;Self-erecting Tower Crane 4000 lbs & under lifting capacity;Traveling Crane (bridge type); Skid Rigs; Dredge Operator; Mechanic; Concrete Paver (over 27E); Concrete Spreader and Distributor; Forklift/ Telehandler (machinery- moving / steel erection); Hydro Blaster, 10,000 psi and over

GROUP 4: Material Hoists; Stack Hoists; Hydraulic Backhoe (tractor or truck mounted); Hydraulic Crane, 5 tons or under (tractor or truck mounted); Hoist (tuggers 5 tons & over); Hydro-Excavators/Daylighters; Concrete Pumps Rotec type Conveyors; Tractor/Bulldozer/End Loader (over 40 hp); Motor Patrol; Scraper Operator; Sideboom; Straddle Carrier; Welder; Bituminous Plant and Paver Operator; Roller over 5 tons; Rail Leveling Machine (Railroad); Tie Placer; Tie Extractor; Tie Tamper; Stone Leveler; Rotary Drill Operator and Blaster; Percussion Drill Operator; Air Track Drill and/or Hammers; Gantrys (under 20,000 lbs); Tencher (wheel type or chain type having 8 inch or larger bucket); Milling Machine; Off-Road Material Haulers.

GROUP 5: Backfiller; Concrete Auto Breaker (large); Concrete Finishing Machines (road type); Rubber Tired Roller; Concrete Batch Hopper; Concrete Conveyor Systems; Grout Pumps; Concrete Mixers (14S or over); Screw Type Pumps and Gypsum Pumps; Tractor, Bulldozer, End Loader (under 40 hp); Trencher (chain type, bucket under 8 inch); Industrial Locomotives; Rollers under 5 tons; Stump Grinder/Chipper

(Large); Timber Equipment; Firemen (pile drivers and derricks); Personnel Hoist, Telehandler over 8000 lbs; Robotic Tool Carrier with or without attachments

GROUP 6: Tampers - Compactors (riding type); Assistant Engineer; A-Frames and Winch Trucks; Concrete Auto Breaker; Hydrohammers (small); Brooms and Sweepers; Hoist (tuggers under 5 tons); Boats (Tug, Safety, Work Barges, Launch); Shouldering Machine Operator; Prestress Machines; Screed Operator; Stone Crushers and Screening Plants; Screed Operators (milling machine), Farm or Industrial Tractor Mounted Equipment; Post Hole Digger; Fireman (asphalt plants); Air Compressors over 400 CFM; Generators, over 150 KW; Augers (vertical and horizontal); Air, Electric, Hydraulic Jacks (slipform); Skid Steer Loaders (with or without attachments); Boiler Operators (temporary heat); Refrigeration Plant/Freeze Machines; Power Pack Vibratory/Ultra Sound Drivers and Extractors; Welding Machines; Heaters (mechanical); Pumps; Winches (small electric); Oiler and Greaser; Rotary Drill Tender; Conveyor; Forklifts/Telehandler 8000 lbs & under; Elevators: Automatic Hoists; Pumps (well points); Combination Small Equipment Operators

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ENGI0139-003 06/06/2022

REMAINING COUNTIES

	Rates	Fringes
Power Equipment Operator		
Group 1	$ 45.22	24.85
Group 2	$ 43.97	24.85
Group 3	$ 41.57	24.85
Group 4	$ 41.04	24.85
Group 5	$ 38.97	24.85
Group 6	$ 37.44	24.85

HAZARDOUS WASTE PREMIUMS:
EPA Level ""A"" Protection: $3.00 per hour
EPA Level ""B"" Protection: $2.00 per hour
EPA Level ""C"" Protection: $1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of over 100 tons; Cranes, Tower Cranes, and Derricks with boom, leads and/or jib lengths 176 ft or longer.

GROUP 2: Backhoes (Excavators) weighing 130,00 lbs and over;

Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or less; Cranes, Tower Cranes, and Derricks with boom, leads, and/or jib lengths 175 ft or less; Caisson Rigs; Pile Driver

GROUP 3: Backhoes (Excavators) weighing under 130,000 lbs; Travelling Crane (bridge type); Milling Machine; Concrete Paver over 27 E; Concrete Spreader and Distributor; Concrete Laser Screed; Concrete Grinder and Planing Machine; Slipform Curb and Gutter Machine; Boring Machine (Directional); Dredge Operator; Skid Rigs; over 46 meter Concrete Pump.

GROUP 4: Hydraulic Backhoe (tractor or truck mounted); Hydraulic Crane, 10 tons or less; Tractor, Bulldozer, or End Loader (over 40 hp); Motor Patrol; Scraper Operator; Bituminous Plant and Paver Operator; Screed-Milling Machine; Roller over 5 tons; Concrete pumps 46 meter and under; Grout Pumps; Rotec type machine; Hydro Blaster, 10,000 psi and over; Rotary Drill Operator; Percussion Drilling Machine; Air Track Drill with or without integral hammer; Blaster; Boring Machine (vertical or horizontal); Side Boom; Trencher, wheel type or chain type having 8 inch or larger bucket; Rail Leveling Machine (Railroad); Tie Placer; Tie Extractor; Tie Tamper; Stone Leveler; Straddle Carrier; Material Hoists; Stack Hoist; Man Hoists; Mechanic and Welder; Off Road Material Haulers.

GROUP 5: Tractor, Bulldozer, or Endloader (under 40 hp); Tampers -Compactors, riding type; Stump Chipper, large; Roller, Rubber Tire; Backfiller; Trencher, chain type (bucket under 8 inch); Concrete Auto Breaker, large; Concrete Finishing Machine (road type); Concrete Batch Hopper; Concrete Conveyor Systems; Concrete Mixers, 14S or over; Pumps, Screw Type and Gypsum); Hydrohammers, small; Brooms and Sweeeprs; Lift Slab Machine; Roller under 5 tons; Industrial Locomotives; Fireman (Pile Drivers and Derricks); Pumps (well points); Hoists, automatic; A-Frames and Winch Trucks; Hoists (tuggers); Boats (Tug, Safety, Work Barges and Launches); Assistant Engineer

GROUP 6: Shouldering Machine Operator; Farm or Industrial Tractor mounted equipment; Post Hole Digger; Auger (vertical and horizontal); Skid Steer Loader with or without attachments; Robotic Tool Carrier with or without attachments; Power Pack Vibratory/Ultra Sound Driver and Extractor; Fireman (Asphalt Plants); Screed Operator; Stone Crushers and Screening Plants; Air, Electric, Hydraulic Jacks (Slip Form); Prestress Machines; Air Compressor, 400 CFM or over; Refrigeration Plant/Freese Machine; Boiler Operators (temporary heat); Forklifts; Welding Machines; Generators; Pumps over 3""; Heaters, Mechanical; Combination

small equipment operator; Winches, small electric; Oiler;
Greaser; Rotary Drill Tender; Conveyor; Elevator Operator

IRON0008-002 06/13/2022

BROWN, CALUMET, DOOR, FOND DU LAC, KEWAUNEE, MANITOWOC, MARINETTE, OCONTO, OUTAGAMI, SHAWANO, SHEBOYGAN, AND WINNEBAGO COUNTIES:

	Rates	Fringes
IRONWORKER.....	$ 41.00	28.95

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

IRON0008-003 06/01/2021

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WALWORTH (N.E. 2/3), WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
IRONWORKER.....	$ 40.57	28.40

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

IRON0383-001 06/05/2022

ADAMS, COLUMBIA, CRAWFORD, DANE, DODGE, FLORENCE, FOREST, GRANT, GREENE, (Excluding S.E. tip), GREEN LAKE, IOWA, JEFFERSON, JUNEAU, LA CROSSE, LAFAYETTE, LANGLADE, MARATHON, MARQUETTE, MENOMINEE, MONROE, PORTAGE, RICHLAND, ROCK (Northern area, vicinity of Edgerton and Milton), SAUK, VERNON, WAUPACA, WAUSHARA, AND WOOD COUNTIES

	Rates	Fringes
IRONWORKER.....	$ 39.00	28.58

IRON0512-008 05/01/2022

BARRON, BUFFALO, CHIPPEWA, CLARK, DUNN, EAU CLAIRE, JACKSON, PEPIN, PIERCE, POLK, RUSK, ST CROIX, TAYLOR, AND TREMPEALEAU COUNTIES

	Rates	Fringes
IRONWORKER	$ 41.00	33.11

IRON0512-021 05/01/2022

ASHLAND, BAYFIELD, BURNETT, DOUGLAS, IRON, LINCOLN, ONEIDA, PRICE, SAWYER, VILAS AND WASHBURN COUNTIES

	Rates	Fringes
IRONWORKER	$ 36.94	33.11

LABO0113-002 06/01/2022

MILWAUKEE AND WAUKESHA COUNTIES

	Rates	Fringes
LABORER		
Group 1	$ 32.65	23.09
Group 2	$ 32.80	23.09
Group 3	$ 33.00	23.09
Group 4	$ 33.15	23.09
Group 5	$ 33.30	23.09
Group 6	$ 29.14	23.09

LABORERS CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator; Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster and Powderman

GROUP 6: Flagperson; traffic control person

LABO0113-003 06/01/2022

OZAUKEE AND WASHINGTON COUNTIES

	Rates	Fringes
LABORER		
Group 1	$ 31.90	23.09
Group 2	$ 32.00	23.09
Group 3	$ 32.05	23.09
Group 4	$ 32.25	23.09
Group 5	$ 32.10	23.09
Group 6	$ 28.99	23.09

LABORERS CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated);

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; powderman

GROUP 6: Flagperson and Traffic Control Person

LABO0113-011 06/01/2022

KENOSHA AND RACINE COUNTIES

	Rates	Fringes
LABORER		
Group 1	$ 31.71	23.09
Group 2	$ 31.86	23.09
Group 3	$ 32.06	23.09
Group 4	$ 32.03	23.09

Group 5.....$ 32.36 23.09
Group 6.....$ 28.85 23.09

LABORERS CLASSIFICATIONS:

GROUP 1: General laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator; Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster and Powderman

GROUP 6: Flagman; traffic control person

LABO0140-002 06/01/2022

ADAMS, ASHLAND, BARRON, BAYFIELD, BROWN, BUFFALO, BURNETT, CALUMET, CHIPPEWA, CLARK, COLUMBIA, CRAWFORD, DODGE, DOOR, DOUGLAS, DUNN, EAU CLAIRE, FLORENCE, FOND DU LAC, FOREST, GRANT, GREEN, GREEN LAKE, IRON, JACKSON, JUNEAU, IOWA, JEFFERSON, KEWAUNEE, LA CROSSE, LAFAYETTE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, MONROE, OCONTO, ONEIDA, OUTAGAMIE, PEPIN, PIERCE, POLK, PORTAGE, PRICE, RICHLAND, ROCK, RUSK, SAUK, SAWYER, SHAWANO, SHEBOYGAN, ST. CROIX, TAYLOR, TREMPEALEAU, VERNON, VILLAS, WALWORTH, WASHBURN, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

Rates Fringes

LABORER
Group 1.....$ 36.42 18.68
Group 2.....$ 36.52 18.68
Group 3.....$ 36.57 18.68
Group 4.....$ 36.77 18.68
Group 5.....$ 36.62 18.68
Group 6.....$ 33.05 18.68

LABORER CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bitminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator, Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk and Pavement); Strike Off Man

GROUP 4: Line and Grade Secialist

GROUP 5: Blaster; powderman

GROUP 6: Flagperson; Traffic Control

LABO0464-003 06/01/2022

DANE COUNTY

	Rates	Fringes
LABORER		
Group 1	$ 36.70	18.68
Group 2	$ 36.80	18.68
Group 3	$ 36.85	18.68
Group 4	$ 37.05	18.68
Group 5	$ 36.90	18.68
Group 6	$ 33.05	18.68

LABORERS CLASSIFICATIONS:

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminious Worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator; Demolition Burning Torch

Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; Powderman

GROUP 6: Flagperson and Traffic Control Person

PAIN0106-008 05/01/2022

ASHLAND, BAYFIELD, BURNETT, AND DOUGLAS COUNTIES

	Rates	Fringes
Painters:		
New:		
Brush, Roller	$ 33.99	22.70
Spray, Sandblast, Steel	$ 34.59	22.70
Repaint:		
Brush, Roller	$ 33.09	22.70
Spray, Sandblast, Steel	$ 32.49	22.70

PAIN0108-002 06/01/2022

RACINE COUNTY

	Rates	Fringes
Painters:		
Brush, Roller	$ 39.60	21.79
Spray & Sandblast	$ 40.60	21.79

PAIN0259-002 05/01/2008

BARRON, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN, PIERCE, POLK, RUSK, SAWYER, ST. CROIX, AND WASHBURN COUNTIES

	Rates	Fringes
PAINTER	$ 24.11	12.15

PAIN0259-004 05/01/2015

BUFFALO, CRAWFORD, JACKSON, LA CROSSE, MONROE, TREMPEALEAU, AND VERNON COUNTIES

Rates Fringes

PAINTER.....$ 22.03 12.45

PAIN0781-002 06/01/2022

JEFFERSON, MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

Rates Fringes

Painters:
Bridge.....$ 38.15 24.80
Brush.....$ 37.40 24.80
Spray & Sandblast.....$ 38.15 24.80

PAIN0802-002 06/01/2021

COLUMBIA, DANE, DODGE, GRANT, GREEN, IOWA, LAFAYETTE, RICHLAND, ROCK, AND SAUK COUNTIES

Rates Fringes

PAINTER
Brush.....$ 29.98 18.78

PREMIUM PAY:
Structural Steel, Spray, Bridges = $1.00 additional per hour.

PAIN0802-003 06/01/2022

ADAMS, BROWN, CALUMET, CLARK, DOOR, FOND DU LAC, FOREST, GREEN LAKE, IRON, JUNEAU, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA, OUTAGAMIE, PORTAGE, PRICE, SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WAUSHARA, WAUPACA, WINNEBAGO, AND WOOD COUNTIES

Rates Fringes

PAINTER.....$ 34.68 18.94

PAIN0934-001 06/01/2022

KENOSHA AND WALWORTH COUNTIES

Rates Fringes

Painters:
Brush.....$ 36.70 24.69

Spray.....$ 37.70 24.69
Structural Steel.....$ 36.85 24.69

PAIN1011-002 06/06/2021

FLORENCE COUNTY

	Rates	Fringes
Painters:.....	$ 26.71	14.38

PLAS0599-010 06/01/2021

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
Area 1.....	$ 42.06	20.87
Area 2 (BAC).....	$ 37.73	23.80
Area 3.....	$ 38.74	22.46
Area 4.....	$ 38.59	22.66
Area 5.....	$ 38.16	22.98
Area 6.....	$ 34.94	26.36

AREA DESCRIPTIONS

AREA 1: BAYFIELD, DOUGLAS, PRICE, SAWYER, AND WASHBURN COUNTIES

AREA 2: ADAMS, ASHLAND, BARRON, BROWN, BURNETT, CALUMET, CHIPPEWA, CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC, FOREST, GREEN LAKE, IRON, JEFFERSON, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST CROIX, SAUK, SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

AREA 3: BUFFALO, CRAWFORD, EAU CLAIRE, JACKSON, JUNEAU, LA CROSSE MONROE, PEPIN, PIERCE, RICHLAND, TREMPEALEAU, AND VERNON COUNTIES

AREA 4: MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

AREA 5: DANE, GRANT, GREEN, IOWA, LAFAYETTE, AND ROCK COUNTIES

AREA 6: KENOSHA AND RACINE COUNTIES

PLUM0011-003 05/07/2018

ASHLAND, BAYFIELD, BURNETT, DOUGLAS, IRON, SAWYER, AND WASHBURN COUNTIES

	Rates	Fringes
PLUMBER	$ 40.63	20.72

PLUM0075-002 06/01/2016

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
PLUMBER	$ 40.27	21.47

PLUM0075-004 06/01/2016

DODGE (Watertown), GREEN, JEFFERSON, LAFAYETTE, AND ROCK COUNTIES

	Rates	Fringes
PLUMBER	$ 40.52	21.47

PLUM0075-009 06/01/2016

COLUMBIA, DANE, IOWA, MARQUETTE, RICHLAND AND SAUK COUNTIES

	Rates	Fringes
PLUMBER	$ 38.82	20.12

PLUM0111-007 05/28/2018

MARINETTE COUNTY (Niagara only)

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 33.33	24.48

PLUM0118-002 06/01/2022

KENOSHA, RACINE, AND WALWORTH COUNTIES

	Rates	Fringes
Plumber and Steamfitter	$ 47.50	25.92

PLUM0400-003 05/29/2022

ADAMS,BROWN, CALUMET, DODGE (except Watertown), DOOR, FOND DU LAC, GREEN LAKE,KEWAUNEE, MANITOWOC, MARINETTE (except Niagara), MENOMINEE, OCONTO, OUTAGAMIE, SHAWANO, SHEBOYGAN, WAUPACA, WAUSHARA, AND WINNEBAGO COUNTIES

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 46.37	20.96

PLUM0434-002 05/30/2021

BARON, BUFFALO, CHIPPEWA, CLARK, CRAWFORD, DUNN, EAU CLAIRE, FLORENCE, FOREST, GRANT, JACKSON, JUNEAU, LA CROSSE, LANGLADE, LINCOLN, MARATHON, MONROE, ONEIDA, PEPIN, PIERCE, POLK, PORTAGE, PRICE, RUSK, ST. CROIX, TAYLOR, TREMPEALEAU, VERNON, VILAS, AND WOOD COUNTIES

	Rates	Fringes
PIPEFITTER	$ 44.65	20.72

PLUM0601-003 06/01/2022

DODGE (Watertown), GREEN, JEFFERSON, LAFAYETTE, MILWAUKEE, OZAUKEE, ROCK, WASHINGTON AND WAUKESHA COUNTIES

	Rates	Fringes
PIPEFITTER	$ 50.00	28.93

PLUM0601-009 06/01/2022

COLUMBIA, DANE, IOWA, MARQUETTE, RICHLAND AND SAUK COUNTIES

	Rates	Fringes
PIPEFITTER	$ 52.06	26.86

TEAM0039-002 06/01/2021

	Rates	Fringes
TRUCK DRIVER		
1 & 2 Axle Trucks	$ 32.57	23.81
3 or more axles; Euclids or Dumptor, Articulated Truck, Mechanic	$ 32.72	23.81

SUWI2011-001 11/16/2011

	Rates	Fringes
WELL DRILLER	$ 16.52	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or

""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

PROJECT TABLE OF CONTENTS

-- End of Project Table of Contents --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 00 00.00 13

GENERAL

-- End of Section Table of Contents --

SECTION 01 00 00.00 13

GENERAL

PART 1 GENERAL

The Lock 4 End Cell project includes but is not limited to installing a circular sheet pile end cell filled with concrete, installation of a tailwater gage and gage house in the end cell, demolishing a portion of the lower guide wall, demolition and disposal of the existing gage house, repair of the existing storm sewer outlet wing wall, and installation of a new catch basin and storm sewer.

1.1 ORGANIZATION OF SPECIFICATIONS

The specifications which govern the materials and equipment to be furnished and the work to be performed under this contract are listed in the Table of Contents. No attempt has been made in the specifications to segregate work to be performed by any trade, craft, or subcontractor. Any segregation between the trades or crafts shall be solely a matter for agreement between the Contractor, Contractor's employees, and subcontractors.

1.2 USE OF REFERENCES

Reference to the standards, specifications, or codes of any technical society, organization, or association, or local, State, or Federal authority shall mean the specific edition or revision listed.

Various publications are referenced in other sections of the specifications to establish requirements for the work. Any referenced publication is to be used solely for technical requirements. Measurement and payment and any other matters respecting the administration of this contract shall be governed by the terms of this contract without considering any referenced publication. These references are identified in each section by document number, date and title. The addresses, phone numbers, and Internet addresses (if available) for references cited in these specifications are listed in the Unified Facilities Guide Specification: UFGS 01 42 00 SOURCES FOR REFERENCE PUBLICATIONS. The UFGS 01 42 00 is available on the TECHINFO page of the Corps of Engineers Huntsville District Internet site: http://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre Construction Condition Survey; G

SD-11 Closeout Submittals

Post Construction Condition Survey; G

PART 2 PRODUCTS

2.1 RECYCLED/RECOVERED MATERIALS

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

PART 3 EXECUTION

3.1 DISPOSAL OF DEBRIS AND WASTE

The Contractor's attention is directed to Section 01 57 20.00 13 ENVIRONMENTAL PROTECTION and to the following CONTRACT CLAUSES: 52.236-7 PERMITS AND RESPONSIBILITIES; 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS; 52.236-10 OPERATIONS AND STORAGE AREAS; and 52.236-12 CLEANING UP. Burning will not be permitted at the project site and debris or waste shall not be left on the site. Disposal of debris and waste shall be by one of the following methods:

3.1.1 Disposal offsite for useful purposes

In the interest of conservation, it is required that the Contractor make a reasonable effort to dispose of the material offsite for some useful purpose. For example, timber may be cut into convenient lengths and utilized for making saw logs, posts, cordwood, wood chips for paper making or other uses, or other similar use.

3.1.2 Disposal in a locally operated sanitary landfill

Contractor shall select the disposal site with the approval of the Contracting Officer. The Contractor shall secure the required permits for disposal and provide copies of the permit to the Contracting Officer.

3.1.3 Disposal of Solid Construction Debris and Waste

Disposal of Solid Construction Debris and Waste shall consist of removal from the construction site and disposal in compliance with Federal, State, and local requirements for solid waste disposal. Contractor shall select the disposal site with the approval of the Contracting Officer.

3.2 SCHEDULING

3.2.1 General

It shall be the responsibility of the Contractor to schedule and execute the work, incorporating the necessary requirements set forth in these specifications. The Contractor shall develop and submit a schedule in accordance with Section 01 32 01.00 13 PROJECT SCHEDULE and CONTRACT CLAUSE: 52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS.

3.2.2 Notification

The Contractor shall inform the Government in writing, at the pre-construction conference, as to which hours of the day and days of the week for which work will be performed. The Contractor shall notify the Government at least 24 hours before work is to be conducted on overtime, in multiple shifts, on weekends, or on Federal Government holidays.

3.2.3 Lock and Dam Operations

The Contractor shall not interfere with normal lock and dam operations. Lock and Dam personnel will not accept deliveries, phone calls, or mail or deliver messages for the Contractor.

3.3 PRE CONSTRUCTION CONDITION SURVEY AND POST CONSTRUCTION CONDITION SURVEY

The Contractor shall submit for Government Approval a PRE CONSTRUCTION CONDITION SURVEY prior to starting any work which shall include photographs and video footage in MPEG-3 format documenting the existing pre construction condition of all facilities to receive work. These facilities include but are not limited to all areas within the work limits including roads, parking areas, side walks, loading docks, boat ramps, trees, scrubs, lawns, handrail, cable raceways, light supports, and buildings. The Contractor shall also submit POST CONSTRUCTION CONDITION SURVEY of these same areas consisting of photographs and video footage recordings in MPEG-3 format upon completion of the project.

3.4 OTHER CONTRACTS

The Government may undertake, award, or have other on-going contracts and work in the area of this project. The Contractor shall coordinate their work with the other Contractors to prevent delays to this project and interferences with those contracts. The Contractor shall expect minor delays and rescheduling due to these other contracts and work. Coordination shall be through the Contracting Officer. The other contracts and work in the area of this project are listed below. These contracts will be considered in accordance to CONTRACT CLAUSE: 52.236-8 OTHER CONTRACTS.

3.4.1 List other contracts

3.5 Other Work

The Contractor shall contact the other local units of government for work they may have going on in the area and coordinate work and schedules to prevent any delays in this contract.

3.6 SOIL BORING DATA

Government provided soil boring data and boring locations are shown on the contract drawings.

3.7 SOUNDING DATA

Sounding data was obtained along the lower guide wall on 18 October 2013 and on 17 August 2015 and is attached to the end of this section. Sounding data is in ASCII format and is available from the Government upon request.

3.8 ATTACHMENTS

Sounding Data

-- End of Section --

SECTION 01 00 00.00 13 GENERAL

ATTACHMENTS

SOUNDING DATA

P5_752_2_20131018		WCM

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ST. PAUL MINNESOTA

ALMA LOWER LIGHT

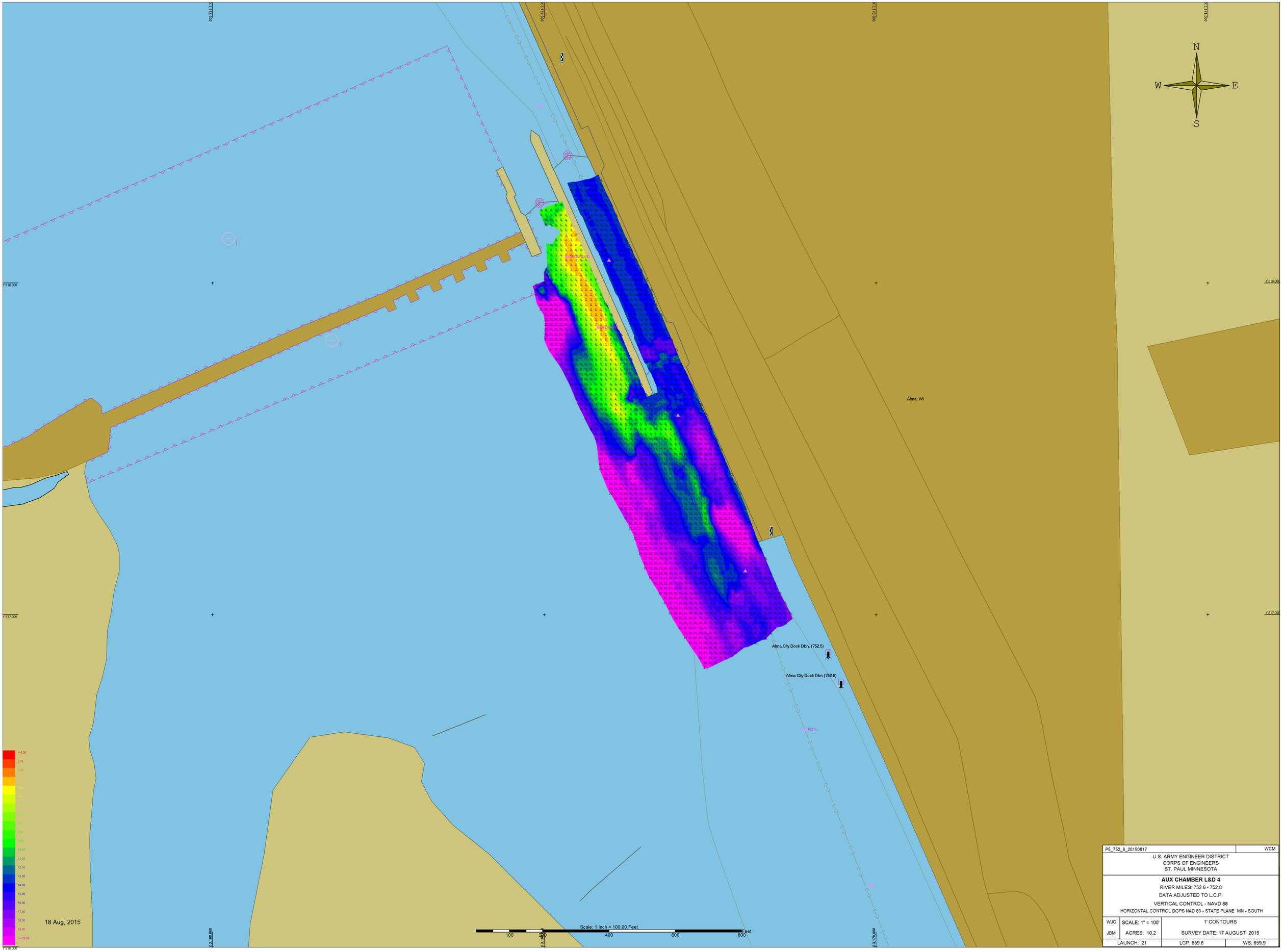
RIVER MILES: 624.7 - 624.8

SOUNDINGS ADJUSTED TO L.C.P.

VERTICAL CONTROL - NAVD 88

HORIZONTAL CONTROL DGPS NAD 83 - STATE PLANE MN - SOUTH

BLT	SCALE: 1" = 400'	CONTOURS: 9' & 10.5'
KBS	ACRES: 82.7	SURVEY DATE: 18 OCTOBER 2013
LAUNCH: 22	WS: 660.0	LCP:659.6



P5_752_6_20150817		WCM
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ST. PAUL MINNESOTA		
AUX CHAMBER L&D 4 RIVER MILES: 752.6 - 752.8 DATA ADJUSTED TO L.C.P. VERTICAL CONTROL - NAVD 88 HORIZONTAL CONTROL DGPS NAD 83 - STATE PLANE MN - SOUTH		
WJC	SCALE: 1" = 100'	1' CONTOURS
JBM	ACRES: 10.2	SURVEY DATE: 17 AUGUST 2015
LAUNCH: 21	LCP: 659.6	WS: 659.9

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 11 00

SUMMARY OF WORK

-- End of Section Table of Contents --

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Salvage Plan; G

1.2 WORK COVERED BY CONTRACT DOCUMENTS

1.2.1 Project Description

The design consists of 33 ft diameter, pile founded, sheet pile end cell, tremie filled with a self- consolidated concrete. The cell will be placed adjacent to the downstream end of the lower guide wall tie-back monoliths. An expansion joint, 2 inches wide, will be placed between the constructed end cell and remaining features. Creating a smooth and flush riverward transition, a precast structural wall panel will be installed along the riverward vertical face. The existing gage house will be completely removed and replaced with a new gage house founded on top of the installed cell. Concrete repairs will be performed to the remaining features, such as, the intercepting sewer, downstream wing wall, and the remaining lower guide wall tie-back-end monoliths. A concrete apron will be placed between the existing wing wall and end cell. This apron will serve as scour protection for discharging water from the intercepting sewer. A sheet pile cut off wall will be driven below the apron, while riprap will be placed on the downstream side, for additional protection.

The Contractor shall provide all plant, labor, and materials, and perform all operations necessary to complete all the work included in the contract as shown and specified. The items described above are not all inclusive and the Contractor is responsible for providing any quality control, supervision, environmental protection, safety, management, and any other incidental items which may be necessary to provide a complete properly functional project.

1.2.2 Location

The work is located on the left descending bank of the Upper Mississippi River in the village of Alma, Wisconsin, situated in Buffalo County. The work location is shown in the USGS Alma, Wisconsin 7.5 quadrangle in the vicinity of MGRS grid coordinate 15T WK 86344 08299. The exact location

and work limits are shown in the plan set.

1.3 EXISTING WORK

In addition to FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements:

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work must be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF UNDERGROUND UTILITIES

Contact local utility locating service a minimum of 72 hours prior to excavating, to mark utilities, and within sufficient time required if work occurs on a Monday or after a Holiday. Verify existing utility locations indicated on contract drawings, within area of work.

Identify and mark all other utilities not managed and located by the local utility companies. Scan the construction site with Ground Penetrating Radar (GPR), electromagnetic, or sonic equipment, and mark the surface of the ground, pier deck or paved surface where existing underground utilities or utilities encased in pier structures are discovered. Verify the elevations of existing piping, utilities,and any type of underground or encased obstruction not indicated, or specified to be removed, that is indicated or discovered during scanning, in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.4.1 Notification Prior to Excavation

Notify the Contracting Officer at least 7 days prior to starting excavation work.

1.5 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the Contracting Officer to be salvaged remain the property of the Government. Segregate, itemize, deliver and off-load the salvaged property at the Government designated storage area located within 1 mile of the construction site.

Provide a Salvage Plan, listing material and equipment to be salvaged, and their storage location. Maintain property control records for material or equipment designated as salvage. Provide a system for property control in the salvage plan. Store and protect salvaged materials and equipment until disposition by the Contracting Officer.

1.6 ATTACHMENTS

List of attachments:

a. Boring Logs

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

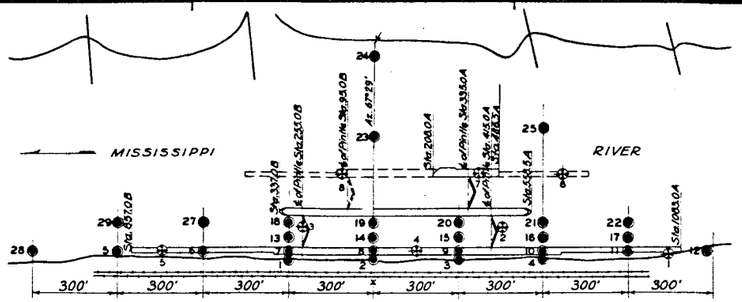
Not used.

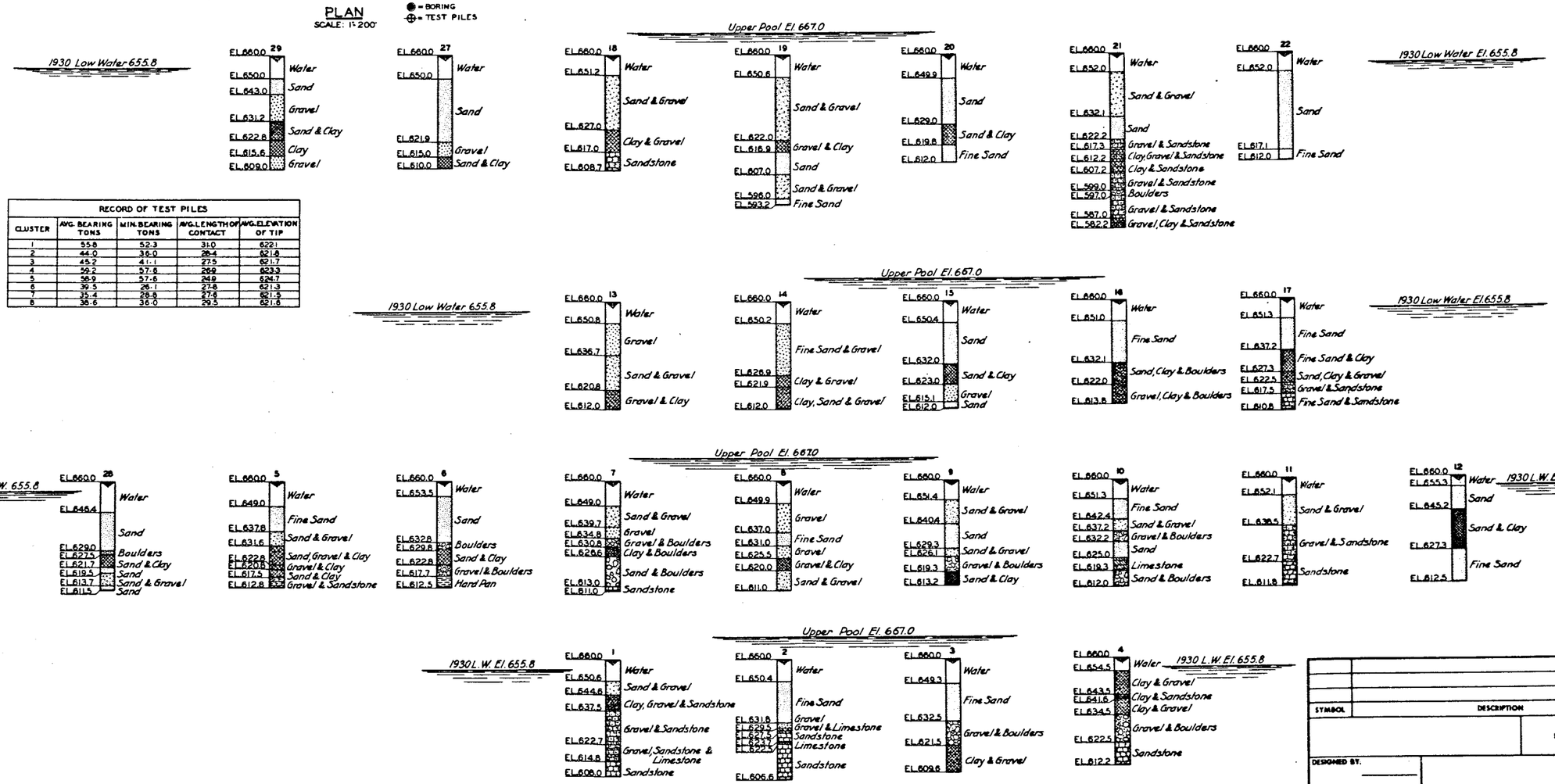
-- End of Section --

SECTION 01 11 00 SUMMARY OF WORK

ATTACHMENTS

BORING LOGS





RECORD OF TEST PILES				
CLUSTER	AVG. BEARING TONS	MIN. BEARING TONS	AVG. LENGTH OF CONTACT	AVG. ELEVATION OF TIP
1	55.8	52.3	31.0	622.1
2	44.0	36.0	28.4	621.8
3	45.2	41.1	27.5	621.7
4	59.2	57.6	26.9	623.3
5	58.9	57.6	24.9	624.7
6	39.5	26.1	27.8	621.3
7	35.4	28.8	27.6	621.5
8	38.6	36.0	29.5	621.8

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
CHIEF BRANCH
CHIEF BRANCH
APPROVED BY:
CHIEF ENGG. DIVISION
DATE:

STRUCTURAL STABILITIES STUDY–MISSISSIPPI RIVER
LOCK & DAM NO. 4, ALMA, WISCONSIN
STABILITY ANALYSIS–LOCK 4
PRECONSTRUCTION BORINGS

SCALE NONE
SPEC. NO.
DRAWING NUMBER
SHEET OF

PLATE 3

USACE-MVP-0000092879

Hole No. 86-13m

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL DISTRICT	SHEET 1 OF 8 SHEETS

1. PROJECT: Lock and Dam 4
2. LOCATION (Coordinates or Station): See map
3. DRILLING AGENCY: US CEC
4. HOLE NO. (As shown on drawing title and file number): 85-13m
5. NAME OF DRILLER: Ken HARMON
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 72 FT
8. DEPTH DRILLED INTO ROCK: —
9. TOTAL DEPTH OF HOLE: 72FT
10. SIZE AND TYPE OF BIT: 2¾ Roller and 3½ in Roller
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 750
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 16; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: 13.1 FT / 659.1
16. DATE HOLE: STARTED Jan 14 86; COMPLETED Jan 15 86
17. ELEVATION TOP OF HOLE: 672.2
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: Spradley

ELEVATION 672.2 (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		OL	TOP Soil BLACK organic ROOT hairs	A		use STRAND 2x2½
671.3	0.7		SAND Poorly graded	U		140 pound HAMMER
	1	SP	Reddish GRAVEL 10% Coarse 65% Quartz 75% Med 20% calcite 15% F6 5% BASALT 10%	G 6		falling 30in for Blow count
	2		UNCONsolidated SOFT	E R		Hollow stem auger used for casing to 15 ft mud used below 15 feet
	3		DRY Subangular - Sub Rounded NO STRUCTURE NON plastic NON cemented	3 STZ 2	D2.0 R1.6 S#1	
	4			2	4.5 5.0	
				2		
	5			3 5 2x2½		
				P	D3.0	
	6			4	R1.0	
		SP		S		
	7			H		
	8			8 STD 2	D2.0 R2.0	
	9			2	#2 9.0	2% FINES D10 - 0.25
				2	10.0	
662.2	10			4 10		

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PROJECT: L+D4 | HOLE NO. 86-13m

Hole No. 86-13M

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL DISTRICT	SHEET 2 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE: STARTED / COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR Spradley

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
662.2				2x2½		
			AS ABOVE			
		SP		P	D3.0	
	11			4	R1.2	
				S		
660.7	12					
			Some LARGE GRAVEL ≅ 11IN diameter	H		
659.1	13 / 3.1		WATER STABILIZED after 16 hours	13 STD		
				1	D2.0	
					R0.8	
				0	S#3	
	14			1	13.0 / 14.0	
				0		
	15			15 2x2½		
				P	D3.0	
					R1.6	
				4		
	16	SP				
				S		
	17			H		
	18			18 STD		
				2	D2.0	
					R1.4	
					S#4	
	19			3		
				4	19.0 / 20.0	4% FINES D10-0.12
	20			5 20		

Hole No. 85-13M

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL DISTRICT	SHEET 3 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
652.2			AS ABOVE	2x2½		
		SP		P	D3.0	
	21			U	R0.8	
650.7	21.5	GP	Fine GRAVel Poorly GRADED Quartz and BASALT ANGular	S	S#5 21.5	
	22			H	22.0	
		SP	SAND Poorly graded			
	23		Rounded Quartz 75% Rounded BASALT 15% angular calcite 10%	23 STD 3	D2.0 R1.2	
	24		GRAVel 20% course 60% med 10% Fine 10% white to GRAY	3 5	24.5 25.0 S#6	
	25		dry unconsolidated wet NON cemented NO STRUCTURE Fluvial NON plastic	U 25 2x2½ P	D3.0 R1.0	
	26	SP		U S		
	27			H		
	28			28 STD 5	D2.0 R1.4	
	29			4 7	S#7 29.0 30.0	2% FINES D10 - 0.22
	30			8 30		

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PROJECT LTD4

HOLE NO. 85-13M

Hole No.

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL DISTRICT	SHEET 4 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR Spradley

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
642.2			AS ABOVE	2x2½		
				P	D3.0	
	31			U	R0.9	
				S		
	32			H		
	33			33		
639.0	3.2		thin white silty lam	STD 6	D2.0 R2.0	
	34			7		
				1	34.5 35.0	
	35			1 35	STD 8	
636.9	5.3			2x2½		
	36		This Area appears to Be Tailas composed mostly of hard Dolomite with some SAND mixed in Highly mechanically fractured.	30	D3.0 R0.1	Reason for Lost SAmples unknown Replace BASKETS in 2x2½ and STD
	37			34		
	38			10 38		
				STD 3	D2.0 R0.0	
	39			3	NO SAMPLE	
				20		
	40			13 40		

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PROJECT LTD4

HOLE NO. 86-13m

Hole No. 86-13M

DRILLING LOG	DIVISION SNLD	INSTALLATION ST PAUL DISTRICT	SHEET 5 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
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	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
632.2			TALUS intermixed w/ 4	2x2½		
			Composed of			
			Dolomite		D3.0	
			HARD	6	R0.8	
	41		SANDY			
			LT GRAY - LT Green			
			NO STRUCTURE			
			SILT STONE	10		
	42		LT GRAY - LT GREEN			
			Glauconitic			
			HARD			
			Dense			
			Cemented Dolo	24 43		
	43		SAND Red	STD		
			FG-MG Soft	17	D2.0	
			GRAVELLY		R0.6	
			SOFT			
	44		slightly Clayey	24	S# 1	
			SAND White	19	40.0 / 45.0	
			SOFT			
627.2	45		NO STRUCTURE	22 45		
			UNCONSOLIDATED	2x2½		
			NO CEMENT			
			GRAVELLY			
	46			12		
		SP	SAND Poorly graded			
			Quartz 60%		D3.0	
			Calcite 30%		R2.2	
			BASALT 10%			
	47			60		
			Red BASALT gives SAND Reddish color — Course 5% Med 70% FG 20%			
	48		Very uniform	132 48		
			NON cemented	STD	D2.0	
			SOFT	12	R2.0	
			WET			
			NO STRUCTURE		S#	
	49		NONplastic	18	10	92% FINES
			Fluvial		48.5 / 49.0	D10 - 0.80
				50		
	50			60 50		

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PROJECT LTD4 | HOLE NO. 86-13M

Hole No. 85-13M

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL DISTRICT	SHEET OF SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR Spradley

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
622.2			AS ABOVE	2x2½		
	51	SP		45	D3.0 R1.6	
	52			54		
619.6			GREEN CALC SILT LAM			
	53			58 53 STD		
				8	D2.0 R2.0 SH 11	
	54			16	53.5 / 54.0	
		SP		20		
617.2	55			34 55 2x2½		
	56		well Rounded BASALT and quartz Gravel ≅ 1IN dia Still SP	43	D3.0 R2.8	
	57	SP	GRAVel 25% Course 65% med 10% Fine 10%	54		
	58			79 58 STD		
				12	D2.0 R2.0	
	59	SP		20	SH 12	* 14% FINES
				20	59.5 / 60.0	
	60			28 60		

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PROJECT L7D4 HOLE NO. 86-13M

Hole No. 86-13m

DRILLING LOG	DIVISION NLD	INSTALLATION ST PAUL DISTRICT	SHEET 7 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
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7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED — COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR Spradley

ELEVATION 612.2 a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		SP	AS ABOVE	2x2½		
	61			35	D3.0 R2.1	
	62			46		High blow count at 62 do to 3 in cobble jamed into end of sampler
609.2	63	SP	GRAVEL becomes smaller ≅ ½ in dia	104 63 STD		Cathead on rig Breaks use manual 140 Lbs falling 30 inches starting at 62 FT
				25	D2.0 R2.0	
	64			18	S# 13	
				18	64.0 64.5	
	65			20 65 2x2½		
		SD		70	D3.0 R2.0	
	66					
605.7	65		GRAVEL STOPS			
	67			100		
	68			37 66 STD	D2.0	
				16	R2.0	
	69			18	68.0 68.5	
				35	S# 14	
	70			34 70		

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PROJECT LTD 4 HOLE NO. 86-13m

Hole No. 86-13m

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL DISTRICT	SHEET 8 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
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5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED: — COMPLETED:
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR Spradley

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
600.2						
			AS ABOVE	STD		
			GRAVEL Resumes	38	D2.0	
					R2.0	
					~~S4~~	
	71	SP		44	15	
				45	71.5	
					72.0	
	72			84 72		Bottom of Hole 72FT
	73					
	74					
	75					

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PROJECT LAD 4 | HOLE NO. 86-13m

Hole No. 86-13M

DRILLING LOG	DIVISION NCD	INSTALLATION ST PAUL	SHEET 1 OF 1 SHEETS

1. PROJECT LED 4	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
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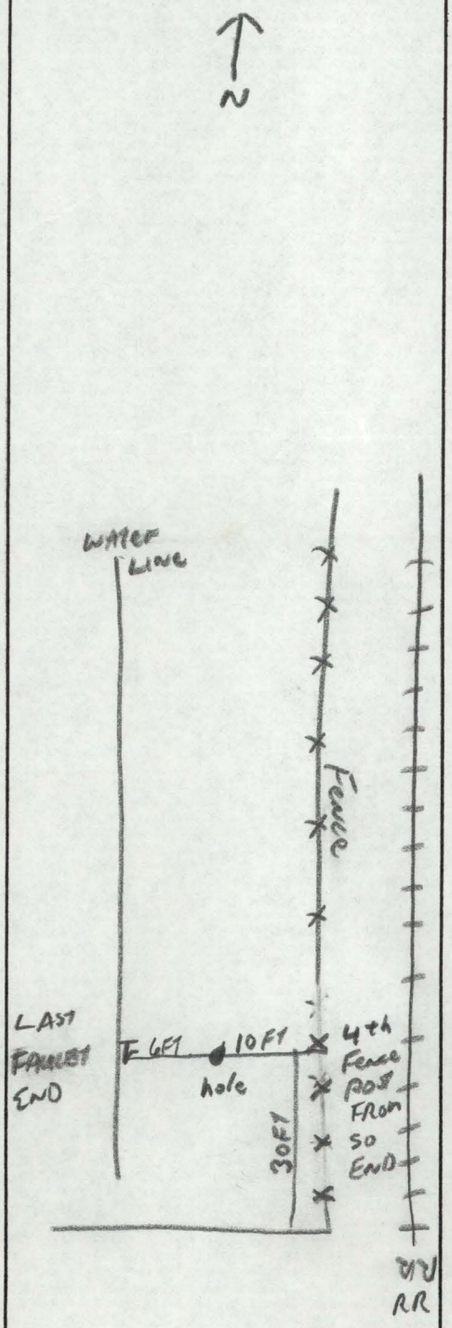
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			MAP of 86-13M			
Lock						Misc.



~~By control station?~~

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PROJECT LED 4 | HOLE NO. 86-13M

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 14 00.00 13

WORK RESTRICTIONS

-- End of Section Table of Contents --

SECTION 01 14 00.00 13

WORK RESTRICTIONS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in a accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Navigation Plan; G

Site Security Requirements; G

1.2 EXISTING GROUNDS AND ROADWAYS

1.2.1 Parking

Contractor parking will be permitted only in the area(s) shown, including the Contractor's staging area. No parking will be allowed on the grass. Contractor parking shall be coordinated with the Government.

1.2.2 Snow Removal

The Contractor shall be responsible for snow removal in the Contractor's access, work, and parking areas.

1.2.3 Haul Routes

The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limits on these roads. The Contractor shall be responsible for all damage to existing roads and property occasioned by an of its operations. When intending to transport any heavy loads on roadways, the Contractor shall investigate all weight limits for roads and or bridges interned for use and shall secure any required bonds or permits form the respective owner or owners. The Contractor shall obtain all required permits for hauling (over size, over weight, or any other) prior to hauling any such items. Roads shall be kept clear of all debris generated by the Contractor's operations. Roads shall be cleaned of any spillage on a daily basis. Upon completion of all work requiring the use of local or Government owned roads, the roadways shall be restored to their pre-construction condition by cleaning and/or reconstruction of damaged drainage facilities, base courses, and pavements as necessary. Repairs shall be made in the same manner as original construction. No separate

payment will be made for maintaining and restoring the condition of the roads and all costs in connection therewith shall be considered incidental to the performance of the work. Also, no separate payment will be made for obtaining or securing haul permits.

1.3 BLASTING

Blasting will not be permitted.

1.4 LOCK AND DAM 4 POINT OF CONTACT

The point of contact for Lock and Dam 4 is shown below:

Mr. Joe Minnis (Lockmaster)
Office Phone: 651.290.5951

1.5 STAGING AREA

All construction laydown and staging areas used for staging of material, equipment, supplies, filed offices and parking shall be as shown on the drawings. The Contractor shall coordinate final location of all laydown and staging areas with the Contracting Officer for approval to allow sufficient room for staff and public access prior to mobilizing to the site.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXISTING UTILITIES

3.1.1 General

The Contractor shall coordinate all utility relocation requirements and make payment to the utility companies for all services, fees, and permits required to relocate and reestablish service. The Contractor shall be responsible for all costs related to protecting existing utilities.

3.1.2 Buried Utilities

The approximate locations of known existing buried utilities are shown on the drawings to the extent of available information at the time the drawings were prepared. Prior to commencing excavation, the Contractor shall accurately locate all such installations. The Contracting Officer shall immediately be notified if the Contractor damages any existing utility lines not intended to be removed. Repair of damaged utilities shall be in accordance with CLAUSE 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS.

3.2 DEFINED NON-NAVIGATION SEASON

The Lock and Dam No. 4 will be closed to navigation generally from the last week of November to the first Monday of March, weather dependent. The Non-navigation windows are as follows:

Closes on 4 December 2023; Opens on 6 March 2024

Closes on 2 December 2024; Opens on 3 March 2025

3.3 CONTRACTOR PROPOSED DISPOSAL AREAS

Any disposal sites proposed by the Contractor that are not already identified by the Government as approved for this project are subject to approval by the Contracting Officer. This approval process may require the Government to prepare an environmental assessment at no cost to the Contractor. This may require additional review time and may result in additional requirements to offset environmental effects associated with the use of the site. Proposed sites which involve the excavation or placement of material within a cultural site, wetland, wooded area, floodplain, or other environmentally sensitive area will not be approved.

3.4 NAVIGATION NOTICE

The main lock shall be continuously open to full width navigation, except as indicated in the Defined Non-Navigation Season paragraph above. Once the Contractor's plan is approved, the Government will provide public notice of the construction and any approved restrictions. When the Contractor provides notice that it is ready to perform tasks for which a helper boat is required, the Contractor and the Contracting Officer shall verify compliance with the Contractor's approved navigation plan as specified. Changes or substitute measures to the plan must be submitted 7 days prior to actual implementation and be approved by the Contracting Officer.

3.5 ALLOWABLE OUTAGES DURING NAVIGATION SEASONS

The Contractor, for the months of April through November, may request navigation outages where the lock is closed to navigation for construction activities. The maximum total of allowed outages per month is 96 hours with each outage being no greater than 24 hours. There must be at least 24 hours between each outage to allow for passage of accumulated navigation through the lock. A minimum 7-day notice must be provided to the navigation industry prior to each outage. To accommodate peak recreational traffic periods, closures may not be scheduled to occur Friday, Saturday, Sunday or on the Memorial Day, Labor Day, or 4th of July Holidays.

3.6 RIVER BOTTOM ELEVATION MEASUREMENTS

The Contractor shall measure the river bottom elevations at and around the end monolith of the lower guide wall prior to the start of an work on the end cell structure in accordance with Section 01 71 23.05 13 CONTRACTOR SURVEYS. These measurements shall be submitted to the Government in tabular form for review and acceptance prior to starting work on the end cell structure or starting and removals associated with the lower guide wall and existing gage house.

River bottom elevations shall be obtained by performing hydrographic surveys using sonar equipment (fathometer) system or manual methods at the location immediately adjacent to the guide wall and out as far as 20 feet from the wall, and downstream within the end cell foot print. The end cell measurements shall extend to a minimum around the outside perimeter of the end cell foot print. If a sonar equipment system is used, it shall employ positioning equipment to georeference each measurement. If manual sounding equipment is used, sounding locations shall be referenced from the guide

wall. The vertical accuracy of the soundings regardless of whether they are sonar or manual shall be +/- .5 feet. The horizontal accuracy of the two methods shall be +/- 1.0 feet. The number of sonar sounding shall be recorded as a rate not less than 10 per second. Manual soundings of the river bottom shall be at a minimum taken at the joints and midpoints of both sides of each monolith at locations immediately adjacent to each monolith and at locations 8 feet out from the wall. The Contractor shall provide a safe working environment for hydrographic data collection where survey may be obtained to the level of accuracy required for the project.

3.7 PRE AND FINAL DIVING INSPECTIONS

The Contractor shall perform a diving inspection of the river bottom at and around the end monolith of the lower guide wall and downstream within the end cell foot print prior to the start of any work on removing the portions of the lower guide wall or gage house foundation or the end cell structure. This inspection shall verify and record the river bottom conditions, and to search for any obstructions that may delay or impact construction of the project features. The obstructions include but are not limited to riprap, pieces of reinforcement, timber debris, and miscellaneous sheet piling.

The Contractor shall perform a final diving inspection of the river bottom immediately adjacent to the guide wall and out as far as 20 feet from the wall. This inspection shall also extend a minimum of 20 feet around the outside perimeter of the end cell or to the end of the riprap and bedding section where it extends further than 20 feet from the cell. The final inspection is to enable visual verification of the conditions of the guide wall / end monolith / end cell transition, the riprap and bedding section, and river bed around the end cell and to serve as a baseline for future inspections.

The pre and final diving inspections of the river bottom must consist of, but are not limited to a high definition video recording (720p or better) and acoustic imaging. The videos shall be of a quality that will allow the Government to readily assess site conditions at the time the videos are obtained. Videos where factors such as lighting, focus, and clarity do not allow for the Government to clearly evaluate site conditions shall be reshot at no additional cost to the Government. Configure the high definition video to include on-screen titles such as time and date, and narration between the diver and surface observer.

3.8 RIVER NAVIGATION ASSISTANCE

The lock will not be closed to navigation unless approved by the Contracting Officer and in accordance with paragraph Allowable Outages During Navigation Seasons.

3.8.1 Navigation Assistance

To assist navigation within one-half mile downstream of Lock and Dam No. 4, the Contractor shall provide a helper boat. The helper boat shall be alongside tows entering and exiting the lock and when passing construction areas and shall offer any other assistance to navigation as necessary. The purpose of this assistance is to:

1) Protect life of working personnel.

2) Protect incomplete construction works from potential damage due

to barge strikes.

3) Protect navigation interests from damage and delays associated with ongoing construction.

4) Assist passage through the area where modified approach conditions impact the ability of vessels to safely transmit the construction area and approach to the lock.

3.8.1.1 Helper Boat Availability

The helper boat shall be available during the navigation season twenty-four (24) hours per day, 7 days per week, including weekends and holidays. Helper boat assistance shall commence with the placement of any obstruction or construction feature that impedes the approach to or exit from the navigation lock until such time that the obstruction is removed or until a completed, functional lower end cell is turned over to the Government for operation. For the purposes of this requirement, the Contractor is advised that areas downstream and landward of the existing guidewall are used for vessel approach. Therefore, any feature or obstruction in this area is considered to present a hazard to navigation and requires the availability of a helper boat. Vessels may elect not use the helper boat; however, the service must be present to assist if needed.

3.8.1.2 Minimum Helper Boat Requirements

The Contractor shall provide assistance as directed by the tow boat operator with a twin screw boat having a minimum of 1,000 horsepower. The boat shall be equipped with power winches and at least one deckhand. The tow boat operator will continue to provide power at the stern of the tow. Helper boat assistance will be coordinated by the tow operator.

3.8.2 Navigation Plan

The Contractor shall establish and maintain a plan to ensure the safety of industry and recreational traffic in the construction area. This plan shall include actions as required to protect the public and prevent damage to the incomplete construction. The Contractor shall be responsible for coordinating with the Coast Guard and other regulator agencies to implement any necessary restrictions. The Contractor shall also develop and implement a plan to provide public notice of any construction and any necessary restrictions and closures as well as the availability of the helper boat for assistance to tows passing through the lock.

3.8.3 Government Vessels

The Contractor is advised that Government Vessels may be required to transit the lock and construction area at any time during the navigation season, including during closure periods to respond to critical operations. The Contractor will be required to provide a helper boat to the site to assist Government Vessels within 8 hours notice from the Government. In addition, during lock closure periods, the Government will make every effort to configure tows with limited length and with to facilitate safe passage around construction activities. The Contractor is advised that vessels under contract to the Government are considered Government Vessels.

3.8.4 Payments

No separate or direct payment will be made for any costs incurred by the Contractor for compliance with the provisions of this section in regard to river navigation assistance and all costs in connection therewith shall be considered as a subsidiary obligation of the Contractor.

3.9 SITE SECURITY REQUIREMENTS

3.9.1 Transportation Worker Idendity Card

All shift leaders identified by the Contractor accessing the fenced facility are required to have a Transportation Worker Identity Card (TWIC) to access the site unescorted. Contractor personnel without a TWIC shall submit a plan as to how they will meet this requirement. The plan must be approved by the Contracting Officer and the District Security Manager.

3.9.2 Security Fencing

Temporary project security fencing shall be used to isolate the public from all construction activities and construction laydown and staging areas designated as public access area.

3.10 RAILROAD COORDINATION

The Contractor shall coordinate all work activities with the BNSF Railroad. The Contractor is responsible for coordinating with BNSF and determining what, if any, monitoring or flagging requirements are necessary and shall bear all costs associated with any work required by the railroad such as pre and post construction surveys of the railroad right of way or tracks as well as coordinating and paying for any required railroad flagging services. No separate payment will be made for this work needed to satisfy and comply with BNSF Railroad requirements.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

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MEASUREMENT AND PAYMENT

-- End of Section Table of Contents --

SECTION 01 22 00.00 13

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 COMPENSATION

The payment provided for in the contract shall constitute full compensation for furnishing all materials and for performing all work under the contract in a complete and acceptable manner. The contract work shall include providing plant, equipment, tools, supplies, labor, supervision, incidental materials, quality control, environmental protection, and meeting safety requirements, and for performing all work required for which separate payment is not otherwise provided. Compensation for all work shown, specified, or essential to completion of the project (whether or not the specific material or operation is indicated) shall be included in the bid price. The payment provided for in the contract includes compensation for all risk, loss, damage, and expense arising out of the nature of the work or its prosecution, subject to conditions of the contract. Payment for each contract line item will constitute full compensation for furnishing the materials and constructing the work complete in place as specified.

1.2 APPROVAL OF MATERIALS OR ALTERNATES

Requests for approval of materials and products, or substitutes thereof, will not be considered prior to award of the contract.

1.3 QUANTITY SURVEYS

The Contractor shall provide quantity surveys for bulk materials measured by volume or weight, unless an alternate method of measurement is specified. Quantity surveys are specified in Section 01 71 23.05 13 CONTRACTOR SURVEYS.

1.4 MEASUREMENT UNITS

When materials are measured in units other than the measurement units specified as the basis of payment, the measured quantities shall be converted to the specified unit of measure. Factors for conversions from one basis or unit of measurement to another shall be approved by the Contracting Officer.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Delivery Ticket

Submit certified delivery tickets.

1.6 JOB PAYMENT ITEMS

Payment items for the work of this contract for which contract Job payments will be made are listed in the BIDDING SCHEDULE and described below. All costs for items of work, which are not specifically mentioned to be included in a particular job or unit price payment item, shall be included in the listed job basis payment item most closely associated with the work involved. The job price and payment made for each item listed shall constitute full compensation for performing all work required for which separate payment is not otherwise provided.

1.8.1 Performance and Payment Bonds

1.6.1 Payment

Payment will be made for the premium paid for Performance and Payment Bonds required by this contract in accordance with FAR 52.232-5.

1.6.2 Unit of Measure

Unit of Measure: Job

1.6.3 Miscellaneous Metals

1.6.3.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for miscellaneous metals as shown and specified. Work includes, but is not limited to, design, fabrication, and installation of miscellaneous metals, resetting handrail, new handrail and gate, check post, sign resetting, ladder, wall armor, corner protection, setting anchors, angle iron, plates, and miscellaneous connections. Debris shall be removed from the site and properly disposed. All incidentals required to complete the miscellaneous metal work shall be included in the bid price, including disposal fees. This item does not include miscellaneous metal materials addressed under other bid items.

1.6.3.2 Unit of Measure

Unit of Measure: Job

1.6.4 Mass Concrete

1.6.4.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for mass concrete as shown and specified. Work includes, but is not limited to, concrete, structural steel reinforcement, miscellaneous embedded materials, sealants, joints, forming, placing, finishing, curing, protection of concrete, and removal and disposal of constriction debris. All incidentals required to complete the mass concrete work shall be included in the bid price, including disposal fees.

1.6.4.2 Unit of Measure

Unit of Measure: Job

1.6.5 Precast Concrete

1.6.5.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for precast concrete as shown and specified. Work includes, but is not limited to, design, fabrication, and installation of precast concrete, removal and proper offsite disposal of waste, chemical anchors, reinforcement, miscellaneous embedded materials, sealants, joints, forming, placing, finishing, curing, and protection of concrete in these structures. All incidentals required to complete the precast concrete work shall be included in the bid price, including disposal fees.

1.6.5.2 Unit of Measure

Unit of Measure: Job

1.6.6 Electrical Work

1.6.6.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for electrical work as shown and specified. Work shall include, but is not limited to, wire and cable, lamps, conduits and raceways, and resetting light pole and fixtures.

1.6.6.2 Unit of Measure

Unit of Measure: Job

1.6.7 Demolition and Removals

1.6.7.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for demolition and removals as shown and specified. Demolition and removals work shall include, but is not limited to, sawcutting, coring, removal and proper offsite disposal of waste, and the removal and proper onsite storage of signage, light pole, and hand railing, including disposal fees. This item does not include demolition or removals addressed under other bid items. Any required underwater excavation shall be considered to be incidental to this payment item.

1.6.7.2 Unit of Measure

Unit of Measure: Job

1.6.8 Gage House

1.6.8.1 Payment

Payment will be made for furnishing all materials, equipment, and labor

and performing all operations necessary for the gage house as shown and specified. Work includes, but is not limited to, design, fabrication, and installation of the gage house, removal and proper offsite disposal of any construction debris. The new gage house will be constructed on the new end cell. The gage house will match the design of the existing upstream gage house. Updates to the site grounding system made to accommodate the new electrical subpanel and will allow for future expansion are incidental to this bid item as well as relocating the existing instrumentation to the new gage house. New exterior luminaries are also included under this payment item. All incidentals required to complete the gage house shall be included in the bid price, including disposal fees.

1.6.8.2 Unit of Measure

Unit of Measure: Job

1.6.9 Existing Tie-back Wall and Interceptor Sewer Wing Wall Concrete Repairs

1.6.9.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for the existing tie-back wall and interceptor sewer wing wall repairs as shown and specified. Work includes, but is not limited to, demolition of unsound concrete, surface preparation, anchor installation, reinforcement installation, formwork, joints, placing and curing of concrete or grout, finishing, and protection of concrete or grout in these structures. All incidentals required to complete the existing tie-back wall and interceptor sewer wing wall repairs work shall be included in the bid price, including disposal fees.

1.6.9.2 Unit of Measure

Unit of Measure: Job

1.6.10 Erosion Protection Slab

1.6.10.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for removing the existing erosion protection slab and installing a new erosion protection slab as shown and specified. Work includes, but is not limited to, demolition and removal of the existing erosion protection slab, formwork, reinforcement, joints, placing and curing, finishing and protection of concrete. All incidentals required to complete the erosion protection slab shall be included in the bid price, including disposal fees.

1.6.10.2 Unit of Measure

Unit of Measure: Job

1.6.11 Hydrographic Survey

1.6.11.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for performing the hydrograph survey and providing any related reports or data needed to confirm the

pre-work bathymetry and post work bathymetry and as constructed riprap sections and underwater excavation necessary to compute quantities. All incidentals required to complete the erosion protection slab shall be included in the bid price.

1.6.11.2 Unit of Measure

Unit of Measure: Job

1.7 UNIT PRICE PAYMENT ITEMS

Unit price payment items are listed in the BIDDING SCHEDULE and described below. The unit price any payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, testing and reporting, and for performing all work required for each of the unit price items.

1.7.1 Steel H-Piling

1.7.1.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for constructing the steel H-piling as shown and specified. Work includes, but is not limited to, delivery and handling, driving, cutting, performing testing, submitting driving records, and removal and proper offsite disposal of debris. All incidentals required to complete the steel H piling driving work shall be included in the bid price, including disposal fees. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles; backdriving; cutting off piles; splicing; build-ups; or any cutoff length of piles.

1.7.1.2 Measurement

Steel H Piles shall be measured for payment on the basis of length, to the nearest linear foot, along the axis of each pile acceptably in place below the cutoff elevation shown. No allowance will be made for waste, damaged materials, or used for the convenience of the Contractor.

1.7.1.3 Unit of Measure

Unit of Measure: Linear Foot

1.7.2 PS31 Metal Sheet Piling

1.7.2.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for constructing the PS31 metal sheet piling as shown and specified. Work includes, but is not limited to, delivery and handling, driving, cutting, performing testing, submitting driving records, and removal and proper offsite disposal of debris. All incidentals required to complete the PS31 metal sheet piling driving work shall be included in the bid price, including disposal fees. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles; backdriving; cutting off piles; splicing; build-ups; or any cutoff length of piles.

1.7.2.2 Measurement

PS31 metal sheet piling shall be measured for payment on the basis of sheet pile area, to the nearest square foot. Area shall be computed by multiplying the total length times the gross width as shown on the sketch attached to the end of the specification section. Only piles acceptably driven shall be measured for payment. In addition, for installed piling directed to be cut off before reaching the penetration depth shown, measurement for payment will be from the cutoff elevation to the actual penetration elevation. No allowance will be made for waste, damaged materials, or used for the convenience of the Contractor.

1.7.2.3 Unit of Measure

Unit of Measure: Square Foot

1.7.3 Z Metal Sheet Piling

1.7.3.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary for constructing the Z metal sheet piling as shown and specified. Work includes, but is not limited to, delivery and handling, driving, cutting, performing testing, submitting driving records, and removal and proper offsite disposal of debris. All incidentals required to complete the Z sheet piling driving work shall be included in the bid price, including disposal fees, and the PSA23 rolled corner. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles; backdriving; cutting off piles; splicing; build-ups; or any cutoff length of piles.

1.7.3.2 Measurement

Z metal sheet piling shall be measured for payment on the basis of sheet pile area, to the nearest square foot. Area shall be computed by multiplying the total length times the gross width as shown on the sketch attached to the end of the specification section. Only piles acceptably driven shall be measured for payment. In addition, for installed piling directed to be cut off before reaching the penetration depth shown, measurement for payment will be from the cutoff elevation to the actual penetration elevation. No allowance will be made for waste, damaged materials, or used for the convenience of the Contractor.

1.7.3.3 Unit of Measure

Unit of Measure: Square Foot

1.7.4 Riprap and Bedding

1.7.4.1 Payment

Payment will be made for furnishing all materials, equipment, and labor and performing all operations necessary to place riprap and bedding as shown and specified. Work includes, but is not limited to, furnishing and delivering to the site acceptable riprap and bedding that meets the quality and gradation requirement, testing, and installation of the riprap and bedding to the thickness and lines and grades shown on the plans.

1.7.4.2 Measurement

Riprap and bedding shall be measured for payment by comparing the post excavation/pre-placement bathymetric survey to the post placement bathymetric survey and computing the volume excavated in cubic yards. No payment will be made for riprap or bedding installed over the lines and grades shown on the plans.

1.7.4.3 Unit of Measure

Unit of Measure: Cubic Yard

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

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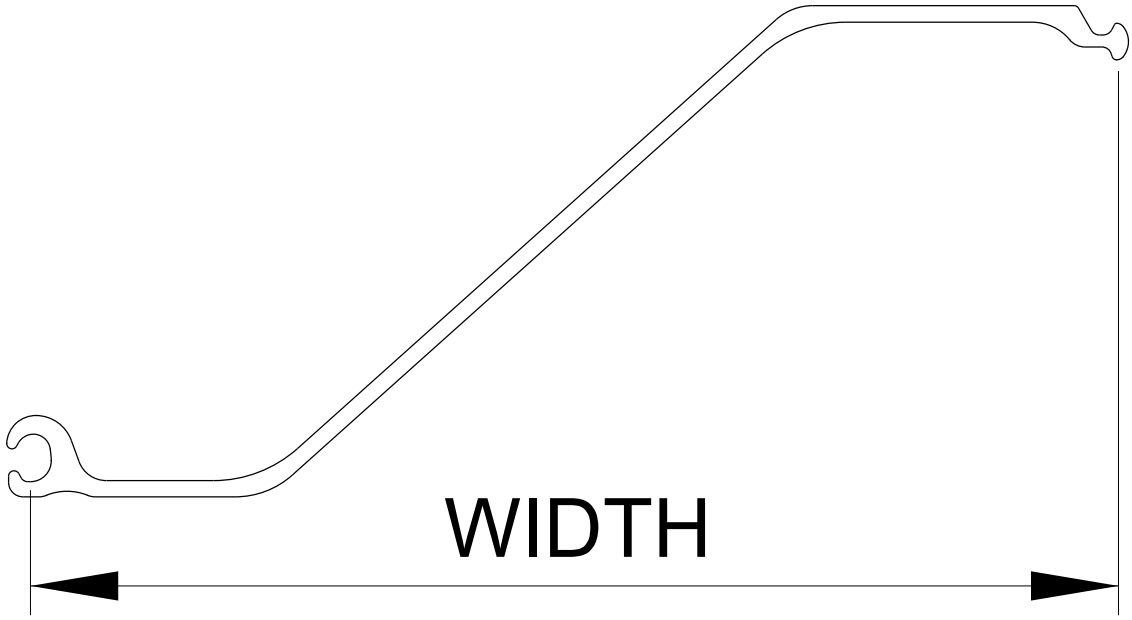
MEASUREMENT AND PAYMENT

ATTACHMENTS

SHEETPILE SKETCH (DETAIL A)



DETAIL A

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PROJECT SCHEDULE

-- End of Section Table of Contents --

SECTION 01 32 01.00 13

PROJECT SCHEDULE

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

PROJECT SCHEDULER QUALIFICATIONS; G,COR

Initial Project Schedule; G,COR

SD-02 Shop Drawings

Project Schedule Updates; G,COR

1.2 PROJECT SCHEDULER QUALIFICATIONS

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating and production of reports. The authorized representative must have a minimum of 2-years experience scheduling construction projects similar in size and nature to this project with scheduling software that meets the requirements of this specification. Representative must have a comprehensive knowledge of CPM scheduling principles and application.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULES FOR CONSTRUCTION CONTRACTS (FAR 52.236-15), a project schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall contribute in developing and maintaining an accurate project schedule. The approved project schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of progress payments.

3.2 BASIS FOR PAYMENT

The project schedule shall be the basis for measuring Contractor progress. The Contracting Officer will use an approved project schedule to evaluate Contractor progress for payment purposes. In the case where project schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the project schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until the project schedule updates have been accepted.

3.3 SOFTWARE

Computer software systems utilized by the Contractor to produce the project schedule shall be capable of providing all requirements of this specification.

3.3.1 Use of the Critical Path Method

The project schedule shall clearly show the critical path. If a network analysis system is used, the Critical Path Method (CPM) of network calculation shall be used to generate the project schedule, provided in either the Precedence Diagram Method (PDM) or the Arrow Diagram Method (ADM).

3.3.2 Level of Detail Required

The project schedule shall include an appropriate level of detail. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the project schedule.

3.3.2.1 Activity Durations

The Contractor shall breakout job contract line items into subcategories, or activities. The number of activities shall be sufficient to allow the progress to be accurately determined between payment periods.

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 calendar days. Examples of procurement activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.3.2.3 Critical Activities

The following activities shall be listed as separate line activities on the Contractor's project schedule:

a. Prefinal inspection.

b. Correction of punchlist from prefinal inspection.

c. Final inspection.

3.3.2.4 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government furnished property, and notice to proceed for phasing requirements.

3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party (Prime Contractor, subcontractor, Government agency, etc.) responsible to perform the work. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.6 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers to, but is not limited to, a work breakdown structure for the project schedule. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from notice to proceed to the contract completion date. The notice to proceed date shall be taken as the date that notice to proceed was received.

3.3.3.1 Constraint of Last Activity

Completion of the last activity in the project schedule shall be constrained by the contract completion date. If the early finish of the last activity falls after the contract completion date, then the critical path shall show a negative float.

3.3.3.2 Early Project Completion

If the project schedule shows project completion prior to the contract completion date, the Contractor shall identify activities that have been accelerated and activities that are scheduled in parallel to support the "early" completion.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.5 Default Progress Data Disallowed

The Contractor shall document the actual start and actual finish dates on the daily quality control report for every in-progress or completed activity and ensure that the data contained on the daily quality control reports is the sole basis for project schedule updating. Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual start and finish dates on the CPM schedule shall match those dates provided from Contractor quality control reports.

3.3.6 Out-of-Sequence Progress

The Contracting Officer shall be notified prior to work on any activities that are out-of-sequence with the project schedule. The Contractor shall update the project schedule to correct any out-of-sequence work.

3.3.7 Extended Non-Work Periods

Non-work periods of over 5 working days shall be identified by addition of activities that represent the delays.

3.3.8 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below.

3.4.1 Initial Project Schedule Submission

The project schedule shall provide a reasonable sequence of activities which represent work through the entire contract period and shall be at a reasonable level of detail.

3.4.2 Project Schedule Updates

Based on the result of progress meetings, the Contractor shall submit periodic project schedule updates not later than 4 working days after every monthly progress meeting.

The updated project schedule shall contain all approved progress, revisions and adjustments, based on the regular progress meeting.

The Contractor shall also furnish information and project schedule data, which in the judgment of the Contracting Officer, is necessary for verifying the Contractor's progress.

3.4.3 Standard Activity Coding Dictionary

The Contractor shall submit, with the initial project schedule, a coding scheme that shall be used throughout the project schedule for all activity codes contained in the project schedule. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. For example, a responsibility code value, "ELE", may be identified as "Electrical Subcontractor". Activity code values shall represent the same information throughout the duration of the contract.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted for each project schedule submission:

3.5.1 Earnings Report

The Contractor shall submit a compilation of the Contractor's Total

Earnings on the project through the most recent Monthly Progress Meeting. Activities shall be grouped by contract line item. The printed report shall contain, for each contract line item: activity number, activity description, line item amount, total quantity, quantity to date, percent complete (based on price), and earnings to date. A total project percent complete shall also be provided. If necessary to substantiate partial payment and requested by the Contracting Officer, the earnings report shall detail activities within a contract line item.

3.5.2 Network Diagram

A network diagram shall be required on the initial project schedule submission and on periodic submissions when requested by the Contracting Officer (not less than quarterly). The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The network diagram shall be constructed to meet the following conditions:

a. Continuous Flow. Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram.

b. Project Milestone Dates. Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

c. Critical Path. The critical path shall be clearly shown.

d. Banding. Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

e. S-Curves. Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project.

3.6.1 Meeting Attendance

The Contractor's project manager and the Contractor's authorized representative responsible for preparation of the project schedule shall attend the regular progress meeting.

3.6.2 Progress Meeting Contents

Update information, including actual start dates, actual finish dates, remaining durations, and cost-to-date shall be subject to the approval of the Contracting Officer. The Contractor shall address the following minimum set of items, on an activity by activity basis, during each progress meeting.

a. Start and Finish Dates. The actual start and actual finish dates for each completed activity. The actual start and projected finish dates for each activity in-progress.

b. Completion. The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains defects.

c. Project Schedule Changes. All changes pertaining to notice to proceed on change orders, change orders to be incorporated into the project schedule, Contractor proposed changes in work sequence, corrections to project schedule for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

d. Other Changes. Other changes required due to delays in completion of any activity or group of activities include unusually severe weather, product procurement, or other delays or work stoppages which make re-planning the work necessary.

3.7 REQUESTS FOR TIME EXTENSIONS

Provide a justification of delay to the Contracting Officer in accordance with the contract clauses for approval within 10 days of a delay occurring. Also prepare a time impact analysis for each Government request for proposal (RFP) to justify time extensions.

3.7.1 Justification of Delay

Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the Government. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider any concurrency of delay. A time extension becomes part of the project schedule and all future schedule updates upon approval by the Contracting Officer.

3.7.2 Time Extension

The Contracting Officer must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.8 OWNERSHIP OF FLOAT

Float available in the project schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 00

SUBMITTAL PROCEDURES

-- End of Section Table of Contents --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

SD-03 Product Data

SD-04 Samples

SD-05 Design Data

SD-06 Test Reports

SD-07 Certificates

SD-08 Manufacturer's Instructions

SD-11 Closeout Submittals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause 52.236-21 entitled "Specifications and Drawings for Construction," government approved submittals are considered to be "shop drawings."

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is

responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause 52.243-4 "Changes" shall be given promptly to the Contracting Officer.

When resubmitting previously disapproved submittals, the Contractor shall provide a summary with description of the changes made to address each Government Comment, and the location in the submittal by page and line number. The changes will be highlighted in the submittal.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.6 MEASUREMENT AND PAYMENT

The work of this section will not be measured for payment. The Contractor shall be responsible for the work of this section, without any direct compensation being made other than the payment received for contract items.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in

compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER

At the end of this section is a sample Submittal Register, showing items of equipment and materials for which submittals are required by the specifications. This list may not be all inclusive and additional submittals may be required. The Contractor shall use RMS to produce the Submittal Register and to track and transmit all submittals. The Contractor shall maintain a submittal register for the project in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM).

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. 30 days (exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. The submittal register shall provide for a reasonable timely distribution of shop drawings as they are prepared (particularly within a specific discipline, i.e.: structural, mechanical).

3.4 TRANSMITTAL FORM (ENG FORM 4025)

A sample transmittal form (ENG Form 4025) is attached to this section, however the ENG Form 4025 shall be produced using RMS and shall be used for submitting both Government approved and information only submittals.

3.5 SUBMITTAL PROCEDURE

3.5.1 Submittal Copies

The Contractor shall submit 1 hardcopy and 1 electronic copy of each submittal (both government approved and for information only), unless otherwise indicated. Each transmittal shall address submittal items from only one specification section. Transmittals returned for resubmission shall be resubmitted in their entirety. When approved by the Contracting Officer, routine test reports and delivery tickets may be submitted with daily quality control reports in place of following submittal procedures under this section.

3.5.2 Schedule

Shop drawings shall be submitted with ample time to secure Government approval prior to the time the items covered thereby are to be delivered to the site. Additional time should be allowed for possible resubmittal. Materials fabricated or delivered without Government approval of the shop drawing will be subject to rejection. All submittals shall be made prior to commencement of applicable work, and allow adequate time for government review acceptable to the Contracting Officer.

3.5.3 Shop Drawings

Shop drawings shall be reproductions on high quality paper with clear legible print. Drawings shall generally be bordered a minimum of one inch and trimmed to neat lines. Shop drawing quality will be subject to

approval. Each shop drawing, including catalog data, shall be identified with a title block including the name of the Contractor, contract number, name and location of project, and name of the item of work or structure to which the shop drawing applies. Catalog data, including specifications and full descriptive matter, may be submitted as shop drawings. Catalog data must be supplemented as necessary to include all pertinent data to verify conformance to the contract documents. When catalog data includes non applicable data, the applicable data shall be clearly indicated.

3.5.4 Warranties

Any items that are submitted for review or approval of the Contracting Officer should include a copy of the manufacturer's standard warranty if one is available.

3.5.5 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control its procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7 GOVERNMENT APPROVED SUBMITTALS

After review of submittals requiring Government approval is completed the Contractor will receive a signed and dated electronic version of the ENG Form 4025-R with submittal attached indicating approval or requirement for resubmittal. No hardcopies of the submittals will be returned to the Contractor unless indicated elsewhere.

3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR

(Firm Name)

_____ Approved

_____ Approved with corrections as noted on submittal data and/or attached sheet(s).

SIGNATURE: _____

TITLE: _____

DATE: _____

3.10 LIST OF ATTACHMENTS

a. Submittal Register

b. Transmittal Form (ENG 4025)

-- End of Section --

SECTION 01 33 00 SUBMITTAL PROCEDURES

ATTACHMENTS

SUBMITTAL REGISTER

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
LD4 Guidewall End Cell

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 00 00.00 13	SD-01 Preconstruction Submittals															
			Pre Construction Condition	3.3	G													
			Survey															
			SD-11 Closeout Submittals															
			Post Construction Condition	3.3	G													
			Survey															
		01 11 00	SD-01 Preconstruction Submittals															
			Salvage Plan	1.5	G													
		01 14 00.00 13	SD-01 Preconstruction Submittals															
			Navigation Plan	3.8.2	G													
			Site Security Requirements	3.9	G													
		01 22 00.00 13	SD-03 Product Data															
			Delivery Ticket															
		01 32 01.00 13	SD-01 Preconstruction Submittals															
			PROJECT SCHEDULER	1.2	G COR													
			QUALIFICATIONS															
			Initial Project Schedule	3.4.1	G COR													
			SD-02 Shop Drawings															
			Project Schedule Updates	3.4.2	G COR													
		01 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.6	G													
			Activity Hazard Analysis (AHA)	1.7	G													
			Crane Operators	1.5.1.2	G													
			SD-06 Test Reports															
			Notifications and Reports	1.11														
			Accident Reports	1.11.2	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
LD4 Guidewall End Cell

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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		01 35 26	Crane Reports	1.11.3														
			SD-07 Certificates															
			Standard Lift Plan	1.6.1.2	G													
			Critical Lift Plan	1.6.1.3	G													
			Naval Architecture Analysis	1.6.1.4	G													
			Confined Space Entry Plan	1.6.1.1														
			Confined Space Entry Permit	1.8														
			Hot Work Permit	1.8														
			Certificate of Compliance	1.11.4														
		01 45 04.00 13	SD-01 Preconstruction Submittals															
			CONTRACTOR QUALITY	3.2	G													
			CONTROL (CQC) PLAN															
		01 50 02.00 13	SD-02 Shop Drawings															
			Site Plan															
			Government Field Office															
			SD-06 Test Reports															
			Formaldehyde Emission Test															
			Results															
		01 57 20.00 13	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.7	G	ENV												
		01 71 23.05 13	SD-01 Preconstruction Submittals															
			Construction Surveying Work	3.1.3.2	G	SURV												
			Plan and Schedule															
			Quality Control Plan	1.8.1	G	SURV												
			Preliminary Survey		G	SURV												

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		01 71 23.05 13	Professional Certification and	1.9.1	G SURV													
			Work Experience															
			SD-11 Closeout Submittals															
			As-Built Survey		GSURV													
			Geospatial Data	1.5														
		01 78 02.00 10	SD-11 Closeout Submittals															
			As-Built Drawings	1.2	G													
		02 41 00	SD-01 Preconstruction Submittals															
			Existing Conditions	1.7.2	G													
			Documentation															
			SD-07 Certificates															
			Demolition Plan	1.9	G													
		03 01 00	SD-01 Preconstruction Submittals															
			Qualifications	1.5.3	G STR													
			Work Plan	1.5.5	G STR													
			Work Plan	1.6.1	G STR													
			Rebar Dowel Bar Installation Plan		G MAT													
			Drilling Program Plan	1.5.7	G MAT													
			Quality Control Plan	1.5.2	G STR													
			SD-03 Product Data															
			Conventional Concrete	2.5														
			Polymers	2.6														
			Miscellaneous Materials And	2.7														
			Equipment															
			Drillin Equpment															
			SD-04 Samples															

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		03 01 00	Reinforcement And	2.4														
			Reinforcement Supports															
			Polymers	2.6														
			Miscellaneous Materials And	2.7														
			Equipment															
			SD-05 Design Data															
			Formwork And Shoring	3.1.3	G STR													
			Repair Procedures	1.5.1	G STR													
			Mixture Proportioning	2.8	G STR													
			SD-06 Test Reports															
			Mixture Proportioning	2.8														
			Quality Control	3.1.5														
			Quality Control	3.2.3														
			Quality Control	3.3.3														
			Quality Control	3.4.3														
			Quality Control	3.5.3														
			Tolerance Report	1.6.2														
			Reinforcement And	2.4														
			Reinforcement Supports															
			Conventional Concrete	2.5														
			Polymers	2.6														
			Miscellaneous Materials And	2.7														
			Equipment															
			SD-07 Certificates															
			Qualifications	1.5.3														

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		03 01 00	Reinforcement And	2.4														
			Reinforcement Supports															
			Conventional Concrete	2.5														
			Polymers	2.6														
			SD-08 Manufacturer's Instructions															
			Equipment For Concrete	2.2														
			Preparation															
			Conventional Concrete	2.5														
			Polymers	2.6														
			Miscellaneous Materials And	2.7														
			Equipment															
		03 11 14	SD-02 Shop Drawings															
			Shop Drawings	1.2	G STR													
			SD-03 Product Data															
			Materials	2.1	G STR													
			SD-06 Test Reports															
			Formwork Not Supporting Weight	3.2.1	G STR													
			Of Concrete															
			Formwork Supporting Weight Of	3.2.2	G STR													
			Concrete															
			Inspection	3.3	G STR													
		03 15 00.00 10	SD-02 Shop Drawings															
			Horizontal Joint Layout		G STR													
			SD-03 Product Data															
			Preformed Expansion Joint Filler															
			Sealant															

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		03 15 00.00 10	SD-07 Certificates															
			Preformed Expansion Joint Filler		G STR													
			Sealant		G STR													
		03 20 00.00 10	SD-02 Shop Drawings															
			Reinforcement	3.1	G													
			STR															
			SD-03 Product Data															
			Reinforcing Steel	2.1														
			Wire Ties	2.2														
			Supports	2.3														
			SD-07 Certificates															
			Welding Qualifications	1.3.1	G STR													
			Steel Bar Butt-Splicer	1.3.2	G													
			Qualifications															
			Butt-Splicing Procedure	1.3.3	G													
			Qualifications															
		03 45 33	SD-01 Preconstruction Submittals															
			Manufacturer Qualifications	1.4.1.1	G STR													
			Designer Qualifications	1.4.1.2	G STR													
			Welding Qualifications	1.4.1.3	G STR													
			SD-02 Shop Drawings															
			Drawings of precast members		G STR													
			SD-03 Product Data															
			Anchorage and lifting inserts and		G STR													
			devices															
			SD-05 Design Data															

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		03 45 33	Concrete mix design	1.4.3	G STR													
			Drawing And Design Calculation	1.2.1.2	G STR													
			Information															
			Contractor-furnished mix design;		G STR													
			Cement		G													
			STR															
			Pozzolan		G													
			Slag Cement		G													
			Silica Fumes		G													
			Air-Entraining Admixture		G													
			Water-Reducing Admixture		G													
			Accelerating Admixture		G													
			Aggregates		G													
			Air Content		G													
			Compressive Strength		G													
			Slump		G													
			Moisture Content		G													
			Unit Weight		G													
			SD-07 Certificates															
			Quality control procedures		G													
			STR															
			Construction Records		G													
			Qualified Welders		G STR													
			Batch Ticket	1.4.4	G STR													
			SD-11 Closeout Submittals															
			Concrete batch ticket information		G													

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		03 45 33	STR															
		03 70 00	SD-01 Preconstruction Submittals															
			Underwater Sloped Grade		G MAT													
			Placement Plan															
			SD-02 Shop Drawings															
			Concrete Lifts	3.2.2.7	G													
			SD-03 Product Data															
			Aggregate	2.4.2	G													
			Batch Plant	2.6.1	G													
			Construction Joint Treatment	3.1.3	G													
			Curing and Protection	3.4	G													
			Cold-Weather Protection	3.4.7	G													
			Hot-weather Placing	3.2.2.2	G													
			Maturity Method		G STR													
			Mixers															
			Laboratory Area															
			Equipment	2.6														
			Special Temperature-Controlled	3.2.2.6	G													
			Concrete															
			Surface Retarder	2.4.8	G STR													
			SD-05 Design Data															
			Concrete Mixture Proportioning	2.2.10	G													
			Design Test Plan(s)															
			Thermal Analysis and Thermal	2.2.12	G													
			Control Plan															
			SD-06 Test Reports															

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		03 70 00	Mixer Uniformity															
			Quality of Aggregates	2.4.2.2	G													
			Concrete Materials	2.4														
			Tests and Inspections	3.5														
			Temperature Monitoring	3.4.8.1														
			Concrete Mixture Proportioning		G STR													
			Report															
			Non-Shrink Grout Mixture		G STR													
			Final Concrete Report		G													
			SD-07 Certificates															
			Laboratory Requirements	3.5.1.1														
			Technician and Inspector	3.5.1.2														
			Certification Requirements															
			Lead Auditor Qualification															
			Requirements															
			Cementitious Materials	2.4.1														
			Air-Entraining Admixtures	2.4.4.1														
			Other Chemical Admixtures															
			Membrane-Forming Curing	2.4.5.2														
			Compound															
			Wet-Cure Sheeting Materials	2.4.5.1														
			Bonding Agents	2.4.7														
			Retarding Admixtures	2.4.4.2														
		05 05 23.13 10	SD-03 Product Data															
			Welding Procedure Qualifications	1.5	G STR													

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		05 05 23.13 10	Welder, Welding Operator, and	1.5.5	G STR													
			Tacker Qualification															
			Inspector Qualification	1.5.6	G STR													
			Previous Qualifications		G STR													
			Pre-qualified Procedures	1.5.3	G STR													
			SD-06 Test Reports															
			Quality Control	3.2	G STR													
			Nondestructive Examination	3.3.1	G STR													
			SD-07 Certificates															
			Certified Welding Procedure	1.5	G STR													
			Specifications															
			Certified Procedure Qualification	1.5	G STR													
			Records															
			Certified Welder Performance	1.5.5.2	G STR													
			Qualifications															
		05 50 13	SD-02 Shop Drawings															
			Fabrication and Erection		G													
			Drawings															
			Installation Drawings		G													
			Fabrication Drawings		G													
			Fabrication Finishes															
			Templates, Erection and		G													
			Installation Drawings															
			Qualified Welders		G STR													
			Certified Mill	2.1	G													
		05 52 00	SD-02 Shop Drawings															

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		05 52 00	Fabrication Drawings	1.2.1	G													
			Fabrication Drawings	2.1	G													
			SD-03 Product Data															
			Concrete Inserts		G													
			Masonry Anchorage Devices		G													
			Protective Coating		G													
			Aluminum Railings and Handrails	2.2.1	G													
			Anchorage and Fastening	1.2.1	G													
			Systems															
			SD-07 Certificates															
			Welding Procedures	1.4.1	G													
			Welder Qualification	1.4.2	G													
			SD-08 Manufacturer’s Instructions															
			Installation Instructions	3.2														
			Hardware	3.2														
		09 96 00	SD-01 Preconstruction Submittals															
			Equipment List	1.3	G													
			SD-03 Product Data															
			Polyurethane Coatings	2.2.1	G													
			SD-04 Samples															
			Color Chips		G													
			SD-07 Certificates															
			Polyurethane Coatings	2.2.1	G													
			Manufacturer's Printed	3.1.3	G													
			Instructions															
		09 97 02	SD-01 Preconstruction Submittals															

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		09 97 02	Safety, Health, and	1.2	G													
			Environmental Requirements															
			Accident Prevention Plan	1.2.1	G													
			Respiratory Protection Plan	1.2.1.5	G													
			Airborne Sampling Plan	1.2.2.1	G													
			Medical Surveillance Plan	1.2.2	G													
			Waste Disposal Plan	1.2.3.1	G													
			Waste Manifest		G													
			SD-03 Product Data															
			Manufacturer's SDS Product Data	Part 2	G													
			Sheet															
			SD-04 Samples															
			Product Samples	Part 2	G													
			Special Paint Formulas	2.1	G													
			Solvent and Thinners		G													
			SD-06 Test Reports															
			Inspection Reports	3.4														
			Medical Status Report	1.2.2.2														
			Change in Medical Status Report	1.2.2.3														
			Air Monitoring Test Plan	1.2.2.1	G													
			Air Monitoring Test Report	1.2.2.1														
			SD-07 Certificates															
			Certified EHS Professional	1.4.1														
			Coating Thickness Gage	1.4.2														
			Qualification															
		26 05 00.00 40	SD-02 Shop Drawings															

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		26 05 00.00 40	Marking Strips		G													
			SD-03 Product Data															
			Conduits and Raceways	2.1.1	G													
			Wire and Cable	2.2.1	G													
			Splices and Connectors	3.2.5	G													
			Switches	2.2.4	G													
			Receptacles	2.2.5	G													
			Outlet Boxes, Pull Boxes and	2.1.2	G													
			Junction Boxes															
			Circuit Breakers	2.1.3.1	G													
			Timer Switch	2.1.4	G													
			Automatic Remote Temperature		G													
			Switch															
			Panelboards	2.1.3	G													
			Heater Lampholder		G													
			Heating Lamp		G													
			Luminaries		G													
			SD-06 Test Reports															
			Continuity Test	3.3	G													
			600-Volt Wiring Test	3.3	G													
			Ground-Fault Receptacle Test	3.3	G													
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	3.1														
		26 05 26.00 40	SD-03 Product Data															
			Ground Wires	2.1.1	G													
			Connectors and Fasteners	2.1.2	G													

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		26 05 26.00 40	Conductive Corrosion Inhibiting	2.1.3	G													
			Compounds															
			Ground Buses	2.1.4	G													
			SD-11 Closeout Submittals															
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		31 23 20	SD-01 Preconstruction Submittals															
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			Material Certificates		G													
			SD-11 Closeout Submittals															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
LD4 Guidewall End Cell

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		31 41 16	Pile Driving Record	3.5	G													
		31 62 16.16	SD-01 Preconstruction Submittals															
			Installation Procedures		G													
			Contractor's Geotechnical		G													
			Consultant															
			Testing Agency Qualification	3.3.3	G													
			Wave Equation Analysis	3.1.1	G													
			Instrumentation and Monitoring		G													
			Program Report															
			SD-02 Shop Drawings															
			Pile splices	2.2.4.1	G													
			Pile placement	3.2.3	G													
			Steel Points	2.2.1														
			Encasements															
			SD-03 Product Data															
			Pile Driving Equipment		G													
			Pile Driving Records	3.2.2	G													
			Delivery, Storage, and Handling	1.5	G													
			SD-05 Design Data															
			Wave Equation Analysis	3.1.1														
			Quantities List	3.1.2	G													
			Procedure for Insufficient Pile		G													
			Length															
			SD-07 Certificates															
			Pile Material Certificates of	2.2.1	G													
			Compliance															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
LD4 Guidewall End Cell

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		31 62 16.16	Pile Splices	2.2.4.1	G													
			Pile Shoes		G													
			SD-11 Closeout Submittals															
			Pile Driving Records	3.2.2														
		31 62 17.01 13	SD-01 Preconstruction Submittals															
			Dynamic Pile Testing Work Plan		G STR													
			SD-03 Product Data															
			Pile Test Equipment Calibration		G STR													
			SD-06 Test Reports															
			Dynamic Driving Stresses		G STR													
			DYNAMIC TEST REPORT		G STR													
		35 31 19.00 13	SD-01 Preconstruction Submittals															
			Material Sources		G GT													
			Survey Plan for Verification of		G GT													
			Section															
			SD-02 Shop Drawings															
			Survey Sections for Verification of															
			Section															
			SD-06 Test Reports															
			Gradation Test															
			SD-07 Certificates															
			Certified Weight Scale Tickets															

SUBMITTAL TRANSMITTAL

(USACE 4025)

U.S. Army Corps of Engineers (USACE)

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE

For use of this form, see ER 415-1-10; the proponent agency is CECW-CE.

DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (*This section will be initiated by the contractor*)

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____

SPECIFICATION SEC. NO. (*Cover only one section with each transmittal*)	PROJECT TITLE AND LOCATION	THIS TRANSMITTAL IS FOR: (*Check one*) ☐ FIO ☐ GA ☐ DA ☐ CR ☐ DA/CR ☐ DA/GA

ITEM NO. (*See Note 3*)	**DESCRIPTION OF SUBMITTAL ITEM** (*Type size, model number/etc.*)	**SUBMITTAL TYPE CODE** (*See Note 8*)	**NO. OF COPIES**	**CONTRACT DOCUMENT REFERENCE**		**CONTRACTOR REVIEW CODE**	**VARIATION** Enter "Y" if requesting a variation (*See Note 6*)	**USACE ACTION CODE** (*Note 9*)
				SPEC. PARA. NO.	**DRAWING SHEET NO.**			
a.	**b.**	**c.**	**d.**	**e.**	**f.**	**g.**	**h.**	**i.**

REMARKS	I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.	
	NAME OF CONTRACTOR	SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED (*List by item No.*)	NAME AND TITLE OF APPROVING AUTHORITY	SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each Transmittal shall be numbered consecutively. The Transmittal Number typically includes two parts separated by a dash (-). The first part is the specification section number. The second part is a sequential number for the submittals under that spec section. If the Transmittal is a resubmittal, then add a decimal point to the end of the original Transmittal Number and begin numbering the resubmittal packages sequentially after the decimal.

3. The "Item No." for each entry on this form will be the same "Item No." as indicated on ENG FORM 4288-R.

4. Submittals requiring expeditious handling will be submitted on a separate ENG Form 4025-R.

5. Items transmitted on each transmittal form will be from the same specification section. Do not combine submittal information from different specification sections in a single transmittal.

6. If the data submitted are intentionally in variance with the contract requirements, indicate a variation in column h, and enter a statement in the Remarks block describing he detailed reason for the variation.

7. ENG Form 4025-R is self-transmitting - a letter of transmittal is not required.

8. When submittal items are transmitted, indicate the "Submittal Type" (*SD-01 through SD-11*) in column c of Section I.
   Submittal types are the following:
   SD-01 - Preconstruction SD-02 - Shop Drawings SD-03 - Product Data SD-04 - Samples SD-05 - Design Data SD-06 - Test Reports
   SD-07 - Certificates SD-08 - Manufacturer's Instructions SD-09 - Manufacturer's Field Reports SD-10 - O&M Data SD-11 - Closeout

9. For each submittal item, the Contractor will assign Submittal Action Codes in column g of Section I. The U.S. Army Corps of Engineers approving authority will assign Submittal Action Codes in column i of Section I. The Submittal Action Codes are:

   A -- Approved as submitted.
   B -- Approved, except as noted on drawings. Resubmission not required.
   C -- Approved, except as noted on drawings. Refer to attached comments. Resubmission required.
   D -- Will be returned by separate correspondence.
   E -- Disapproved. Refer to attached comments.
   F -- Receipt acknowledged.
   X -- Receipt acknowledged, does not comply with contract requirements, as noted.
   G -- Other action required *(Specify)*
   K -- Government concurs with intermediate design. (*For D-B contracts*)
   R -- Design submittal is acceptable for release for construction. (*For D-B contracts*)

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

-- End of Section Table of Contents --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2012) Fall Protection
ASSE/SAFE A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
ASSE/SAFE Z359.2	(2007) Minimum Requirements for a Comprehensive Managed Fall Protection Program

ASME INTERNATIONAL (ASME)

ASME B30.22	(2010) Articulating Boom Cranes
ASME B30.3	(2012) Tower Cranes
ASME B30.5	(2011) Mobile and Locomotive Cranes
ASME B30.8	(2010) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2013) Standard for Portable Fire Extinguishers
NFPA 70E	(2012; Errata 2012) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces

29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes & Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.502	Fall Protection Systems Criteria and Practices
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

a. High Visibility Accident. Any mishap which may generate publicity or high visibility.

b. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even though provided by a physician or registered personnel.

c. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

d. Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

e. Load Handling Equipment (LHE) Accident. A LHE accident occurs when any one or more of the elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing, resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking;

overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.) Any mishap meeting the criteria described above shall be documented in both the Contractor Significant Incident Report (CSIR) submitted within five days both as provided by the Contracting Officer.

f. Operating Envelope. The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane,the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook and the load, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G

Crane Operators; G

Submit proof of Qualifications.

SD-06 Test Reports

Notifications and Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph, "Notifications and Reports."

Accident Reports; G

Crane Reports

SD-07 Certificates

Standard Lift Plan; G

Critical Lift Plan; G

Naval Architecture Analysis; G

Confined Space Entry Plan

Confined Space Entry Permit

Hot Work Permit

Certificate of Compliance

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, and all applicable federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.5.1 Personnel Qualifications

1.5.1.1 Site Safety and Health Officer (SSHO)

The SSHO must meet the requirements of EM 385-1-1 Section 1 and ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Designated Representative/alternate shall be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO's training, experience, and qualifications shall be as required by EM 385-1-1 paragraph 01.A.17, entitled SITE SAFETY AND HEALTH OFFICER (SSHO), and all associated sub-paragraphs.

A Competent Person shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the Contracting Officer for acceptance in consultation with the Safety Office.

1.5.1.1.1 Contractor Quality Control (QC) Person:

The Contractor Quality Control System Manager cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties.

1.5.1.2 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 15 and Section 16. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.

1.5.2 Personnel Duties

1.5.2.1 Site Safety and Health Officer (SSHO)

The SSHO shall:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily quality control report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPs and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Maintain a list of hazardous chemicals on site and their material safety data sheets.

k. Immediately notify the Contracting Officer of any OSHA representatives entering the site.

l. Failure to perform the above duties may result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.5.3 Meetings

1.5.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review,

and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP, identified during the Contracting Officer's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Construction work is not permitted to begin work until an APP is established that is acceptable to the Contracting Officer.

1.6 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A. Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor quality control manager, and any designated Certified Safety Professional (CSP).

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the Contracting Officer's office and at the job site.

Continuously review and amend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.6.1 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.6.1.1 Confined Space Entry Plan

Develop a confined or enclosed space entry plan in accordance with EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

1.6.1.2 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-2 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of 3 months.

1.6.1.3 Critical Lift Plan - Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Section 16.H.01, using Form 16-3. In addition, Critical Lift Plans are required for the following:

a. Lifts over 50 percent of the capacity of barge mounted mobile crane's hoist.

b. When working around energized power lines where the work will get closer than the minimum clearance distance in EM 385-1-1 Table 16-1.

c. For lifts with anticipated binding conditions.

d. When erecting cranes.

1.6.1.3.1 Critical Lift Plan Planning and Schedule

Critical lifts require detailed planning and additional or unusual safety precautions. Develop and submit a critical lift plan to the Contracting Officer 30 calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1, Section 16.F.03.

1.6.1.3.2 Lifts of Personnel

In addition to the requirements of EM 385-1-1, Section 16.H.02, for lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1, Section 16.T.

1.6.1.4 Barge Mounted Mobile Crane Lift Plan

Provide a Naval Architecture Analysis and include an LHE Manufacturer's Floating Service Load Chart in accordance with EM 385-1-1, Section 16.L.03.

1.6.1.5 Multi-Purpose Machines, Material Handling Equipment, and Construction Equipment Lift Plan

Multi-purpose machines, material handling equipment, and construction equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Written approval from a qualified registered professional engineer, after a safety analysis is performed, is allowed in lieu of the OEM's approval. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart.

1.6.1.6 Fall Protection and Prevention (FP&P) Plan

The plan must comply with the requirements of EM 385-1-1, Section 21.D and ASSE/SAFE Z359.2, be site specific, and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A competent person or qualified person for fall protection must prepare and sign the plan documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum every six months, for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.6.1.7 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section 21.N and ASSE/SAFE Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.6.1.8 Excavation Plan

Identify the safety and health aspects of excavation, and provide and prepare the plan in accordance with EM 385-1-1, Section 25.A and Section 31 23 20 UNDERWATER EXCAVATION.

1.6.1.9 Site Demolition Plan

Identify the safety and health aspects, and prepare in accordance with Section 02 41 00 DEMOLITION and referenced sources.

1.7 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any construction activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.8 DISPLAY OF SAFETY INFORMATION

Within one calendar day(s) after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, Section 01.A.07. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.9 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.10 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.11 NOTIFICATIONS and REPORTS

1.11.1 Accident Notification

Notify the Contracting Officer as soon as practical, but no more than four hours after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any load handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until

the Government investigation team arrives on-site and Government investigation is conducted.

1.11.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, property damage accidents resulting in at least $20,000 in damages, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable USACE Accident Report Form 3394, and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

b. Conduct an accident investigation for any load handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The Contracting Officer will provide a blank copy of the accident report form. Document a load handling mishap using the CRANE AND/OR RIGGING ACCIDENT/INCIDENT NOTIFICATION reporting form contained in the attachments at the end of this section.

1.11.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Section 16.D and as specified herein with Daily Reports of Inspections.

1.11.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16). Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). Post certifications on the crane.

1.12 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.13 CONFINED SPACE ENTRY REQUIREMENTS.

Contractors entering and working in confined spaces while performing general industry work are required to follow the requirements of OSHA 29 CFR 1926 and comply with the requirements in Section 34 of EM 385-1-1, OSHA 29 CFR 1910, and OSHA 29 CFR 1910.146.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.2 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to FAR 52.243-4, "Changes" and FAR 52.236-2, "Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Apply for utility outages at least 5 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSE/SAFE Z359.2 and EM 385-1-1, Sections 21.A and 21.D.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.C.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraph 21.0. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926 Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabineers shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a minimum safety factor of 2 as per 29 CFR 1926.502(d)(8).

3.4.4 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.5 Rescue and Evacuation Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.5.2 Load Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, Section 16.

b. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection in accordance with ASME B30.5. Perform all testing in accordance with the manufacturer's recommended procedures.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

d. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11 and ASME B30.5 or

ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

3.5.3 Use Of Explosives

Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

3.6 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.6.1 Utility Locations

All underground utilities in the work area must be positively identified by a third party, independent, private utility locating company in addition to any station locating service and coordinated with the station utility department.

3.6.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system.

3.6.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company shall locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.7 PORTABLE EXTENSION CORDS

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately remove from service all damaged extension cords. Portable extension cords shall meet the requirements of EM 385-1-1, NFPA 70E, and OSHA electrical standards.

3.8 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, OSHA Directive CPL 2.100 and OSHA 29 CFR 1926. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 34 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

3.9 LIST OF ATTACHMENTS

a. Crane Accident Reporting Procedures

b. Hot Work Permit

-- End of Section --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

ATTACHMENTS

CRANE ACCIDENT REPORTING FORM

CRANE AND/OR RIGGING ACCIDENT/INCIDENT NOTIFICATION

Accident Category: ☐ Crane Accident ☐ Rigging Accident

From District	To: Crane Working Group Attn: Ellen Stewart 441 G Street NW Washington, DC 20314 ellen.b.stewart@usace.army.mil
Activity:	Report No (CESO):

Crane Serial No:	Class (I or II):	Accident Date:	Time: (24 hr format)

Category of Service: ☐ General Duty ☐ Floating Plant	Crane Type: (see instructions)	Crane Manufacturer:

Was Crane/Hoist used as part of a Critical Lift: ☐ Yes ☐ No	Was Critical Lift Plan Prepared? ☐ Yes ☐ No If yes, please attach documentation.
Location:	Weather:

Crane Capacity:	Hook Capacity:	Weight of Load on hook:

Fatality or Permanent Disability? ☐ Yes ☐ No Reported in ENGLink? ☐ Yes ☐ No	Material/Property Cost Estimate:

Accident Type:

☐ Personal Injury, Lost time ☐ Load Collision ☐ Overload ☐ Damaged Rigging Gear

☐ Personal injury, Non-LT ☐ Two Blocked ☐ Dropped Load ☐ Damaged Crane

☐ Crane Collision ☐ Damaged Load ☐ Other: Specify _____

Direct Cause of Accident:

☐ Improper Operation ☐ Equipment Failure ☐ Inadequate Visibility

☐ Improper Rigging ☐ Switch Alignment ☐ Inadequate Communication

☐ Track Condition ☐ Procedural Failure ☐ Other: Specify _____

Chargeable to:

☐ Signal Person ☐ Rigger ☐ Operator

☐ Maintenance ☐ Management/Supervision ☐ Other: Specify _____

Crane Function:

☐ Travel ☐ Hoist ☐ Rotate ☐ Luffing ☐ Telescoping ☐ Other ☐ N/A

Is this accident indicative of a recurring problem? ☐ Yes ☐ No

If yes, list ENGLink Report Nos.: _____

ATTACH COMPLETE AND CONCISE SITUATION DESCRIPTION, CORRECTIVE/PREVENTIVE ACTIONS TAKEN AND PHOTOS AS ENCLOSURE (1). Include probable cause and contributing factors. Assess damages and define responsibility. For equipment malfunction or failure, include specific description of the component and the resulting effect or problem caused by the malfunction or failure. List immediate and long term corrective/preventive actions to be taken and to whom they were assigned.

Preparer:	Phone:	E-mail:	Org:	Date:

Concurrences: (Include Code, Signature and Date)

	Org:	Date:
	Org:	Date:
Certifying Official (Crane Accident Only):	Org:	Date:

Initial Details / Facts:

Site diagram/sketch (attach)

Photographs (attach)

CRANE AND RIGGING ACCIDENT/INCIDENT REPORT INSTRUCTIONS

This form is designed for fax transmission without a cover page or by e-mail and, with enclosures and signatures shall be the official document. Electronic submission will be accepted without signatures but the names of the preparer, concurring personnel, and certifying official (for crane accidents only) shall be filled in. The e-mail address is: ellen.b.stewart@usace.army.mil

1. Accident Category: Indicate either crane accident or rigging gear accident.
2. From: The District/POC that is responsible for reporting the accident.
3. Activity: The activity/location where the accident took place.
4. Report No.: The activity assigned accident number (CESO will assign a tracking number).
5. Crane Serial No.: The serial number(s) of the equipment involved.
6. Class: Identify the Class of Crane (Class I or II).
7. Accident Date: The date the accident occurred.
8. Time: The time (24 hour clock) the accident occurred (e.g., 1300).
9. Category of Service: General site activities or Floating Plant operations
10. Crane Type: The type of crane involved in the accident (select from this list)
    - TLL - Telescopic Boom Crane (Swing Cab)
    - TSS - Telescopic Boom Crane (Fixed Cab)
    - LB - Lattice Boom Crane
    - TWR - Tower Crane
    - OVR - Overhead Crane
    - ABC - Articulating Boom Crane
    - ABL - Articulating Boom Loader
    - OTHER - Describe
11. Crane Manufacturer: The manufacturer of the crane (e.g., Dravo, Grove, P&H), if applicable.
12. Was the crane or rigging gear being used in a Critical Lift (per 16.H)?
13. Was a Critical Lift Plan prepared? If so, attach this documentation.
14. Location: The detailed location where the accident took place (e.g., building 213, dry dock 5).
15. Weather: The weather conditions at time of accident (e.g., wind, rain, cold).
16. Crane Capacity: The certified capacity of the crane (e.g., 120,000 pounds), if applicable.
17. Hook Capacity: The capacity of the hook involved in the accident at the max radius of the operation, if applicable.
18. Weight of Load on Hook: If applicable, the weight of the load on the hook.
19. Fatality or Permanent Disability?: Check yes or no.
20. Material/Property Cost Estimate: Estimate total cost of damage resulting from the accident.
21. Reported in ENGLink? Self-explanatory.
22. Accident Type: Check all that apply.
23. Direct Cause of Accident: Check all that apply.
24. Chargeable to: Check all that apply.
25. Crane Function: Check all functions in operation at time of accident. Check N/A if a rigging gear accident.
26. Is this a recurring problem?: Check yes or no. Identify any other similar accidents.
27. Situation Description/Corrective Actions: Self-explanatory.
28. Preparer: Self-explanatory.
29. Concurrences: Self-explanatory.
30. Certifying Official (Crane Accidents Only): Self-explanatory.
31. Brief Description: No more than one paragraph summarizing the resultant incident.
32. Background and Detailed Description: Provide the relevant background in a descriptive timeline of preconditions leading up to the event, as well as a detailed description of the event.
33. Corrective Actions: List all short term and long term corrective actions that are taken to prevent recurrence of the incident. Short Term Corrective Actions are those actions taken that will allow return to work in short time frame. Long Term actions are more ‘programmatic’ in nature and typically include: process revision, changes in training, ‘mistake proofing’, etc.

HOT WORK PERMIT FORM

HOT-WORK PERMIT

For use of this form, see AR 420-1; the proponent agency is ACSIM.

1. LOCATION	2. DATE	3. PERMIT NO.
4. TYPE OF WORK	5. START TIME	6. FINISH TIME
7.a. NAME OF PERSON RESPONSIBLE FOR HOT-WORK AT JOB SITE *(Contractor/Government Employee)*	7.b. SIGNATURE	

PRECAUTIONS BEFORE OPERATIONS

CHECKLIST	CHECK ONE	
	YES	NO
8. Did Fire Department Inspector inspect site?	☐	☐
9. Are there procedures for Fire Department emergency notification? *(Emergency No.)*	☐	☐
10. Are combustibles in area noted?	☐	☐
11. Should combustibles be covered? *(If yes, note in remarks)*	☐	☐
12. Are proper extinguishers on hand?	☐	☐
13. Is wet-down necessary? *(If yes, note in remarks)*	☐	☐
14. Is smoking permissible at work sites?	☐	☐
15. Is continuous fire watch required?	☐	☐
16. Is Fire Department standby required?	☐	☐
17. Are other precautions required? *(If yes, note in remarks)*	☐	☐

18.a. FIRE DEPARTMENT INSPECTOR'S SIGNATURE	18.b. DATE

PRECAUTIONS AFTER OPERATIONS

CHECKLIST	CHECK ONE	
	YES	NO
19.a. Was Fire Department notified after hot-work operation was completed?	☐	☐
19.b. Time:		
20.a. Did Fire Department inspector inspect work site?	☐	☐
20.b. Time:		
21. Are after work conditions safe? *(If no, note in remarks)*	☐	☐
22. Are heat producing devices safe if left at work site?	☐	☐

23.a. FIRE DEPARTMENT INSPECTOR'S SIGNATURE	23.b. DATE

24. REMARKS

NOTE: PERMIT VALID ON DAY OF OPERATION AT ONE LOCATION ONLY

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

-- End of Section Table of Contents --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g., ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: https://www.transportation.org/

AMERICAN CONCRETE INSTITUTE (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
Internet: https://www.concrete.org/

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
130 East Randolph, Suite 2000
Chicago, IL 60601
Ph: 312-670-5444
Fax: 312-670-5403
Steel Solutions Center: 866-275-2472
E-mail: solutions@aisc.org
Internet: https://www.aisc.org/

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
P.O. Box 28518
1711 Arlingate Lane
Columbus, OH 43228-0518
Ph: 800-222-2768 or 614-274-6003
Fax: 614-274-6899

E-mail: tjones@asnt.org
Internet: https://www.asnt.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 800-548-2723; 703-295-6300
Internet: https://www.asce.org/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Two Park Avenue
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet: https://www.asme.org/

AMERICAN WELDING SOCIETY (AWS)
8669 NW 36 Street, #130
Miami, FL 33166-6672
Ph: 800-443-9353
Internet: https://www.aws.org/

APA - THE ENGINEERED WOOD ASSOCIATION (APA)
7011 South 19th St.
Tacoma, WA 98466-5333
Ph: 253-565-6600
Fax: 253-565-7265
Internet: https://www.apawood.org/

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: https://www.astm.org/

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 North Plum Grove Road
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Fax: 847-517-1206
Internet: http://www.crsi.org/

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
EIA has become part of the ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-981-9667
E-mail: onlinesupport@ieee.org
Internet: https://www.ieee.org/

INTERNATIONAL CODE COUNCIL (ICC)
500 New Jersey Avenue, NW
6th Floor, Washington, DC 20001
Ph: 800-786-4452 or 888-422-7233
Fax: 202-783-2348
E-mail: order@iccsafe.org
Internet: https://www.iccsafe.org/

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)
1000 Westgate Drive, Suite 252
St. Paul, MN 55114
Ph: 651-366-6095
Fax: 651-290-2266
E-mail: info@icri.org
Internet: https://www.icri.org/

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1901 North Moore Street
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
Internet: https://safetyequipment.org/

MASTER PAINTERS INSTITUTE (MPI)
2800 Ingleton Avenue
Burnaby, BC CANADA V5C 6G7
Ph: 1-888-674-8937
Fax: 1-888-211-8708
E-mail: info@paintinfo.com or techservices@mpi.net
Internet: http://www.mpi.net/

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Internet: https://www.nema.org

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 800-344-3555
Fax: 800-593-6372
Internet: https://www.nfpa.org

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
Patriots Plaza 1
395 E Street, SW, Suite 9200
Washington, DC 20201
Ph: 800-232-4636
Fax: 513-533-8347
Internet: https://www.cdc.gov/niosh/

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)
200 West Adams St., 2100
Chicago, IL 60606
Ph: 312-786-0300
Bookstore: 312-428-4946
Internet: https://www.pci.org/

SOCIETY FOR PROTECTIVE COATINGS (SSPC)
800 Trumbull Drive
Pittsburgh, PA 15205
Ph: 877-281-7772 or 412-281-2331
Fax: 412-444-3591
E-mail: customerservice@sspc.org
Internet: http://www.sspc.org

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
http://www.wbdg.org/ffc/army-coe/standards
Order Other Documents from:
Official Publications of the Headquarters, USACE
E-mail: hqpublications@usace.army.mil
Internet: http://www.publications.usace.army.mil/
or
https://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
Fax: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: https://www.ntis.gov/
Obtain Military Specifications, Standards and Related Publications from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: https://assist.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet:
https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Internet: https://www.archives.gov/
Order documents from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW

Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: https://www.gpo.gov/

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph: 877-854-3577 or 360-817-5500
E-mail: CustomerExperienceCenter@ul.com
Internet: https://www.ul.com/
UL Directories available through IHS at https://ihsmarkit.com/

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

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RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM)

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RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 MEASUREMENT AND PAYMENT

The work of this section is not measured for payment. The Contractor is responsible for the work of this section, without any direct compensation other than the payment received for contract items.

1.3 CONTRACT ADMINISTRATION

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Government accesses the system using the Government Mode of RMS (RMS GM). The Contractor accesses the system using the Contractor Mode of RMS, referred to as RMS CM, to record, maintain, and submit various information throughout the contract period. The term RMS will be used in the remainder of this section for both RMS GM and RMS CM. The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. RMS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Closeout
Import/Export of Data

1.3.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible. Some correspondence, including pay requests and payrolls, are also to be provided in paper format with original signatures. Paper documents will govern, in the event of discrepancy with the electronic version.

1.3.2 Other Factors

Other portions of this document have a direct relationship to the reporting accomplished through RMS. Particular attention is directed to Contract Clause, 52.236-15 "Schedules for Construction Contracts"; Contract Clause, 52.232-27 "Prompt Payment for Construction Contracts"; Contract Clause, 52.232-5 "Payments Under Fixed-Priced Construction Contracts"; Section 01 32 01.00 13 PROJECT SCHEDULE; Section 01 33 00 SUBMITTAL PROCEDURES; Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS; and Section 01 45 04.00 13 CONTRACTOR QUALITY CONTROL.

1.4 RMS SOFTWARE

RMS is a Windows-based program that can be run on a Windows based PC meeting the requirements as specified in Paragraph: SYSTEM REQUIREMENTS. Download, install and be able to utilize the latest version of the RMS software within 7 calendar days of receipt of the Notice to Proceed. RMS software, user manuals, access and installation instructions, program updates and training information are available from the RMS website (https://rms.usace.army.mil). The Government and the Contractor will have different access authorities to the same contract database through RMS. The common database will be updated automatically each time a user finalizes an entry or change.

1.5 SYSTEM REQUIREMENTS

The following is the minimum system configuration required to run the Contractor Mode RMS features.

Minimum RMS System Requirements	
Hardware	
Windows-based PC	1.5 GHz 2 core or higher processor
RAM	8 GB
Hard drive disk	200 GB space for sole use by the RMS system
Monitor	Screen resolution 1366 x 768
Mouse or other pointing device	
Windows compatible printer	Laser printer must have 4 MB+ of RAM
Connection to the Internet	minimum 4 Mbs per user
Software	
MS Windows	Windows 10 x 64 bit (RMS requires 64 bit O/S) or newer

Minimum RMS System Requirements	
Word Processing software	Viewer for MS Word 2013, MS Excel 2013, or newer
Microsoft.NET Framework	Coordinate with Government QA Representative for free version required
E-mail	MAPI compatible
Virus protection software	Regularly upgraded with all issued manufacturer's updates and is able to detect most zero day viruses.

1.6 CONTRACT DATABASE - GOVERNMENT

The Government will enter the basic contract award data in RMS prior to granting the Contractor access. The Government entries into RMS will generally be related to submittal reviews, correspondence status, and Quality Assurance(QA)comments, as well as other miscellaneous administrative information.

1.7 CONTRACT DATABASE - CONTRACTOR

Contractor entries into RMS establish, maintain, and update data throughout the duration of the contract. Contractor entries generally include prime and subcontractor information, daily reports, submittals, RFI's, schedule updates and payment requests. RMS includes the ability to import attachments and export reports in many of the modules, including submittals. The contractor responsibilities for entries in RMS typically include the following items:

1.7.1 Administration

1.7.1.1 Contractor Information

Enter all current Contractor administrative data and information into RMS within 7 calendar days of receiving access to the contract in RMS. This includes, but is not limited to, Contractor's name, address, telephone numbers, management staff, and other required items.

1.7.1.2 Subcontractor Information

Enter all missing subcontractor administrative data and information into RMS CM within 7 calendar days of receiving access to the contract in RMS or within 7 calendar days of the signing of the subcontractor agreement for agreements signed at a later date. This includes name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed.

1.7.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office

with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C" or "RFP".

1.7.1.4 Equipment

Enter and maintain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5 Reports

Track the status of the project utilizing the reports available in RMS. The value of these reports is reflective of the quality of the data input. These reports include the Progress Payment Request worksheet, Quality Control (QC) comments, Submittal Register Status, and Three-Phase Control worksheets.

1.7.1.6 Request For Information (RFI)

Create and track all Requests For Information (RFI) in the RMS Administration Module for Government review and response.

1.7.2 Finances

1.7.2.1 Pay Activity Data

Develop and enter a list of pay activities in conjunction with the project schedule. The sum of pay activities equals the total contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities assigned to a CLIN equals the amount of each CLIN.

1.7.2.2 Payment Requests

Prepare all progress payment requests using RMS. Update the work completed under the contract at least monthly, measured as percent or as specific quantities. After the update, generate a payment request and prompt payment certification using RMS. Submit the signed prompt payment certification and payment request as well as supporting data either electronically or by hard copy. Unless waived by the Contracting Officer, a signed paper copy of the approved payment certification and request is also required and will govern in the event of discrepancy with the electronic version.

1.7.3 Quality Control (QC)

Enter and track implementation of the 3-phase QC Control System, QC testing, transferred and installed property and warranties in RMS. Prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements in RMS. Maintain all data on a daily basis. Insure that RMS reflects all quality control methods, tests and actions contained within the Contractor Quality Control (CQC) Plan and Government review comments of same within 7 calendar days of Government acceptance of the CQC Plan.

1.7.3.1 Quality Control (QC) Reports

The Contractor's Quality Control (QC) Daily Report in RMS is the official

report. The Contractor can use other supplemental formats to record QC data, but information from any supplemental formats are to be consolidated and entered into the RMS QC Daily Report. Any supplemental information may be entered into RMS as an attachment to the report. QC Daily Reports must be finalized and signed in RMS within 24 hours after the date covered by the report. Provide the Government a printed signed copy of the QC Daily Report, unless waived by the Contracting Officer.

1.7.3.2 Deficiency Tracking.

Use the QC Daily Report Module to enter and track deficiencies. Deficiencies identified and entered into RMS by the Contractor or the Government will be sequentially numbered with a QC or QA prefix for tracking purposes. Enter each deficiency into RMS the same day that the deficiency is identified. Monitor, track and resolve all QC and QA entered deficiencies. A deficiency is not considered to be corrected until the Government indicates concurrence in RMS.

1.7.3.3 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS. Worksheets for the three-phase control meetings are generated within RMS.

1.7.3.4 Labor and Equipment Hours

Enter labor and equipment exposure hours on a daily basis. Roll up the labor and equipment exposure data into a monthly exposure report.

1.7.3.5 Accident/Safety Reporting

Both the Contractor and the Government enter safety related comments in RMS as a deficiency. The Contractor will monitor, track and show resolution for safety issues in the QC Daily Report area of the RMS QC Module. In addition, follow all reporting requirements for accidents and incidents as required in EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and as required by any other applicable Federal, State or local agencies.

1.7.3.6 Definable Features of Work

Enter each feature of work, as defined in the approved CQC Plan, into the RMS QC Module. A feature of work may be associated with a single or multiple pay activities, however a pay activity is only to be linked to a single feature of work.

1.7.3.7 Activity Hazard Analysis

Import activity hazard analysis electronic document files into the RMS QC Module utilizing the document package manager.

1.7.4 Submittal Management

Enter all current submittal register data and information into RMS within 7 calendar days of receiving access to the contract in RMS. The information shown on the submittal register following the specification section 01 33 00 SUBMITTAL PROCEDURES will already be entered into the RMS database when access is granted. Use RMS to group electronic submittal documents into transmittal packages to send to the Government. Some

submittals cannot be imported into RMS. These submittals may include very large electronic files, samples, spare parts, mock ups, color boards, or where hard copies are specifically required. Track transmittals and update the submittal register in RMS on a daily basis throughout the duration of the contract.

1.7.5 Schedule

Enter and update the contract project schedule in RMS by either manually entering all schedule data or by importing the Standard Data Exchange Format (SDEF) file, based on the requirements in Section 01 32 01.00 13 PROJECT SCHEDULE.

1.7.6 Closeout

Closeout documents, processes and forms are managed and tracked in RMS by both the Contractor and the Government. The Contractor is responsible to ensure that all closeout documents are entered, completed and documented within RMS.

1.8 IMPLEMENTATION

Use of RMS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS system. RMS is an integral part of the Contractor's required management of quality control.

1.9 NOTIFICATION OF NONCOMPLIANCE

Take corrective action within 7 calendar days after receipt of notice of RMS non-compliance by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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CONTRACTOR QUALITY CONTROL

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SECTION 01 45 04.00 13

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 3740	(2019) Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00: SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

CONTRACTOR QUALITY CONTROL (CQC) PLAN; G

1.3 QUALITY CONTROL ORGANIZATION

1.3.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and alternate(s) and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be maintained at the

site at all times, except as otherwise acceptable to the Contracting Officer.

1.3.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a person with a minimum of 5 years experience in related duties on construction work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall not have any additional or collateral duties such as project superintendent or SSHO in addition to quality control. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

1.3.3 Additional Requirement

In addition to the above qualifications, the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors". This course is periodically offered through the Government in the Minneapolis - St. Paul, Minnesota metropolitan area.

1.3.4 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with Contract Clause 52.246-12 Inspection of Construction. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN

3.2.1 General

The Contractor shall furnish for review by the Government, not later than 15 days after receipt of notice to proceed, the CQC Plan proposed to implement the requirements of Contract Clause 52.246-12 Inspection of Construction. The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent or someone higher in the Contractor's organization.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM).

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests

including documentation in RMS.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action in RMS.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in the CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 10 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01 33 00 SUBMITTAL PROCEDURES. The CQC system manager shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.5 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.5.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans, documents, and materials are approved or accepted. Copies of the plans shall be available at the preparatory meeting. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analyses to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to

the acceptable level of workmanship required in order to meet contract specifications.

3.5.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare workmanship with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.5.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.5.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.6 TESTS

3.6.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that

control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.6.2 Testing Laboratories

A link to a current listing of validated testing laboratories is available at: https://mtc.erdc.dren.mil

3.6.2.1 Compliance Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.6.2.2 Compliance Recheck

If the selected laboratory fails the Compliance check, the Contractor will be assessed a charge of $1000.00 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.6.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.6.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Contracting Officer. Coordination for each specific test, exact delivery location, and dates will be made with the Contracting Officer.

3.7 COMPLETION INSPECTION

3.7.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in Contract Contract Clause 52.211-10 ALT I, COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK, or by the specifications, the CQC System Manager shall conduct an inspection of the work and update the deficiency list in RMS to include all items which do not conform to the approved drawings and specifications. The deficiency listing in RMS shall be edited to reflect the estimated date by which the deficiencies shall be corrected. The CQC System Manager shall make a second inspection to ascertain that all deficiencies have been corrected. Once the Contractor verifies correction of said deficiencies, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.7.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. The Government will update the deficiency list in RMS. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.7.3 Final Acceptance Inspection

The Contractor's quality control inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer shall be in attendance during the final acceptance inspection. Additional Government personnel may also be in attendance. The final acceptance inspection shall be formally scheduled by the Contractor based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection, provided that the Contracting Officer receives the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled CONTRACT CLAUSE 52.246-12 INSPECTION OF CONSTRUCTION.

3.8 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be submitted through RMS. The contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by RMS shall be the Contractor's official report. The reports shall include, as a minimum, the following information:

a. Contractor or subcontractor and its area of responsibility.

b. Operating plant and equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project, the number of personnel working, weather conditions encountered, and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Reports shall be submitted electronically to the Government within 24 hours after the date covered by the report. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report. Reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The signed, printed copy of the daily CQC Report shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.9 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

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TEMPORARY CONSTRUCTION FACILITIES

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SECTION 01 50 02.00 13

TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Site Plan;

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

Government Field Office;

The Contractor shall submit a preliminary plan and description of the mobile office facilities which it proposes to furnish prior to proceeding with procurement thereof.

SD-06 Test Reports

Formaldehyde Emission Test Results

The Contractor shall submit formaldehyde emission test results for any administrative or government field offices as specified in this section.

1.3 GROUNDS AND ROADWAYS

1.3.1 Availability of Grounds

The boundary limits of the grounds made available for the Contractor's use during the life of the contract are shown on the drawings. Any additional rights-of-entry or grounds desired by the Contractor shall be obtained by the Contractor at its own expense, and copies of agreements for the use of such rights-of-entry shall be furnished to the Contracting Officer before entering thereon. Such agreements shall clearly relieve the Government of any responsibility for damages resulting from the use of the grounds.

1.3.2 Drainage Facilities

Insofar as natural drainage from the protected areas is obstructed by contract operations, it shall be the Contractor's responsibility to make adequate provision for accommodating such drainage in a satisfactory manner during the life of this contract, either by temporary means or by use of the permanent construction and operation of the permanent facilities.

1.4 PAVEMENT REMOVAL AND REPLACEMENT

Where roads are cut, removed, or otherwise damaged in the prosecution of the work the Contractor shall repair or replace all pavements or other surfacings so removed or damaged to their preconstruction condition. After backfill is completed on streets to be paved, a temporary surface shall be laid down and the street opened to the traffic in order to provide access to abutting property. Restoration of the original street surface shall be completed no later than 60 calendar days after starting excavation. Should weather conditions preclude the restoration of the original surface material, temporary resurfacing utilizing a bituminous mixture shall be installed with the final surface constructed no later than June 1 of the following construction season.

1.5 AVAILABILITY AND USE OF UTILITY SERVICES

1.5.1 Temporary Electrical Facilities

The Contractor shall be responsible for coordination and costs for electrical power required for the Contractor's operations, including all costs for utility company hookup, installation/dismantling of transformers and distribution lines. In general, the Contractor shall establish its own service connection with the utility company. If the Contractor proposes to use an existing Government service connection, a request shall be submitted for approval to verify the Contractor's use will not interfere with operation of the facilities, and the monthly service fees will be paid for in whole (including Government power consumption) by the Contractor.

1.5.2 Sanitation

The Contractor shall provide and maintain within the construction area field-type sanitary facilities in accordance with EM 385-1-1. These facilities shall include but not be limited to toilet, washing, and drinking water facilities. Government toilet facilities will not be available to Contractor's personnel.

1.5.3 Telephone

The Contractor shall make arrangements and pay all costs for its telephone facilities desired. Government personnel will not take or deliver messages for the Contractor.

1.6 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. Dust control shall be provided as stated in Section 01 57 20.00 13 ENVIRONMENTAL PROTECTION.

1.6.1 Off-Site Haul Routes

The Contractor shall be responsible for securing all permits required along haul routes, in accordance with Section 01 00 00.00 13 HAUL ROUTE PERMITS. The Contractor shall be the sole permittee and shall be responsible for meeting all obligations of the permits. A copy of each permit shall be submitted to the Contracting Officer. The Contractor has sole responsibility for damage or deterioration of the Contractor's haul routes.

1.6.2 On-Site Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control chosen by the Contractor shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Contracting Officer shall be removed and the area restored to its pre-construction condition.

1.6.3 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate

illumination to provide sufficient visual warning of the hazard during both day and night.

1.7 CONTRACTOR'S TEMPORARY FACILITIES

1.7.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.7.2 Formaldehyde Emission Requirements

Any administrative field offices the Contractor proposes to use shall be tested for formaldehyde emission by a state certified laboratory prior to being brought on site. The formaldehyde emission level shall not exceed 0.016 ppm. If this level is exceeded for any administrative field office, the Contractor shall take appropriate action to reduce the formaldehyde emission concentration to an acceptable level or shall provide another administrative field office that meets the requirements. No Luan, MDF, vinyl gypsum, or products that contain urea-formaldehyde will be allowed.

1.7.3 Staging Area

The boundary limits of the grounds made available for the Contractor's use during the life of the contract are shown on the drawings as "Work Limits", "Construction Limits", and/or staging area(s). Trailers, materials, or equipment shall not be placed or stored outside the work limits.

1.8 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

PART 2 PRODUCTS

2.1 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

2.1.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

2.1.2 Project and Safety Signs

The Contractor shall furnish and erect a Project sign and a Safety sign in

a location selected by the Contracting Officer at the project site prior to the start of Construction. The requirements for the signs and their content shall be as shown on the drawings at the end of this section. The data required by the safety sign shall be corrected daily. Signs shall be maintained throughout the construction period, and upon completion of the project, the signs shall be removed from the site. The PROJECT DESCRIPTION and PROJECT NAME shall be as follows:

LOCK AND DAM 4
END CELL
MISSISSIPPI RIVER BASIN
ALMA, WISCONSIN

PART 3 EXECUTION

3.1 MAINTENANCE OF GROUNDS

Borrow areas, stockpiles, and other grounds stripped of natural vegetation or disturbed by the Contractor's operations shall be kept free of noxious weeds, debris, and unnecessary materials and supplies. Control of vegetation shall comply with local ordinances.

3.2 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

3.3 RESTORATION

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will remain the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including topsoil and seeding as necessary.

3.4 SUMMARY OF ATTACHMENTS

a. Project Sign Requirements

-- End of Section --

SECTION 01 50 02.00 13

TEMPORARY CONSTRUCTION FACILITIES

ATTACHMENTS

US Army Corps of Engineers

ENGINEERING AND CONSTRUCTION BULLETIN

No. 2020-1 **Issuing Office:** CECW-EC **Issued:** 31 Jan 20 **Expires:** 31 Jan 22

SUBJECT: USACE Construction Project Signs and Use of the Army Star

CATEGORY: Directive and Policy

1. **References**:

a. Engineer Pamphlet (EP) 310-1-6a, Sign Standards Manual, VOL 1, 01 June 2006.

b. Army Regulation (AR) 601–208, The Army Brand and Marketing Program, 16 July 2013.

2. **Purpose.** Provide direction and guidelines regarding use of the Army Star emblem for USACE construction projects signage.

a. **Design.** USACE policy to include guidelines on fabricating, locating, and mounting construction project signs is provided in Engineer Pamphlet (EP) 310-1-6a, Sign Standards Manual, VOL 1, Section 16, dated 01 June 2006. The guidelines for accomplishing all construction projects now includes a requirement to add the Army Star emblem to construction project signs. Accordingly, graphic format guidance on page 16-2 of EP 310-1-6a is hereby modified to incorporate the Army Star logo on construction project signs for all projects, both on and off USACE facilities. For official Army Brand information refer to Army Regulation (AR) 601-208, The Army Brand and Marketing Program, 16 July 2013. The Army Star logo dimensions for height and width of are multiples of four high by three wide. The proper incorporation of the Army Star logo in the standard USACE construction project signage is illustrated in the attached examples of construction project sign graphics.

3. **Directions.** Effective upon release of this ECB, all USACE projects will display signage that features the Army Star logo as part of the overall USACE construction project signage. Construction projects will incorporate the Army Star logo into the standard construction project identification sign, as shown in the attachments. Engineering and construction project specification writers are responsible to update the construction project signage text of their standard contract specification clause to include incorporation of the Army Star logo for all projects. District Sign Program Managers or District or MSC Chiefs of Natural Resources in Operations Division can provide the specific graphics.

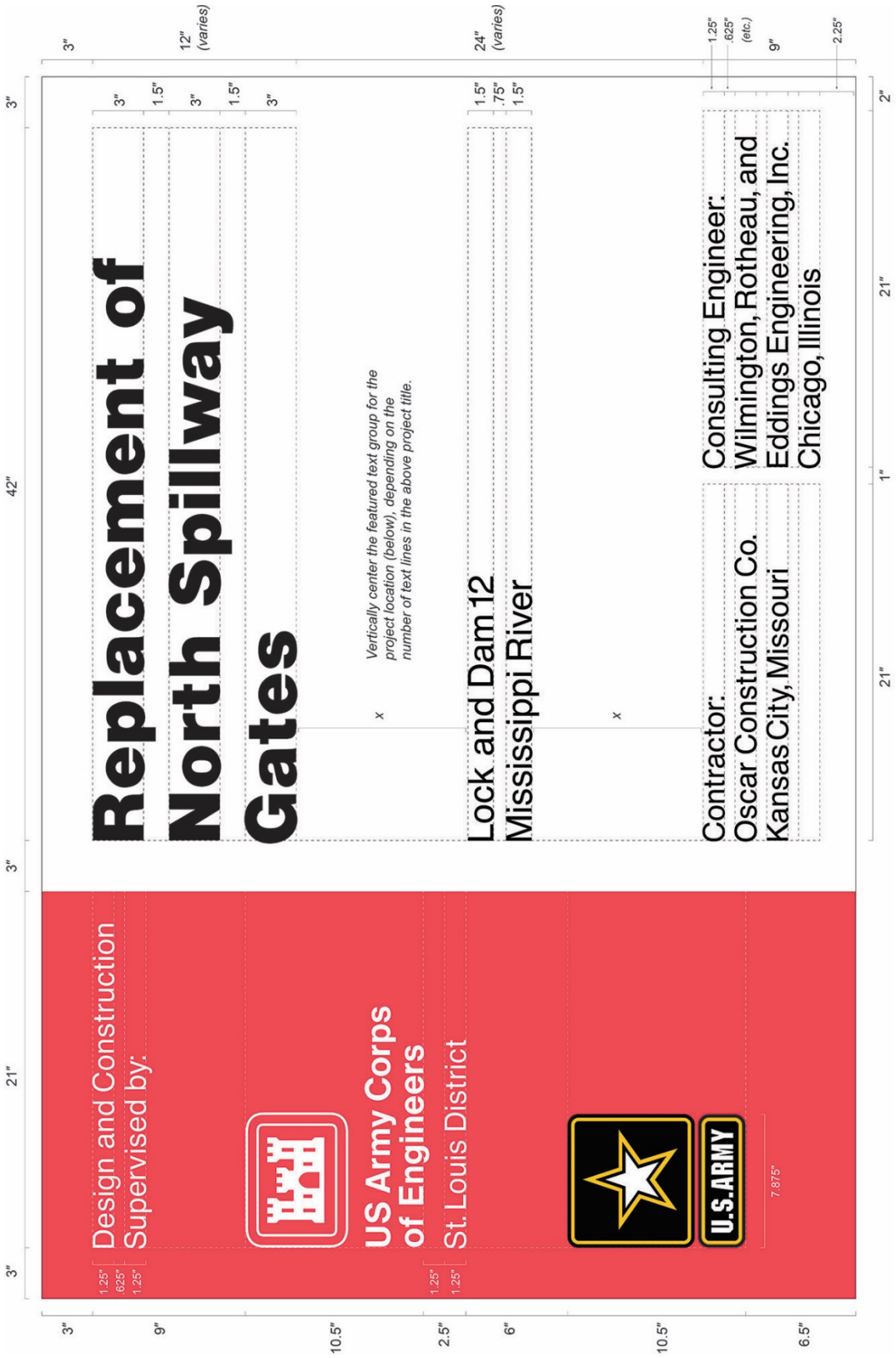
4. **Update.** All new requirements will be included in the next appropriate policy document update.

5. **Points of Contact.** HQUSACE points of contact for this ECB are AJ Jensen, USACE National Sign Program Manager, Mandatory Center of Expertise (MCX), CENWK-OFH-T, (816) 389-3840 and Jennifer L. Kline, P.E., HQUSACE CECW-EC, (202) 761-0076.

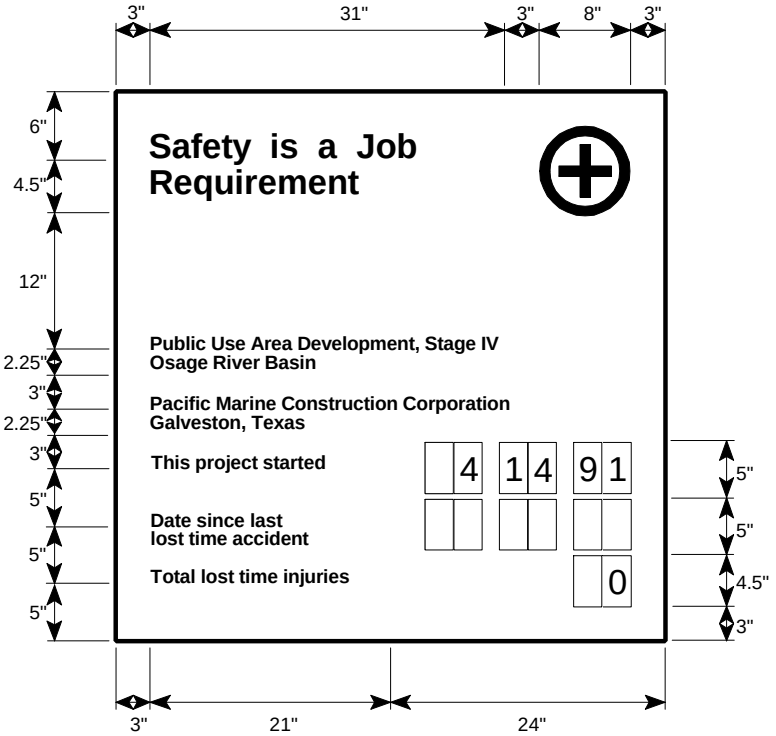
//S//
CHRISTINE T. ALTENDORF, P.E., PHD, SES
Chief, Engineering and Construction
U.S. Army Corps of Engineers

Encl.
Attachment A – Example Graphic of Signage with Dimensions for MILCON Project
Attachment B – Example Graphic of Signage with Dimensions for Civil Works Project

ATTACHMENT B: Example Graphic of Signage with Dimensions for Civil Works Project



SAFETY SIGN



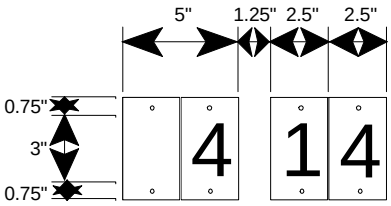
All typography is flush left and rag right, upper and lower case with initial capitals only as shown. Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

Legend Group 1: Standard two-line title "Safety is a Job Requirement" with (8" od.) Safety Green First Aid logo. Typeface: 3" Helvetica Bold; Color: Black.

Legend Group 2: One- to two-line project title legend describes the work being done under this contract and name of host project. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

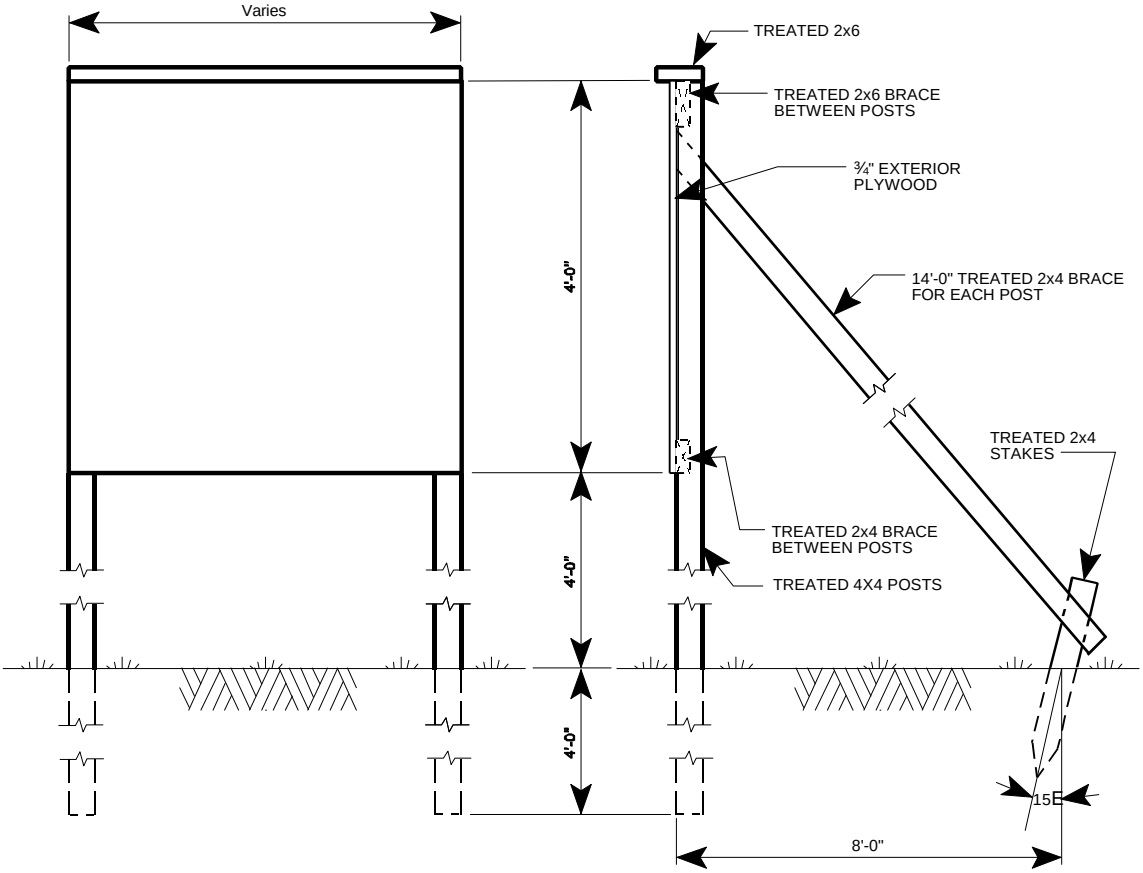
Legend Group 3: One- to two-line identification: name of prime contractor and city, state address. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

Legend Group 4: Standard safety record captions as shown. Typeface: 1.25" Helvetica Regular; Color: Black.



Replaceable numbers are to be mounted on white 0.060 aluminum plates and screw-mounted to background. Typeface: 3" Helvetica Regular; Color: Black; Plate size: 2.5" x 4.5".

SIGN ERECTION DETAILS



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ENVIRONMENTAL PROTECTION

-- End of Section Table of Contents --

SECTION 01 57 20.00 13

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions of Waters of the United States
40 CFR 68	Chemical Accident Prevention Provisions
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
49 CFR 171 - 178	Hazardous Materials Regulations

ENGINEERING MANUALS (EM)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

US ARMY CORPS OF ENGINEERS TECHNICAL REPORT

WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (e.g. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water means that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.6 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.7 Surface Discharge

The term "Surface Discharge" means that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit from the governing agency to discharge water.

1.2.8 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.9 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with the WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall be responsible for any delays resulting from failure to comply with any Federal, State, or Local environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, regional and local laws and regulations.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G,ENV

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items

formally identified in this section. Before the start of construction, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan, possible subsequent additions and revisions to the plan including any reporting requirements, and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. In the event that this project does not require a NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) stormwater/construction permit, the Contractor shall as part of the ENVIRONMENTAL PROTECTION PLAN, prepare an erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided during construction. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, and Federal, State, and local laws and regulations.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including

methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow and disposal areas.

j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer, and the local Fire Department for flammable materials, in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction.

l. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Federal, State, regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and

travel off the project site.

n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

p. A historical, archaeological, cultural resources, biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical, archaeological, cultural resources, biological resources or wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

q. A plan to prevent the spread of invasive species due to construction of this project in accordance with paragraph INVASIVE SPECIES PREVENTION. Development of the plan shall be based on the Wisconsin Department of Natural Resources (WIDNR) publication, "BEST PRACTICES FOR PREVENTING THE SPREAD OF AQUATIC INVASIVE SPECIES" that is contained in the attachments at the end of this section. This publication shall be the standard unless other best management practices have been identified by the state resource agency where the work is to be conducted. Although this guidance specifically addresses removal of aquatic invasive species, the cleaning methods can be used for removal of other invasive species that may be contained in soil or vegetative material on equipment. The plan shall indicate the cleaning procedures to be used on all equipment and watercraft that are to be brought on site, unless stated otherwise. Cleaning operations shall be conducted before entering and before leaving the site. The plan shall provide documentation from the Contractor stating that equipment has been cleaned as specified,

inspected, and found to be free of invasive species. The plan shall indicate the location where each piece of equipment and/or watercraft was last used. If the equipment and/or watercraft was used in Listed Infested Water, the Contractor shall follow Federal, State, and local best practices for cleaning and provide a list of invasive species known to be in that area. Watercraft such as tows and barges used last in a waterbody designated as infested are exempt from the invasive species prevention requirements for aquatic species if kept in the same waterbody and designation without overland transportation.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.10 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping (suspending) all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law. The failure of the Contracting Officer to notify the Contractor of any noncompliance with Federal, State, or local environmental laws or regulations, permits, or the Contractor's Environmental Protection Plan shall not relieve the Contractor of the duty to comply with those laws or regulations, permits, or the Contractor's Environmental Protection Plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PERMITS

Permits obtained by the Government related to the work of this contract are attached at the end of this section. The Contractor is responsible for obtaining all applicable permits or licenses, except those obtained by the Government. The Contractor shall be responsible for implementing the terms and requirements of the permits held by the Contractor or the Government. The Section 401 Water Quality Certification from the State of Wisconsin is attached to the end of this section. Please note that NWP No. 3 for Maintenance applies to the work included in this Contract.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing and maintaining erosion and sediment control measures in accordance with its erosion and sediment control plan. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control

best management practices (BMPs). BMPs may include, but are not limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction entrances, sediment traps, inlet and outfall protection. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, water return for hydraulic dredging, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall plan its operations and perform all work necessary to minimize adverse impact, such as water turbidity, on the habitat for wildlife and on water quality for downstream use.

3.3.2 Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments.

3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands, unless authorized herein. The Contractor shall be responsible for the protection of wetlands shown on the drawings. Authorization to enter specific wetlands identified shall not relieve the Contractor from any obligation to protect other wetlands within, adjacent to, or in the vicinity of the construction site and associated boundaries.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphalt batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with state regulations and/or local ordinances.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Solid wastes (excluding dredge material and clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off the construction site and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored,

and disposed in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off the construction site in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations.

3.5.5 Waste Water

Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs.

3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Existing historical, archaeological, and cultural resources within the Contractor's work area are shown on the drawings, or will be designated by the Contracting Officer, if any have been identified. The Contractor shall protect these resources and shall be responsible for their preservation during the life of the Contract. If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be

temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.8 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, regional, and local laws and regulations.

3.9 PESTICIDES

3.9.1 Pesticide Delivery and Storage

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.9.2 Qualifications

The applicator shall be certified in the state where the work is to be performed.

3.9.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS)shall be available for all pesticide products.

3.9.4 Application

Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.10 INVASIVE SPECIES PREVENTION

The Contractor shall clean each previously used piece of construction equipment and watercraft, unless specified otherwise, prior to bringing it

onto the project site and prior to removing it from the site to prevent the spread of invasive species. The Contractor shall ensure that the equipment and watercraft is free from soil residuals, egg deposits from plant pests, noxious weeds, plant seeds, aquatic plants and animals (including zebra mussels), and residual water. Cleaning of equipment and watercraft shall be in accordance with the Environmental Protection Plan.

If construction equipment or watercraft brought to the project site is found to be contaminated with invasive species, despite implementation of the Best Management Practices, the Contractor shall not use the construction equipment or watercraft in its present state. Any contaminated construction equipment or watercraft in water shall immediately be placed on dry land. The Contractor shall follow decontamination protocols as identified in the environmental protection plan. Contaminated equipment shall be decontaminated on site if there is an area that meets decontamination protocols. If this is not possible, the equipment shall be quarantined on site until a decontamination plan is approved by the Contracting Officer. Such equipment shall not be used on site until all invasives have been removed and documentation verifying the results of the cleaning is provided.

3.11 MAINTENANCE OF POLLUTION CONTROL FACILITIES AND DEVICES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.13 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause 52.236-12 CLEANING UP. The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work.

-- End of Section --

SECTION 01 57 20.00 13

ENVIRONMENTAL PROTECTION

ATTACHMENTS

MN DNR

PREVENTION OF AQUATIC INVASIVE SPECIES

Best Practices for Preventing the Spread of Aquatic Invasive Species

All equipment[1] being transported on roads or placed in Waters of the State shall be free of prohibited and regulated invasive species and unlisted non-native species (any other species not native to Minnesota)

1. **Project plans or documents should identify Designated Infested Waters**[2] located in or near the project area.

2. **Prior to transportation along roads into or out of any worksite, or between water bodies within a project area, all equipment** must be free of any aquatic plants, water, and prohibited invasive species.
   A. **Drain** all water from equipment where water may be trapped, such as tanks, pumps, hoses, silt curtains, and water-retaining components of boats/barges (see Figures 5 & 6) **AND**
   B. **Remove** all visible aquatic remnants (plants, seeds and animals). Removal of mud & soil is not required at all sites, though is encouraged as a Best Practice. Removal of mud and soil may be required on sites designated as infested (see #4).

3. **Prior to placing equipment <u>into any waters</u>,** all equipment must be free of aquatic plants and non-native animals.

4. **Additional measures are required on *Designated Infested Waters* to remove and kill prohibited species such as zebra mussels, quagga mussels, New Zealand mudsnails, faucet snails, or spiny waterfleas.**
   Note: The DNR is available to train site inspectors and/or assist in these inspections. Contact the appropriate Regional Invasive Species Specialist: www.mndnr.gov/invasives/ais/contacts.html
   A. For day use equipment (in contact with the water for 24 hours or less); Perform #2 above or,
   B. For in-water exposure greater than 24 hours: Perform #2 above, and inspect all equipment for the prohibited invasive species present (see Figure 1).

   Then choose one of the following three: **on-site treatment**, **off-site treatment**, or **customized alternative**.

Figure 1. Invasive species may not be readily visible on equipment. Some species are less than 1/4 inch in size.
Photo credit: Brent Wilber, Lunda Construction

On-Site Treatment

Remove by handscraping or powerwashing (minimum 3000 psi) all accessible areas (Figures 1 and 2) **AND**

Kill Prohibited Aquatic Invasive Species in non-accessible areas using one or more of the following four techniques:

- **Hot Water (minimum 140°F) for ten seconds** (Figure 2) for zebra mussels, quagga mussels, New Zealand mudsnails, faucet snails **OR**
- **Air Dry** (Figures 3 & 4)
  Spiny waterfleas – air dry for a minimum of 2 days
  New Zealand mudsnails – air dry for a minimum of 7 days
  zebra or quagga mussels, faucet snails – air dry for a minimum of 21 days **OR**
- **Freezing Temperatures**
  zebra mussels - expose to continuous temperature below 32°F for 2 days **OR**
- **Crush**
  Crush rock, concrete, or other debris by running it through a crushing plant to kill prohibited species

Figure 2. Removal of aquatic remnants is required before transporting.
Photo credit: Peter Leete, DNR

Off-Site Treatment

Under certain conditions, the DNR will allow transportation of equipment off-site after partial removal of prohibited species (for example, after "removal" has been done and equipment will be taken to a facility to complete final treatment [i.e., "kill"]) This is a 'one-way pass' to allow transport to a storage area or disposal facility. This option can only be utilized if the receiving site is at least 300 feet from riparian areas, wetlands, ditches, stormwater inlets or treatment facilities, seasonally-flooded areas, or other waters of the state. To be allowed to use the off-site treatment option you must do the following:

- Read, complete, and comply with the appropriate authorization form for transportation of Prohibited Invasive Species at www.mndnr.gov/invasives/ais_transport.html (Note that a completed form is required to be in every vehicle that is transporting equipment containing infested species) **AND**
- Complete on-site treatment described in 4B above prior to re-use in or adjacent to water.

Contact a DNR Invasive Species Specialist for authorization of a customized alternative

There may be situations due to time of year, length of exposure, type of equipment, or site conditions that a DNR Invasive Species Specialist could approve alternative methods or requirements for treatment. Contact the appropriate Regional Invasive Species Specialist: www.mndnr.gov/invasives/contacts.html

5. **Temporary appropriations of water from Designated Invested Waters to utilize elsewhere (such as for dust control, landscaping, bridge washing, etc.) is not allowed except by permit, thus should be avoided.**

   If use of Designated Infested Waters is unavoidable, permit information is located at www.mndnr.gov/waters/watermgmt_section/appropriations/permits.html

Figure 3. Drying will also kill aquatic organisms. Lay out materials to dry in the proper time. Drying times vary by species. Inspect after drying period is over.
Photo credit: Dwayne Stenlund, MnDOT

Figure 4. Drying techniques must not trap water. This equipment will not dry adequately.
Photo credit: Peter Leete, DNR

Figure 5. Pumping from designated infested waters for use elsewhere on the project is prohibited without a permit.
Photo credit: Peter Leete, DNR

Figure 6. Drain all water from equipment where water may be trapped. Remove drain plugs and drain hoses prior to transport.
Photo Credit: Peter Leete, DNR

Document Information
www.mndnr.gov/waters/watermgmt_section/pwpermits/gp_2004_0001_manual.html
Best Practices for Meeting DNR GP 2004-0001 (published 5/11, updated 12/12) – Chapter 1/Page 8

More on the DNR Invasives Species Program can be found at: www.mndnr.gov/AIS

[1] **'Equipment'** is defined as any implement utilized in construction. This includes boats, barges, heavy machinery, light machinery, or other material that may be moved on-site or off-site, including but not limited to rock (riprap) or timber for temporary workpads, backhoes, pumps, hoses, worksite isolation materials (eg, sheet pile or jersey barriers), boats, barges, temporary staging materials, erosion prevention products, sediment control products (eg, silt curtain), water trucks that take water from open bodies of water (eg, dust control), or dewatering components.
[2] **List of Designated Infested Waters**: http://files.dnr.state.mn.us/eco/invasives/infested_waters.pdf

DNR Contact Information

DNR Ecological and Water Resources lists area office staff at www.mndnr.gov/waters

DNR Ecological and Water Resources
500 Lafayette Road, Box 32, St. Paul, MN 55155-4032, (651)259-5700 or 5100

DNR Ecological and Water Resources website provides information at www.mndnr.gov or by calling (651) 259-5700 or 5100.

DNR Information Center

This information is available in an alternative format on request

Twin Cities: (651) 296-6157
Minnesota toll free: 1-888-646-6367
Telecommunication device for the deaf (TDD): (651) 296-5484
TDD toll free: 1-800-657-3929

WISCONSIN 401 WATER QUALITY CERTIFICATION

BEFORE THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Application of the United States Department of the Army,)
Corps of Engineers, for Water Quality Certification for the)
Final Regulations Pertaining to the Issuance, Reissuance,)
and Modification of Nationwide Permits

On September 15, 2020, the United States Department of the Army, Corps of Engineers (COE), published its notice regarding the Issuance of Nationwide Permits (NWPs) in the Federal Register (agency docket number COE–2020–0002). The publication includes new, existing, and modified NWPs. Publication of these NWPs serves as the Corps' application to the State for water quality certification (WQC) under Section 401 of the Federal Clean Water Act (CWA).

The Wisconsin Department of Natural Resources (WDNR) has examined the regulations promulgated by the COE and United States Environmental Protection Agency pursuant to Section 401, CWA, and Chapters NR 102, 103, and 299, Wisconsin Administrative Code (Wis. Adm. Code).

The WDNR has determined the following conditions for the NWPs are required to ensure compliance with state water quality standards enumerated in s. 299.04, Wis. Adm. Code. Water quality in Wisconsin will be adequately protected so long as these conditions are met and the requirements of the final NWPs are consist with the public noticed drafts. This certification shall expire when the nationwide permits expire.

Section 401 Certification does not release the permittee from obtaining all other necessary federal, state, and local permits, licenses, certificates, approvals, registrations, charters, or similar forms of permission required by law. It does not limit any other state permit, license, certificate, approval, registration, charter, or similar form of permission required by law that imposes more restrictive requirements. It does not eliminate, waive, or vary the permittee's obligation to comply with all other laws and state statutes and rules throughout the construction, installation, and operation of the project. This Certification does not release the permittee from any liability, penalty, or duty imposed by Wisconsin or federal statutes, regulations, rules, or local ordinances, and it does not convey a property right or an exclusive privilege.

The conditions of this Certification cannot be used for other permit decisions, permit types or licenses that are not expressly listed in the agency docket number COE–2020–0002. Pursuant to 40 CFR 121.5, a certification request must be submitted to the state of Wisconsin for all individual license or permit requests. This includes projects undertaken by federal agencies including U.S. Army Corp of Engineer projects.

This Certification does not replace or satisfy any environmental review requirements, including those under the Wisconsin Environmental Policy Act (WEPA) or the National Environmental Policy Act (NEPA).

STATE CONDITIONS AND LIMITATIONS OF CERTIFICATION

GENERAL CONDITIONS:

1. The permittee shall allow the WDNR reasonable entry and access to the discharge site to inspect the discharge for compliance with the certification and applicable laws.

   Justification: On-site inspection is a critical element to gather necessary information for water quality certification decisions and quality control and assurance of data provided by the applicant. This authorization is required pursuant to s. NR 299.05(3)(d)2.c, Wis. Adm. Code.

2. Water quality certification is denied without prejudice for activities involving the temporary stockpiling of dredged or fill material in waters of the state, including wetlands.

   Justification: Physical alterations can degrade surface waters through the filling, dredging or stockpiling of materials. Pursuant to ss. NR 102.05 and NR 103.03, Wis. Adm. Codes, no waters of the state including wetlands shall be lowered in quality unless it has been affirmatively demonstrated to the department that such a change is justifiable. To satisfy these antidegradation and water quality protection requirements, individual certification is warranted to properly demonstrate that temporary stockpiling of dredged or fill material is warranted.

3. Water quality certification is denied without prejudice for activities that have the potential to adversely impact Area of Special Natural Resource Interest (ASNRI) waters designated under to s. NR 1.05, Wis. Adm. Code.

   Justification: Pursuant to ch. NR 207, Wis. Adm. Code, Wisconsin's antidegradation standards prohibit degradation of outstanding resource waters and limits degradations to exceptional resource waters. Additionally, formal consultation with the Voigt Task Force is needed on projects which could have impacts on wild rice or wild rice habitat. For these reasons, all projects that have the potential to degrade ASNRI waters designated under s. 30.01(1am), Wis. Stat. are denied without prejudice. ASNRI waters are available on the DNR's surface water data viewer at https://dnr.wisconsin.gov/topic/SurfaceWater/swdv.

4. Water quality certification is denied without prejudice for activities that have the potential to adversely impact Public Rights Features (PRFs) designated under to s. NR 1.06, Wis. Adm. Code.

   Justification: Pursuant to s. NR 102.04(1)(a) and (b), Wis. Adm. Code, objectionable deposits or debris shall not be present in such amounts as to interfere with public rights in waters of the state. Public Rights Features are most sensitive to these types of deposits and warrant individual water quality

water quality certification

certification to ensure that wildlife, recreation, and fish and aquatic life standards under ch. NR 102, Wis. Adm. Code are satisfied.

PRFs are available on the DNR's surface water data viewer at https://dnr.wisconsin.gov/topic/SurfaceWater/swdv.

5. No discharges of dredged or fill material below the ordinary high water mark of a navigable stream as defined by s. 310.03(5), Wis. Adm. Code, may take place during fish spawning periods or times when nursery areas would be adversely impacted. These periods are:
   - September 15th through May 15th for all trout streams and upstream to the first dam or barrier on the Root River (Racine County), the Kewaunee River (Kewaunee County), and Strawberry Creek (Door County). To determine if a waterway is a trout stream, you may use the WDNR website trout maps at http://dnr.wi.gov/topic/fishing/trout/streammaps.html.
   - September 15th through June 15th on all Great Lakes tributaries upstream to the first dam or barrier.
   - November 1st through June 15th for Lake Michigan waters surrounding Door County including Green Bay and all harbors and bays.
   - September 15th through July 1st for Lake Superior waters surrounding Douglas County including St. Louis River and all harbors and bays.
   - March 1st through June 15th for ALL OTHER waters.

   Justification: Pursuant to s. NR 102.04(3), Wis. Adm. Code, aquatic life designations include spawning areas for cold water and warm water fish and aquatic life habitat. Water quality criteria are derived to ensure spawning activities in Wisconsin are protected.

6. The permittee must install in-water best management practices (BMPs) to minimize total suspended solids (TSS), sedimentation and nutrient loadings for any work conducted below the ordinary high water mark (OHWM). Any visual increase in turbidity outside of the approved impact area shall result in the project operations ceasing until BMPs have been modified to address the issue.

   Justification: Pursuant to ss. NR 102.04(1) and NR 102.06, Wis. Adm. Code, objectionable deposits and nutrients may not be present in amounts that interfere with public rights and interests or exceed state standards for surface water. In-water BMPs also help ensure excessive sedimentation, TSS, and nutrient loadings will not result in a violation of state wetland water quality standards under s. NR 103.03, Wis. Adm. Code.

7. The permittee may not use any materials that contains toxic substances in toxic amounts. This may include materials used for structure placement, beneficially reused materials, or fill.

   Justification: Pursuant to chs. NR 102, NR 103, NR 105 and s. NR 299.04(1)(b), Wis. Adm. Codes, water quality criteria and limitations must be satisfied to grant water quality certification.

water quality certification

8. The permittee must ensure that any material used to construct a project is properly contained and stabilized in a manner that will prevent the material from being eroded.

   Justification: Pursuant to ss. NR 102.04(1)(a) and (b) and NR 103.03, Wis. Adm. Code, objectionable deposits or debris shall not be present in amounts that interfere with public rights and interests in waterways or the functions and values of wetlands in Wisconsin.

9. Projects permitted under any NWP must implement planning and pretreatment of equipment to minimize spread of invasive or noxious species, designated under to ch. 40, Wis. Adm. Code.

   Justification: Pursuant to s. NR 103.03(2)(f)3., Wis. Adm Code, water quality certification must prevent conditions conducive to the establishment or proliferation of nuisance organisms in order to protect existing wetland habitat and ecosystems. Invasive species threaten the "protection and propagation of a balanced fish and other aquatic life community" under the "Fish and other aquatic life" designated use in ch. NR 102.04(3), Wis. Adm. Code.

10. Whenever an applicant is completing sediment sampling and analysis, monitoring or disposal of materials from any dredging project, proper sampling and quality assurance methods shall be implemented in alignment with ch. NR 347, Wis. Adm. Code.

    Justification: In order to protect the public rights and interests in the waters of the state and to ensure that data quality is representative of site conditions to make informed water quality certification decisions, all data gathering, sampling, monitoring, data analysis and disposal shall be completed using proper sampling and quality assurance methods in alignment with ch. NR 347, Wis. Adm. Code.

Conditions Applicable to Specific Nationwide Permits Granted Water Quality Certification:

NWP 16 — Return Water From Upland Contained Disposal Areas:

The permittee must ensure that return water from dredging that is directly returned to the original source water meets the same water quality standards that apply to the original source water. If the return water is discharged into a receiving water that is not the original source water, then the permittee must ensure that the discharge water will meet the more stringent water quality standard of the receiving water and the original source water.

Justification: The return water shall not violate state water quality standards established under chs. NR 102, 103 and 105, Wis. Adm. Code.

NWP 18 — Minor Discharges:

water quality certification

The permittee must ensure that direct and secondary impacts to wetlands do not exceed 400 sq. ft.

Justification: Pursuant to s. NR 103.03(2)(d), Wis. Adm. Code, wetlands shall be protected from cumulative impacts of discharges which may result in concentrations or combinations of substances which are toxic or harmful to human, animal, or plant life. Ensuring that the eligibility standard for wetland impacts encompasses primary and secondary impacts will ensure adequate protection from cumulative impacts.

The project scope shall not include installation of nonperforated drain tile which would have a hydrologic impact to a waterway or wetland.

Justification: Sections NR 103.03(1)(a) and (b), Wis. Adm. Code, require that wetland hydrology and storm and flood water storage be adequately protected.

NWP 42 — Recreational Facilities:

The permittee must remove temporary fill within 60 days of placing the material in a waterway or wetland unless mitigation is provided for the temporary loss of function.

Justification: This material can be a source of TSS and nutrients, particularly phosphorus to the receiving water (chs. NR 102 and 103, Wis. Adm. Code).

The permittee shall ensure that the project will not result in a conversion of navigable waters, pursuant to s. NR 310.03(5), Wis. Adm. Code, to uplands or an enclosure of navigable waters that would result in an interference with the public rights in those waters.

Justification: Pursuant to s. NR 102.04(1)(a) and (b), Wis. Adm. Code, objectionable deposits or debris shall not be present in such amounts as to interfere with public rights in waters of the state.

NWP 43 — Stormwater Management Facilities:

The permittee may not convert navigable waterways pursuant to s. 310.03(5), Wis. Adm. Code, or wetlands to treat stormwater.

Justification: Pursuant to s. NR 103.03(1)(a), Wis. Adm. Code, state wetland water quality standards require that wetlands are maintained within natural variation from storm and flood water storage and retention and the moderation of water level fluctuation extremes. Pursuant to s. NR 102.04(1)(a) and (b), Wis. Adm. Code, objectionable

water quality certification

deposits or debris shall not be present in such amounts as to interfere with public rights in waters of the state.

NWP 46 — Discharges in Ditches:

The permittee must remove temporary fill within 60 days of placing the material in a waterway or wetland unless mitigation is provided for the temporary loss of function.

Justification: This material can be a source of TSS and nutrients, particularly phosphorus to the receiving water (chs. NR 102 and 103, Wis. Adm. Code).

NWP 51 – Land-Based Renewable Energy Generation Facilities

The permittee must remove temporary fill within 60 days of placing the material in a waterway or wetland unless mitigation is provided for the temporary loss of function.

Justification: This material can be a source of TSS and nutrients, particularly phosphorus, to the receiving water (chs. NR 102 and 103, Wis. Adm. Code).

The permittee may not convert wetlands to stormwater treatment facilities.

Justification: Pursuant to s. NR 103.03(1)(a), Wis. Adm. Code, state wetland water quality standards require that wetlands are maintained within natural variation from storm and flood water storage and retention and the moderation of water level fluctuation extremes.

The project shall not impact more than 300 linear feet.

Justification: Pursuant to s. NR 207.12, antibacksliding requirements must be satisfied before a relaxation of a standard could be applied. This analysis requires individual water quality certification.

NWP 53 - Removal of Low-Head Dams

The permittee shall ensure that accumulated sediment is adequately controlled to ensure that downstream water quality is protected once the dam is removed.

Justification: This material can be a source of TSS and nutrients, particularly phosphorus to the receiving water (chs. NR 102 and 103, Wis. Adm. Code).

water quality certification

NWP E- Water Reclamation and Reuse Facilities

The permittee shall only use native plantings or, for the purposes of short-term stabilization, early successional non-invasive plantings for the purposes of short-term stabilization followed by native plantings.

Justification: Pursuant to s. NR 103.03(2)(f)3., Wis. Adm Code, water quality certification must prevent conditions conducive to the establishment or proliferation of nuisance organisms in order to protect existing wetland habitat and ecosystems. The invasive species rule, ch. NR 40, Wis. Adm. Code, makes it illegal to possess, transport, transfer or introduce certain invasive species in Wisconsin.

Nationwide Permits Granted Water Quality Certification:

- NWP 3 — Maintenance
- NWP 4 — Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities
- NWP 5 — Scientific Measurement Devices
- NWP 6 — Survey Activities
- NWP 7 — Outfall Structures and Associated Intake Structures
- NWP 13 — Bank Stabilization
- NWP 19 — Minor Dredging
- NWP 20 — Response Operations for Oil or Hazardous Substances
- NWP 22 — Removal of Vessels
- NWP 25 — Structural Discharges
- NWP 27 — Aquatic Habitat Restoration, Enhancement, and Establishment Activities
- NWP 30 — Moist Soil Management for Wildlife
- NWP 31 — Maintenance of Existing Flood Control Facilities
- NWP 32 — Completed Enforcement Actions
- NWP 36 — Boat Ramps
- NWP 37 — Emergency Watershed Protection and Rehabilitation
- NWP 38 — Cleanup of Hazardous and Toxic Waste
- NWP 41 — Reshaping Existing Drainage Ditches
- NWP 45 — Repair of Uplands Damaged by Discrete Events
- NWP 54 — Living Shorelines

Nationwide Permits Denied Water Quality Certification Without Prejudice At This Time:

- NWP 17 – Hydropower Projects

water quality certification

Justification: The NWP is overly broad and can include a wide range of activities. The broad category of activities covered could significantly impact phosphorus and thermal impacts to waterways. Because Wisconsin has numeric standards for phosphorus and temperature pursuant to ch. NR 102, Wis Adm. Code, individual water quality certification is required to determine thermal and nutrient loadings from these areas. Individual water quality certification will also help ensure that state wetlands standards under ch. NR 103, Wis. Adm. Code are satisfied.

- NWP 29 — Residential Developments

Justification: The NWP is overly broad and can include a range of residential development density and can also include a wide array of other integral development pieces. The density of the development can significantly impact phosphorus and thermal impacts to waterways. Because Wisconsin has numeric standards for phosphorus and temperature pursuant to ch. NR 102, Wis. Adm. Code, individual water quality certification is required to determine thermal and nutrient loadings from these areas. Individual water quality certification will also help ensure that state wetlands standards under ch. NR 103, Wis. Adm. Code are satisfied.

- NWP 33 – Temporary Construction, Access, and Dewatering

Justification: Site-specific WQC is appropriate to ensure that site-specific dewatering plans are developed and address sediment-laden materials, which may contain potentially contaminated materials, discharged from dewatering disposal. Oily sheens, odors or colors can be observed in some dewatering activities which may violate water quality standards under ch. NR 102, Wis. Adm. Code.

- NWP 39 — Commercial and Institutional Developments

Justification: The NWP is overly broad and can include a range of commercial and institutional development types and density. These can significantly impact phosphorus and thermal impacts to waterways. Because Wisconsin has numeric standards for phosphorus and temperature pursuant to ch. NR 102, Wis. Adm. Code, individual water quality certification is required to determine thermal and nutrient loadings from these areas. Individual water quality certification will also help ensure that state wetlands standards under ch. NR 103, Wis. Adm. Code are satisfied.

- NWP 40 — Agricultural Activities

water quality certification

Justification: The NWP is overly broad and can include a wide range of agricultural activities. These can significantly impact phosphorus and thermal impacts to waterways. Because Wisconsin has numeric standards for phosphorus and temperature pursuant to ch. NR 102, Wis. Adm. Code, individual water quality certification is required to determine thermal and nutrient loadings from these areas. Individual water quality certification will also help ensure that state wetlands standards under ch. NR 103, Wis. Adm. Code are satisfied.

- NWP 44 — Mining Activities

Justification: The NWP is overly broad and can include a range of activities. Given the proximity of these activities to mining activities there is an increase risk that heavy metals or other toxic substances regulated in ch. NR 105 and 106, Wis. Adm. Code, may be discharged in surface waters at levels that may not comply with state standards.

- NWP 48 — Commercial Shellfish Mariculture Activities

Justification: Nutrient discharges from commercial shellfish activities can be significant depending on the size, placement, and treatment of waters from these areas. Given the range of concentration and placement, individual water quality certification is appropriate for these activities to ensure that state nutrient standards pursuant to s. NR 102.06, Wis. Adm. Code are satisfied. Individual water quality certification will also help ensure that state wetlands standards under ch. NR 103, Wis. Adm. Code are satisfied.

- NWP 52 — Water-Based Renewable Energy Generation Pilot Projects

Justification: Impacts to fish and aquatic life uses and criteria such as temperature from water-based energy generation projects can be significant depending on the size and placement of these projects. Given the broad range of waterways this NWP could apply to, an individual WQC is appropriate to ensure that state water quality standards for fish and aquatic life uses and criteria under NR 102.04, Wis. Adm. Code are satisfied.

<u>Nationwide Permits For Which Water Quality Certification Is Not Required:</u>

This water quality certification decision reflects the NWPs for which certification was requested on November 12, 2020. As stated in the notice, NWPs 1, 2, 9, 10, 11, 28, and 35 do not require section 401 water quality certification because they would authorize activities which, in the opinion of the Corps, could not reasonably be expected to result in a discharge into waters of the United States. Additionally, the notice stipulated that the St. Paul District is proposing to revoke the following NWPs in both Minnesota and Wisconsin: 8, 12, 14, 15, 21, 23, 24, 34, 49, 50, A, B, C,

water quality certification

and D. WDNR is not taking action on these NWPs for these reasons and concludes that a new notification and pre-filing meeting would be required for these NWPs should the position of the St. Paul District change.

NOTICE OF APPEAL RIGHTS

If you believe that you have a right to challenge this decision, you should know that Wisconsin Statutes and administrative rules establish time periods within which requests to review Department decisions must be filed.

To request a contested case hearing pursuant to section 227.42, Wisconsin Statutes, you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources.

This determination becomes final in accordance with the provisions of s. NR 299.05(7), Wisconsin Administrative Code, and is judicially reviewable when final. For judicial review of a decision pursuant to Sections 227.52 and 227.53, Wisconsin Statutes, you have 30 days after the decision becomes final to file your petition with the appropriate circuit court and to serve the petition on the Secretary of the Department of Natural Resources. The petition must name the Department of Natural Resources as the respondent.

Reasonable accommodation, including the provision of informational material in an alternative format, will be provided for qualified individuals with disabilities upon request.

This notice is provided pursuant to section 227.48(2), Wisconsin Statutes.

Dated at Madison, Wisconsin 10/11/2021 | 11:26 AM CDT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

By DocuSigned by: Dave Siebert D2E3F67B71CE4F2...
David R. Siebert

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CONTRACTOR SURVEYS

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SECTION 01 71 23.05 13

CONTRACTOR SURVEYS

PART 1 GENERAL

1.1 DEFINITIONS

Construction Surveying: Accurately providing all necessary computations, stakes and marks to establish lines, slopes, elevations, points, and continuous profile grades in accordance with the requirements and tolerances of the project to enable a construction Contractor to perform all required construction work for the project in accordance with the Contract requirements; and so that the Contracting Officer can perform all necessary contract administration duties.

Terrain Model (.DGN): A set of three-dimensional triangles mathematically computed from point data collected on the surface being modeled. Models are used to define irregular surfaces, particularly the surface of the earth..

Digital Terrain Model (.DTM): A surface model created using Bentley InRoads software that incorporates the elevations of significant topographic features, bathymetric features, mass points and breaklines that are irregularly spaced to better characterize the true shape of the bare-earth terrain.

Geospatial Data: Data or information that identifies the geographic location of features and boundaries on Earth, such as natural or constructed features. Spatial data is usually stored as coordinates and topology, and is data that can be mapped.

Global Navigation Satellite System (GNSS): Refers to a global constellation of satellites providing signal from space transmitting positioning and timing data. This includes GPS, GLONASS, Galileo, Beidou and other regional systems.

Positioning Equipment: Refers to devices that produce (directly or indirectly) geographic coordinates or elevation values as an output. See paragraph POSITIONING EQUIPMENT for examples.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-1-1003	(2011) Engineering and Design: NAVSTAR Global Positioning System Surveying
EM 1110-1-1005	(2007) Engineering and Design: Control and Topographic Surveying

EM 1110-1-2909	(2012) Engineering and Design: Geospatial Data and Systems
EM 1110-2-1003	(2013) Engineering and Design: Hydrographic Surveying
EM 1110-2-6056	(2010) Engineering and Design: Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums

1.3 AVAILABLE DATA FROM THE GOVERNMENT

3D design files (.dgn), and digital terrain models (.dtm) are available upon request. Converting these files to other formats is the Contractor's responsibility.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Surveying Work Plan and Schedule; G, SURV

Information as defined in Paragraph: Layout Surveys.

Quality Control Plan; G, SURV

Information as defined in Paragraph: Quality Control Plan.

Preliminary Survey; G, SURV

Information as defined in paragraph: Preliminary Surveys.

Professional Certification and Work Experience; G, SURV

Information as Defined in paragraph: Professional Certification and Work Experience.

SD-11 Closeout Submittals

As-Built Survey; G,SURV

Information as defined in Paragraph: As-Built Surveys.

Geospatial Data

Information as defined in Paragraph: GEOSPATIAL DATA.

1.5 GEOSPATIAL DATA

1.5.1 Metadata

All geospatial information submitted must include Federal Geographic Data Committee (FGDC) compliant metadata. See EM 1110-1-2909 or http://www.fgdc.gov/metadata/documents/workbook_0501_bmk.pdf for more information.

1.5.2 Geospatial Information

Geospatial data that may be used include any of the following information: GIS drawings/maps, hydrographic surveys, topographic mapping, georeferenced digital drawings generated from hard copy maps/drawings, high-order geodetic control (horizontal and vertical) surveys using Global Navigation Satellite System (GNSS) or Global Positioning System (GPS) and conventional survey techniques for control and property/boundary surveys. Develop accuracies using EM 1110-1-1005 - Chapter 6 and EM 1110-1-1003 - Chapter 8.

1.5.2.1 GNSS/GPS Data

Collect and submit to the Contracting Officer the GNSS observables (L1/L2) in both the GNSS receiver's native format and the Receiver Independent Exchange Format (RINEX) all Real Time Kinematic, Static, and Differential Surveys. If a Virtual Reference Network (VRS) is not used, a completed observation log sheet is required for each base station occupation/session. All GNSS/GPS control surveys require "closed" observation campaigns. A "closed" campaign consists of more than one observation of each control point. Use appropriate observation times for the level of accuracy required for the type of work.

1.5.2.2 Field Notes/Books

Submit all original field books/notes/computation sheets fully describing the geospatial data collection and all significant events related to said event. This allows the Contracting Officer to apply quality assurance measures to the data collect. Compile the format and content of field notes/books according to EM 1110-1-1005-Chapter 12.

1.6 DATUMS AND UNITS OF MEASURE

Use the spatial reference information on the drawings. Ensure all geospatial data submitted is referenced to the National Spatial Reference System (NSRS).

1.7 MEASUREMENT AND PAYMENT

No separate payment will be made for the work covered under this section. Include all costs associated with this section within the contract bid items most closely related to the work.

1.8 QUALITY CONTROL

Establish and maintain quality control for the work of this section to assure compliance with the contract requirements. Maintain records of quality control for all geospatial data collection including but not limited to the following:

1.8.1 Quality Control Plan

Submit a plan for conducting quality control for the work to be performed under this specification. Approval of the QCP by the Contracting Officer is required prior to commencing field work. Outline the personnel, equipment, and activities scheduled by the Contractor or subcontractor(s) to meet contract requirements. Include the expected data formats to be submitted. Determine and use the appropriate procedures and techniques for the required tasks.

1.8.2 Layouts and Surveys

Keep a daily log of layout work and surveys consisting of type and location using the Government-furnished control system as stated in the CONTRACT CLAUSE 52.236-17 LAYOUT OF WORK.

1.9 PROFESSIONAL SURVEYOR

All geospatial data collections must be accomplished under the direction of a professional surveyor licensed and registered by the state or states in which the work is done. The professional surveyor shall be on site at all times during surveying activities. The professional surveyor shall not have additional duties such as Superintendent or CQC System Manager.

1.9.1 Professional Certification and Work Experience

Provide documentation verifying the professional surveyor is licensed and registered by the state or states in which the work is done. Provide documentation verifying that the professional surveyor has a minimum of three years experience performing similar type work. For hydrographic surveys, provide documentation verifying a minimum of three years of experience in hydrographic surveying of navigable channels. Possession of a current hydrographic certification from the American Congress for Surveying and Mapping (ACSM) is acceptable in lieu of the registered Professional Surveyor requirement for hydrographic surveys.

1.10 GEOSPATIAL DATA COLLECTION EQUIPMENT

1.10.1 Positioning Equipment

Positioning equipment for geospatial data collection shall achieve the required accuracy for the work being performed. Perform initial calibration and subsequent checks in accordance with the manufacturer's instructions or the latest guidance documents (see paragraph REFERENCES). Provide documentation of all calibrations and subsequent checks to the Contracting Officer. Positioning equipment includes, but is not limited to, the following: conventional/robotic total stations, GNSS/GPS systems, and digital levels.

1.10.2 Hydrographic Survey Equipment

Perform hydrographic surveys using a sonar equipment (fathometer) system or manual methods. Sonar equipment systems employ positioning equipment (see paragraph POSITIONING EQUIPMENT) to georeference each measurement. The vertical accuracy of the eco depth sounder shall be +/- 0.5 feet. The horizontal accuracy shall be +/- 1.0 feet. The number of soundings shall be recorded at a rate of not less than 1 per 10 linear feet. Provide a safe working environment for hydrographic data collection.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 COMMENCEMENT, PERFORMANCE, AND COMPLETION

3.1.1 General

Execute all surveys in accordance with EM 1110-1-1003, EM 1110-1-1005, EM 1110-1-2909, EM 1110-2-1003, and EM 1110-2-6056. Layout the work from the Government furnished horizontal/vertical control points in accordance with CONTRACT CLAUSE 52.236-17 LAYOUT OF WORK. 7 calendar days prior to commencing construction operations, have in place sufficient stakes and markings allowing the Contracting Officer to observe the field layout of the alignment and limits of each feature of work. Stake each feature of work to define area limits such that the Contracting Officer can easily determine, without additional surveys, if alignment and/or limit adjustments need to be made. For embankments, levees, floodwalls, and similar work, define control line, stationing, outermost fill/cut limits, and work limits with staking. For structures and similar work, stake the structure corners and grid lines. Stake general site work to define staging areas, storage areas, and other area limits as directed. The Contracting Officer may waive these requirements for certain areas. The layout shall be sufficient for the Contracting Officer to mark trees, vegetation and other features to be left undisturbed. Contracting Officer approval of field layout is required prior to commencement of work.

These stakes shall remain or be replaced as needed during all periods of active work. If stakes become damaged or are moved, the Contractor shall replace them within 24 hours. The Contracting Officer shall have the right to suspend work if the grade stakes are not maintained.

Perform observations of all control points in accordance with the accuracy level appropriate for the type of work being performed. Tie all geospatial data collections to a fixed control point that is published in the National Spatial Reference System (NSRS).

3.1.2 Alignment Changes

The Contracting Officer reserves the right to make changes in the alignment of any feature of work as may be found necessary during the course of the contract. Make no alignment changes or abandonment without prior written approval from the Contracting Officer.

3.1.3 Geospatial Data Collection

The Contracting Officer reserves the right to be present for all geospatial data collection field work.

For preliminary, as-built, quantity surveys and verification of design section surveys perform a breakline and grid style survey/point cloud of the project area at sufficient spacing to accurately define site conditions and as-built conditions but not to exceed 100 feet. Conduct the breakline and grid style survey/point cloud with an equipment type that can meet or exceed the requisite accuracies.

Produce and submit the following for approval: (1) a terrain model in

Bentley CONNECT .DGN format, a DTM surface file in Bentley InRoads .DTM format, LandXML format 1.2, or in a format compatible with Bentley CONNECT approved by the Contracting Officer. The terrain model should include spot elevations, breaklines, voids and contours. The surface file should include triangles, breaklines and surface boundary features. (2) If a surface file (.DTM) is submitted, also submit a vector file of planimetric features and point data in a format compatible with Bentley MicroStation®. Draw all point and vector (non-raster) data at elevation.

3.1.3.1 Preliminary Surveys

Run a preliminary survey, locating the control line (if applicable), all other significant features that may affect the design and/or construction of the project within the limits of the work, and all existing conditions from which construction of the design features will be based. Submit all geospatial data (raw and processed) used to derive preliminary survey documentation as evidence of performance and for review by the Contracting Officer for compliance with applicable standards and guidance. At a minimum, collect the preliminary survey using the appropriate data collection equipment (paragraph GEOSPATIAL DATA COLLECTION EQUIPMENT) for the accuracy level required. Deliver all geospatial data according to paragraph GEOSPATIAL DATA.

3.1.3.2 Layout Surveys

Conduct layout surveys for all project features necessary to complete the project as represented in the plans. Perform surveys in a timely manner and that is reflective of the continuing and ongoing nature of construction and inspection activities. This will generally require frequent, separate site visits by the Contractor's survey crew to the project location to accommodate the various stages of construction and inspection activities that will occur.

The Contractor is:

1. responsible for the preservation of all reference points, monuments, government land corners (Public Land Survey System corner monuments), horizontal and vertical control points, stakes, and marks that are established by the Government or others within the project limits. If the Contractor fails to preserve these items and if the Government must reestablish them, the Contracting Officer will deduct a charge from monies due or becoming due the Contactor. All Public Land Survey System corner monuments recovered or reestablished require a record of location be filed with the appropriate authority with a copy sent to the Contracting Officer.

2. responsible to review, balance, adjust, correct, and investigate Government-furnished data and to perform work on survey data and control points that may be necessary to use the survey points and data, all at no extra cost to the Government, unless it is determined by the Contracting Officer that latent errors existed in the information provided by the Government.

3. to start and end all level runs, traverses, or GNSS/GPS control surveys, from known control.

4. to set all stakes and marks in such a manner that is highly visible and notations thereon legible and sufficiently descriptive, unless otherwise agreed to.

5. to bear all costs, including but not limited to the cost of actual reconstruction of Contract work that may be incurred due to errors in Contractor's Construction Surveying.

6. Surveying Activities

a. Provide the Contracting Officer a 14 calendar day written notice before the Contractor needs the Government to establish any horizontal and vertical control points shown in the construction documents.

b. Submit for approval, prior to commencing Surveying work, a written Construction Surveying Work Plan and Schedule detailing:

i. Pertinent information as to how the requirements in these specifications are being met by the Contractor.

ii. A project specific Construction Surveying Work Schedule for the Construction Surveying and how it relates to the time frame for construction activities and the Government inspection needs.

iii. A proposed method of communications between the Contractor and Government Personnel.

iv. How and when the Contractor will make delivery of the as-built Survey Data to the Contracting Officer.

c. During the course of construction, provide notice of commencement of any Construction Surveying activities.

3.1.3.3 As-Built Surveys

3.1.3.3.1 Project Elements and Features

After construction, conduct an as-built survey of all project elements and features to accurately document the relationship between the design location and construction location. Provide all geospatial data (raw and processed) used to derive as-built documentation to the Contracting Officer. Ensure data is in compliance with applicable standards and guidance. At a minimum, electronically collect all as-built surveys of project elements and features using the appropriate data collection equipment (paragraph GEOSPATIAL DATA COLLECTION EQUIPMENT) for the accuracy level required and produce sufficient documentation of the as-built conditions. Deliver all geospatial data according to paragraph GEOSPATIAL DATA.

3.1.3.3.2 Utilities

Conduct an as-built field survey of all utilities, culverts and pipelines after installation or relocation to determine the final locations and elevations of all utility structures such as manholes, catch basins, gate valves, cleanouts, service connections, and other special controls or structures. Final elevations shall be determined for all sewer inverts, castings, and other elevations shown in the contract drawings. For utilities that are removed and not replaced, the removal limits and elevations shall be surveyed. Show locations using the same convention as the original contract drawings. Include this information on the

Contractor Record Drawings in Section 01 78 02.00 10 CLOSEOUT SUBMITTALS.

3.1.3.4 Quantity Surveys for Measurement and Payment

Perform quantity surveys in accordance with CONTRACT CLAUSE 52.236-16 QUANTITY SURVEYS--ALTERNATE I. Perform quantity surveys for all features of work necessary to establish measurement for partial and final payments. Complete surveys in enough detail to accurately determine quantities and verify the required section. Tasks include, but are not limited to, the following:

1. Initially, perform geospatial data collection prior to initiation of construction of the feature of work according to paragraph Geospatial Data Collection.

2. At time periods at which partial payments are to be requested, perform geospatial data collection according to paragraph Geospatial Data Collection.

3. Provide documentation and all associated files to the Contracting Officer showing all calculations, notes, and determinations. Include cross-sections with quantity calculations for material within the design section and quantity of material outside the design section.

4. For the final payment request, complete a final geospatial data collection according to paragraph Geospatial Data Collection.

The Contracting Officer may use the surveys for tolerance verification purposes. Additionally, the Contracting Officer may authorize an independent verification of any surveys.

3.1.3.5 Surveys for Verification of Design Section

For bid items where the unit of measure for payment is not in units of volume but where the work required is based on achieving specific section requirements, perform surveys as defined in this paragraph to verify that the design section requirements have been satisfactorily achieved. Perform the surveys using appropriate methods for the verification of the thickness and geometry of the materials placed as required by the contract documents. Tasks include, but are not limited to, the following:

1. Initially, perform geospatial data collection prior to initiation of construction of the feature of work according to paragraph Geospatial Data Collection.

2. At time periods at which verification of design section is requested, perform geospatial data collection according to paragraph Geospatial Data Collection.

3. Provide documentation and all associated files to the Contracting Officer showing all calculations, notes, and determinations. Include cross-sections with quantity calculations for material within the design section and quantity of material outside the design section.

4. Complete a final geospatial data collection according to paragraph Geospatial Data Collection.

The Contracting Officer may use the surveys for tolerance verification purposes. Additionally, the Contracting Officer may authorize an

independent verification of any surveys.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 02.00 10

CLOSEOUT SUBMITTALS

-- End of Section Table of Contents --

SECTION 01 78 02.00 10

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

As-Built Drawings; G,

1.2 AS-BUILT DRAWINGS

1.2.1 Working Drawings

The Contractor shall maintain a separate set of marked-up full-scale drawings indicating as-built conditions. These drawings shall show all changes and revisions made up to the time the work is completed and accepted. These drawings shall be maintained in a current condition at all times until completion of the work and shall be available for review by Government personnel at all times. All work that differs from the drawings, including modifications and optional materials shall be indicated.

1.2.2 Final Drawings

An electronic copy and a full size hardcopy of the Final As-built Drawings shall be submitted. In addition to the requirements below, the drawings shall be in accordance with the As-built Survey requirements as stated in SECTION 01 71 23.05 13 CONTRACTOR SURVEYS

1.2.3 Changes and Corrections

The Final As-built Drawings shall include, but not be limited to, the following information:

a. Changes in grade, elevation, cross sections, location or alignment of roads, earthwork, structures or utilities.

b. Changes in details.

1.2.4 Drawing Standards

a. Deleted items shall be indicated in red.
b. Added items or changed locations shall be shown in green.
c. Variations shall be shown in the same general detail utilized in the contract drawings.

d. Revisions shall be shown on all drawings and details related to the changed feature.
e. All markups shall be neat, clean and legible.
f. Where contract drawings or specifications present options, only the option selected for construction shall be shown.

1.3 APPROVAL

All information, records, and drawings shall be submitted prior to the contract completion date and will become the property of the Government.

Approval of final as-built drawings is required before final payment is made to the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - EXISTING CONDITIONS

SECTION 02 41 00

DEMOLITION

-- End of Section Table of Contents --

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site. The work includes demolition, salvage, of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless other otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions Documentation; G

SD-07 Certificates

Demolition Plan; G

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses" conform to the safety requirements contained in ASSE/SAFE A10.6

1.5 BURNING

The use of burning at the project site for disposal of refuse and debris will not be permitted.

1.6 DUST CONTROL

Prevent the spread of dust and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.7 PROTECTION

1.7.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights.

1.7.2 Existing Conditions Documentation

In addition to photographic and videographic documentation of the existing conditions in accordance with Section 01 14 00.00 13, the Contractor shall conduct a survey to collect horizontal and vertical data to document the existing location and elevation of points along the existing lock guidewall. This information will be used monitor for settlement or movement of the existing guidewall structure during construction. The Contractor shall also conduct a survey to collect horizontal and vertical data to document limits and elevation of points along the existing interceptor sewer. This information will be used to monitor and avoid interference with new construction when driving steel sheet piling. Submit the survey information in CAD file format.

1.7.3 Items to Remain in Place

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.7.4 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from the work area daily.

1.7.5 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate

area.

1.7.6 Utility Service

Maintain existing utilities to stay in service and protect against damage during demolition and deconstruction operations.

1.7.7 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of ay cutting, removal, deconstruction, or demolition work performed under this contract.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as required with workers skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

1.9 REQUIRED DATA

Prepare a Demolition Plan. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, or any coordination with other rework in progress a detailed description of the methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by the Contracting Officer prior to beginning the work.

1.10 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency requirements specified.

1.11 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.12 AVAILABILITY OF WORK AREAS

See section 01 14 00.00 13 WORK RESTRICTIONS

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

Remove existing structures required to be removed as shown, transport and properly dispose of waster materials.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Concrete

Saw concrete along straight lines to a depth of a minimum 3 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.4 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Transport structural steel shapes to a designated area as directed by the Contracting Officer, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.5 Miscellaneous Metal

Salvage shop-fabricated items such as steel gratings, metal ladders, metal railings, and similar items as whole units. Scrap metal shall become the

Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility.

3.1.6 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Concrete and Masonry: Completely fill holes and depressions, left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.1.7 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification and protected from damage.

3.1.8 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3 DISPOSAL OF REMOVED MATERIALS

3.3.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified.

3.3.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.3.3 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.4 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

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DIVISION 03 - CONCRETE

SECTION 03 01 00

REHABILITATION OF CONCRETE

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SECTION 03 01 00

REHABILITATION OF CONCRETE

PART 1 GENERAL

1.1 SCOPE

This specification governs the rehabilitation of structural concrete.

1.2 DEFINITIONS

1.2.1 Bracing

Temporary supplemental members used to avoid local or global instability during construction, evaluation, or repair that are intended to be removed after completion of construction.

1.2.2 Delamination

A planar separation in a material that is roughly parallel to the surface of the material.

1.2.3 Rehabilitation

Repairing or modifying an existing structure to a desired useful condition.

1.2.4 Repair

The reconstruction or renewal of concrete parts of an existing structure for its maintenance or to correct deterioration, damage, or faulty construction of members or systems of a structure.

1.2.5 Shoring

Props or posts of timber or other material in compression used for the temporary support of excavations, formwork, or unsafe structures; the process of erecting shores.

1.2.6 Termination Joint

The interface where a placement of repair material meets existing concrete, the edge of an expansion joint, or other existing surfaces.

1.2.7 Unsound Concrete

Concrete that is fractured, delaminated, spalled, deteriorated, defective, contaminated or otherwise damaged.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 288	(2017) Standard Specification for Geosynthetic Specification for Highway Applications

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 503.2-503.4	(2010, R 2003) Three Epoxy Specifications
ACI 503.3	(2010) Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate
ACI 503.7	(2007) Specification for Crack Repair by Epoxy Injection
ACI 548.4	(2011) Standard Specification for Latex-Modified Concrete (LMC) Overlays
ACI 548.8	(2007) Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks
ACI 548.9	(2008) Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks
ACI 548.10	(2010) Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks
ACI 548.12	(2012) Specification for Bonding Hardened Concrete and Steel to Hardened Concrete with an Epoxy Adhesive

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 37	(2015) Design Loads on Structures During Construction

ASTM INTERNATIONAL (ASTM)

ASTM A775/A775M	(2017) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C387/C387M	(2017) Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
ASTM C496/C496M	(2017) Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C881/C881M	(2020a) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C882/C882M	(2020) Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C928/C928M	(2020a) Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
ASTM C1059/C1059M	(2021) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1438	(2013; R 2017) Standard Specification for Latex and Powder Polymer Modifiers for use in Hydraulic Cement Concrete and Mortar
ASTM C1583/C1583M	(2013) Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
ASTM C1600/C1600M	(2017) Standard Specification for Rapid Hardening Hydraulic Cement
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D93	(2019) Standard Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester
ASTM D323	(2015a) Vapor Pressure of Petroleum Products (Reid Method)

ASTM D450/D450M	(2007; E 2013; R 2013) Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing
ASTM D542	(2014) Index of Refraction of Transparent Organic Plastics
ASTM D1078	(2011) Standard Test Method for Distillation Range of Volatile Organic Liquids
ASTM D2103	(2015) Standard Specification for Polyethylene Film and Sheeting
ASTM D3418	(2015) Transition Temperatures of Polymers by Differential Scanning Calorimetry
ASTM D4016	(2014) Viscosity of Chemical Grouts by Brook field Viscometer (Laboratory Method)
ASTM D4580/D4580M	(2012) Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding
ASTM E329	(2020) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 310.2R	(2013) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications; G, STR

Work Plan; G, STR

Rebar Dowel Bar Installation Plan; G, MAT

Drilling Program Plan; G, MAT

Quality Control Plan; G, STR

SD-03 Product Data

Conventional Concrete

Polymers

Miscellaneous Materials And Equipment

Drillin Equpment

SD-04 Samples

Reinforcement And Reinforcement Supports

Polymers

Miscellaneous Materials And Equipment

SD-05 Design Data

Formwork And Shoring; G, STR

Repair Procedures; G, STR

Mixture Proportioning; G, STR

SD-06 Test Reports

Mixture Proportioning

Quality Control

Tolerance Report

Reinforcement And Reinforcement Supports

Conventional Concrete

Polymers

Miscellaneous Materials And Equipment

SD-07 Certificates

Qualifications

Reinforcement And Reinforcement Supports

Conventional Concrete

Polymers

SD-08 Manufacturer's Instructions

Equipment For Concrete Preparation

Conventional Concrete

Polymers

Miscellaneous Materials And Equipment

1.5 QUALITY ASSURANCE

1.5.1 General Requirements

a. Follow the requirements of Section 03 70 00 MASS CONCRETE for work involving portland cement concrete.

b. To protect personnel from overexposure to toxic materials, conform to the applicable manufacturer's Safety data sheets or local regulations. Submit manufacturer's Safety Data Sheets for all polymers as well as other potentially hazardous materials.

c. Submit the repair procedures for executing the work as well as the test data and documentation on materials used for repair. Submittal must include component materials, mixture proportions, and supplier's quality control program.

d. Inspection and testing of surface preparation as well as placement of reinforcing steel must be in accordance with provisions included herein and the Contract Document.

e. Sampling and testing of materials, as well as inspection and testing of work, must be in accordance with established procedures, manufacturer's instructions, specific instructions from the Contracting Officer if given, or recommended practices as referenced herein and the Contract Documents.

f. Trial batches and testing requirements for various repair materials specified are the responsibility of the Contractor.

g. The testing agency must inspect, sample, and test repair materials and concrete production as required. When it appears that material furnished or work performed by Contractor fails to conform to Contract Documents the testing agency will immediately report such deficiency.

1.5.2 Quality Control Plan

Submit a quality control plan as specified in Sections 01 45 00.00 10 QUALITY CONTROL and 03 70 00 MASS CONCRETE.

1.5.3 Qualifications

The submittals must where applicable, identify agencies and individuals who will be working on this contract and their relevant experience. Do not make changes in approved agencies or personnel without prior approval of the Contracting Officer.

1.5.3.1 Testing Agencies

In addition to the requirements of Section 01 45 00.00 10 QUALITY CONTROL, agencies that test concrete materials must meet the requirements of ASTM C1077. Testing agencies that test or inspect placement of reinforcing steel must meet the requirement of ASTM E329. Submit data on qualifications of Contractor's proposed testing agency for acceptance.

1.5.3.2 Quality Control Personnel

Field tests of repair materials required must be made by an ICRI Concrete Surface Repair Technician Tier 2. Submit resumes, pertinent information,

past experience, training and education of all operators of specialized demolition equipment if needed for this and the three paragraphs above.

1.5.3.3 Contractor Qualifications

The contractor performing the repair work must have been involved in a minimum of three concrete repair projects similar in size and scope to this project for at least five years. Submit information, including name, dollar value, date, and point-of-contact for similar projects which demonstrates the required experience and/or training.

1.5.3.4 Worker Qualifications

a. Each worker engaged in the use of specialized removal or application equipment, including saw operators, hydromilling equipment operators, epoxy injection, must have satisfactorily completed an instruction program and three years of experience in the operation of the equipment.

b. Workers installing adhesive anchors must be ACI Adhesive Anchor Installer certified or equivalent.

1.5.3.5 Regulatory Requirements

Perform all work in accordance with applicable Federal, State, and local safety, health, and environmental requirements. The Contractor is responsible for obtaining all permits required by Federal, State, and local agencies for the performance of the work.

1.5.4 Pre-Construction Conference

Conduct a pre-construction conference to discuss repair materials performance requirements, control provisions, and roles and responsibilities for the Work to ensure that the Contractor's personnel understand all aspects of the repair material, its properties and application procedures. The conference must include the Contracting Officer or authorized representative, the Contractor's field superintendent and foreman, and a competent Technical Representative of the material manufacturer, and other involved trades or supplier representatives. The Technical Representative must be fully qualified to perform the work.

1.5.5 Work Plan

Prepare a work plan describing the methods of concrete removal and repair, including methods, equipment and materials to be used for each feature. Submit the work plan for approval at least 30 days prior to the start of the work. The plan must include, but not be limited to, repair materials to be used with specific information on products and/or constituents, and requirements for handling, storage, etc., equipment to be used, surface preparation, and requirements for placement, finishing, curing and protection specific to the materials used. Include a description of field demonstrations in the work plan. Do not commence work until the work plan and field demonstration representative of the type of work are approved.

1.5.6 Rebar Dowel Installation Plan

The Contractor must submit a plan for installing the underwater rebar dowels for review and comment. The plan must describe the sequence for

installation and other restrictions as outlines in the plans or as specified. The reinforcement and epoxy installation procedures must be determined by the Contractor. The installation plan must include descriptions of methods and equipment to be used for alignment of drilled holes. The rebar dowel installation plan shall also include the following:

a. Descriptions of drilling, epoxy grouting, and miscellaneous equipment.

b. Construction sequence.

c. Drilling procedure.

d. Hole preparation and clean out methods.

e. Epoxy grout installation.

f. Rebar dowel placement and installation

g. Verification plan of the correct placement and installation of rebar dowels.

1.5.7 Drilling Program Plan

Submit the Drilling Program Plan, per ER 1110-1-1807, at least 45 days prior to any drilling associated with rebar dowels.

1.6 ACCEPTANCE OF REHABILITATION WORK

1.6.1 General Requirements

a. Completed concrete rehabilitation work must conform to applicable requirements of Contract Document and this specification. The Contractor is responsible to bring Work into compliance with requirements of Contract Documents if the Concrete repair work fails to meet one or more requirements of Contract Documents.

b. Correct rejected repair work by removing and replacing or by strengthening with additional construction acceptable to the Contracting Officer. Use repair methods that meet applicable requirements for function, durability, dimensional tolerances, and appearance.

c. Submit proposed work plan, repair methods, materials, and modifications to the Work needed to correct rejected repair work to meet the requirements of Contract Documents.

1.6.2 Tolerances

a. Construction tolerances for repairs must conform to ACI 117. Where existing conditions do not allow tolerances to conform to ACI 117, use the details and materials for such conditions as indicated in the Contract Documents. For conditions not shown or that are different than indicated in the Contract Documents, notify the Contracting Officer before proceeding with the work at those locations.Provide a tolerance report as required by Section 03 70 00 MASS CONCRETE.

b. Inaccurately formed concrete surfaces resulting in concrete members with dimensions that exceed ACI 117 tolerances are subject to

rejection.

1.6.3 Appearance

Concrete surfaces not meeting the requirements of the Contract Documents must be brought into compliance.

1.7 PROTECTION OF COMPLETED REHABILITATION WORK

a. Do not allow construction loads to exceed the loads that a structural member or structure is safely capable of supporting without damage. Provide supplemental support if construction loads are expected to exceed safe load capacity.

b. Protect repaired and adjacent areas from damage by construction traffic, equipment, and materials. During the curing period, protect repair materials from damage by mechanical disturbances, including load-induced stresses, shock, and vibration.

c. Protect repair materials from environmental damage by weather events during the length of the curing period.

PART 2 PRODUCTS

Products or materials used must conform to the requirements included herein as well as the Contract Documents. The usage of other products or materials not covered by this requirement or specified in the Contract Documents are permitted upon approval by the Contracting Officer. Additional information and submittals for products and materials not included in this document including product data, samples, design data, test reports, certificates, manufacturer's instructions, and field reports must be submitted as requested by the Contracting Officer.

2.1 MATERIALS FOR SHORING AND BRACING

2.1.1 Shoring and Bracing Systems

Use commercially manufactured and engineered shoring and bracing systems and components, except where custom built assemblies of lumber or other suitable materials are permitted by the Contracting Officer.

2.1.2 Design Requirements

The design of the bracing and shoring must be based on ASCE/SEI 37.

a. Non-manufactured shoring and bracing systems must have calculations signed and sealed by a Licensed Design Professional.

b. Members of non-manufactured shoring systems, must be designed in accordance with the provisions of the governing building code for the specific material of the member.

c. Members of manufactured shoring systems, consisting of pre-engineered components designed and produced specifically for structural shoring, must be used in accordance with the manufacturer's recommendations.

2.2 EQUIPMENT FOR CONCRETE PREPARATION

Means and methods used for concrete removal and surface preparation must

be selected and used such as to minimize damage to the structure and to the concrete substrate that remains.

2.2.1 Equipment for Concrete Removal

Removal equipment and techniques must be suitable to produce concrete surface profiles and level of cleanliness in designated areas as required by this specification and the contract Documents.

2.2.1.1 Cutting Equipment

a. The following cutting equipment are permitted: High-pressure water jet without abrasives saw cutting Diamond wire cutting.

b. Cutting, lifting, and transporting equipment must be adequate to cut, support, and transport concrete sections without incurring any damage to the existing structure.

2.2.1.2 Concrete Breakers

a. Provide sharp tips on breaker equipment to minimize microcracking damage in partial depth removal.

b. The use of the following impact equipment and methods is permitted: Hand-held breakers Boom-mounted breakers.

c. The maximum breaker size is 90 lbs for hand held breakers and 150 ft-lbs for boom mounted breakers..

2.2.1.3 Hydromilling Equipment

a. Hydromilling equipment must include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water re-supply equipment. The water tank and auxiliary re-supply equipment must be of sufficient capacity to permit continuous operations.

b. Hydrodemolition for concrete removal is permitted in the following locations: Wing wall of existing interceptor sewer.

c. Use protective covers and barriers to protect adjacent surfaces not intended to be repaired from water blasting and over-spray.

d. Use equipment capable of delivering pressures of 5000 psi to 40,000 psi at 2 gal/min to 50 gal/min for concrete removal and surface preparation.

2.2.2 Surface preparation and cleaning equipment

2.2.2.1 Abrasive Blasting

a. Use dry or wet oil-free abrasive blasting capable of removing loose micro-fractured (bruised) or otherwise damaged or pulverized concrete surfaces, and rust from exposed steel reinforcement, and providing a surface profile in compliance with the Contract Documents.

b. Use the following abrasive blasting methods: Sandblasting or shotblasting.

2.2.2.2 Low Pressure Water Cleaning

Use equipment capable of delivering 1000 psi to to 5000 psi at 2 gal/min to 10 gal/min for cleaning loose material from repair areas.

2.2.2.3 Other Cleaning Equipment

Use equipment that delivers oil free air capable of cleaning loose material and debris from repair areas. If necessary to dry the concrete surface, clean, dry, compressed air may be used. Also, use vacuums capable of removing loose material and debris.

2.2.3 Drilling Equipment

The Contractor shall submit a description and list of the drilling equipment that will be used that is suitable for advancing the drill tools to the depths and at the alignment underwater. The Contractors's Quality Control manager must verify that the equipment used on site is the same as the equipment submitted for approval.

2.3 MATERIALS FOR FORMWORK AND EMBEDDED ITEMS

a. Formwork and embedded items must meet the requirements specified in Section 03 11 14 FORMWORK FOR CONCRETE.

b. Install and remove formwork without damaging or staining the existing structure or repair material.

c. Forms used for polymer concrete/mortars must be tight enough to hold the material that is used without leaking. All surfaces where bond is not desired, but which are exposed to the monomer or resin, must be treated with a form release agent.

2.4 REINFORCEMENT AND REINFORCEMENT SUPPORTS

2.4.1 Steel Bars, Wires, and Fiber-reinforced Concrete

a. Reinforcement and reinforcement support must meet the requirements specified in Section 03 20 00.00 10 CONCRETE REINFORCEMENT.

b. Repair coating damage incurred during shipment, storage, handling, and placing of reinforcing bars in accordance with the appropriate ASTM standard practices for repair of damaged reinforcement ASTM A780/A780M ASTM A775/A775M ASTM A934/A934M. Damaged areas must not exceed 2 percent of surface area in each linear foot of each bar.

c. Mechanical splices for coated reinforcement must have compatible coatings, in accordance with manufacturer's instructions. Splices for galvanized reinforcement must be galvanized or coated with dielectric material. Splices used with epoxy-coated or dual-coated reinforcement must be coated with dielectric material.

d. Submit mill certificates and shop drawings as requirement by Section 03 20 00.00 10 CONCRETE REINFORCEMENT.

2.5 CONVENTIONAL CONCRETE

a. Portland cement concrete materials must meet the requirements specified in Section 03 70 00 MASS CONCRETE.

b. For cement based bonding systems use neat portland cement or a blend of portland cement and an ASTM C33/C33M fine aggregate filler proportioned one to one by mass. The water-to-cement ratio of the bonding mixture must be equal to the water-to-cement ratio of concrete used as a repair or overlay material. Water used must meet ASTM C1602/C1602M requirements.

c. Use cementitious materials indicated in the Contract Documents.Use cementitious materials of the same brand and type from the same manufacturing plant as the cementitious materials used in the concrete represented by the submitted field test records or used in trial mixtures.

d. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in the concrete represented by submitted historical data or used in trial mixtures.

e. Refer to Section 03 70 00 MASS CONCRETE for details on submittals involving conventional concrete.

2.6 POLYMERS

a. The requirements for the properties of polymers and aggregates used in polymers must meet the requirements specified in this paragraph as well as the properties specified in the referenced specifications and the Contract Documents.

b. Polymers used must be compatible with other polymers and materials used on the project. Unless repair materials are specified in the contract documents, the Contractor is responsible for verifying material compatibilities.

c. Submit product data, manufacturer's Safety Data Sheets,samples, design data, test reports, certificates, manufacturer's instructions, and field reports for materials as required by this document as well as the referenced specifications and the Contract Documents.

2.6.1 Epoxies

a. Epoxy mortars and epoxy compounds must conform to ASTM C881/C881M.

b. Epoxy mortars used for repairing defects in hardened portland cement concrete must meet the requirements of ACI 503.2-503.4.

c. Epoxy used for crack repair must meet the requirements of ACI 503.7.

d. Epoxy used to produce a skid-resistant surface on hardened concrete must meet the requirements of ACI 503.3.

e. Epoxy used for overlays must meet the requirements of ACI 548.8 or ACI 548.9.

f. Epoxy used for bonding freshly mixed concrete and hardened concrete must meet the requirements of ASTM C881/C881M.

g. Epoxy used for bonding hardened concrete and steel to hardened concrete must meet the requirements of ACI 548.12.

h. Epoxy resins for use in repairs or embedding anchors and dowels underwater shall conform to ASTM C881/C881M, Type IV, V, VI, and VII, Grades 1, 2, or 3 and classes B, C, D, E, and F and can be verified to exhibit sufficient bond strength when installed in underwater applications.

2.6.2 Latexes

a. Latex used in polymer modified portland cement concrete/mortar must meet the requirements of ASTM C1438.

b. Latex used in polymer modified portland cement concrete overlays must meet the requirements of ACI 548.4.

c. Latex used for bonding freshly mixed concrete and hardened concrete must meet the requirements of ASTM C1059/C1059M, Type II.

2.6.3 Methacrylates

a. Methyl methacrylate slurry (MMS) used for overlays must meet the requirements of ACI 548.10.

b. High molecular weight methacrylate (HMWM) must be a 2-component, rapid curing, and solvent-free system.

c. HMWM monomers must be a high molecular weight or substituted methacrylate that conforms the following properties:

Physical Properties of HMWM Monomer		
Property	Test Method	Criteria
Vapor Pressure Flash Point Density	ASTM D323 ASTM D93	Less than 0.02 psi at 77 degrees F Greater than 200 degrees F Greater than 8.4 lbs. per gal. at 77 degrees F
Viscosity Index of Refraction Boiling point @ 0.02 psi Shrinkage on cure	ASTM D4016 ASTM D542 ASTM D1078	12 ± 4 cps at 73 degrees F 1.470 ± 0.002 158 degrees F Less than 11 percent
Glass Transition Temperature (DSC)	ASTM D3418	158 degrees F

Physical Properties of HMWM Monomer		
Curing Time (100 g mass)	ASTM D3418	Greater than 40 minutes at 73 degrees F, with 4 percent cuemene hydroperoxide
Bond Strength	ASTM C882/C882M	Greater than 1,500 psi

d. The initiator/promoter system for HMWM must be capable of providing a surface cure time of not less than 40 minutes nor more than 3 hours at the surface temperature of the concrete during application. The initiator/promoter system must be such that the gel time may be adjusted to compensate for changes in temperature that may occur throughout the treatment application.

d. The initiator/promoter system for HMWM must meet the following criteria:

Initiator Cuemene Hydroperoxide	78 percent
Promoter Cobalt Napthenate	6 percent

2.6.4 Aggregate

a. Unless otherwise specified or recommended by the polymer material manufacturer, aggregate used with polymers must meet ASTM C33/C33M requirements.

b. Aggregate properties and proportions used with polymers must meet the requirements of the polymer material manufacturer, the requirements of the referenced polymer standard, and the Contract Documents.

c. Aggregate used with polymers must be dry and free of dirt, asphalt, and other organic materials. Aggregate moisture content must be less than 1 percent by weight.

d. For patch repairs, the maximum-sized aggregate must not be greater than one third the depth of the patch area.

2.7 MISCELLANEOUS MATERIALS AND EQUIPMENT

2.7.1 Packaged and proprietary materials

The required properties for the materials listed in this paragraph must meet the properties specified in the Contract Documents. Submit Product data, samples, design data, test reports, certificates, manufacturer's instructions, and field reports as required by the Contracting Officer and the Contract Documents.

a. Packaged, rapid hardening concrete repair materials must conform to ASTM C928/C928M.

b. Packaged, mortar and concrete must conform ASTM C387/C387M.

c. Rapid hardening cement must conform to ASTM C1600/C1600M.

Water used with packaged and proprietary materials must meet ASTM C1602/C1602M requirements. Aggregates must meet the repair material manufacturer's requirements if available and ASTM C33/C33M if such requirements are not specified.

2.7.2 Bond Breakers

a. Bond breaker materials must meet the requirements of ASTM D2103, and must have a minimum thickness of 0.010 in., AASHTO M 288, Erosion Control, Class B, ASTM D450/D450M, Type II.

b. Bond breaker materials used must not have detrimental effects on portland cement concrete and reinforcement.

2.7.3 Structural steel

Structural steel used for repairs must meet the requirements of 05 12 00 STRUCTURAL STEEL.

2.7.4 Concrete Accessories

All concrete accessories not included in this document must meet the requirements specified in Section 03 70 00 MASS CONCRETE.

2.7.5 Miscellaneous Equipment

a. Equipment designed specifically for the application of repair materials must be used as required by the repair material manufacturer and the referenced specification.

b. Equipment not listed in this specification but referenced or used for repairs must be clean and in good operating condition.

c. All supplies and equipment must be available in sufficient quantities to allow continuity in the installation project and quality assurance.

2.8 MIXTURE PROPORTIONING

a. Portland cement-based concrete mixtures must be in accordance with the requirements of Section 03 70 00 MASS CONCRETE.

b. Polymer concrete/mortar/resin/monomer proportioning, handling, and mixing procedures as well as equipment used for mixing these materials must conform to the requirements of the referenced material specifications and the repair material manufacturer's directions.

c. Polymer-modified portland cement concrete proportioning, handling, and mixing procedures as well as equipment used for mixing these materials must conform to the requirements provided by the repair material manufacturer as well as ACI 548.4 when such materials are used for overlays.

d. Proportioning and mixing materials not specified above must follow the requirements provided by the repair material manufacturer.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 Examination

Locate area of unsound concrete or delamination using hammer sounding or chain drag sound methods in accordance to ASTM D4580/D4580M. Denote and mark perimeter boundaries and notify the Contracting Officer to approve the unsound concrete layout boundaries.

3.1.2 Protection

Protect pedestrians, motorized traffic, mechanical, electrical, and plumbing equipment, surrounding construction, project site, landscaping, and surrounding buildings from damage or injury resulting from concrete rehabilitation work.

a. Construct dust and debris barriers surrounding repair work perimeter to control dust and to protect and control construction traffic.

b. Dispose of runoff from wet demolition or surface preparation operations in accordance with all local ordinances. Disposal methods must avoid soil erosion, avoid undermining pavements and foundations, damage to landscaping and vegetation, and minimize water penetration through other parts of buildings.

c. Collect and neutralize alkaline wastes and acid wastes and dispose in accordance with local, state, and federal regulations.

d. Comply with local noise ordinances during demolition operations.

e. Perform demolition work and surface preparation work in a manner that minimizes disturbances of operations. Coordinate work with the Contracting Officer.

f. Submit a proposed protection plan for approval by owner representative and Licensed Design Professional.

3.1.3 Formwork and Shoring

Execution of formwork and shoring must meet the requirements specified in Section 03 11 14 FORMWORK FOR CONCRETE.

3.1.3.1 Formwork

a. Construct forms to sizes, shapes, lines, and dimensions to match existing adjacent surfaces and textures. Provide forms that match openings, offsets, chamfers, anchorages, inserts and other features as described on Contract Documents. Construct forms to accommodate installation of products by other trades. Provide forms for easy removal to minimize damage to concrete surfaces and adjacent surfaces. Apply form release coating over formwork surfaces prior to each concrete placement. Form release agents must not be applied to or come in contact with the repair area concrete substrate or reinforcement.

b. Do not damage repair material during removal of formwork for columns, walls, sides of beams, and other parts not supporting weight of

concrete or repair material. Perform needed repair and treatment required on vertical surfaces at once and follow immediately with specified curing. Remove all formwork anchors embedded in existing concrete. Fill anchor holes and repair all damage to existing concrete at anchor holes.

3.1.3.2 Shoring

a. Provide shoring in accordance with the shoring drawings prior to performing work to brace the substrate structure temporarily while repair work is proceeding. Shoring must be designed, documented, and stamped by a Licensed Design Professional. Shoring designs must be submitted to and approved by the Contracting Officer prior to work commencing.

b. Leave formwork and shoring in place to support existing loads, construction loads and weight of repair material in beams, slabs, and other structural members until in-place strength of repair material determined in accordance with the Contract Documents. For post-tensioned construction, leave formwork and shoring in place until stressing is complete. When shores and other supports are arranged to allow removal of form-facing material without allowing structural slab or member to deflect, form-facing material and its horizontal supporting members may be removed at an earlier age.

3.1.4 Concrete preparation

a. Remove concrete as needed per the removal requirements of this section. Limits on removal equipment are specified in the paragraph titled EQUIPMENT FOR CONCRETE PREPARATION.

b. Remove foreign material, such as dirt, oil, grease, or other chemicals, from the cracks before injection using compressed air, low-pressure water, or vacuuming. Allow wet surfaces to dry at least 24 hours.

c. Immediately before placing the repair material or installing formwork, make the repair area available for inspection by the Contracting Officer. Obtain acceptance by the Contracting Officer of surface preparation before proceeding with Work. If the Work is rejected, perform additional operations to the satisfaction of Contracting Officer.

d. Perform tensile pull-off tests in accordance with ASTM C1583/C1583M. Pull-off strength must meet or exceed 250 psi. Test a minimum of 3 specimens at locations no greater than 500 square yards of prepared surface.

e. The prepared surface must have a concrete surface profile equivalent to CSP 5 as defined by ICRI 310.2R.

3.1.5 Quality Control

3.1.5.1 Quality control of surface preparation

Evaluation of prepared substrate must be continuously monitored to assure that the prepared substrate surface meets project requirements.

3.1.5.2 Quality control of repair overlays

All components of overlay PPCC materials must be certified by the material manufacturer or aggregate supplier to meet all project testing requirements. During the PPCC overlay, take mixed samples and check that the materials are mixed properly. Confirm that the right PC overlay thickness was applied by recording the volume of PC overlay materials and the substrate surface area covered by the overlay.

3.1.6 Curing

a. For portland cement concrete Work, follow the requirements indicated in 03 70 00 MASS CONCRETE.

b. For polymer concrete/mortar Work, follow manufacturer's requirements for curing.

c. For polymer modified portland cement concrete Work follow manufacturer's requirements for curing.

3.1.7 Clean up

a. Clean and remove all spills and leaks of injection adhesive and stains caused by the injection adhesives.

b. Dispose wastewater used for cutting and cleaning without staining or damaging the existing surfaces of the structure or the environment of the project area. The method of disposal must meet all the requirements of Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

3.1.8 Safety

a. Provide Safety Data Sheets (SDS) for products on site reviewing them before work begins.

b. Provide safety guards, maintenance, and warnings for all machinery and equipment.

c. Have personal protection equipment practice in place - eye protection and face guards.

d. Have all workers in contact with wet cementitious material wear protective gloves and clothing.

e. Provide eyewash facilities on-site with location signage.

f. Provide dust masks for workers operating mixers.

g. Have confined space procedures in place including adequate ventilation in closed spaces before operating equipment or using products that emit potentially dangerous or toxic exhaust, fumes, or dust.

h. Provide secured storage available for all hazardous or flammable materials.

i. Conduct safety meetings prior to beginning repair operations.

3.2 CRACK REPAIR

3.2.1 Preparation

3.2.1.1 General Requirements

a. Clean all cracks in accordance with the paragraph titled Concrete Preparation.

b. Do not repair cracks when the temperature of the concrete is below freezing and moisture conditions indicate the possibility of ice on the internal surfaces of the crack.

c. Do not apply adhesive if the temperature of the concrete is not within the range of application temperatures recommended by the manufacturer of the adhesive.

3.2.1.2 Crack routing

Inspect surfaces adjacent to crack to receive repair material. If deteriorated, route a V-groove section at the crack face until sound concrete is reached.

3.2.1.3 Sealing

a. For epoxy injection, apply a surface seal over all exterior faces of the crack that can be reached to contain the injection adhesive in the crack.

b. For gravity fill repairs, apply a surface seal along the bottom surface of the element that can be reached to contain the repair material in the crack.

3.2.2 Application

3.2.2.1 Epoxy Injection

a. Install the injection entry and venting ports using flush mounted or drilled fittings per proprietary manufacturer's instructions.

b. Space the ports at 8 in..

c. Inject the epoxy using material manufacturer's recommended equipment.

d. Apply recommended manufacturer's injection pressure.

e. For vertical or inclined cracks, apply injection by pumping epoxy into entry ports at the lowest elevation, cap, and move upward.

f. For horizontal cracks, apply injection by proceeding from one end of the crack to the other until the crack is fully sealed.

g. After 10 min., repeat injection procedure until all ports refuse injection.

h. Remove ports and remove the surface seal by heat, chipping, or grinding or other acceptable means after the injected epoxy has cured.

3.2.2.2 Gravity fill

a. Mix resin or monomer per material manufacturer's instructions.

b. Pre-fill cracks at least 0.125 in. wide with aggregate.

c. Pour resin or monomer onto the surface, over the cracks and spread with brooms, rollers, or squeegees.

d. Work material back and forth over the cracks to maximize fill in crack.

e. Allow at least 20 minutes for material to penetrate cracks.

f. Remove excess material once cracks have been filled to refusal.

g. Broadcast 1 to 2 lbs per square yard of sand.

h. Allow material to cure per material manufacturer's recommendations.

i. Remove sealant and grind smooth.

3.2.3 Quality Control

a. Conduct quality and control tests for metering accuracy and mixing effectiveness of the continuous mixing pump in accordance with ACI 503.7.

b. Qualify the test injection procedures in accordance with ACI 503.7.

3.2.4 Acceptance Criteria

3.2.4.1 Core Sampling

a. Obtain core samples in accordance with ASTM C42/C42M.

b. Allow 24 hours after injection before coring.

c. Obtain cores in a manner that includes as much of the bond line of the repaired concrete as possible. Replace cores that do not intersect the crack for at least 75 percent of the length of the core.

d. Obtain three diameter core from first 100 ft. and one core for each 100 ft. thereafter.

e. If cores would sever reinforcing steel or other embedded items, do not core, and notify the Contracting Officer so that an alternative location can be chosen.

f. Obtain cores at least 2 in. in diameter for visual inspections and at least 4 in. in diameter for the splitting tensile test. Perform a splitting tensile test on one core from the first 100 ft. and one core for each 250 ft. thereafter.

g. Fill core holes with non-shrink grout.

3.2.4.2 Core Testing

a. Test a portion of the core samples for the splitting tensile strength in accordance with ASTM C496/C496M.

b. Allow 72 hours after injection before beginning splitting tensile tests

c. Prepare core sample per ASTM C42/C42M.

d. Align the core so that the crack is in a plane as close to vertical as possible.

3.2.4.3 Acceptance

Work is acceptable if at least 90 percent of the depth of the crack in each core is filled with adhesive.

3.3 CORROSION AND SURFACE REPAIR

3.3.1 Preparation

3.3.1.1 Identification of Extent of Concrete Removal

a. Configure geometry of removal area to maximize the use of right-angle geometry, avoiding reentrant corners, and to obtain uniformity of depth. Determine the depth, location, and size of reinforcing bars prior to removal of concrete.

b. Perform visual inspection and hammer tapping, chain drag sounding, or other methods acceptable by the Contracting Officer to identify cracked, delaminated, spalled, disintegrated, and otherwise unsound concrete for removal. Mark boundaries of repair area before concrete removal.

c. Inspect the marked boundaries with the Contracting Officer prior to commencing with the concrete removal. Revise the repair area boundaries as instructed by the Contracting Officer.

3.3.1.2 Shoring and Formwork

a. Provide shoring and formwork per the paragraph titled Formwork and Shoring.

b. For post-tensioned concrete, detension strands and wires as required by Contract Documents prior to repair.

3.3.1.3 Concrete Removal

a. Remove concrete from repair areas to indicated depth and profile. Notify Contracting Officer if additional delaminated, fractured, or unsound concrete is present.

b. Do not damage embedded reinforcing and adjacent concrete. The removal methods must produce minimal microcracking (bruising) of the prepared substrate surfaces. Avoid directly striking reinforcing steel with impact tools used for concrete removal.

c. Provide perpendicular edges at perimeter of repair area. The perimeter of the repair areas must be saw cut to a depth of 0.50 to 0.75 in.. For vertical surfaces, provide 45-degree slope at repair boundaries to facilitate air and rebound escape. Do not cut or damage embedded reinforcement or other embedded items. If embedded reinforcing steel or other embedded items are too close to the surface to provide the

perpendicular edge cut, notify the Contracting Officer for direction before proceeding.

d. Extend concrete removal along the corroded reinforcing steel to a point where there is no further delamination, concrete cracking, or reinforcing steel corrosion, and where the reinforcement is bonded to the surrounding concrete.

e. Remove concrete around the exposed layer of reinforcement to a uniform depth beyond within the repair areas to provide a minimum clearance between exposed reinforcing steel and surrounding concrete of 0.75 in., or at least 0.25 in. larger than the maximum nominal size of the coarse aggregate in the repair material.

3.3.1.4 Preparation of Concrete Substrate Surface

a. Confirm perpendicular edges at repair area perimeter, and reinstate if damaged by concrete removal process. Remove loosely bonded concrete, bruised or fractured concrete, and bond-inhibiting materials such as dirt, concrete slurry, or any other detrimental materials from the concrete substrate using approved methods. Where concrete has been removed by impact methods, abrasive blasting must be used to prepare the surface and remove bruised concrete.

b. Provide substrate surface profiles as specified in the Contract Documents.

c. Visually inspect and sound substrate surface to confirm that no further delaminations or otherwise unsound concrete remains. If encountered, notify the Contracting Officer.

d. Clean the substrate per the paragraph titled Concrete preparation.

3.3.2 Application

3.3.2.1 Existing Reinforcement Preparation

a. Clean existing reinforcement that will remain. Remove corrosion and/or other laitance and notify the Contracting Officer if section loss is greater than 20%.

b. Permit evaluation of existing reinforcement and placement of new reinforcement by the Contracting Officer.

3.3.2.2 Placement of New Reinforcement

See specification section 03 20 00.00 10 CONCRETE REINFORCEMENT for placement and installation of new reinforcement.

3.3.2.3 Placement of Concrete

a. If portland cement concrete is used as the repair material, follow the requirements indicated in 03 70 00 MASS CONCRETE as well the Contract Document for proportioning, mixing, and placing concrete. For all other materials, follow material manufacturer's recommendations.

b. A bonding agent must be used.

c. Apply corrosion inhibitors as designated by the Contract Documents.

d. Bristle broom a thin coat of the repair material into the saturated surface dry substrate filling roughened surface pores before placing the repair material in the repair area. Do not allow thin coat to dry before placing repair material.

e. Consolidate the repair material after placement with a vibrating screed or internal vibrator.

f. Finish the surface to match surface finish and texture requirements indicated in the Contract Document. Screed, float and trowel the repair material or broom the surface for non-slip texture. Follow the requirements of 03 70 00 MASS CONCRETE.

3.3.2.4 Placement of Other Repair Materials

a. Equilibrate repair material(s) and substrate to the temperature, cleanliness of substrate and reinforcement, and moisture requirements of the repair material manufacturer's requirements.

b. Comply with the repair material manufacturer's requirements for batching, mixing, placing and curing repair materials.

c. Review consistency of the mixed repair material(s) relative to the parameters documented in the repair material manufacturer product data sheet. If non-conforming, adjust consistency in compliance with the repair material manufacturer's requirements.

d. Apply or install repair material(s) within the application time frame (pot life) requirements of the repair material manufacturer's requirements, and place and consolidate to provide well-compacted repair.

e. Finish and tool repair materials, finished in accordance with the repair material manufacturer's written instructions and as indicated in Contract Documents.

f. Protect installed repair material(s) from damage, exposure to environmental conditions that are detrimental to the uncured or cured properties of the material. Cure in accordance with the requirements of the repair material manufacturer's requirements.

3.3.3 Quality Control

a. Protect concrete surfaces, beyond limits of surfaces receiving bonding agent adhesive, against spillage. Immediately remove any bonding agent adhesive that has spilled beyond desired area. Perform cleanup with material designated by bonding agent adhesive manufacturer. Avoid contamination of work area.

b. The bond strength between the existing concrete and the repair material must be a minimum of 250 psi per ASTM C1583/C1583M. Test a minimum of 3 specimens at locations no greater than 500 square yards of prepared surface.

3.4 OVERLAYS

3.4.1 Preparation

3.4.1.1 Bonded Overlays

a. Provide surface preparation as required in this Section.

b. Repair cracks and patch deteriorated concrete prior to final surface preparation.

c. Apply additional preparation requirements specified by the overlay material manufacturer

3.4.2 Application

3.4.2.1 Portland Cement Concrete

a. Apply the specified bonding agent. Follow the requirements of 3.4.2.4.

b. Follow the requirements of Section 03 70 00 MASS CONCRETE and the Contract Documents for installing forms, placing reinforcement, placing and consolidating concrete, and finishing concrete.

3.4.2.2 Polymer-modified Portland Cement Concrete

For polymer modified portland cement concrete overlays follow manufacturer's requirements for placing and finishing the overlay.

3.4.2.3 Polymer Concrete/Mortar

For polymer concrete overlays, follow manufacturer's requirements for placing and finishing the overlay.

3.4.2.4 Bonding Agents

a. Use an epoxy bonding agent or latex bonding agent to improve the bonding between the overlay and the existing concrete.

b. Follow material manufacturer's instructions for mixing, preparing, and applying bonding agent. Do not exceed the manufacturer’s thickness recommendations.

c. Condition materials and the existing concrete surface to a temperature consistent with manufacturer’s recommendations at the time of installation.

d. Do not allow bond agents to dry before placement of repair material.

3.4.3 Quality Control

a. Concrete overlays must meet all the strength and durability requirements of 03 70 00 MASS CONCRETE. Material properties must meet the requirements defined in PRODUCTS.

b. The bond strength between the existing concrete and the overlay must be a minimum of 250 psi per ASTM C1583/C1583M. Test a minimum of 3 specimens at locations no greater than 500 square yards of prepared

surface.

3.4.4 Joints

a. Construct expansion and contraction joints in concrete overlay at the locations shown. Maintain alignment of control joints within 1/4 in., to either side, of the required joint alignment.

b. Construct expansion joints in the overlay at existing joint locations in the base slab while maintaining joint width and type, and extending the full depth of the overlay.

c. Construct control joints by tooling the plastic concrete, then sawcutting at the appropriate time. Saw control joints to a minimum of 25 percent of the thickness of the slab. Maintain an ample supply of saw blades on the job before concrete placement is started, and have at least one standby sawing unit in good working order available at the jobsite at all times during the sawing operations. Begin sawcutting as soon as it is possible to saw the concrete without damaging adjacent concrete.

d. Inspect the faces of joints during sawcutting for undercutting or washing of the concrete due to early sawing. Complete sawcutting within 16 hours of concrete placement. Continue sawcutting regardless of weather conditions. Delay sawing if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint or chipping, tearing, or spalling of the concrete occurs at the surface. Discontinue sawing when a crack develops ahead of the saw cut.

e. Immediately after the joint is sawed, flush the saw cut and adjacent concrete surface thoroughly with water until all residue from sawing is removed from the joint. Control and dispose of waste water from sawcutting and cleanup in accordance with Section 01 57 20.00 13 ENVIRONMENTAL PROTECTION.

3.5 CONCRETE STRENGTHENING

a. For enlargement of slabs using overlays see the paragraph titled OVERLAYS.

b. For all other types of strengthening follow the requirements contained in this paragraph.

3.5.1 Preparation

a. Use equipment and methods specified in the paragraph titled EQUIPMENT FOR CONCRETE PREPARATION and the Contract Documents to produce a sound, rough, open-pore surface at locations where bonding between existing and new concrete is required.

b. Round members of existing concrete with corners to minimum ½ in. radius. Roughened corners must be smoothed with putty

c. Clean all surfaces from contaminant and remove unsound concrete using the prescribed cleaning equipment and methods in the paragraphs titled PRODUCTS. All laitance, dust, dirt, oil, curing compound, existing coatings, and any other matter that could interfere with bonding concrete to the repair material must be removed.

d. Follow the procedures of the paragraphs titled CRACK REPAIR and CORROSION AND SURFACE REPAIR. The concrete surface must be in good condition and all cracking, surface repair, and corrosion related problems must be adequately addressed prior to proceeding with concrete strengthening procedures.

e. Insure that materials used for repairs are compatible with materials used for strengthening. Consult with the repair material manufacturers for information concerning material compatibility.

f. Surfaces not intended to be strengthened must be covered as needed to protect against contamination and spills.

g. Surfaces intended to be strengthened must be protected before application so that no materials that can interfere with bond are redeposited on the surface.

3.5.2 Application

3.5.2.1 Section enlargement

a. Install dowel reinforcement as required by the Contract Documents. Follow the adhesive or mechanical anchor manufacturer's procedures for installing dowels.

b. Install formwork and shoring following the requirements of this section.

c. Install reinforcement and reinforcement supports. Follow the requirements specified in Section 03 70 00 mass CONCRETE.

d. Follow the requirements of Section 03 70 00 MASS CONCRETE to place, consolidate, and finish concrete.

3.5.2.2 Externally bonded systems

3.5.2.2.1 Steel Plates

a. Bond steel plates to concrete using the methods and materials specified in the Contract Documents.

b. For bonding steel plates to concrete using an epoxy resin follow the requirements and procedures of ACI 548.12.

c. For bonding steel plates to concrete using mechanical or adhesive anchors, follow the procedures provided by the material manufacturer.

3.5.2.2.2 Fiber-reinforced Polymer Laminates

The following procedures are general procedures used for the installation of FRP laminates. If the FRP system used requires conflicting procedures, consult with the Contracting Officer before proceeding.

a. Insure that all surfaces that will receive FRP are clean, dry, and free of contaminants.

b. Insure that the workplace is well ventilated and that the repair material is applied at a time when the air temperature, concrete surface temperature, and the relative humidity are as required by the

repair material manufacturer.

c. Temporary protection of the Work area is required during installation and until the resins have cured. If temporary shoring is required, the FRP system must be fully cured before removing the shoring and allowing the structural member to carry the design loads.

d. If a primer is required, the primer must be applied uniformly to all areas on the concrete surface where the FRP system is to be placed at the manufacturer’s specified rate of coverage. Protect the primer from dust, moisture, and other contaminants before applying the FRP system

e. Putty must be used in an appropriate thickness and sequence with the primer as recommended by the FRP manufacturer. The system-compatible putty must be used only to fill voids and smooth surface discontinuities before the application of other materials. Rough edges or trowel lines of cured putty must be ground smooth before continuing the installation. Allow the putty to cure as specified by the FRP system manufacturer before proceeding.

f. Proportion, mix, and apply resins components in accordance with the FRP system manufacturer’s recommended procedures.

g. Install and cure the FRP system per the manufacturer's recommendations.

h. During installation of wet layup FRP systems, entrapped air between layers must be released or rolled out before the resin sets. Sufficient saturating resin must be applied to achieve full saturation of the fibers. Furthermore, successive layers of saturating resin and fiber materials must be placed before the complete cure of the previous layer of resin. If previous layers are cured, interlayer surface preparation, such as light sanding or solvent application as recommended by the system manufacturer, is required.

i. Follow the FRP material manufacturer's recommendations for the application of protective coatings. Do not clean the installed FRP with a solvent before a protective coating is installed.

3.5.3 Quality Control

The cured FRP system must be evaluated for delaminations or air voids between multiple plies or between the FRP system and the concrete. Methods such as acoustic sounding (hammer sounding), ultrasonics, and thermography can be used to detect delaminations. The following requirements apply to wet layup systems:

a. Small delaminations less than 2 square inch each are permissible as long as the delaminated area is less than 5 percent of the total laminate area and there are no more than 10 such delaminations per 10 square feet

b. Large delaminations, greater than 25 square inch, can affect the performance of the installed FRP and must be repaired by selectively cutting away the affected sheet and applying an overlapping sheet patch of equivalent plies.

c. Delaminations less than 25 square inch must be repaired by resin injection or ply replacement.

For other FRP systems, delamination must be evaluated and repaired in accordance with the material manufacturer direction. Upon completion of the Work, the laminate must be reinspected to verify that the repair was properly accomplished.

-- End of Section --

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DIVISION 03 - CONCRETE

SECTION 03 11 14

FORMWORK FOR CONCRETE

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SECTION 03 11 14

FORMWORK FOR CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 347	(2014; Errata 1 2017) Guide to Formwork for Concrete

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PS 1	(2009) Structural Plywood (with Typical APA Trademarks)

ASTM INTERNATIONAL (ASTM)

ASTM C 31/C 31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 39/C 39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 1074	(2019) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2017) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

1.2 DESIGN REQUIREMENTS

The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. The formwork, including bracing and shoring for stay-in-place PZ settle forms and precast wall unit, shall be designed for anticipated live and dead loads and shall comply with the tolerances specified in Section 03 70 00 MASS CONCRETE, paragraph CONSTRUCTION TOLERANCES. However, for surfaces with an ACI 347 Class A surface designation, the allowable deflection for facing material between studs, for studs between walers and walers between bracing shall be limited to 0.0025 times the span. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. The formwork analysis and design, including all shop drawings and calculations, shall be signed and sealed by a licensed professional engineer. The adequacy of formwork design and construction shall be

monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, STR

Drawings and design computations for all formwork required, including bracing and shoring for stay-in-place PZ sheetpile forms and precast wall unit, shall be submitted at least 30 days either before fabrication on site or before delivery of prefabricated forms.

SD-03 Product Data

Materials; G, STR

Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, and form coating.

SD-06 Test Reports

Formwork Not Supporting Weight Of Concrete; G, STR

If forms are to be removed in less than 24 hours on formwork not supporting the weight of concrete, the evaluation and results of the control cylinder tests or maturity instrumentation shall be submitted to and approved before the forms are removed.

Formwork Supporting Weight Of Concrete; G, STR

Prior to forms, supporting the weight of concrete, being removed, the evaluation and results of the control cylinder tests or maturity instrumentation shall be submitted to and approved before the forms are removed.

Inspection; G, STR

Submit field inspection reports for concrete forms and embedded items.

1.4 SHOP DRAWINGS

The shop drawings and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Class "A and A-HV" Finish

This class of finish shall apply to the vertical surfaces of the guidewall and end cell. The form material shall be composed of new, well-matched tongue-and-groove lumber or new plywood panels conforming to APA PS 1, Grade B-B concrete form, Class I.

2.1.2 Form Coating

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, follow the recommendation of the form coating manufacturer.

2.2 ACCESSORIES

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Form Construction

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. Continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class or classes specified and tolerances specified in paragraph DESIGN REQUIREMENTS. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

3.1.2 Chamfering

Joints and surfaces of concrete which will be exposed to water flow or water movements shall not be chamfered. All exposed joints, edges and external corners where specifically shown to be chamfered, shall be

chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated twelve inches outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.1.3 Coating

Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.2 FORM REMOVAL

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed as specified in Sections 03 70 00 MASS CONCRETE. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M at the expense of the Contractor by an independent laboratory that complies with ASTM C1077 and shall be tested within 4 hours after removal from the site. The Contractor may use maturity instrumentation instead of control cylinders to determine the compressive strength of the concrete. ASTM C 1074 procedures shall be used for estimating concrete strength by means of the maturity method. All expenses associated with instrumenting the concrete and evaluating the strength using maturity relationships shall be the responsibility of the Contractor.

3.2.1 Formwork Not Supporting Weight of Concrete

Formwork for gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed. Form removal before 24 hours will be allowed horizontal surfaces such as overlay slabs and sidewalks

provided the ambient temperature during this period has not fallen below 50 degrees F at any time since placement and evidence from compressive tests on field-cured concrete control cylinders or maturity instrumentation indicates that the concrete has attained a compressive strength of at least 1000 psi. Control cylinders shall be prepared for each set of forms to be removed before 24 hours. The stability of the concrete shall be evaluated by a structural engineer at the Contractor's expense prior to removal of the forms and the calculations made available for Government review upon request.

3.2.2 Formwork Supporting Weight of Concrete

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders or maturity instrumentation indicate evidence the concrete has attained 75 percent of the design strength, of the selected element. Acceptable strength is determined on the average of at least two test specimens at the desired age, with no single specimen 500 psi less than 75 percent of the design strength for the particular element.

3.3 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

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EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS IN CONCRETE FOR CIVIL WORKS

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SECTION 03 15 00.00 10

EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS IN CONCRETE FOR CIVIL WORKS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D 2835	(1989; R 2017) Lubricant for Installationof Preformed Compression Seals in Concrete Pavements
ASTM D 3542	(1991; R 2019) Standard Specification forPreformed Polychloroprene ElastomericJoint Seals for Bridges
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D5249	(2010; R 2016) Standard Specification for Backer Material for Use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Horizontal Joint Layout; G, STR

Shop drawings and fabrication drawings prepared by the Contractor, indicating location, spacing, depth, and width of the horizontal contraction joints within the top slab of the End Cell.

SD-03 Product Data

Preformed Expansion Joint Filler

Sealant

SD-07 Certificates

Preformed Expansion Joint Filler; G, STR

Sealant; G, STR

1.3 DELIVERY, STORAGE, AND HANDLING

Protect material delivered and placed in storage off the ground from moisture, dirt, and other contaminants. Deliver sealants in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D1751 or ASTM D1752. Unless otherwise indicated, filler material shall be 2 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D5249.

2.2 JOINT SEALS AND SEALANTS

Provide a joint sealent that conforms to the following:

Field-Molded Type for all horizontal and vertical joints permanently submerged underwater use a single component, moisture curing, non-staining, non-bleeding, polyurethane base type conforming to ASTM C920, Type S, Grade NS, Class 100/50, Use I, color as selected by the Contracting Officer. For all horizontal and vertical joints not submerged underwater, use a single component, moisture curing, non-staining, non-bleeding, polyurethane base type conforming to ASTM C920, Type S, Grade NS, Class 100/50, use NT, for non-traffic areas, and use T2 for pedestrian and vehicular traffic areas, color as selected by the Contracting Officer.

The bond breaker tape shall act as a bond breaker to allow joint movement without undue stress to the sealant. The tape shall be self adhesive, pressure sensitive tape, usually made from a Tetrafluoroethylene (TFE) fluorocarbon or polyethylene material, to which the sealant will not adhere, recommended by the sealant manufacturer to suit application.

2.2.1 Compression Seal and Lubricant

Compression seal shall have an extruded profile and shall be made from polychloroprene (neoprene) conforming to the requirements of ASTM D 3542. The material shall have a minimum 2,000-psi tensile strength requirement and 225% elongation at break. The profile shall be structured so that its cross section features a multi-celled web design that exerts a constant pressure to the joint wall interfaces. Lubricant for installation shall conform to ASTM D 2835 or

PART 3 EXECUTION

3.1 INSTALLATION

Joint locations and details, including materials and methods of installation of joint fillers, shall be as specified, as shown, and as directed. In no case shall any fixed metal be continuous through an expansion joint.

3.2 SAWED JOINTS

Saw joints early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Start cutting as soon as the concrete has hardened sufficiently to prevent raveling of the edges of the saw cut. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use concrete sawing machines that are adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Cut joints to true alignment and in sequence of concrete placement. Remove sludge and cutting debris. Form reservoir for joint sealant.

3.3 EXPANSION JOINTS

Preformed expansion joint filler shall be used in expansion and isolation joints in vertical surfaces where indicated. The filler shall extend the full slab depth,unless otherwise indicated in the drawings. The edges of vertical joints shall be neatly finished with a 3/4" chamfer, as shown in the drawings. The edges of the horizontal joints shall be neatly finished with an edging tool of 1/4 inch radius.

3.4 JOINT SEALANT

All contraction joints and expansion joints in vertical and horizontal surfaces shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.5 CONSTRUCTION JOINTS

Construction joints are specified in SECTION 03 70 00 MASS CONCRETE.

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CONCRETE REINFORCEMENT

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CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; R 2015) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 318	(2019; Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2018) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2018) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement; G, STR

SD-03 Product Data

Reinforcing Steel

Wire Ties

Supports

SD-07 Certificates

Welding Qualifications; G, STR

Steel Bar Butt-Splicer Qualifications; G

Butt-Splicing Procedure Qualifications; G

1.3 QUALITY ASSURANCE

1.3.1 Welding Qualifications

Welders are required to be qualified in accordance with AWS D1.4/D1.4M. Perform qualification test at the worksite and notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M. Submit a list of qualified welders names.

1.3.2 Steel Bar Butt-Splicer Qualifications

Steel bar butt-splicers are required to be certified to have satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year. Submit certificates on the Qualifications of Steel Bar Butt-Splicers prior to commencing butt-splicing.

1.3.3 Butt-Splicing Procedure Qualifications

Perform three tests of each size steel bar to be spliced using the proposed butt-splicing method, in the presence of the Contracting Officer. Tension test to destruction, these test butt-splices and unspliced bars of the same size, plot each test with stress-strain curves. Submit test results for approval. Butt-splices not meeting the specified strength and deformation requirements will not be approved.

1.4 DELIVERY, STORAGE, AND HANDLING

Store reinforcement and accessories off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

Reinforcing steel of deformed bars conforming to ASTM A615/A615M, or ASTM A706/A706M Grade 60. Sizes shall be as indicated on the project drawings. Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of the reinforcing steel.

2.2 WIRE TIES

Use wire ties that are 16 gauge or heavier black annealed steel wire.

2.3 SUPPORTS

Design bar supports for formed surfaces in accordance with CRSI 10MSP and fabricate of steel or precast concrete blocks. Provide precast concrete blocks with wire ties and not less than 4 inches square when supporting reinforcement on ground. Precast concrete block must have compressive strength equal to that of the surrounding concrete. Coat steel supports for coated or galvanized bars with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bar. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, use galvanized, plastic protected or stainless steel supports within 1/2 inch of concrete surface. Concrete supports used in concrete exposed to view must have the same color and texture as the finish surface. For slabs on grade and topping slabs on steel deck, supports use precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Fabricate and place reinforcement steel and accessories as specified, as indicated, and as shown on approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown must be in accordance with ACI SP-66 and ACI 318. Cold bend reinforcement unless otherwise authorized. Bending may be accomplished in the field or at the mill. Do not bend bars after embedment in concrete. Place safety caps on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Face wire tie ends away from the forms.

3.1.1 Placement

Reinforcement must be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Place reinforcement in accordance with ACI 318 at locations indicated plus or minus one bar diameter. Do not continue reinforcement through expansion joints and place as indicated through construction or contraction joints. Cover with concrete coverage as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, requires approval before concrete is placed.

3.1.2 Placing Tolerances

Conform bar spacing and concrete cover to ACI 117.

3.1.3 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4/D1.4M. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced

transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

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PRECAST STRUCTURAL CONCRETE

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SECTION 03 45 33

PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016) Building Code Requirements for Structural Concrete and Commentary
ACI RAP-1	Structural Crack Repair by Epoxy Injection

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A27/A27M	(2013; R 2016) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated,

	120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A496/A496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497/A497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C1107/C1107M	(2014a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1240	(2014) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C150/C150M	(2016; E 2016) Standard Specification for Portland Cement
ASTM C231/C231M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C494/C494M	(2016) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881/C881M	(2015) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C94/C94M	(2016a) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2014) Standard Specification for Slag

	Cement for Use in Concrete and Mortars
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1999) Manual for Quality Control for Plants and Production of Structural Precast Concrete Products, 4th Edition
PCI MNL-120	(2010) PCI Design Handbook - Precast and Prestressed Concrete, 6th Edition

WISCONSIN DEPARTMENT OF TRANSPORTATION (WISDOT)

WISDOT 106.3.3	(2017) Approval by Certification, Standard Specifications (Spec)

1.2 SYSTEM DESCRIPTION

The work includes the provision of precast non-prestressed concrete herein referred to as precast members. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members.

1.2.1 Design Requirements

Design precast members in accordance with ACI 318 and the PCI MNL-120. Design precast members (including connections) for the design load conditions and spans indicated, handling and erection stresses, and for additional loads imposed by openings and supports of the work of other trades. Design precast members for handling without cracking in accordance with the PCI MNL-120.

1.2.1.1 Loads

Loadings for members and connections shall include all dead load, live load, applicable construction loads such as handling, erection loads, and other applicable loads.

1.2.1.2 Drawing and Design Calculation Information

Submit drawings and design calculations indicating complete information for the fabrication, handling, and erection of the precast member. Design calculations and drawings of precast members (including connections) shall be made by a registered professional engineer experienced in the design of precast concrete members. The drawings shall indicate, as a minimum, the following information:

a. Plans, elevations and other drawing views showing the following:

(1) Member piece marks locating and defining products furnished by the manufacturer.

(2) Location and size of openings.

(3) Relationships to adjacent material.

(4) Joints and openings between members and between members and other construction.

(5) Location of field installed anchors.

(6) Erection sequences and handling requirements.

(7) Lifting and erection inserts.

b. Elevations, sections and other details for each member showing the following:

(1) Connections between members and connections between members and other construction.

(2) Dimensioned size and shape for each member with quantities, position and other details of reinforcing steel, anchors, inserts and other embedded items.

(3) Lifting, erection and other handling devices and inserts.

(4) Surface finishes of each member.

c. Strength properties for concrete, steel and other materials.

d. Methods for storage and transportation.

e. Description of loose, cast-in and field hardware.

f. All dead, live, handling, erection and other applicable loads used in the design.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer Qualifications; G, STR

Designer Qualifications; G, STR

Welding Qualifications; G, STR

SD-02 Shop Drawings

Drawings of precast members; G, STR

SD-03 Product Data

Anchorage and lifting inserts and devices; G, STR

SD-05 Design Data

Concrete mix design; G, STR

Drawing And Design Calculation Information; G, STR

Contractor-furnished mix design; G, STR

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cement, pozzolans, slag cement, silica fume, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained versus sieve size. Test reports shall be submitted along with the concrete mix design. Obtain approval before concrete placement.

Cement; G, STR

Pozzolan; G, STR

Slag Cement; G, STR

Silica Fumes; G, STR

Air-Entraining Admixture; G, STR

Water-Reducing Admixture; G, STR

Accelerating Admixture; G, STR

Aggregates; G, STR

Submit test results for aggregates in accordance with ASTM C1260 for potential alkali-silica reactions.

Air Content; G, STR

Compressive Strength; G, STR

Slump; G, STR

Moisture Content; G, STR

Unit Weight; G, STR

SD-07 Certificates

Quality control procedures; G, STR

Construction Records; G, STR

Construction records of the manufacturing, handling, and erection of the precast concrete members shall be submitted.

Qualified Welders; G, STR

Batch Ticket; G, STR

SD-11 Closeout Submittals

Concrete batch ticket information; G, STR

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Manufacturer Qualifications

Provide precast structural concrete sections manufactured by an organization experienced in the manufacture of precast concrete. Produce sections/units under plant-controlled conditions conforming to PCI MNL-116 by a firm certified under the PCI Plant Certification Program and requirements specified in WISDOT 106.3.3.

1.4.1.2 Designer Qualifications

The designer shall be a registered professional engineer within the United States and at least 5 years of recent experience.

1.4.1.3 Welding Qualifications

Provide AWS D1.1/D1.1M qualified welders who are currently certified and have maintained their certificates over the past year.

1.4.2 Regulatory Requirements

Provide precast members in conformance with ACI 318 and PCI MNL-120.

1.4.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, silica fume, slag cement, and admixtures, and applicable reference specification. Provide mix proportion data using at least three different water-cement ratios for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregates changes.

1.4.4 Certificates: Record Requirement

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Transportation

1.5.1.1 Transporting Members

In transporting members by truck, railroad car, or barge, provision shall be made for supporting the members in a manner to avoid excessive stresses

that could cause cracking or other damage, except battens can be continuous over more than one stack of units, with adequate bracing to ensure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are satisfactory provided the members are fully seated on the outer bolsters at not more than 3 feet or the depth of the member from the end and the inner bolster is not more than 8 feet from the end of the member or the designated pickup point. Adequate padding material shall be provided between tie chains or cables to preclude chipping of concrete.

1.5.1.2 Lateral Deflection or Vibration

Any noticeable indication of lateral deflection or vibration during transportation shall be corrected by rigid bracing between members or by means of lateral trussing.

1.5.2 Storage

1.5.2.1 Storage Areas

Storage areas for precast members shall be stabilized, and suitable foundations shall be provided, so differential settlement or twisting of members will not occur.

1.5.2.2 Stacked Members

Stacked members shall be separated and supported by battens placed across the full width of each bearing point. Battens shall be arranged in vertical planes at a distance not greater than the depth of the member from designated pickup points. Battens shall not be continuous over more than one stack of precast units. Stacking of members shall be such that lifting devices will be accessible and undamaged. The upper members of a stacked tier shall not be used as storage areas for shorter members or equipment.

1.5.3 Handling of Members

The location of pickup points for handling of the members and details of the pickup devices shall be shown in shop drawings. Members shall be handled only by means of approved devices at designated locations. Members shall be maintained in an upright position at all times and picked up and supported as shown in approved shop drawings.

PART 2 PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318. The minimum compressive strength of concrete at 28 days shall be 4,500 psi, unless otherwise indicated. The maximum water to cementitous ratio (W/CM) is 0.40. Add air-entraining admixtures at the mixer to produce between 4 and 7 percent air by volume when tested in accordance with ASTM C231/C231M.

2.2 MATERIALS

2.2.1 Cement

ASTM C150/C150M, Type I, II, or III with a maximum alkali content of 0.60 percent.

2.2.1.1 Fly Ash and Pozzolan

ASTM C618, Type N, F, or C, except that the maximum calcium oxide content shall be 8.0 percent, the maximum available alkalies shall be 1.5 percent, and the maximum allowable loss on ignition shall be 6 percent for Type N and F. Class C shall not be used with reactive aggregates.

2.2.1.2 Slag Cement

ASTM C989/C989M, Grade 100 or 120.

2.2.1.3 Silica Fume

ASTM C1240, provide silica fume that is a by-product of silicon or ferrosilicon production.

2.2.2 Water

Water shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete, ACI 318.

2.2.3 Aggregates (ASTM C33)

2.2.3.1 Aggregates Selection

Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement, nor in an amount sufficient to cause excessive expansion of concrete.

2.2.3.2 Alkali-Silica Reactivity

Evaluate and test fine and coarse aggregates to be used in all concrete for alkali-aggregate reactivity in accordance with ASTM C1260.

2.2.4 Grout

2.2.4.1 Nonshrink Grout

Nonshrink grout shall conform to ASTM C1107/C1107M and shall be a commercial formulation suitable for the application proposed.

2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C260/C260M.

2.2.5.2 Accelerating

ASTM C494/C494M, Type C or E.

2.2.5.3 Water Reducing

ASTM C494/C494M, Type A, E, or F.

2.2.6 Reinforcement

See specification section 03 20 00.00 10 CONCRETE REINFORCEMENT

2.2.6.1 Reinforcing Bars

ASTM A615/A615M, Grade 60.

2.2.6.2 Wire

ASTM A82/A82M or ASTM A496/A496M.

2.2.6.3 Welded Wire Fabric

ASTM A185/A185M or ASTM A497/A497M.

2.2.7 Metal Accessories

Provide ASTM A123/A123M or ASTM A153/A153M galvanized.

2.2.7.1 Inserts

ASTM A27/A27M Grade U-60-30.

2.2.7.2 Structural Steel

ASTM A36/A36M.

2.2.7.3 Bolts

ASTM A307; ASTM A325.

2.2.7.4 Nuts

ASTM A563.

2.2.7.5 Washers

ASTM F844 washers for ASTM A307 bolts, and ASTM F436 washers for ASTM A325 bolts.

2.3 PRODUCTION QUALITY CONTROL PROCEDURES

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318 for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other

approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C94/C94M. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 160 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.01 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather shall be repaired. Defects that involve more than 36 square inches of concrete shall be grounds for rejection. Any precast member that is
structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected. Defects shall be repaired or rejected. An epoxy injection in accordance with ACI RAP-1 using an epoxy meeting ASTM C881/C881M, Type IV, Grade 1 and Class appropriate for the ambient temperature at the time of repairs shall be used as the repair method.

2.3.4.1 Unformed Surfaces

Provide a floated finish. Top surface of precast shall be raked to produce a rough tine finish.

2.3.4.2 Formed Surfaces

Exposed Surfaces: Provide a surface finish to match surface finishes of similar elements in existing guide wall. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.

2.3.5 Acceptance/Rejection of Defects

2.3.5.1 Minor Defects

All honeycombed areas, chipped corners, air pockets over 1/4 inch in diameter, and other minor defects involve less than 36 square inches of concrete shall be repaired. Form offsets of fins over 1/8 inch shall be ground smooth. All unsound concrete shall be removed from defective areas prior to repairing. All surfaces permanently exposed to view shall be repaired by a blend of portland cement and white cement properly

proportioned so that the final color when cured will be the same as adjacent concrete.

2.3.5.2 Major Defects

Major defects are those which involve more than 36 square inches of concrete or expose stressing tendons or reinforcing steel. If one or more major defects appear in a member, it shall be rejected. Cracks of a width of more than 0.01 inch shall be cause for rejection of the member.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast members.

3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent cast in place concrete section or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.4/D1.4M for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation. Welding of epoxy-coated reinforcing is not allowed.

3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill indicated keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 CONSTRUCTION RECORDS

Complete construction records shall be kept and submitted to the government in a report format of the manufacturing, handling, and erection of the precast - concrete members. Records shall be kept for, but not limited to, the following items:

a. Specifications of material used in the manufacture of the members.

b. Time-temperature history of the concrete members from casting and throughout the curing period and prior of being transported.

c. Records of the inspection of the members each time they are moved.

d. Records of any defects in the member and any corrective measures taken.

-- End of Section --

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MASS CONCRETE

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SECTION 03 70 00

MASS CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

Concrete and other materials covered in this section are required for massive concrete elements in the planned construction. The elements which these specifications govern are the following:

The massive concrete elements are defined in paragraph DESIGN REQUIREMENTS. The concrete elements shall be placed monolithically without the formation of cold joints.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 295	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; R 2015) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM C1059/C1059M	(2021) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete

ASTM C1064/C1064M	(2017) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1074	(2019) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123/C123M	(2014) Standard Test Method for Lightweight Particles in Aggregate
ASTM C1260	(2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131/C131M	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142/C142M	(2017) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C157/C157M	(2017) Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate

	(Accelerated Mortar-Bar Method)
ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C192/C192M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C40/C40M	(2020) Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C535	(2016) Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C566	(2019) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C595/C595M	(2021) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C87/C87M	(2017) Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

ASTM C881/C881M	(2020a) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C928/C928M	(2020a) Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
ASTM C94/C94M	(2021) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D4791	(2019) Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 100	(1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 130	(2001) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 94	(1995) Corps of Engineers Specification for Surface Retarders

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Underwater Sloped Grade Placement Plan; G, MAT

The Contractor shall submit a plan for installing the underwater

sloped grade concrete placement plan for review and approval. The plan must describe the sequence for placement and othe restrictions as outlined in the plans and as specified. The underwater sloped grade concrete placement plan must include, but is not limited to:

a. Conctruction Sequence.
b. Descriptions of methods and equipment to be used for subgrade/substrate preparation.
c. Forwork to be used, if required.
d. Concrete mix design.
e. Descriptions of mehtods and equipment to be used for concrete placement.
f. Descriptions of methods and equipment to be used to verify slope alignment.

SD-02 Shop Drawings

Concrete Lifts; G

Submit the concrete lifts plan according to paragraph "Concrete Lifts".

SD-03 Product Data

Aggregate; G

Submit information identifying the aggregate source to be used along with gradation tests for fine and coarse aggregates. The gradation test for fine aggregate shall include the No. 8 and No. 30 sieve sizes. Submit specific gravity and absorption of fine and coarse aggregates determined by ASTM C128 and ASTM C127, respectively.

Batch Plant; G

Batch plants, submit details and data on the concrete plant a minimum of 30 days prior to assembly for conformance review with the requirements of paragraph "PLANT AND EQUIPMENT"

Construction Joint Treatment; G

Submit the method and equipment proposed for joint cleanup and waste disposal 30 days before concrete placement begins.

Curing and Protection; G

Submit the curing media and methods 30 days before concrete placement begins.

Cold-Weather Protection; G

When concrete is to be placed under cold-weather conditions, a description of the materials and methods proposed for protection of the concrete shall be furnished 60 days in advance of anticipated need date for review.

Hot-weather Placing; G

When concrete is to be placed under hot-weather conditions, a description of the materials and methods proposed for protection of the concrete shall be furnished 60 days in advance of anticipated need date for review.

Maturity Method; G, STR

Prior to using the maturity method, submit data in accordance with ASTM C1074 using project materials and concrete mix proportions used on the project to demonstrate the correlation between maturity and compressive strength of laboratory cured test specimens to the Contracting Officer.

Mixers;

For on-site mixers, submit the make, type, capacity, and number of concrete mixers proposed for use 30 days prior to installation.

Laboratory Area;

For Project specific (on-site or mobile laboratories), submit details and data on the laboratory area within 15 days prior to the initial delivery of aggregate.

Equipment;

Submit data on placing equipment and methods to be used.

Special Temperature-Controlled Concrete; G

When special temperature controls are required, submit all methods and equipment 60 days in advance of anticipated date required for use.

Surface Retarder; G, STR

SD-05 Design Data

Concrete Mixture Proportioning Design Test Plan(s); G

Prepare and submit a Concrete Mixture Proportioning Design Test Plan(s) in advance of all Trial Batch testing in order to coordinate and document the objectives and methods employed to test proposed mixes. The Mix Design Test Plan shall be reviewed and approved in advance of Trial Batch testing activities. Revised Trial Test Plans shall be provided for approval in advance of conducting any subsequent trials.

Thermal Analysis and Thermal Control Plan; G

Submit 30 days before concrete placement begins a Thermal Analysis and Thermal Control Plan for each wall placement and lift of concrete placed within the end cell. The Thermal Analysis and Thermal Control Plan(s) shall be in accordance with paragraph "Thermal Analysis and Thermal Control Plan(s)".

SD-06 Test Reports

Mixer Uniformity;

Submit the results of the initial mixer uniformity tests at least 5 days prior to the initiation of placing. The initial test results submitted shall not be more than three months old. Additional tests shall be conducted and submitted within six months of the previous tests. Uniformity testing shall continue until all concrete is placed.

Quality of Aggregates; G

Submit aggregate quality tests at least 30 days prior to start of concrete placement.

Concrete Materials;

Submit certified copies of laboratory test reports, including mill tests and all other test data, for Portland cement, pozzolan, slag cement, admixtures, and curing compound proposed for use on this project 30 days prior to start of concrete placement.

Tests and Inspections;

Submit test results and inspection reports daily and weekly as specified in paragraph "TESTS AND INSPECTIONS".

Temperature Monitoring;

Submit the data from all temperature monitoring. Include the raw temperature data and plots of maximum concrete temperature, temperature at the surface, and the temperature differential.

Concrete Mixture Proportioning Report; G, STR

Submit the Concrete Mixture Proportioning Report, as described in paragraph "Mass Concrete Mixture Testing Requirements", a minimum of 30 days prior to conducting the thermal analysis testing.

Non-Shrink Grout Mixture; G, STR

Submit a Non-Shrink Grout Mixture Design for Approval.

Final Concrete Report; G

The contractor shall Submit a Final Concrete Report that includes but is not limited to the following:

The Final Concrete Report shall be in accordance with EM 1110-2-2000 chapter 11 Concrete Report. Prepare a narrative describing the general placement process between installation and stripping of the forms. Include in the narrative any unique placement problems and how these problems were overcome. Photographs showing typical form-work, conveying and placing equipment. Tabs or other means to easily navigate through the report. Cover page showing the contract title and number. Submit the report in 1 electronic and 1 hard copy format. The electronic copy must be searchable. Coordinate with Government Representative for acceptable electronic format. The hard copy shall be bound with a durable front and back cover. This report shall cover

specification section 03 45 33 and 03 70 00.

SD-07 Certificates

Laboratory Requirements;

Submit Accreditation or validation by the National Voluntary Laboratory Accreditation Program, American Association for Laboratory Accreditation, AASHTO Accreditation Program or other nationally recognized independent authority on laboratories that are performing any testing required for this project. Submit documentation 30 days prior to performance of any testing and be specific as to testing equipment and procedures that are covered.

Technician and Inspector Certification Requirements

Submit statements including certificates that the concrete testing technicians and concrete inspectors meet the qualification requirements of paragraph "Technician and Inspector Certification Requirements."

Lead Auditor Qualification Requirements

Submit statements and documentation that the Lead Auditor meets the qualification requirements of paragraph "Lead Auditor Qualification Requirements" prior to the concrete testing/inspection.

Cementitious Materials;

Cementitious Materials, including Portland cement and Pozzolan, and Slag Cement will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished.

Air-Entraining Admixtures;

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

Other Chemical Admixtures;

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

Membrane-Forming Curing Compound;

Membrane-Forming Curing Compound shall be certified for compliance with all specification requirements.

Wet-Cure Sheeting Materials;

Wet-curing sheet materials shall be certified for compliance with all specification requirements.

Bonding Agents;

Descriptive literature and certification in advance of their use.

Retarding Admixtures;

1.4 QUALITY ASSURANCE (GOVERNMENT TESTING AND SAMPLING)

1.4.1 Construction Testing by the Government

1.4.1.1 General

The Government will sample and test cementitious materials, admixtures, aggregates, and concrete during construction as considered appropriate to determine compliance with the specifications. Provide materials, facilities and labor as necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with COE CRD-C 100. Slump and air content will be determined in accordance with ASTM C143/C143M and ASTM C231/C231M. Compression test specimens will be made and laboratory cured in accordance with ASTM C31/C31M and will be tested in accordance with ASTM C39/C39M.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

2.1.1 Definition of Mass Concrete

Mass concrete for this project shall be as defined by the American Concrete Institute (ACI) Committee 207. The following structural elements listed in paragraph titled, "Mass Concrete Mix Design Requirements" are considered Mass Concrete; End Cell, Topping/Underwater Sloped Grade Apron, and Guide Wall.

2.1.2 Mass Concrete Mix Design Requirements

STRUCTURAL ELEMENT	W/CM Ratio	Compressive Strength (psi)	Air Content (%)	Slump (inches)	Slump Flow (inches)	Nominal Maximum Aggregate Size (inches)
End Cell	.30 to 0.45	4,500 @ 28 days	6.5 +/- 1.5	1 to 4	22 to 26	1
Topping/Underwater Sloped Grade Apron						
Guide Wall						
Non-Shrink Grout	0.35 to 0.40	7,500	7.5 +/- 1.5	4 to 6	N/A	3/8

2.1.3 Minimum Concrete Compressive Strength

The specified minimum compressive strength (f'c) for all Structural Elements is defined in paragraph Concrete Mix Design Requirements. Note: Placements less than 12 inches in depth do not require a thermal analysis and a thermal control plan.

2.1.4 Maximum Water-Cementitious Materials (W/CM) Ratio

The W/CM ratios required, for the submitted concrete mixture proportions to be used on this project will be used to control the maximum allowable water content for each concrete mixture proportion. The water - cementitious material ratio (w/cm) for all massive structural elements is defined in paragraph Concrete Mix Design Requirements.

2.2 MIXTURE PROPORTIONS

2.2.1 Composition

Mass concrete shall be composed of cementitious materials, water, fine and coarse aggregates, and admixtures. The cementitious materials shall be portland cement in combination with pozzolan and/or pozzolan and slag cement. Approved admixtures include an Air-Entraining admixture plus a Water Reducing and a High Range Water Reducing admixture. A retarding admixture may be used only when approved by the Contracting Officer. No chemical admixtures other than those listed above shall be used.

2.2.2 Nominal Maximum Size of Coarse Aggregate (NMSCA)

The nominal maximum-size of coarse aggregate to be used for all massive structural elements is defined in paragraph Mass Concrete Mix Design Requirements.

2.2.3 Air Content

The air content by volume shall be determined by ASTM C231/C231M. The air content of the sample measured in accordance with ASTM C231/C231M. The specified air content shall be present in the concrete when the concrete has been placed in the forms. The air content for all massive structural elements is defined in paragraph Mass Concrete Mix Design Requirements.

2.2.4 Slump

The slump shall be determined in accordance with ASTM C143/C143M and as defined in paragraph Mass Concrete Mix Design Requirements, except where placement by pump is approved. If another location is approved by the Contracting Officer and selected for performing slump tests other than at the point of placement, duel sampling will be performed to develop correlation between the two sampling locations.

For pump placement, the final slump after the addition of an approved high range water reducer shall be 6-1/2 inches plus or minus 1-1/2 inches. Only polycarboxylate-based high range water reducing admixtures meeting ASTM C494/C494M Type A OR Type F shall be used to produce concrete with sufficient workability for placement without segregation. No excessive bleeding shall be permitted. Sampling for pump placement is to be taken at the transfer point from the delivery vehicle to the pump hopper.

2.2.5 Slump Flow

The slump flow shall be determined in accordance with ASTM C1611 Test Method for Slump Flow of Self-Consolidating Concrete (SCC) and shall have a flow of 22 to 26 inches. The visual index rating of the mixture shall be maintained at 1 or less. Sampling for SCC placement is to be taken at the transfer point from the delivery vehicle to the transport hopper.

2.2.6 Under Water Concrete

When concrete is intended for placement under water using the tremie technique, the concrete shall be proportioned to be cohesive and flow with minimal segregation. Viscosity modifying admixtures are permitted for under water concrete. Proportioning guidance in ACI 304R shall be considered. Concrete mixtures shall be qualified for tremie placement methods based on a trial placement approved by the Contracting Officer. Comply with document COE CRD-C 661-06; Specification for Anti-Washout Admixtures for Concrete. Use ACI 546.2R as a guide in developing under water concrete, however mix design must meet contract requirements given in this section. Use non self-consolidating under water concrete for concrete fill placements with a sloped grade.

2.2.7 Required Average Compressive Strength, f'cr

In meeting the strength requirements specified in paragraph "Minimum Concrete Compressive Strength", the selected mixture shall have proportions so as to produce an fcr exceeding f'c based on the value of f'c as follows:

Specified Compressive Strength f'c (psi)	Required Average Compressive Strength, f'cr (psi)
Less than 3,000	f'c + 1000
3,000-5,000	f'c + 1200
Greater than 5,000	1.10f'c + 700

2.2.8 Documenting Average Strength

Documentation that proposed concrete proportions produce the required average strength, f'cr, determined in paragraph "Required Average Compressive Strength, f'cr", shall be based on laboratory trial batches as specified in paragraphs "Mass Concrete Mixture Testing Requirements" and "Proportioning Responsibility." Documentation shall include compression strength, slump, and air content test results performed on concrete produced using the proposed mixture proportions.

2.2.9 Proportioning Responsibility

The Contractor shall be responsible for developing an optimum mixture design with special considerations for concrete mixture(s) intended to be placed both above and below water. These mixture(s)shall be proportioned reduce or control the heat of hydration and the resulting temperature rise to avoid damaging the concrete through excessive temperatures and temperature differences. Some mixtures, especially those containing higher amounts of pozzolans, may have slow strength gain which may impact form design and form removal time.

As provided by ACI 211.1, Appendix 3, subsequent to approval for use of Mix Designs for the Project, if there becomes a need to make adjustments in the field, such adjustments outside of those allowed by the approval documents (such as dosage ranges of some or all of the admixtures) shall be tested at the plant for plastic properties and submitted in writing for

approval by the Contracting Officer. At no time shall the Contractor make adjustments to cement contents, maximum water contents, water/cementitious ratios (W/CM) without the prior written approval of the Contracting Officer. Coarse and fine aggregate quantities adjustments in the field shall be limited to 10% of the original quantities as approved by the Contracting Officer.

At the Contracting Officer's discretion, Government Materials Engineer may be assigned to facilitate coordination, review and approvals during proportioning activities. The Contractor shall provide a minimum of 7 days notice prior to trial batching and testing activities to facilitate Government presence at the site of these activities.

2.2.10 Concrete Mixture Proportioning Design Test Plan(s)

The Contractor shall engage the services of an Independent Testing Laboratory (ITL) to conduct the required tests and evaluations. The ITL's facility, testing equipment and procedures, and recording procedures shall comply with the requirements of ASTM C1077 as well as the specific requirements of all tests being conducted by the ITL. The Contractor shall direct the ITL as to specific proportioning of the materials and mixes during the trial batch testing. The Concrete Mixture Proportioning Design Test Plan(s) shall include the name and address of the ITL where the testing shall be conducted, the date(s) that the testing is planned; support data on the fine and coarse aggregates, cementitious materials, and admixtures; tabulation of concrete mixture proportions that are to be investigated, number and type of specimens to be cast and when they would be tested; along with the name and address of the Concrete consultant who will be performing the thermal analysis. Submit the Concrete Mixture Proportioning Design Test Plan(s) to the Contracting Officer at least 7 days prior to the start of the tests.

2.2.11 Concrete Mixture Testing Requirements

Submit the mix proportions, slump/slump flow, air content, temperature and the concrete cylinder testing results used to develop the mix design(s). Submit the results of the required tests listed in the following table for each proposed mix. Include the structure or portion of the structure where each submitted concrete mixture proportions is proposed for use. Include the dates planned for placing each concrete mixture proportion and the planned concrete placement temperature to allow evaluation of the concrete mixture proportion based on the submitted thermal analysis. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

The Contractor shall develop an optimum mixture design with the right combination of materials that will reduce the amount of tensile stresses and the heat of hydration that could potentially lead to cracking. The trial mixtures shall include but are not limited to the conditions and testing requirements listed in this paragraph.

Trial mixtures having proportions, consistencies, maximum slump, maximum air content, and adiabatic heat rise suitable for the work shall be made based on ACI 211.1, using at least three different water cementitious materials ratios (W/CM) which will produce a range of strengths encompassing those required for the work. For each portion of the structure, mixture proportions shall be selected so that the strength and (W/CM) requirements specified. The trial mixtures shall have a slump and

air content within plus or minus 3/4 inch and plus or minus 0.5 percent, respectively, of the maximum permitted. The target water cementitious materials ratios required in paragraph "Maximum Water-Cementitious Materials (W/CM) Ratio," include the total weight of cement plus pozzolan and slag cement, converted from absolute volume as described in ACI 211.1. Trial mixtures shall be designed in accordance with the procedure in ACI 211.1, Chapter 6, using the absolute volume basis for determining the required amount of fine aggregate. The dry rodded weight per cubic foot of the coarse aggregate determined according to ASTM C29/C29M; the fineness modulus of the fine aggregate determined according to COE CRD-C 104; the adiabatic heat rise and yield, slump and air content shall be reported. For each water cementitious materials ratio at least five pairs of 6 inch x 12 inch test cylinders for each test age shall be made and cured in accordance with ASTM C192/C192M. They shall be tested in accordance with ASTM C39/C39M at 7, 14, 28, 56 and 90 days. From these test results a curve shall be plotted and submitted showing the relationship between water cementitious materials ratio and strength at design age. Trial mixtures for concrete to be placed underwater will contain anti-washout admixture per the manufacturer's recommendations.

The results of these tests shall be summarized in table form and included in the Concrete Mixture Proportioning Report. The Concrete Mixture Proportioning Report shall include the concrete mixture proportions for each mix design tested, the results of the testing in table form, descriptions of the resulting properties of the different mix designs and differences between mixes, and the reasons for selecting the Contractor's recommended optimal mix design for each structural element. The report shall be submitted to the Contracting Officer for approval.

The Contractor shall submit the combination of materials that will produce concrete to meet the requirements of the structure with respect to workability, dimensional stability and freedom from cracking, low temperature rise, adequate strength, durability and low permeability to the Government for approval.

2.2.12 Thermal Analysis and Thermal Control Plan(s)

Submit a Level 2 thermal analysis, as specified in ETL 1110-2-542 (dated 30 May 1997) and a thermal control plan in accordance with ACI 301 for the mass concrete mix design(s) to be used for each massive structural element listed in paragraph Mass Concrete Mix Design Requirements. Submit the thermal analysis and thermal control plan for review and approval a minimum of 30 days in advance of the anticipated date of concrete placement.

The thermal analysis submittal must include all assumptions and calculations made. If a proprietary software program is used, include a description of the program including all calculations, equation assumptions, material properties, and a complete list of all input and output from the program.

The thermal control plan submittal must identify the maximum temperature and temperature differential, which is not allowed to exceed 160 degrees Fahrenheit and 35 degrees Fahrenheit, respectively. Except that a maximum temperature differential may vary with time as shown in the following table, granted the Contractor can demonstrate to the Contracting Officer that the developed tensile stress does not exceed the tensile strength of the concrete, or the developed tensile strain capacity of the concrete. In addition, each submitted thermal control plan shall ensure that the

differential between the core temperature and the surface temperature is never high enough to cause cracking.

Optional Temperature Differential Range provided addition testing.

Hours After Placement (hrs)	Maximum Temperature Differential (degrees F)
0 - 24	20
24 - 48	30
48 - 72	40
72	50

The thermal analysis, thermal control plan, and the adiabatic heat rise of the proposed mix designs shall be submitted at least 30 days in advance of the anticipated date of concrete placement.

2.2.13 Delivery of Samples

Representative samples for all concrete materials proposed for this project shall be delivered to the ITL that will be performing the trial batch testing at least 1 day prior to the start of that testing and at least 90 days before concrete placement is expected to begin. Samples of approved aggregates shall be obtained in accordance with the requirements of ASTM D75/D75M. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by manufacturer's test reports indicating compliance with applicable specification requirements.

2.3 CONSTRUCTION TOLERANCES

Construction tolerances shall meet the requirements of ACI 117 and the tables below. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance shall be the controlling tolerance. Tolerances shall not extend the structure beyond legal boundaries. Except as specified otherwise, plus tolerance increases the amount or dimension to which it applies, or raises a level alignment and minus tolerance decreases the amount or dimension to which it applied, or lowers a level alignment. A tolerance without sign means plus or minus. Where only one signed tolerance is specified, there is no limit in the other direction.

TOLERANCES		
(1)	VERTICAL ALIGNMENT:	
	Formed Surfaces	1/4 inch in 10 feet
(2)	HORIZONTAL ALIGNMENT/DEVIATION FROM ELEVATION AS SHOWN ON DRAWINGS	

TOLERANCES		
	Top surface of concrete lift above water / to receive additional concrete - Vertical deviation	+1/2 inch, -1/2 inch
(3)	FINAL TOP HORIZONTAL SURFACES	
	Top horizontal surfaces shall be placed to the elevation shown on the drawings and finished in accordance with the paragraph FINISHING. The top surface of the end cell shall be sloped riverward a minimum 1% from the center point.	

2.4 CONCRETE MATERIALS

2.4.1 Cementitious Materials

2.4.1.1 Portland Cement

Portland cement shall conform to ASTM C150/C150M, Type II, maximum 8% amount of tricalcium aluminate, low-alkali, including false-set requirement or as otherwise approved.

2.4.1.2 Portland-Limestone Cement

Portland-Limestone cement shall conform to the requirements of ASTM C595/C595M, Type IL, 5-15% limestone is permitted.

2.4.1.3 Pozzolan Other than Silica Fume

Pozzolan other than silica fume shall conform to ASTM C618, Class F, and, in addition, limits in Table 4 in accordance to AASHTO M 295, Uniformity Requirements (for entrained air) shall apply to all fly ash. Fly ash shall also meet the requirements for Effectiveness in Controlling Alkali-Silica Reaction in Table 4 in accordance to AASHTO M 295. Test results showing that the proposed combination of cementitious materials and aggregates will expand less than 0.10 percent in 16 days when tested in accordance with ASTM C1567 may be substituted for the Effectiveness in Controlling Alkali-Silica Reaction test. If used, replacement of cement with Fly Ash Class F shall be between 20 and 40 percent by mass of cementitious material.

2.4.1.4 Slag Cements

Slag cements shall conform to ASTM C989/C989M, Grade 100. If used, replacement of cement with slag cement shall be between 30 and 50 percent by mass of cementitious material. Note: Replacement of cement with slag cement of up to 70 percent may be considered acceptable pending approval from the Contracting Officer.

2.4.2 Aggregate Sources

Concrete aggregates may be furnished from any source capable of meeting the quality and grading requirements stated in the following paragraphs.

After award of the contract, designate in writing only one source or combination of sources proposed to furnish aggregates.

2.4.2.1 Aggregate Composition

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of natural and manufactured sands. Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, or a combination thereof. Fine and coarse aggregates proposed for use in concrete shall be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 percent at 16 days after casting. Should the test data indicate an expansion of 0.10 percent or greater, the aggregate(s) shall be rejected or additional testing using ASTM C1260 and ASTM C1567 shall be performed. The additional testing using ASTM C1260 and ASTM C1567 shall be performed using the low alkali portland cement in combination with slag cement, or Class F fly ash. Slag cement shall be used in the range of 40 to 50 percent of the total cementitious material by mass. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass.

2.4.2.2 Quality of Aggregates

Aggregates delivered to the mixer shall meet the following requirements:

TEST LIMITS			
PROPERTY	FINE AGGREGATE	COARSE AGGREGATE	TESTS
Specific Gravity	2.4 to 2.9	2.4 to 2.9	ASTM C127 ASTM C128
Absorption	0.2% to 2%	0.2% to 4%	ASTM C127 ASTM C128
Clay Lumps and Friable Particles	Less than or equal to 3.0%	Less than or equal to 5.0%	ASTM C142/C142M
Material Finer than No. 200 Sieve	Less than or equal to 3.0%	Less than or equal to 1.0%	ASTM C117
Organic Impurities	Not Darker than No. 3, Not less than 95 percent		ASTM C40/C40M ASTM C87/C87M
L.A. Abrasion	--	Less than or equal to 50%	ASTM C131/C131M ASTM C535
Magnesium Sulfate Soundness (5 cycles)	Less than or equal to 15%	Less than or equal to 15%	COE CRD-C 130

TEST LIMITS			
PROPERTY	FINE AGGREGATE	COARSE AGGREGATE	TESTS
Chert, less than 2.40 specific gravity	--	Less than or equal to 5.0%	ASTM C123/C123M
Coal and Lignite, less than 2.00 specific gravity	Less than or equal to 0.5%	Less than or equal to 5.0%	ASTM C123/C123M

2.4.2.3 Grading

2.4.2.3.1 Fine Aggregate

The grading of the fine aggregate as delivered to the mixers shall be such that the individual percent retained on any sieve shall not vary more than 3 percent from the percent retained on that sieve in a fixed grading selected by the Contractor with the approval of the Contracting Officer. The fixed grading may be selected at the start of concrete placement and based upon 30 days fine aggregate production or selected after the first 30 days of concrete placement. The minimum individual percent retained on the 2.36 mm (No. 8) sieve shall be 5 percent and on all smaller sieves, except the 75 µm (No. 200), shall be 10 percent. In addition to the grading limits, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.25 nor more than 2.85. The grading of the fine aggregate shall also be controlled so that the fineness moduli groups (average of the current test and the previous two tests) of the fine aggregate as delivered to the mixer shall not vary more than 0.10 from the target fineness modulus of the fixed grading selected by the Contractor and approved by the Contracting Officer. The range of each group shall not exceed 0.20. The fineness modulus shall be determined in accordance with COE CRD-C 104.

SIEVE DESIGNATION U.S. STANDARD SQUARE MESH	PERMISSIBLE LIMITS PERCENT BY MASS, PASSING
3/8 inch	100
No. 4	95 - 100
No. 8	80 - 95
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 - 30

SIEVE DESIGNATION U.S. STANDARD SQUARE MESH	PERMISSIBLE LIMITS PERCENT BY MASS, PASSING
No. 100	0 - 10
No. 200	0 - 5

2.4.2.3.2 Coarse Aggregate

The coarse aggregate shall be washed and finish screened immediately prior to delivery to the batch plant bins. The grading of the coarse aggregate within each size group shall conform to the following requirements as delivered to the mixer.

Percent by Mass Passing Individual Sieves			
U.S. Standard Sieve Size	1-1/2 to 3/4 inch	3/4 inch to No. 4	1/2 inch to No. 4
2 inches	100		
1-1/2 inch	90-100		
1 inch	20-45	100	
3/4 inch	0-10	90-100	100
1/2 inch	--	--	90-100
3/8 inch	0-2	20-55	40-70
No. 4		0-10	0-15
No. 8		0-5	0-5

2.4.2.4 Particle Shape

The quantity of flat and elongated particles in the separate size groups of coarse aggregate, as determined by ASTM D4791, using a value of 3 for width-thickness ratio and length-width ratio shall not exceed 15 percent in any size group.

2.4.2.5 Moisture Content

The fine aggregate shall not be placed in bins at the batch plant until it is in a stable state of moisture content less than 7 percent based on oven-dried weight, when delivered to the mixer . A stable moisture content shall be reached when the variation in the percent of total moisture tested in accordance with ASTM C566 and when sampled at the same location will not be more than 0.5 percent during 1 hour of the 2 hours prior to placing the material in the batch plant bins and the variation in moisture content when sampled at the same location shall not be more than 2.0 percent during the last 8 hour period that the aggregate remains in the stockpile. The coarse aggregate shall be delivered to the mixers with the least amount of free moisture and the least variation in free moisture

practicable under the job conditions. Under no conditions shall the coarse aggregate be delivered to the mixer "dripping wet".

2.4.2.6 Aggregate On-site Storage

Fine aggregate and each size of coarse aggregate shall be stored in separate size groups adjacent to the batch plant and in such a manner as to prevent the intermingling of size groups or the inclusion of foreign materials in the concrete. Sufficient fine and coarse aggregate shall be maintained at the site at all times to permit continuous placement and completion of any lift of concrete started. Duel storage shall be provided for each size of aggregate. This will allow use from one area for a placement and the other for receiving and acceptance of new material on site for the next placement.

2.4.3 Water

Water for washing aggregates and for mixing and curing concrete shall be free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances and shall comply with COE CRD-C 400. The temperature of the curing water shall be plus 20 °F or minus 20 °F from the temperature of the concrete surface being moist cured. Only water conforming to specification requirements will be used. Municipally supplied drinking water need not be tested.

2.4.4 Admixtures

All chemical admixtures furnished as liquids shall be in a solution of suitable viscosity for field use as supplied or specified by the product Manufacturer.

2.4.4.1 Air-Entraining Admixtures

The air-entraining admixture shall conform to ASTM C260/C260M and shall consistently entrain air in the specified ranges under field conditions.

2.4.4.2 Retarding Admixtures

A retarding admixture shall meet the requirements of ASTM C494/C494M, Type B, or D, except that the 6-month and 1-year compressive strength tests are waived. The admixture may be added to the concrete mixture only when approved. Use of Type D shall not be the reason to reduce the cementitious material content unless used in mixture proportioning studies. A retarding admixture shall not be used to increase the time interval between mixing and placing. A retarding admixture shall not be used unless approved by the Contracting Officer.

2.4.4.3 Water-Reducing Admixture

A water-reducing admixture shall meet the requirements of ASTM C494/C494M, Type A or D, except that the 6-month and 1-year compressive strength tests are waived. The admixture may be added to the concrete mixture only when its use is approved and after mixture proportioning studies.

2.4.4.4 High-Range Water-Reducing Admixture (HRWRA)

High-range water-reducing admixture shall meet the requirements of ASTM C494/C494M, Type F or G, except the 6-month and 1-year strength requirements shall be waived. The HRWRA used to meet the slump

requirements specified for transporting concrete using a pump shall be polycarboxylate-based. Provide the services of a manufacturer's technical representative experienced in mixture proportioning and placement procedures of concrete containing HRWRA. The technical representative shall be available for consultation during mixture proportioning and shall be on-site for the first placement of concrete containing HRWRA. The admixture may be used only after mixture proportioning studies and when approved.

2.4.4.5 Anti-Washout Admixture

Anti-washout admixtures must be a non ionic cellulose derivative provided in liquid form and must be capable of minimizing the washout of paste and fine aggregate from concrete being placed underwater, such that the maximum allowable washout is not exceeded when the admixture is used at the recommended dose of the manufacturer. The anti-washout admixture must comply with the requirements of COE CRD-C 661. Anti-washout admixture must be used in concrete at the direction of the Contracting Officer.

2.4.4.6 Material Source of Admixtures

Contractor shall notify the Contracting Officer of the source and manufacturing plant location of all concrete admixtures proposed for use on the project prior to conducting trial batch tests. Contractor may submit more than one source for pre-approval for trial batch testing. Admixtures will only be accepted from producers whose product has been tested by a lab which has been accredited by the National Voluntary Laboratory Accreditation Program, American Association for Laboratory Accreditation, AASHTO Accreditation Program or other nationally recognized independent authority or has been certified to ISO 17025. Contractor shall obtain approval for use of source prior to conducting laboratory trial batches for proposed concrete mixture proportions.

2.4.5 Curing Materials

2.4.5.1 Wet-Cure Sheeting Materials

White-Burlap-Polyethylene Sheet or the equivalent meeting the requirements of ASTM C171, shall be used. Polyethylene film and curing paper shall not be used. Submit a manufacturer's certificate certifying that the materials comply with the requirements of ASTM C171, if sheet curing is used.

2.4.5.2 Membrane-Forming Curing Compound

Membrane-forming curing compound shall conform to ASTM C309, Type 1D or 2. If Type 1D is used, all concrete in which Type 1D is used as the curing agent shall be shielded from the direct rays of the sun using opaque sheets for at least 3 days. Surfaces that are to be painted or are to receive subsequent coatings, or floors that are to receive adhesive applications of resilient flooring shall conform ASTM C 1315. The curing compound selected shall be compatible with any subsequent paint, roofing, coating, or flooring specified.

2.4.6 Packaged Dry Repair Materials

Packaged dry rapid-hardening cementitious materials for concrete repairs shall be a commercial formulation conforming to ASTM C928/C928M requiring only the addition of water. The drying shrinkage shall be no greater than

0.05% when tested in accordance with ASTM C157/C157M.

2.4.7 Bonding Agents

Submit descriptive literature and certification in advance of their use. Bonding agents shall meet the following requirements:

2.4.7.1 Latex Bonding Agent

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C1059/C1059M, Type II.

2.4.8 Surface Retarder

If the Contractor elects to use surface retarder, it shall conform to COE CRD-C 94.

Manufacturer’s literature accompanied by manufacturer’s instructions for application shall be submitted for surface retarders to be used to aid in construction joint preparation.

2.5 MATURITY SENSORS

The Contractor has the option of using the Maturity Method for determination of in-place concrete strength for removal of formwork and terminating moist curing. If used, maturity sensors shall meet the requirements of ASTM C1074, paragraph 7.2. The sensors shall be capable of storing unalterable maturity data (temperature/time/maturity every hour) and be available to all users via the handheld or wireless "reader" devices for at least 90 days for determination of in-place compressive strength of the concrete and can be used to determine time of formwork removal and the minimum length of moist curing required prior to application of membrane-curing compound for remainder of specified days of curing.

2.6 PLANT AND EQUIPMENT

The batching, mixing, conveying, and placing systems shall have a capacity sufficient to maintain a steady supply of concrete at a rate necessary to keep all exposed surfaces and construction joints plastic and free of potential cold joint conditions. Submit the methods and description of the equipment proposed for transporting, handling, and depositing the concrete for review, 30 days before concrete placement begins. The data submitted shall include site drawings or sketches with locations of equipment and placement site. Show that plant capacity exceeds requirements identified in the concrete placement plan in the Concrete Lifts submittal.

2.6.1 Batch Plant

Batch plants may be wet (central) or dry type, as required by the supply rates and distribution systems. Batch Plants shall meet the requirements of the Concrete Plant Manufacturer's Bureau (CPMB) and shall be inspected by a certified engineer recognized by the National Ready Mixed Concrete Association in accordance with the NRMCA Batch Plant and Mixer Truck Compliance Checklist. The batching, mixing, conveying, and placing systems shall have a capacity of at least 100 cubic yards per hour. Batch plant shall meet the following requirements.

2.6.2 Record

An accurate record shall be provided for each batch produced and shall conform to the following detailed requirements, as recorded and provided to the Contractor from the Concrete Batch Plant on printed tickets for every load of concrete batched. Tickets will be provided with 5 copies, with the Batch Plant operation maintaining 2, the Contractor and ITL inspector receiving the other 2 tickets for their records, and the Contracting Officer receiving 1 ticket. Tickets shall include:

a. The batch number

b. The time of batch

c. The truck number and driver

d. The mix design used, defined by product number and description

e. Size of the batch and cumulative quantity batched for the order

f. The materials specified in the mix design

g. The target batch weights of all materials

h. The water available to be added to the batch

i. Final W/CM ratio of the Load

j. Water or admixtures added to the load before discharge of the concrete

k. The moisture included in the aggregates

l. The actual weights batched

m. Materials batched out of tolerance if applicable

The batching data will be electronically stored in an unalterable format in the batching system and the information will be periodically downloaded for permanent storage.

2.7 TRANSPORTING EQUIPMENT

Transporting equipment shall be designed, operated, and maintained so that it does not cause or permit segregation or loss of material. The concrete shall not be dropped vertically more than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized.

2.7.1 Buckets

Bottom-dump buckets shall conform to the following requirements: the interior hopper slope shall be not less than 70 degrees from the horizontal; the minimum dimension of the clear gate opening shall be at least five times the nominal maximum size of the aggregate, and the area of the gate opening shall not be less than 2 square feet; the bucket gates shall be grout-tight when closed, shall be of the double clamshell type, and shall be manually, pneumatically, or hydraulically operated; and the gate-opening mechanism shall be designed to close the gates automatically when the control is released or when the air or hydraulic line is broken.

If gate actuation is dependent on integral air or hydraulic reservoirs, the capacity of the reservoirs shall be sufficient to open and close the gates three times without recharging the reservoir.

2.7.2 Trucks

Truck mixers or agitators used for transporting central-mixed concrete shall conform to the applicable requirements of ASTM C94/C94M. Truck mixers shall not be used to transport concrete with larger than 1-1/2 inch nominal maximum-size aggregate or 2 inch or lower slump. Nonagitating trucks may be used for transporting central-mixed concrete over a smooth road when the hauling time is less than 15 minutes and the slump is less than 3 inches. Bodies of nonagitating trucks shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

2.7.3 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating truck, the chutes supplied by the truck manufacturer as standard equipment may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment shall not be permitted for conveying concrete except when specifically approved and in no case shall slump be increased to accommodate their use.

2.7.4 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer or delivery truck to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete or loss of mortar at the transfer point(s) and the point of placing. The idler spacing shall not exceed 36 inches. Belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. Belt width shall be a minimum of 24 inches if the MSCA is 6 inches and shall be a minimum of 16 inches if the MSCA is 3 inches or less. The MSCA required in mixture proportions furnished by the Government will not be changed to accommodate the belt width.

2.7.5 Pump Placement

Concrete may be conveyed by positive-displacement pump when approved. The pumping equipment shall be piston or squeeze-pressure type. The pipeline shall be rigid-steel pipe or heavy-duty flexible hose. Aluminum pipe shall not be used. The inside diameter of the pipe shall be at least 3 times the nominal maximum size of the coarse aggregate in the concrete to be pumped but not less than 4 inches.

2.7.6 Transfer Hoppers

Concrete may be charged into non-agitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in non - agitating transfer hoppers more than 30 minutes.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

3.1.1 Vibrators

This paragraph applies only to concrete that is not self-consolidating.An adequate number of vibrators shall be on hand to meet placing requirements, and spare vibrators shall be available to maintain production in the event of breakdown. There shall be adequate air pressure available for air vibrators and adequate voltage for electric vibrators. Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

APPLICATION	HEAD DIAMETER (inch)	FREQUENCY VPM	AMPLITUDE (inch)
Thin walls	1-1/4 - 2-1/2	9,000 - 13,500	0.020 - 0.04
General construction	2 - 3-1/2	8,000 - 12,000	0.025 - 0.05
Heavy sections	3 - 6	7,000 - 10,500	0.030 - 0.06
Mass concrete	5 - 7	5,500 - 8,500	

The frequency and amplitude shall be within the range indicated in the tabulation as determined in accordance with paragraph TESTS AND INSPECTIONS below.

3.1.2 Embedded Items

Before placing concrete, take care to determine that all embedded items are securely fastened in place as indicated in the drawings or required. Embedded items shall be free of oil and other foreign matter such as loose coatings of rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed by the Contracting Officer. Any air or water lines or other materials embedded in structures, as authorized construction expedients, shall conform to the above requirements and upon completion of their use shall be backfilled with concrete or mortar. Temporarily fill voids in sleeves, inserts, and anchor slots with readily removable materials to prevent the entry of concrete into voids. Welding will not be permitted on embedded or otherwise exposed metals which are in contact with concrete surfaces. Tack welding of or to embedded items will not be permitted.

3.1.3 Construction Joint Treatment

Submit the method and equipment proposed for joint cleanup and waste disposal, for review 30 days before concrete placement begins.

3.1.3.1 Above Water Joint Preparation

Concrete surfaces to which other concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning by sandblasting, high-pressure water jet, air-water cutting, or bush hammering, jack hammering, or any other approved method, with approved equipment. A surface retarder may be used meeting the requirements of

COE CRD-C 94 to allow surface preparation to occur up to 48 hours after the concrete has obtained its final set. Bush hammering and jack hammering will not be permitted for joint preparation. Surface cutting by air-water jets will not be permitted for concrete surfaces congested with reinforcing steel or if they are relatively inaccessible. If, for any other reason, it is considered undesirable to disturb the surface of a lift before it has hardened, the use of sandblasting or high-pressure water jet after hardening will be required. Regardless of the method used, the resulting surface shall be free from all laitance and inferior concrete so that clean, well-bonded coarse aggregate particles are exposed uniformly over the lift surface. Application of the joint treatment method shall be such that the edges of the larger particles of aggregate are not undercut. Where joint preparation occurs more than 2 days prior to placing the next lift or where the work in the area subsequent to the joint preparation causes dirt or debris to be deposited on the surface, the surface shall be cleaned as the last operation prior to placing the next lift. The surface of the construction joint shall be kept continuously wet for the first 12 hours of the 24 hours prior to placing concrete, except that the surface shall be damp with no free water at the time of placement.

3.1.3.2 Below Water Joint Preparation

Concrete surfaces below the tail water elevation, to which other concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by clearing. All marine growth, sediment, and debris shall be remove/cleaned from the surface prior to placing the next lift. The method and equipment used to clean and prepare the surfaces shall include but are not limited to high-pressure water jets, chippers, abrasive jetting, mechanical scrubbers, and self-propelled water jet vehicles. The surface cleaning and preparation shall be conducted a minimum of two hours prior to placing the next lift.

3.1.3.3 Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time, generally between 4 and 12 hours after placement and only on horizontal construction joints. This period may be modified if a retarder is used to prolong the setting of the cement at surface of the concrete. The air pressure used in the jet shall be 90 to 110 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, furnish samples of the material to be used and shall demonstrate the method to be used in its application. After cutting, the surface shall be washed and rinsed until the wash water is no longer cloudy. If air-water cutting does not produce acceptable results, the surface shall be prepared by high-pressure water jet or sandblasting.

3.1.3.4 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the high-pressure water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.3.5 Wet Sandblasting

This method of joint preparation may be used when the concrete has reached sufficient strength to prevent undercutting of coarse aggregate particles. The operation shall be continued until all accumulated laitance, coatings, stains, debris, and foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose material. This method may be used on both horizontal and vertical surfaces.

3.1.3.6 Other Approved Methods

Concrete removal processes involving the use of bush hammering in excess of 15 pounds (impact force) and jack hammers in excess of 30 pounds (impact force), dry sandblasting, or scrabblers shall not be used without approval by the Contracting Officer. A heavier hand-held breaker for concrete removal may be used provided the Contractor can prove to the Contracting Officer that the heavier breaker will not result in micro cracking or other damage to the existing structure.

3.1.3.7 Waste Water Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall meet all requirements of Section 01 57 20.00 13 ENVIRONMENTAL PROTECTION.

3.2 TRANSPORTING AND PLACING

3.2.1 Transporting

Methods and equipment for conveying and depositing the concrete into the form shall be subject to approval. The capacity of the transporting system shall be sufficient to supply concrete at a rate to prevent cold joints forming during placement. A properly designed and sized elephant trunk and rigid drop chute bottom section which will prevent free-fall within the elephant trunk and rigid drop chute will be used if concrete is to drop more than 5 feet. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the concrete shall discharge into a pipe or elephant trunk that is long enough to extend through the reinforcing bars to within 5 feet of the placing surface. In no case will concrete be discharged to free fall through the reinforcing bars.

3.2.1.1 Transporting by Bucket

Provide indicating and signaling devices to control the identification of types or classes of concrete as they are mixed and discharged into buckets for transfer to the forms. Each type or class of concrete shall be visually identified by placing a colored tag or marker on a bucket as it leaves the mixing plant so that the concrete may be positively identified in the forms and placed in the structure in the desired position.

3.2.1.2 Transporting by Pump

The nominal maximum-size coarse aggregate shall not be reduced or mixture proportions changed to accommodate a pump. The distance and height to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the pump continuously. When pumping is

completed, concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each operation the equipment shall be thoroughly cleaned and flushing water shall be properly disposed of outside the forms.

3.2.1.3 Transporting by Belt Conveyor

Methods and equipment for transporting the concrete by belt conveyor into the form are subject to approval.

3.2.1.4 Transporting by Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C94/C94M. Non-agitating equipment may be used for transporting plant-mixed concrete over a smooth road when the hauling time is less than 15 minutes. Bodies of non-agitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.2.2 Placing

The capacity of the placing system shall be sufficient to supply concrete at a rate which will prevent cold joints in any placement. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Concrete shall be deposited as close as possible to its final position in the forms, and in so depositing, there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively placed and consolidated in horizontal layers not exceeding 2 feet in thickness with a minimum of lateral movement. The amount of concrete deposited shall be such that it can be readily and thoroughly consolidated and shall not exceed 4 cubic yards in one pile. All concrete-placing equipment and methods shall be subject to approval. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation.

3.2.2.1 Time Interval Between Mixing and Placing

Concrete mixed in stationary mixers and transported by nonagitating equipment shall be placed within 30 minutes after it has been mixed. When concrete is truck mixed or when a truck mixer or agitator is used for transporting concrete mixed by stationary mixers, the concrete shall be delivered to the site of the work, and discharge shall be completed within 90 minutes after introduction of the cement to water.

3.2.2.2 Hot-Weather Placing

Concrete shall not be placed without an approved Hot Weather Plan. Concrete shall be properly placed and finished with approved procedures in accordance with ACI 305R. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete. The concrete-placing temperature shall not exceed 85 degrees F (60 degrees F for concrete for horizontal repairs). Cooling of the mixing water or

aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. Steel forms and reinforcements shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature. When the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square feet per hour, provision for windbreaks, shading, fog spraying, or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. Surfaces cured with non-pigmented compound shall be shielded from direct rays from the sun for 3 days.

3.2.2.3 Cold Weather Placing

Concrete shall not be placed without an approved Cold Weather Plan. Special temperature control is required for all mass concrete elements as determined by the Thermal Control Plan. The placing temperature of the non mass concrete elements shall be as recommended in ACI 306R, Table 5.1, with the temperature of the concrete measured in accordance with ASTM C1064/C1064M. Heating of the mixing water and/or aggregates may be required to regulate the concrete-placing temperatures. The materials shall be heated in such a manner that they will be free from ice, snow, and frozen lumps before entering the mixer. Air and form temperature in contact with concrete shall be above 50 degrees F prior to placing concrete and maintained for the first 3 days, after placement and then at a temperature above 32 degrees F for the remainder of the specified curing period. Thermometers shall be installed at such locations in accordance with paragraph "Temperature Monitoring". During the period of protection removal, heat shall be shut down and insulation or tents shall be removed in a systematic schedule such that the temperature differential between the air and concrete surface does not exceed 25 degrees F. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Submit methods and equipment for review and comments 30 days in advance of anticipated date required for use.

3.2.2.4 Placing Concrete Underwater

Underwater Concrete placements shall be deposited through water by a tremie or concrete pump. Concrete being placed underwater shall be self-consolidating concretes (SCC). The methods and equipment used shall be submitted in advance of placement for review and approval by the Contracting Officer. Concrete buckets may be used only to charge the hopper on top of the tremie. Concrete buckets shall not be lowered under water and the concrete discharged subaqueously. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end of the pump line or tremie pipe shall be kept submerged continuously in the concrete after placement starts. The underwater seal shall be effected in a manner that will not produce undue contamination of the concrete or turbulence in the water. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie or pump lines shall not be moved horizontally during a placing operation, unless removed, moved, and properly restarted, and a sufficient number of tremies or pump lines shall be provided so that the maximum horizontal flow will be limited to 15 feet.

3.2.2.5 Low Slump Mass Concrete

3.2.2.5.1 Placing Concrete Under Water with a Sloped Grade

The Contractor shall comply with ACI 301 if not detailed in this paragraph. Concrete must be deposited in water by one or more tremie(s). The tremie must be of heavy gauge steel pipe with an inside diameter equal to or greater than eight times the nominal maximum size of aggregates. The methods and equipment used must be subject to approval by the Contracting Officer. Concrete buckets will not be permitted for under water placement of concrete. The tremie(s) must be water tight and sufficiently large to permit free flow of concrete. The discharge end of the pump line or tremie shaft must be kept continuously submerged in the concrete a minimum of two feet. If multiple tremies are used they must be aligned to place concrete at multiple elevations similar to a step progression. Before concrete placement commences measure the water velocity at the depth in which concrete is to be placed. Water velocity recorded must not be greater than 6 feet per second. Do not place any concrete if the water velocity is greater than 6 feet per second. Concrete must be placed in a continuous operation to produce one mass to the maximum extent possible. The under water seal must be effected in a manner that will not produce undue turbulence in the water. Use an open tremie with retrievable traveling plug (go-devil) or a closed tremie with a plate and gasket wired to the bottom to start a new placement. However, only the closed tremie with a plate and gasket wired to the bottom must be used to restart an ongoing concrete placement. If the tremie looses the seal for any reason, the placement must be halted immediately and the tremie removed, resealed in the dry, and restarted. The tremie shaft(s) must be kept full of concrete to a point well above the water surface. Placement must proceed without interruption until the concrete has been brought to the required height and slope within the confinement of the end cell sheet piling. The tremie must not be moved horizontally during a placing operation, and a sufficient number of tremies must be provided such that the maximum horizontal flow is limited to 5 feet.
To prevent segregation, concrete deposited under water must be carefully deposited in a compact mass in its final position by means of a tremie pipe, or other approved method, and must not be disturbed after being deposited. Still water must be maintained at the point of deposit. The water level must be regulated so that there must be no fluctuation of water head that could be injurous to the concrete. Concrete depositing under water must be carried out continuously from start to finish. The surface of the concrete must be kept as close to horizontal as practicable at all times. To ensure thorough bonding, each succeeding layer of concrete must be deposited before the preceeding layer has taken its initial set. In the event of long delays in the pour during which the already deposited tremie has started to set, remove the laitance and prepare the surface in accordance to the paragraph Below Water Joint Preparation.

3.2.2.6 Special Temperature-Controlled Concrete

Refer to paragraph Special Temperature Controlled Concrete Protection

3.2.2.7 Concrete Lifts

The time of placement and the depth of concrete between each lift shall be determined based on the thermal analysis and thermal control plan. Otherwise, the following shall govern. All concrete shall be deposited in

approximately horizontal layers about 18 inches in thickness in stepped progression at such a rate that the formation of cold joints will be prevented. Slabs shall be placed in one lift, unless 2.5 foot or more deep. A minimum of five successive horizontal layers in stepped progression shall be used for 7.5 foot lifts. Where 5 foot lifts are required, a minimum of three successive horizontal layers in stepped progression shall be used. Each new layer of concrete shall be placed on the oldest exposed layer. The maximum exposed bulkhead face of concrete between adjacent monoliths shall not exceed 15 feet except as otherwise approved. Approval for single lift placements greater than 15 feet high shall be obtained from the Contracting Officer. Documentation for the higher placement shall address form design, concrete placement rate (maximum feet/hour) based on the proposed concrete mixture proportion and ambient temperature, and evaluation of compressive strength of concrete prior to form removal so the placement will be able to adequately support lateral forces and moments. Submit a lift drawing and bill of materials for each lift of concrete. Only one lift shall be shown on a drawing. These drawings shall be to scale and shall show all embedded items in sufficient detail for the proper installation and prosecution of the work. All embedded electrical and/or mechanical items shall be identified. The drawings shall not be less than 22 by 34 inches in size and the scale used shall be sufficiently large to clearly show all details of the structure covered by these drawings. A note shall be included on each lift drawing indicating all contract drawings from which the lift drawing was prepared. Submit 3 copies of each drawing for review at least 30 days prior to scheduling the lift for placement. Include the concrete placement rate in cy/hr required by the concrete lift plan.

3.2.2.8 Consolidation

Below water placements: All concrete required for underwater placement shall be self-consolidating concrete (SCC). Internal vibrating is not required after placement of the SCC mix. Above water placements: Immediately after placing concrete above water, each layer of concrete shall be consolidated by internal vibrating equipment. Vibrators shall not be used to cause concrete to flow for significant distances within the forms. Hand spading may be used if necessary together with internal vibration along formed surfaces permanently exposed to view. Form vibrators shall not be used unless forms are specifically designed for this use and unless specifically approved. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding unhardened layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly. Slabs 8 inches or less in depth shall be consolidated by approved methods.

3.3 FINISHING

3.3.1 Unformed Surfaces

The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 40 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or evaporation retarding film shall be made in advance of placement to prevent plastic shrinkage cracks, and such protective measures shall be taken before, during, and

immediately after finishing as operations require. All unformed surfaces of concrete that are not to be covered by additional concrete or backfill shall have a float finish, unless a trowel finish is specified, and shall be true to elevation as shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown and left true and regular. All top horizontal exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. The concrete shall be thoroughly consolidated before finishing operations commence or before leaving it for future concrete or backfill placement.

3.3.1.1 Float Finish

Surfaces to receive a float finish shall be screeded and darbied or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall not be of aluminum or magnesium. After the water sheen has disappeared, the concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true even plane. The finished surface shall be a true plane within 1/4 inch in 6 feet.

3.3.1.2 Broom Finish

A broom finish shall be applied to the top of the end cell and the guide wall. Exterior surfaces shall be sloped for drainage, unless otherwise shown. The concrete surface to be broom finished shall first be given a float finish. The surface shall then be broomed with a stiff fiber-bristle broom in a direction transverse to that of the traffic.

3.3.2 Formwork

3.3.2.1 Formwork Removal

Concrete strength for formwork removal may be determined by the maturity method in accordance with ASTM C1074, or use of standard field cylinder breaks. Prior to using maturity method, submit data using project materials to demonstrate the correlation between maturity and compressive or flexural strength of laboratory cured test specimens to the Contracting Officer.

3.3.2.2 Formed Surface Repair

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

3.3.2.3 Class A Finishes

Surfaces listed in Section 03 11 14 FORMWORK FOR CONCRETE to have classes A, A-HV, and B finishes shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 16 square inches in area and less than 1/2 inches deep; bug holes exceeding 1/2 inch in diameter shall be chipped and filled with dry-packed mortar; holes left by removal of tie rods shall be reamed and filled with the below specified material; defective and unsound concrete areas larger than described shall

be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of ASTM C881/C881M, Type V; a latex bonding agent meeting the requirements of ASTM C1059/C1059M, Type II; or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete prior to the bonding agent or grout drying, in accordance with the paragraph "MATERIAL AND PROCEDURE FOR REPAIRS" below prior to the bonding agent or grout drying.

3.3.2.4 Class D Finish

Surfaces listed in Section 03 11 14 FORMWORK FOR CONCRETE and as shown in the drawings to have class D finish, shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 48 square inches in area or more than 2 inches deep shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of ASTM C881/C881M, Type V; a latex bonding agent meeting the requirements of ASTM C1059/C1059M, Type II; or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with the following paragraph prior to the bonding agent or grout drying. Defective areas, voids, and honeycombs smaller than 48 square inches and less than 2 inches deep, and bug holes exceeding 1-1/2 inches in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar.

3.3.2.5 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Contracting Officer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 40 degrees F during placement, finishing, and curing. Packaged materials meeting the requirements of Paragraph "Packaged Dry Repair Materials: may be used in lieu of dry-packed mortar when approved. Other methods and materials for repair may be used only when approved in writing. Repairs of the so called "plaster-type" will not be permitted.

3.4 CURING AND PROTECTION

Submit the curing media and methods to be used for review 30 days before concrete placement begins.

3.4.1 Curing Time

All concrete shall be cured by one of the following methods or combination of methods for the period of time given below corresponding to the cementing materials used in the concrete:

Cementitious Materials	Protection / Curing Period
Type II portland cement	10 days
Portland cement blended with 25 percent or less fly-ash and/or slag cement	14 days
Portland cement blended with more than 25 percent fly-ash and/or slag cement	21 days

Curing shall begin immediately after placing. Provide all equipment needed for curing and protection of the concrete on hand and ready to install before actual concrete placement begins. The curing medium and method, or the combination of media and methods used, shall be as approved in accordance with paragraph SUBMITTALS, SD-03 Product Data, submittal item "Curing and Protection".

3.4.2 Moist Curing

Horizontal and nearly horizontal surfaces shall be moist cured by ponding, by covering with a wet cure polyethylene sheeting material, or by covering with saturated non - staining burlap or cotton mats. Burlap and cotton mats shall be rinsed to remove soluble substances before using. Other surfaces shall be moist cured when approved or directed by the Contracting Officer. Concrete that is moist cured shall be maintained continuously, not periodically, wet for the duration of the entire curing period. Water for curing shall comply with the requirements of the paragraph WATER in PART 2. If the water, sand, mats, etc. cause staining or discoloration of permanently exposed concrete surfaces, the surfaces shall be cleaned by an approved method. When wood forms are left in place during curing, the forms shall be kept continuously wet except for sealed insulation curing in cold weather. When steel forms are left in place on vertical surfaces during curing of concrete, placements with a minimum dimension greater than 2 feet the forms shall be carefully broken loose from the hardened concrete and curing water continuously introduced into the void. The temperature of the water shall be plus or minus 20 degrees F from the temperature of the concrete surface being moist cured. Horizontal construction joints shall be allowed to dry sufficiently to remove free water immediately prior to placing the next lift.

3.4.2.1 Determination of Length of Moist Curing Based on the Maturity Method

Prior to using maturity method, submit data using project materials to

demonstrate the correlation between maturity and compressive or flexural strength of laboratory cured test specimens to the Contracting Officer. Moist curing of concrete that is to receive additional concrete require the specified curing time to be met, unless the maturity method in accordance with ASTM C1074 is used, see table below.

CONCRETE CONTAINING:	TERMINATION OF MOIST CURING @:
No Slag Cement	**70 percent of the f'c**
Less than 25 percent Slag Cement	14 days
More than 25 percent Slag Cement	21 days

Moist curing of concrete that is NOT to receive additional concrete or a grout cleaned finish require the specified curing time to be met, unless the maturity method in accordance with ASTM C1074 is used, see table below.

CONCRETE CONTAINING:	TERMINATION OF MOIST CURING @:	ADDITIONAL CURING WITH MEMBRANE - CURING COMPOUND.
Less than 25 percent Slag Cement	70 percent of the f'c	YES
More than 25 percent Slag Cement	85 percent of the f'c	YES

3.4.3 Membrane Curing

Membrane curing may be used on surfaces that are not specified or directed to receive moist curing. Membrane-forming curing compound shall not be used on surfaces that contain protruding steel reinforcing, that are heated by free steam, that will have additional concrete bonded to them, that are to be grout-cleaned, or that are to be stained.

3.4.3.1 Nonpigmented Curing Compound

Nonpigmented compound conforming to ASTM C309, Type ID, containing a fugitive dye may be used on surfaces that will be exposed to view when the project is completed. The reflective requirements of ASTM C309 are waived. Surfaces cured with nonpigmented compound shall be shielded from direct rays of the sun for 3 days.

3.4.3.2 Application

The curing compound shall be applied to formed surfaces immediately after the forms are removed. The surfaces shall be thoroughly moistened with water, and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared provided steps have been taken when necessary to prevent premature loss of free water due to excessive evaporation as described in paragraph UNFORMED SURFACES above. The curing compound shall be applied in a two-coat continuous operation by motorized power-spraying equipment or pressure-tank equipment operating at a minimum pressure of 75 psi with provisions for continuous agitation. The application equipment shall be approved in advance. Hand-operated pressure applicators ("garden sprayers") shall not be used except in small, isolated areas as approved.

The compound shall be applied at a uniform coverage of not more than 400 square feet/gallon for each coat. The second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other influence that will disrupt the continuity of the curing membrane.

3.4.4 Sheet Curing

Sheets shall be used only on horizontal or near horizontal surfaces. The sheet shall be in good condition and free from tears and holes, and the burlap shall be kept wet during the curing period.. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.4.5 Sealed Insulation Curing

Between dates listed in paragraph COLD WEATHER PROTECTION below where cold weather protection is provided entirely by insulation, all joints in the insulation shall be sealed to retard moisture loss and maintain a seal throughout the curing period.

3.4.6 Protection

No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. No vibratory earth compaction equipment or pile-driving equipment shall be operated within 100 feet horizontally of concrete less than 75% of the minimum compressive strength. Concrete removal shall not be permitted within 100 feet horizontally of concrete less than 90 days old. Removal plans shall be approved by the Contracting Officer. The surface of the concrete shall be protected from rain or snow during placing.

3.4.7 Cold Weather Protection

Between 1 October of each year and 30 April of the following year, all concrete less than 30 days old shall be protected with insulation that provides an R value not less than 2 hour square foot degree Fahrenheit per BTU. Submit a description of the materials and methods proposed for protection of the concrete, 60 days in advance of anticipated need date when concrete is to be placed under cold-weather conditions.

a. Concrete placed prior to the starting date shall be temporarily protected from the starting date until it reaches an age of 30 days or until the end of the protection period, whichever comes first. Note: Temporary Protection shall be applied when the air temperature has fallen to, or is expected to fall below, 40°F . However, it is allowable for the protection to be removed when the air temperature is above 40 °F.

Concrete placed after the starting date shall be continuously protected during and subsequent to placement until it reaches an age of 30 days or until the end of the protection period, whichever comes first. Note: Continuous Protection shall be applied when the average daily air temperature drops below 40°F for three successive days.

b. The insulation shall be maintained in such a condition that the R value does not diminish during the period of protection. Edges and corners of the placement shall be protected with a double layer of the insulation specified above for a minimum distance of 2 feet in all directions.

c. Forms shall be insulated in such a manner that the combined form-insulation system shall have a thermal resistance (R value) not less than that specified. Insulation and the combined form-insulation system shall remain in place for at least 5 days after placement of the concrete. After 5 days, forms and insulation on vertical surfaces may be removed for periods not to exceed 4 hours in a 24 hour period to allow forms to be moved, and insulation on horizontal surfaces may be removed for periods not to exceed 8 hours in a 24 hour period to allow reinforcement to be installed, insulation to be installed, lift joints to be prepared, etc. provided that suitable precautions are taken to prevent the concrete from being subjected at any time to ambient temperatures of 20 degrees F or below.

d. The first 6 feet of all steel protruding from insulated concrete shall be insulated with material having an R value as stated. All form bolts and metal ribs on the forms shall be insulated in a like manner. During the period of protection there shall be no holes or openings in the insulation or between the insulation and concrete which permit ambient air to penetrate the insulation except as noted for construction purposes. Special attention shall be given to seams, corners, and edges to prevent holes or openings in the insulation.

3.4.8 Special Temperature Controlled Concrete Protection

Anything defined as Mass Concrete, as specified, requires special treatment to ensure that maximum temperature and maximum temperature differential as specified within paragraph "Thermal Analysis and Thermal Control Plan(s)" are not exceeded. Special treatment may involve, but are not limited to the use of a different concrete mix design (with reduced equivalent cement content), precooling of the concrete, the use of surface insulation and/or the use of internal cooling pipes. A thermal control plan for the placement must be developed and submitted for approval prior to the concrete placement. The thermal control plan shall provide information regarding how temperature monitoring will be verified through the use of temperature sensors in the concrete.

3.4.8.1 Temperature Monitoring

Temperature monitoring shall be performed using temperature loggers specifically designed for embedding in concrete for recording temperature. For each mass concrete section and/or element being placed, temperature sensors shall be located at the following: a minimum of three locations along a plane through the center of mass of placement and a minimum of 3 locations at a depth 2 to 3 inches from center of nearest exterior surface. Two sensors shall be installed at each location (a primary and a

backup). The sensors shall be capable of monitoring hourly temperatures, and the data shall be downloaded at least once every 24 hours for the first seven days then at least once every 2 days for the remainder of the period when thermal controls and temperature monitoring are required. Submit monitoring locations for approval 7 days prior to concrete placement.

3.4.8.2 Termination of Thermal Controls and Temperature Monitoring

Thermal control and monitoring can be terminated when all of the following are met:

1. The concrete is at least three days old.
2. The hottest portion of the concrete has reached its maximum temperature and has started to cool.
3. The difference between the hottest portion of the concrete and the average air temperature is less than 35 F.

3.5 TESTS AND INSPECTIONS

3.5.1 General

Perform the following inspection and tests as described, and, based upon the results of these inspections and tests, take the action required and submit reports as required. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease.

3.5.1.1 Laboratory Requirements

The laboratory performing the tests shall conform with the requirements given in ASTM C1077. Accreditation or validation by the National Voluntary Laboratory Accreditation Program, American Association for Laboratory Accreditation, AASHTO Accreditation Program or other nationally recognized independent authority shall be submitted on laboratories that are performing any concrete and concrete materials testing required for this project.

3.5.1.2 Technician and Inspector Certification Requirements

The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The individuals who sample and test the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for ACI Aggregate Technician Certification Program: Aggregate Testing Technician - Level 1. The individual who performs the inspection shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Transportation Construction Inspector (CTCI) or Concrete Construction Inspector (CCI).

3.5.2 Testing and Inspection Requirements

3.5.2.1 Fine Aggregate

3.5.2.1.1 Grading

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C136/C136M , ASTM C117 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. The results shall be recorded on a sheet on which are also shown the specification limits applicable to the project.

3.5.2.1.2 Fineness Modulus Control Chart

Results for fineness modulus shall be grouped in sets of three consecutive tests, and the average and range of each group shall be plotted on a control chart. The upper and lower control limits for average shall be drawn 0.10 units above and below the target fineness modulus, and the upper control limit for range shall be 0.20 units above the target fineness modulus.

3.5.2.1.3 Corrective Action for Fine Aggregate Grading

When the amount passing any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure for any sieve, the fact shall immediately be reported. Whenever a point on the fineness modulus control chart, either for average or range, is beyond one of the control limits, the frequency of testing shall be doubled. If two consecutive points are beyond the control limits, the process shall be considered out of control and concreting shall be stopped. Corrective action shall be taken immediately to determine the cause and effect of the non-compliance. The Contractor shall then engage the services of their technical agent to take corrective action in the form of correcting the material out of tolerance. The Contractor shall notify the Contracting Officer of the non-compliance and provide a plan for corrective action. After two consecutive points have fallen within the control limits, testing at the normal frequency may be resumed.

3.5.2.1.4 Moisture Content Testing

When in the opinion of the Contracting Officer the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with ASTM C566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When an electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.

3.5.2.1.5 Moisture Content Corrective Action

Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device).

3.5.2.2 Coarse Aggregate

3.5.2.2.1 Grading

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C136/C136M for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor is responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When facilities are available to test samples five times as large as those required in ASTM C136/C136M, no averaging shall be done.

3.5.2.2.2 Corrective Action for Grading

When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported. Where two consecutive averages of five tests (or two consecutive tests where large samples are used) are outside specification limits, the process shall be considered out of compliance, and concreting shall be stopped. Corrective action shall be taken immediately to determine the cause and effect of the non-compliance. The Contractor shall then engage the services of their technical agent to take corrective action in the form of correcting the material out of tolerance. The Contractor shall notify the Contracting Officer of the non-compliance and provide a plan for corrective action. After two consecutive points have fallen within the control limits, testing at the normal frequency may be resumed.

3.5.2.2.3 Coarse Aggregate Moisture Content

A test for moisture content of each size group of coarse aggregate shall be made at least once a shift. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified previously for fine aggregate.

3.5.2.2.4 Coarse Aggregate Moisture Corrective Action

Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted to compensate for this.

3.5.2.2.5 Particle Shape Testing

When a problem exists in connection with aggregate particle shape, tests shall be made in accordance with ASTM D4791. Testing frequency shall be not less than one per day, when directed.

3.5.2.2.6 Particle Shape Corrective Action

When testing for particle shape is required, two consecutive failures in the same sieve size shall be immediately reported and a plan submitted for corrective action for approval.

3.5.2.2.7 Material Finer than the No. 200 Sieve

When in the opinion of the Contracting Officer, a problem exists in connection with the cleanliness of aggregate, tests shall be made in accordance with ASTM C117.

3.5.2.2.8 Corrective Action for Material Finer than the No. 200 Sieve

When material finer than the No. 200 sieve exceeds 1.0 percent of the weight of the aggregate finer than 1-1/2 inches or 0.5 percent of the weight of the aggregate coarser than 1-1/2 inches, the Contracting Officer shall be notified and steps, such as washing or other corrective action, shall be initiated immediately.

3.5.2.3 Concrete

3.5.2.3.1 Unit Weight

Determine unit weight of normal weight concrete in accordance to ASTM C138/C138M when compressive strength specimens are fabricated.

3.5.2.3.2 Air Content

The air content of the concrete shall be measured when compressive strength specimens are fabricated. The air content test shall be conducted in accordance with ASTM C231/C231M. Additional tests shall be made when excessive variation in workability is reported, or as directed. Plot test results on control charts. Submit the control charts weekly and make them readily available to the Government. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, perform a second test immediately. Plot the result of each test on a control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph(s) Mass Concrete Design Mix Requirements. Set an upper warning limit and a lower warning limit line 1.0 percentage point above and below the average line, respectively. Set an upper action limit and a lower action limit line 1.5 percentage points above and below the average line, respectively. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the specified air content. If the materials or transportation methods cause air content loss between the mixer and the placement, take correlation samples at the placement site as required by the Contracting Officer, and the control the air content at the mixer as directed.

3.5.2.3.3 Air Content Corrective Action

Whenever points on the control chart approach the upper or lower control limits, an adjustment should be made in the amount of air-entraining admixture batched. If a single test result is outside the specification limit, immediate adjustment is mandatory. As soon as practical after each adjustment, another test shall be made to verify the correction of the

adjustment. Whenever a point falls above the upper control for range, the dispenser shall be calibrated to ensure that it is operating correctly and with good reproducibility. Whenever two consecutive points either for average or range are outside the control limits, the Contracting Officer shall be notified.

3.5.2.3.4 Slump/Slump Flow Testing

The slump/slump flow of the concrete shall be measured when compressive strength specimens are fabricated. The slump and slump flow test shall be conducted in accordance with ASTM C143/C143M or ASTM C1611/C1611M. Additional tests shall be made when excessive variation in workability is reported, or as directed. Plot test results on control charts. Submit the control charts weekly and make them readily available to the Government. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single slump/slump flow test reaches or goes beyond either the upper or lower action limit, immediately perform a second test. Set the upper warning limit at 1/2 inch below the maximum allowable slump/slump flow specified in paragraph(s) Mass Concrete Mix Design Requirements for each type of concrete and, set an upper action limit line and lower action limit line at the maximum and minimum allowable slumps/slump flow, respectively, as specified in the same paragraph. Take samples for slump/slump flow at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump/slump flow. If the materials or transportation methods cause slump/slump flow loss between the mixer and the placement, take correlation samples at the placement site as required by the Contracting Officer, and the slump/slump flow at the mixer controlled as directed.

3.5.2.3.5 Slump/Slump Flow Corrective Action

Whenever points on the control chart approach the upper or lower control limits, an adjustment shall be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount specified in the mixture proportions provided based on the free water available with the aggregates and that amount of water batched. If the adjustments to the batch weights of water and aggregates do not satisfactorily produce the required slump/slump flow, the Contracting Officer may adjust the mixture proportions if the fine-aggregate moisture content is stable and within the required limits. When a single slump/slump flow is outside the control limits, such adjustment is mandatory. As soon as practical after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump/slump flow tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range above the upper control limits, the slump/slump flow shall be considered to be out of control, the concreting operation halted, and the additional testing for aggregate moisture content required shall be undertaken, and action taken immediately to correct the problem.

3.5.2.3.6 Temperature

The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C1064/C1064M. The temperature shall be reported along with the compressive strength data.

3.5.2.3.7 Compression Test Cylinders

At least one set of test cylinders shall be made for every 100 cubic yards produced, for each different concrete mixture placed during the shift. Additional sets of test cylinders shall be made, as directed, when the mixture proportions are changed or when low strengths have been detected. A random sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to start of construction. The plan shall assure that sampling is done in a completely random and unbiased, not just haphazard, manner. From each sample, a set of compression test cylinders shall be made in accordance with ASTM C31/C31M.

A set of cylinders for concrete containing 3/4 inch aggregate shall consist of twelve (12) - 4 x 8 inch cylinders. Three to be tested at 3 days, three at 7 days, three at 28 days, and three at 90 days.

All test cylinders shall be molded and cured in accordance with ASTM C31/C31M and tested in accordance with ASTM C39/C39M. Compression test specimens shall be cured while in the field in accordance with paragraphs 10.1, 10.1.1 and 10.1.2 of ASTM C31/C31M. If cylinders are not delivered to the testing laboratory within 24 to 48 hours after molding, they shall be submerged in a water tank provided by the Contractor, where the surrounding water temperature is maintained by the Contractor at (73.4 plus or minus 3 degreesF) and saturated with calcium hydroxide. Cylinders shall be transported in accordance with ASTM C31/C31M (with cushioning material) and unloaded in the Contractor's designated testing location. All compressive strength tests shall be reported immediately. Quality control charts shall be kept for individual strength tests, moving average for strength and moving average for range for each mixture. The charts shall be similar to those found in ACI 214R.

3.5.2.4 Inspection Before Placing

Foundation or construction joints, forms, and embedded items shall be inspected in sufficient time prior to each concrete placement in order to certify that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.5.2.5 Concrete Placement

3.5.2.5.1 Placing Inspection

The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, yardage placed, and method of placement.

3.5.2.5.2 Placing Corrective Action

The placing foreman shall not permit placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.5.2.6 Vibrators

3.5.2.6.1 Vibrator Testing and Use

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

3.5.2.6.2 Vibrator Corrective Action

Any vibrator not meeting the requirements of paragraph PREPARATION FOR PLACING above shall be immediately removed from service and repaired or replaced.

3.5.2.7 Curing

3.5.2.7.1 Moist Curing Inspections

At least twice each shift, and twice per day on nonworking days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

3.5.2.7.2 Moist Curing Corrective Action

When a daily inspection report lists an area of inadequate moistness, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by one (1) day.

3.5.2.7.3 Membrane Curing Inspection

No curing compound shall be applied until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square feet per gallon. Note whether or not coverage is uniform.

3.5.2.7.4 Membrane Curing Corrective Action

When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

3.5.2.7.5 Sheet Curing Inspection

At least once each shift and once per day on nonworking days, an inspection shall be made of all areas being cured using sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

3.5.2.7.6 Sheet Curing Corrective Action

When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one day.

3.5.2.8 Cold Weather Protection and Sealed Insulation Curing

At least once each shift and once per day on nonworking days an inspection shall be made of all areas subject to cold weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other incongruities which could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

3.5.2.9 Cold Weather Protection Corrective Action

When a daily inspection report lists any holes, tears, unsealed joints, or other incongruities, the deficiency shall be corrected immediately and the period of protection extended for one (1) day.

3.5.2.10 Mixer Uniformity

3.5.2.10.1 Stationary Mixers

On new mixers delivered directly from a manufacturer which has had the mixer certified before delivery an initial uniformity test will not have to be performed. Otherwise, prior to the start of concrete placing and once every 3 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time, interval uniformity of concrete mixing shall be determined in accordance with paragraph "PLANT AND EQUIPMENT - ADDITIONAL REQUIREMENTS FOR PROJECT SPECIFIC BATCH PLANTS (ON-SITE OR MOBILE)". The initial and every fourth set of tests shall be regular tests performed on three batches of concrete. Intermediate uniformity tests shall be abbreviated tests performed on a single batch of concrete. If the mixer fails the abbreviated test, a regular test shall be immediately performed. Whenever adjustments in a mixer or increased mixing time are required because of failure of a uniformity test, the mixer shall be reevaluated by a regular test after the adjustments have been completed. If the Contractor proposes to reduce a mixing time, a regular test shall be performed to evaluate the proposed time. Additional testing shall be performed when directed when there is visible evidence of possible improper mixer performance. Results of all uniformity tests shall be reported in writing.

3.5.2.10.2 Truck Mixers

Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C94/C94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory. Results of tests shall be reported in writing.

3.5.2.11 Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either the

mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.5.3 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

3.6 ATTACHMENTS

A. ETL 1110-2-542, 30 May 1997

-- End of Section --

SECTION 03 70 00 MASS CONCRETE

ATTACHMENTS

ETL 1110-2-542

THERMAL STUDIES OF MASS CONCRETE STRUCTURES

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

CECW-EG

Technical Letter
No. 1110-2-542

30 May 1997

Engineering and Design
THERMAL STUDIES OF MASS CONCRETE STRUCTURES

1. Purpose

This engineer technical letter (ETL) provides guidance for performing thermal studies of mass concrete structures (MCS) as required by Engineer Manual (EM) 1110-2-2000.

2. Applicability

This ETL applies to HQUSACE elements and USACE commands having responsibilities for the design of civil works projects.

3. References

References are listed in Annex 4.

4. Discussion

a. Background. The effects of heat generation in mass concrete were first recognized in the 1920's and 1930's, including the development of artificial cooling of mass concrete using chilled water flowing through embedded pipe. Early thermal analysis of mass concrete made use of very simple concepts and various stepwise hand calculation methods of determining temperature changes. Later development of finite element (FE) techniques made possible more accurate and realistic thermal analysis, culminating in the current development of nonlinear incremental structural analysis (NISA). Current mass concrete thermal analysis practice may employ a variety of methodologies, varying from simple hand calculations and charts using broad assumptions for conditions and concrete properties, to computer spreadsheet temperature balance methods, to FE temperature and stress/strain analysis, and finally NISA.

b. Types of mass concrete structures. Three types of MCS are commonly used in civil works projects: (1) gravity structures such as dams and lock walls; (2) thick shell structures such as arch dams; and (3) thick reinforced structures such as U-frame locks, large pumping stations, powerhouses, large foundations, and massive bridge piers. MCS constructed using the roller-compacted concrete (RCC) construction method are treated in this ETL identically to structures constructed using traditional construction methods.

c. ETL content. Thermal studies for MCS have been categorized into three levels of increasing complexity to provide a convenient frame of reference. This ETL specifically provides information and guidance for thermal studies of MCS and provides methodology for the first two levels of thermal studies. The methodology for the more complex third level is provided by ETL 1110-2-365, which includes many subjects pertinent to Level 1 and Level 2 thermal analyses. EM 1110-2-2201 contains explicit procedures for preliminary temperature studies for arch dams that eventually lead to NISA.

(1) Appendix A provides detailed information and practice for mass concrete thermal studies.

(2) Annex 1 presents current practice for determination of concrete tensile strain capacity for use in cracking analysis.

(3) Annex 2 provides a stepwise procedure for simple, Level 1 thermal analysis, including an example.

(4) Annex 3 provides a procedure for more intensive Level 2 thermal analysis, including an example using simple FE, one-dimensional (1-D) strip models and an example using more complex two-dimensional (2-D), FE methodology.

5. Guidance

a. Descriptions and applications of thermal analysis methods. Thermal analysis is categorized into three levels of complexity. These levels are identified to provide a convenient frame of reference for the analytical processes available to the designer. The level of thermal analysis selected should be appropriate for the size, type, function and risk, and stage of design of the structure, as well as the potential for cost savings resulting from the analysis. Appendix A provides a suggested process for selecting and conducting thermal analysis appropriate for MCS. Small, low-head MCS may require no more than a very simplified thermal analysis. A larger structure, such as a concrete gravity dam, may need only a simplified thermal study at the feasibility level of design, but a more thorough study during preconstruction engineering and design (PED) phase. Certain MCS such as complex lock walls, high gravity dams, and arch dams, may require a NISA during PED. Cost savings may be realized through an adequate thermal study when unnecessary joints can be eliminated or construction controls, such as concrete placing temperatures, can be relaxed. Each higher level of analysis may provide more detailed information but, generally, at a price of increasing complexity and cost of the analytical effort.

(1) Level 1 analysis. This is the simplest level of thermal analysis, using very basic methodology, requiring little or no laboratory testing, and incorporating broad assumptions for site conditions and placement constraints. This level of analysis should be used in thermal evaluations of a general nature, where the consequences of thermal cracking are a concern but pose little safety or stability concerns. The method is appropriate for the project feasibility stage to determine if higher level analysis is necessary for PED and for initial verification of construction controls and structural features such as joint spacing and lift heights. It is applicable to small and low-head structures and those structures where thermal cracking poses little risk of loss of function. These structures may include diversion structures for irrigation canals, low-head flood protection structures, low-head MCS that impound water on an infrequent basis for short durations, and thick reinforced structures such as foundations and massive bridge piers. Annex 2 of Appendix A illustrates this level of analysis.

(2) Level 2 analysis. Level 2 thermal analysis is characterized by a more rigorous determination of concrete temperature history in the structure and the use of a wide range of temperature analysis tools. This level of analysis should be applied to thermal evaluations of more critical structures where the consequences of thermal cracking may pose a significant risk to people or property, may present stability concerns or loss of function, or may result in significant cost savings. This level of analysis is recommended to better identify thermal cracking potential and minimize specific requirements necessary for thermal crack control that can add significant cost to construction. Level 2 analysis may be appropriate for the feasibility study phase of significant structures and may be used to determine if higher-level analysis is necessary during PED. Level 2 thermal analysis is also appropriate for PED for significant MCS. It is applicable to medium to high-head flood protection structures and other significant MCS. These structures may include complex lock walls, medium to high gravity dams, tunnel plugs involving postcooling and grouting, pumping stations, powerhouses, and low-head arch dams. Annex 3 of Appendix A illustrates this level of analysis.

(3) Level 3 analysis. This level is the most complex level of thermal analysis. ETL 1110-2-365 describes the computational methodology and application of Level 3 (NISA) analysis, and ETL 1110-2-536 presents an example of NISA application to the Zintel Canyon Dam. This level of analysis is suitable for very critical structures where cracking poses significant risks. The designer must weigh the high costs of NISA evaluation against the potential benefits of increased analysis detail and capability of simultaneously analyzing thermal and

other structure loading. The method is applicable to critical, high-risk projects, complex or unprecedented structures with little or no previous experience, and structures subject to stress interaction from several simultaneous loading conditions. This level of analysis may also be appropriate for normal thermal studies of more ordinary MSC to optimize thermal controls and potentially reduce construction costs. Candidates for NISA include high gravity dams, arch dams, large and complex lock walls.

b. Cracking analysis methods. Analysis of cracking for Levels 1 and 2 MCS thermal analysis is performed based on the computed concrete temperature distributions, using simplified procedures to relate thermal changes in volume of the MCS to estimate cracking potential. The procedures involve approximations and require assumptions regarding conditions of restraint. Cracking analysis methodology for Levels 1 and 2 thermal analysis is described in Appendix A. For NISA, the cracking analysis is integral with the incremental FE thermal stress-strain analysis as described in ETL 1110-2-365.

6. Action

a. Thermal analysis needs. As required in EM 1110-2-2000, concrete thermal studies are to be performed for any important concrete structure where thermal cracking potential exists. The design team must evaluate the necessity of a thermal study and select the appropriate level of analysis in accordance with the criteria outlined herein. Guidance for performing thermal studies is given in Appendix A.

b. Stage of project development. Evaluation of the thermal study requirements should be done during the Feasibility Phase of project development. Necessary design studies and resources should be included in the Project Management Plan. Proper identification of objectives is the key to determining the required scope of studies. Contact CECW-EG and CECW-ED for assistance in determining appropriate levels of investigation and the necessary resources. Thermal studies are usually performed during the PED phase when project concrete materials and mixtures have been identified. However, the most basic studies may be performed during a feasibility study for a major project or for a complex structure where thermal cracking issues may control subsequent design changes and more complex analysis. Testing requirements should be coordinated to ensure test data are ready at the appropriate time of the study. Appendix A contains more detailed information related to thermal analysis and stages of project development.

c. Testing. The material properties for thermal studies should be based on test results of proposed concrete mixtures for the project, if appropriate to the level of study, the phase of project study, and requirements of the particular project. If concrete properties testing is not appropriate for a specific project, data will be obtained from various published sources and from consultation with concrete specialists at various Field Operating Activities (FOA) and CEWES, and with outside technical specialists.

d. Responsible parties. The materials or structural engineer primarily responsible for the thermal study must ensure that adequate input is obtained from materials, structural, geotechnical, and construction engineers. Coordination is required for selection of environmental conditions, concrete properties, foundation properties, and construction parameters. Review of the thermal study should be conducted at levels commensurate with the scope of the thermal study to ensure that the plan of action being pursued is appropriate. Concrete specialists at various FOA and CEWES, or outside technical specialists, should be consulted for guidance during Level 2 or 3 thermal analysis of MCS.

e. Construction. If construction conditions or requirements change significantly from that assumed during the thermal analysis, the designer should evaluate the need to conduct additional thermal studies. Instrumentation should be installed in important MCS to verify design assumptions and analysis.

f. Documentation. Results of the thermal study should be documented in an appropriate design report.

FOR THE COMMANDER:

Steven L. Stockton, P.E.
Chief, Engineering Division
Directorate of Civil Works

1 Appendix
App A - Techniques for Performing Concrete Thermal Studies

APPENDIX A: TECHNIQUES FOR PERFORMING CONCRETE THERMAL STUDIES

LEVEL 1 AND LEVEL 2

A-1. Introduction

a. Content. This appendix presents general techniques for performing a thermal analysis for mass concrete structures (MCS), with more detailed procedures and examples provided in the annexes. The appendix discusses the general process for thermal studies, thermal analysis concepts, available analytical methods for temperature calculation, data collection, temperature analysis, cracking analysis, documentation of thermal analysis, limitations of thermal analysis, and references. Annex 1 presents current practice for determination of concrete tensile strain capacity for use in cracking analysis. Annex 2 provides a stepwise procedure for simple, Level 1 thermal analysis, including an example. Annex 3 provides a procedure for more intensive Level 2 thermal analysis, including an example using simple finite element (FE), one-dimensional (1-D) strip models and an example using more complex two-dimensional (2-D), FE methodology.

b. Purpose. MCS are constructed using the principles and methods defined for mass concrete by American Concrete Institute (ACI) Committee 207, and Engineer Manual (EM) 1110-2-2000. There are three types of MCS commonly used for civil works projects. Gravity structures are used for dams and lock walls; thick shell structures are used for arch dams; and thick, reinforced plate structures are used for U-frame locks, large pumping stations, powerhouses, large foundations, and massive bridge piers. Arch dam thermal analysis is described in detail in EM 1110-2-2201, which contains specific procedures and considerations that may require a Level 3 nonlinear incremental structural analysis (NISA) analysis.

(1) Thermal analysis considerations. A thermal analysis should account for the environmental conditions at the site, the geometry of the structure, the behavior properties of plain or reinforced concrete members, construction conditions, and should provide a basis for comparing thermal generated strain in the structure with strain capacity of the concrete. An analysis may also need to account for the nonlinear behavior of the concrete members, the interaction of the structure, foundation, and backfill, and the effects of sequential construction, thermal gradients, and other loadings on the structure. Very accurate prediction of temperature distribution, resulting strain and stress, and the prediction of cracking in mass concrete is often difficult, if not impossible, due to the complexity of conditions and the many uncertainties in materials, properties, and construction conditions. However, the information, tools, and methods for thermal analysis described in this document provide a basis for thermal analysis that is sufficiently accurate for sound engineering purposes.

(2) Thermal cracking. While cracking is inherent and of little consequence in some concrete structures, other structures may require a relatively uncracked monolithic condition to function as designed. Subsequent cracking, in the latter case, may render such a structure unstable under design conditions or may allow unnecessary or damaging seepage of water. Cracking in some MCS may increase deterioration rates, the results of which, while not structurally damaging, may introduce significant increases in long-term maintenance or repair costs. In many structures with high public visibility, control of cracking may also be desirable for esthetic reasons.

(3) Thermal analysis objectives. A thermal analysis is necessary and cost effective to attain any of the following design objectives:

- To develop materials and structural and construction procedure requirements for use in feasibility evaluation, design, cost engineering, specifications, and construction of new MCS. Thermal studies provide a rational basis for specifying construction

requirements. A thermal study provides a guide for formulating advantageous design features, optimizing concrete mixture proportions, and implementing necessary construction requirements.

- To provide cost savings by revising the structural configuration, material requirements, or construction sequence. Construction requirements for concrete placement temperature, mixture proportions, placement rates, insulation requirements, and schedule constraints that are based on arbitrarily selected parameters can create costly operations. Cost savings may be achieved through items such as eliminating unnecessary joints, allowing increased placing temperatures, increased lift heights, and reduced insulation requirements.

- To develop structures with improved performance where existing similar structures have exhibited unsatisfactory behavior (such as extensive cracking) during construction or operation. Cracking which requires remedial repairs would be considered unsatisfactory behavior. Cracking which does not affect the overall structural behavior or some function of the structure would not be classified as unsatisfactory behavior.

- To more accurately predict behavior of unprecedented structures for which limited experience is available, such as structures with unusual structural configuration, extreme loadings, unusual construction constraints, or severe operational requirements.

(4) Counteracting thermal cracking. Provisions to counteract predicted thermal cracking are discussed in ACI 207 documents, and typically include:

- Changes in construction procedures, including placing times and temperatures.

- Changes in concrete materials and thermal properties.

- Precooling of concrete materials and controls on concrete placement temperature.

- Postcooling of concrete.

- Construction of joints (with waterstops where necessary) to control location of cracks.

- Construction of water barrier membranes to prevent water from entering cracks.

- Alteration of structure geometry to avoid or control cracking.

- Use and careful removal of insulation.

c. Project design process. A thermal analysis should be performed as early in the design process as possible, but it is preferable that the actual performance of a thermal analysis not take place until test data are available which will typically occur during the preconstruction engineering and design (PED) phase. EM 1110-2-2201 provides project design process considerations for Arch Dams.

(1) Project feasibility. Early in the feasibility phase of project design, the need to perform a thermal analysis should be evaluated, based on the objectives stated above. Any potential construction savings, historical problems related to structural behavior, or special unprecedented structural features should be identified. Proposed solutions requiring thermal analysis should be presented, and the necessary design studies along with their associated costs and schedule should be included in the Project Management Plan as described in Engineer Regulation (ER) 1110-2-1150. A thermal analysis more complex than Level 1 should be performed during the feasibility phase only for very significant or unprecedented structures, and/or those with requirements for unusual construction procedures, and when it has been determined that these factors will significantly affect project costs. A Level 1 thermal analysis during the feasibility phase is primarily to provide insight and information as to whether or not design features and construction requirements for the structure are viable.

(2) PED. The initial investigations needed to verify the potential cost savings, functional improvements, or predicted behavior should be performed in the early stages of the PED. The thermal analysis should include project specific material properties based on test data if appropriate. Initial analyses should be used to investigate 1-D portions of the structure. These analyses should be used to evaluate the need for more advanced thermal analysis, as well as the potential changes needed in design, material properties, or construction parameters.

d. Thermal analysis concepts. Mass Concrete is defined by ACI as "any volume of concrete with dimensions large enough to require that measures be taken to cope with generation of heat from hydration of the cement and attendant volume change to minimize cracking." When portland cement combines with water, the ensuing exothermic (heat-releasing) chemical reaction causes a temperature rise in the concrete mass. The actual temperature rise in an MCS depends upon the heat-generating characteristics of the mass concrete mixture, its thermal properties, environmental conditions, geometry of the MCS, and construction conditions. Usually the peak temperature is reached in a few days to weeks after placement, followed by a slow reduction in temperature. Over a period of several months to several years, the mass eventually cools to some stable temperature, or a stable temperature cycle for thinner structures. A change in volume occurs in the MCS proportional to the temperature change and the coefficient of thermal expansion of the concrete. If volume change is restrained during cooling of the mass, by either the foundation, the previously placed concrete, or the exterior surfaces, sufficient tensile strain can develop to cause cracking. Cracking generally occurs in the main body or at the surface of the MCS. These two principal cracking phenomenons are termed mass gradient and surface gradient cracking, respectively. ACI 207.1R, contains detailed information on heat generation, volume change, restraint, and cracking in mass concrete.

A-2. General Process, Analysis, and Coordination for Thermal Studies

a. Process. The thermal study process at any level consists of several steps which are summarized in Table A-1. These steps are similar for all levels of analysis. The steps can be subdivided amongst three general tasks: data collection, temperature analysis, and cracking analysis. The specific efforts within each of these tasks can vary considerably, depending upon the level of analysis selected for the thermal study. Data collection includes those steps that provide input data and preparation of input for subsequent analysis tasks. Data collection may include information retrieval and testing. Temperature analysis generates the temperatures or temperature histories for the MCS, which are possible scenarios of thermal loadings during construction and subsequent cooling. Cracking evaluation uses temperature data from the temperature analysis, other sources of loading, material properties, concrete/ foundation interaction, geometry, construction parameters, etc., to compute strains and evaluate the potential for cracking in the MCS. This process is directly applicable for evaluating mass gradient and surface gradient cracking for thermal studies (Levels 1 and 2) and for advanced FE thermal studies such as NISA (Level 3). At all levels of thermal analysis, parametric studies are an important part of thermal analysis and are used to assist the engineer in making proper decisions for design and construction.

b. Thermal analysis levels.

(1) Level 1 analysis. This type of analysis is the least complex. It is a simplified or "quick and dirty" methodology, using little or no laboratory testing, and incorporating broad assumptions for site conditions and placement constraints. The approach is to estimate the worst reasonable combination of material properties and site conditions, so that if conditions are acceptable, no further analysis is necessary. If conditions are not acceptable, then more accurate data and possibly a more detailed

Table A-1
Thermal Study Process

Data Collection	Temperature Analysis	Cracking Analysis
Levels 1-3	Levels 1-3	Levels 1 and 2
• Determine Ambient Conditions	• Prepare Temperature Model	• Determine Restraint
Climatological Conditions Foundation Temperature Water Temperatures Solar Radiation	Compute Surface Heat Transfer Coefficients and Other Boundary Conditions Establish Calculation Increments Prepare FE Model (mesh) or Prepare Step-By-Step Method (spreadsheet)	Compute Kf and Kr for: Mass Gradient Analysis Surface Gradient Analysis
• Determine Material Properties		• Determine Thermal Strains
Concrete Foundation		Strain = $(C_{tk})(\Delta T)(Kr)$ for: Mass Gradient Analysis Surface Gradient Analysis
• Determine Construction Parameters	• Compute Temperature Histories	• Estimate Cracking
Geometry/Lift Height Lift Placement Rate Concrete Placement Temperature Concrete Postcooling Construction Start Date(s) Formwork and Insulation Usage	Mass Gradient Analysis: Determine Peak and Ultimate Stable Temperatures Surface Gradient Analysis: Determine Temperature History at Surfaces Determine Depth of Tensile Zone for K_R	Mass Gradient Cracking: Use Mass Gradient Strain & Slow Load TSC Surface Gradient Cracking: Use Surface Gradient Strains & Age-Modified TSC
		Level 3 - NISA
		FE Method: ABAQUS w/ ANACAP-U
		• Conclusions & Recommendations

analysis are necessary. Temperature calculations are limited to simple determinations of peak concrete temperature based on summation of placement temperature and temperature rise produced by heat from the concrete mixture. Cooling from the peak temperature is assumed to progress to the ambient average annual temperature or a cyclic temperature range. Strain, length change, and cracking are computed based on temperature change in the MCS from peak to average ambient, using simple methods for determination of restraint. Other MCS loading conditions are evaluated separately from the thermal analysis at this level. A detailed description of a Level 1 thermal analysis using average monthly temperatures is shown in Annex 2.

(2) Level 2 analysis. Level 2 thermal analysis is characterized by a more rigorous determination of concrete temperature history in the structure and the use of a wide range of temperature analysis tools. Placement temperatures are usually determined based on ambient temperatures and anticipated material processing and handling measures. The temperature history of the concrete mass is approximated by using step-by-step iteration using the Schmidt or Carlson methods or by FE analysis using simple 1-D models, termed "strip" models, or using 2-D models representing cross sections of a structure. Evaluation of thermal cracking within the interior of an MCS, termed mass gradient cracking, and cracking at the surface of MCS, termed surface gradient cracking, are appropriate at this level. Detailed cracking evaluation of complex shapes or loading conditions other than thermal loads is not performed at this level.

(3) Level 3 analysis. Engineer Technical Letter (ETL) 1110-2-365 describes the computational methodology and application of Level 3 (NISA) analysis. ETL 1110-2-536 presents an example of NISA application to the Zintel Canyon Dam. NISA is performed using the FE method, exclusively, to compute incremental temperature histories, thermal stress-strain, stress-strain from other loading, and

cracking prediction results. Significant effort is necessary to collect environmental data, assess and implement applicable construction parameters, acquire foundation materials properties, determine appropriate construction scenarios, and perform testing required for thermal and nonlinear material properties input. Preparation of FE models and conducting temperature and thermal stress analyses which generate significant volumes of data are generally extensive and costly efforts.

c. Parametric studies. A parametric study is a rationally planned set of analyses used to gain a better understanding of thermal performance through the identification and understanding of the effects that critical parameters have on the structure. The effects of a parameter on the structure can be determined by varying that parameter in a set of analyses while holding the other parameters constant. Likely candidates for a parametric study are, but are not limited to, determination of the critical material properties, critical lift sequence or configuration, construction start time, insulation requirements, and placement temperatures. Results from single analyses within the parametric study should be interpreted separately to gain an understanding of the thermal response in each analysis. Then comparisons of results from each analysis in the parametric study can be made and the influence of each parameter identified. Once identified and documented, results and conclusions from parametric studies can be used in subsequent thermal analysis phases. For example, assume a goal of a current thermal study is to reduce construction costs through relaxing controls on concrete placement temperatures. A parametric study is devised, permitting only the lift placement temperature to vary. Results are analyzed, and the highest acceptable placement temperature is selected for subsequent use.

d. Coordination. A design team consisting of structural, materials, geotechnical, cost, and construction engineers should be established prior to performing a thermal analysis. Interdisciplinary coordination is essential to ensure that the analysis is based on reliable concrete and foundation properties and realistic construction techniques. The structural, materials, and construction engineers should predict an appropriate set of construction conditions (e.g., time between lifts, lift heights, type of formwork, formwork removal, construction start date, insulation requirements, etc.) which will approximate actual field conditions and which can be adequately modeled. Concrete properties should be provided for the proposed concrete mixtures by the materials engineer. The structural and geotechnical engineer should develop appropriate foundation material properties. The engineer should obtain the monthly average ambient air temperatures and other climatological information. The engineer must ensure that the specified parameters are properly modeled for the numerical analysis. The engineer performing the thermal analysis may be the materials engineer or the structural engineer, depending on the structure and expertise available in the design organization.

A-3. Data Collection

a. General. Data collection for the thermal analysis includes acquiring information on ambient weather conditions, concrete properties, foundation properties, and construction parameters. The following are descriptions of these data requirements. Data needs and acquisition costs should always be measured against the level of thermal analysis and requirements of the analysis.

b. Ambient environmental conditions. Environmental parameters, including air temperatures, wind, impounded water, and solar radiation can affect cracking in mass concrete.

(1) Climatological conditions. The ambient temperature conditions and variations from ambient temperature during the course of a year at a construction site will affect the need and extent of temperature controls implemented to reduce thermal cracking. The effects of the annual ambient temperature cycle on placement temperatures, short-term and long-term cooling rates, foundation temperatures, and potential starting dates for construction must be considered. Weather data can be acquired from National Oceanic and Atmospheric Administration (NOAA) summaries, from airport or other local weather stations, or from project weather

stations. NOAA data are available on average daily, monthly, and annual temperatures, maximum and minimum daily and monthly average temperatures, humidity, precipitation, and wind velocity. Ambient temperature data will also be used in the computation of concrete placement temperatures. Depending on the project site location, site weather conditions may depart significantly from even local weather stations, necessitating some judgement in weather data usage, and/or some project collection of site-specific data. Adjustments of data from the nearest recording stations to the site can be used to estimate site temperatures. For every 76 m (250 ft) of elevation increase, there is about a 0.5-deg C (1 deg F) decrease in temperature. To account for a positive 1.4-deg lattitude change, temperatures can be reduced 0.5 deg C (1 deg F). Temperature cycles used in thermal analysis may include:

- *A normal annual temperature cycle* is a sinusoidal-like variation of temperatures for a locale obtained from multiyear daily average temperatures.

- An *extreme ambient temperature cycle* can also be used. The extreme ambient temperature cycle can be developed as a sine wave with a 1-year period which captures the coldest and hottest of the extreme monthly average temperatures. The extreme ambient temperature is used to account for the possibility of seasons (months) having much higher or lower temperatures than the average ambient conditions based on multiyear averages.

- *Daily temperature cycles* may be used in areas where daily temperature variation can be 28 deg C (50 deg F) or more. Extreme daily temperature variation can cause significant surface temperature gradients.

The effects of cold fronts may cause significant cracking within an MCS and should be considered when evaluating the MCS. This winter protection evaluation is required mainly to assess the need, duration, and R-value for possible insulation of the structure. Cold fronts have not been commonly included in thermal studies due to their sporadic and unpredictable occurrences. Yet, they do occur and are commonly the cause of cracking during construction. The design team must use the thermal analysis results coupled with experience and engineering judgement to develop the final requirements for insulation during construction.

(2) Water temperatures. The presence of impounded water is generally not necessary in thermal studies, because water impoundment generally occurs long after construction. When needed for unusual analyses, the temperature of the water can be assumed to have an annual variation and may have little variation with great depth. Nearby similar projects are the best source of data.

(3) Solar radiation. The effects of solar radiation during and following construction have often been ignored in thermal analyses. Some thermal analyses have incorporated an increase in ambient temperature of 0.5 to 1.0 deg C (1 to 2 deg F) to account for solar radiation heating of concrete surfaces during construction. EM 1110-2-2201 and ACI 207.1R provide charts allowing approximate estimates of solar radiation effects. Due to the approximate nature of Level 1 analyses, solar radiation should be ignored for Level 1 analysis.

c. Concrete properties. Concrete thermal, mechanical, and physical properties needed for thermal analysis are defined and discussed below. These concrete properties are dependent upon the materials used and upon the proportions of these materials in the concrete mixture. Many of these properties are time- and temperature-dependent. Some of the properties will be determined by laboratory testing and some will be assigned by the engineers. Properties that are determined in laboratory tests should be representative of concrete mixtures containing project specific materials. The test data should be included in the concrete materials documentation. When testing of actual concrete mixtures is not possible, data can be acquired from published data in ACI documents, technical publications, and engineering handbooks, and from prior laboratory testing. Consultation with materials engineers is essential for determining all of the following properties. Variations in material properties due to scatter of test data, differences in behavior of

the material between actual and that predicted by the numerical model, and expected differences between the laboratory mixture and the actual mixture used during construction can be accounted for by performing parametric studies using combinations of the upper and lower bound values of critical properties. Drying shrinkage is generally ignored for analysis of thermal cracking, except for possible application to surface gradient cracking. Test methods identified as ASTM are American Society for Testing and Materials, Philadelphia, PA, methods. Test methods identified as CRD-C (Concrete Research Division-Concrete) are Corps of Engineers methods found in the Handbook for Concrete and Cement published by the U.S. Army Engineer Waterways Experiment Station (WES) (1949). Test methods identified as RTH (Rock Testing Handbook) are Corps of Engineers methods found in the Rock Testing Handbook (USAEWES 1990). Concrete materials and properties are discussed in EM 1110-2-2000, EM 1110-2-2200, EM 1110-2-2201, and ACI Committee 207 documents.

(1) Concrete thermal properties. ACI reports 207.1R, 207.4R, and 207.5R, many WES published thermal studies, and others listed in the related references provide a wide range of laboratory determined concrete thermal properties.

(a) Adiabatic temperature rise (T_{ad}). An adiabatic system is a system in which heat is neither allowed to enter or leave. The adiabatic temperature rise, therefore, is the change in temperature in concrete due to heat of hydration of cement under adiabatic conditions. It is the measure of heat evolution of the concrete mixture in a thermal analysis. In very large masses of concrete, temperatures near the center of the mass will peak near the sum of the placement temperature and the adiabatic temperature rise. Nearer the surface of the placement, the peak temperature will be lower and will be near ambient air temperature. The magnitude of the adiabatic temperature rise and the shape of the curve can vary significantly for different concrete mixtures. Adiabatic temperature rise is determined according to CRD-C 38 (USAEWES 1949). If testing is conducted, generally only for large projects, the concrete mixture tested should be representative of the mixture proportions and constituent materials that will be used for the project. The placement temperature for the test should represent the temperature at which the bulk of concrete is likely to be placed for the MCS. Typical values for adiabatic temperature rise for mass concrete range from 11 to 19 deg C (20 to 35 deg F) at 5 days to 17 to 25 deg C (30 to 45 deg F) at 28 days. For projects where adiabatic temperature rise tests can not be justified, generic adiabatic temperature rise curves in ACI 207.1R can be used. These curves can also be used to develop parametric adiabatic temperature rise curves for use in thermal analysis.

(b) Specific heat (c). Specific heat is the amount of heat required per unit mass to cause a unit rise of temperature. It is affected by temperature changes but should be assumed to be constant for the range of temperatures in MCS. Specific heat is determined according to CRD-C 124 (WES 1949). For mass concrete mixtures, specific heat is not substantially affected by age. Typical values for specific heat of mass concrete range from 0.75 kJ/kg-K (0.18 to 0.28 Btu/lb-deg F).

(c) Thermal diffusivity (h^2). Thermal diffusivity is a measure of the rate at which temperature change can occur in a material and is the thermal conductivity divided by the product of specific heat and unit weight. It is determined according to CRD-C 36 (WES 1949) for concrete with up to 75-mm (3-in.) nominal maximum aggregate size and CRD-C 37 (WES 1949) for concrete with larger nominal maximum aggregate size and is usually conducted between ages of 7 and 28 days. For mass concrete, thermal diffusivity is not substantially affected by temperature or age. Diffusivity is influenced by aggregate type and concrete density. Diffusivity is directly input to the Carlson and Schmidt methods. Thermal diffusivity is used to calculate thermal conductivity used for FE analysis. Typical values for thermal diffusivity of mass concrete range from 0.003 to 0.006 m^2/hr (0.03 to 0.06 ft^2/hr).

(d) Thermal conductivity (K). Thermal conductivity is a measure of the ability of the concrete to conduct heat and is defined as the rate at which heat is transmitted through a material of unit area and thickness when there is a unit difference in

temperature between the two faces. For concrete, thermal conductivity is calculated from the product of thermal diffusivity, specific heat, and density according to CRD-C 44 (WES 1949). Thermal conductivity of mass concrete is not significantly affected by age or by changes in temperature over typical ambient temperature ranges but is influenced by aggregate type. Typical values for thermal conductivity of mass concrete range from 1.73 to 3.46 W/m-K (1 to 2 Btu/ft-hr-deg F).

(2) Concrete mechanical and physical properties. Tests and descriptions of concrete mechanical and physical properties used in thermal studies are described below. Test programs to develop these data can be relatively expensive. Modulus of elasticity, creep, and, to some degree, tensile strain capacity are difficult to estimate without testing. When laboratory tests cannot be performed, the best approach is to use results of more easily performed laboratory tests in conjunction with published information for similar concrete materials and mixtures from other projects.

(a) Modulus of elasticity (E_c). The modulus of elasticity is defined as the ratio of normal stress to corresponding strain below the proportional limit. For practical purposes, only the deformation which occurs during loading is considered to contribute to the strain in calculating the instantaneous modulus of elasticity. Subsequent strain due to sustained loading is referred to as creep. The modulus of elasticity is a function of the degree of hydration and is time and strength dependent. The temperature dependence of the modulus of elasticity is negligible for the range of temperatures of concern in MCS and is ignored. The modulus of elasticity is determined according to CRD-C 19 (WES 1949), which is described as a "chord" modulus. Three other methods of modulus measurement are seen in the literature. Hence, for critical analyses, the engineer may need to determine which method has been used when using published data. Generally, the differences between the methods is small compared to the overall variations in material properties and uncertainties in thermal analysis. ACI formulas for the modulus are not based on mass concrete mixtures and are generally not accurate estimates of mass concrete modulus. To model the time dependency of the modulus of elasticity, tests should span the duration of analysis. Test ages of 1, 3, 7, 28, 90, 180, and possibly 365 days, as well as at the design age, may be considered. Modulus of elasticity of mass concrete is about 6.9 GPa (1×10^6 psi) at 1 day, and ranges from about 21 to 38 GPa (3 to 5.5×10^6 psi) at 28 days, and from about 30 to 47 GPa (4.3 to 6.8×10^6 psi) at 1 year. Tensile E_c is assumed to be equal to the compressive E_c. Sustained modulus of elasticity (E_{sus}) includes the results of creep and can be obtained directly from creep tests by dividing the sustained load on the test specimen by the total deformation. ACI 207.4R includes values of instantaneous and E_{sus}. E_{sus} for tests conducted on specimens loaded at early ages for a period of 1 year will be about one-half that of the instantaneous E_c. E_{sus} for tests conducted on specimens loaded at 90 days or later ages for a period of 1 year will be a slightly higher percentage of the instantaneous E_c. Early age creep information is more important for thermal studies.

(b) Creep. Creep is defined as time-dependent deformation (strain) due to sustained load. Specific creep is creep under unit stress or strain per MPa (psi). Creep results in an increase in strain, but at a continually decreasing rate, under a state of constant stress. Creep is closely related to the modulus of elasticity and compressive strength of the concrete and is thus a function of the age of the concrete at loading. Concrete with a high modulus of elasticity will generally have relatively low creep. Creep is determined according to CRD-C 54 (WES 1949). Creep tests for mass concrete should always be conducted with sealed specimens. So called "drying creep" testing is not appropriate for mass concrete. The test method recommends five ages of loading between 2 days and 1 year to fully define creep behavior. For Level 2 FE thermal analysis, creep data are generally used only in surface gradient analysis, thus, loading ages should span the time during which surface gradients are developing. Loading ages of 1, 3, and 14 days are generally adequate. Creep is not generally used in Level 1 thermal analysis. The effects of creep can be considered by using the sustained modulus of elasticity of the concrete measured during the period of surface gradient development.

(c) Tensile strain capacity (ϵ_{tc}). Tensile strain capacity is the change in length per unit length that can be sustained in concrete prior to cracking. This property is used with the results of temperture analysis to determine whether an MCS will crack and the extent of cracking. Tensile strain capacity is discussed in detail in Annex 1. Tensile strain capacity is time-and rate-of-loading dependent and is strongly dependent on strength. Tensile strain capacity tests are conducted on large concrete beams instrumented to measure strain to failure for strain-based cracking analysis. Tensile strain capacity is determined according to CRD-C 71 (WES 1949).

(d) Tensile strength (F_t). Tensile strength may be used with the results of stress-based thermal analysis to determine if cracking is probable in an MCS. ACI 207.2R discusses tensile strength in some detail. Tensile strength can be measured by several methods, including the splitting tensile method (CRD-C 77 (WES 1949)), direct tension (CRD-C 164 (WES 1949)), and by the flexural test or modulus of rupture method (CRD-C 16 (WES 1949)). The splitting tensile test is more commonly run for mass concrete, due to the simplicity of the test, and because it can be less sensitive to drying than other tests. All tensile strength tests are age dependent, load rate dependent, and moisture content dependent. Prediction of tensile strength based on compressive strength is generally not particularly reliable. For preliminary thermal analysis, the split tensile strength relationship to compressive strength is discussed in ACI 207.2R.

(e) Coefficient of thermal expansion (C_{th}). The coefficient of thermal expansion is the change in linear dimension per unit length divided by the temperature change. The coefficient of thermal expansion is determined according to CRD-C 39 (WES 1949). The value of this property is strongly influenced by the type and quantity of coarse aggregate in the mixture and is not dependent on age or strength. Typical values for the coefficient of thermal expansion for mass concrete range from 5 to 14 millionths/deg C (3 to 8 millionths/ deg F).

(f) Autogenous volume change. Autogenous volume change, commonly called "autogenous shrinkage," is a decrease in volume of the concrete due to hydration of the cementitious materials without the concrete gaining or loosing moisture. This type of volume change occurs in the interior of a large mass of concrete and can be a significant factor. Autogenous shrinkage occurs over a much longer time than drying shrinkage, the shrinkage due to moisture loss that affects only thinner concrete members or a relatively thin layer of the mass concrete near the surface. Although no specific test method exists, autogenous shrinkage can be determined on sealed creep cylinder specimens with no load applied in accordance with CRD-C 54 (WES 1949).

(g) Density (ρ). Density is defined as mass-per-unit volume. It is determined according to CRD-C 23 (WES 1949). Typical values of density for mass concrete range from 2,240 to 2,560 kg/m^3 (140 to 160 lb/ft^3).

d. Foundation properties. The thermal, mechanical, and physical properties of the foundation are dependent on the type of soil or rock, the moisture content, and any discontinuities in the foundation. In situ properties may vary significantly from those obtained from laboratory testing of small samples obtained from borings or test pits. Rock may exhibit anisotropic properties. Exact thermal properties are seldom necessary for the foundation materials, and adequate values for use in a thermal analysis may be obtained from Jumikis (1977) or Kersten (1949). Likewise, exact mechanical properties are not required, and adequate values can be estimated from foundation test data or from Hunt (1986). The structural and geotechnical engineers should jointly select foundation properties based on any in situ properties available and varied based on information from the above referenced texts and past experience.

(1) Thermal properties of foundation rock.

(a) Specific heat (c_{fdn}). Specific heat varies within a narrow range of values. Specific heat for

soil foundations ranges from 0.80 kJ/kg-K (0.19 Btu/lb-deg F) for sand to 0.92 kJ/kg-K (0.22 Btu/lb-deg F) for clay. Specific heat for foundation rock generally ranges from 0.80 to 1.00 kJ/kg-K (0.19 to 0.24 Btu/lb-deg F). Specific heat can be determined according to CRD-C 124 (WES 1949).

(b) Thermal conductivity (K_{fdn}). The thermal conductivity of the foundation material is affected by density and moisture content and the degree of jointing and fracture in rock. The thermal conductivity of foundation materials may range from 4.15 W/m-K (2.4 Btu/ft-hr-deg F) for clay, to 4.85 W/mm-K (2.8 Btu/ft-hr-deg F) for sand, to 5.19 W/m-K (3.0 Btu/ft-hr-deg F) for gravel, and can range from 1.73 to 6.23 W/m-K (1 to 3.6 Btu/ft-hr-deg F) for rock. Thermal conductivity can be determined according to one of several applicable ASTM procedures.

(c) Diffusivity (h^2). Diffusivity of the foundation is direct input to the Carlson and Schmidt step-by-step temperature analysis methods and is sometimes assumed equal to the concrete diffusivity for simplicity. Diffusivity is influenced by material type, rock type, and density. Typical values for thermal diffusivity of rock range from 0.003 to 0.006 m^2/hr (0.03 to 0.06 ft^2/hr). Rock diffusivity can be determined according to CRD-C 36 (WES 1949), or may be calculated according to CRD-C 158 (WES 1949), using test values of thermal conductivity, specific heat, and density.

(2) Mechanical and physical properties of foundation rock.

(a) Modulus of elasticity (E_{fdn}). The modulus of elasticity of foundation materials varies greatly with the grain size, moisture content, and degree of consolidation for soil, and with the degree of jointing and fracture of a rock foundation. Adequate values can be estimated by the geotechnical engineer. Values for foundation rock can be determined by ASTM D 3148; typical values from intact small specimens range from 28 to 48 GPa (4 to 7 × 10^6 psi) for granite and between 14 to 41 GPa (2 to 6 × 10^6 psi) for limestone.

(b) Coefficient of thermal expansion ($C_{th\text{-}fdn}$). The coefficient of thermal expansion for soil foundations is not needed for thermal analysis. The coefficient of thermal expansion for rock foundations can be determined according to ASTM D 4535. The coefficient can vary widely based on rock type; typical values can be found in the references. Measurements have been recorded ranging from 0.9 to 16 millionths/deg C (0.5 to 8.9 millionths/deg F).

(c) Density and moisture content. The density and moisture content of the foundation material must be determined by the geotechnical engineer.

(d) Initial temperature. For Levels 1 and 2 thermal analyses, the initial temperatures for the foundation may be assumed to be at the annual average temperature at the site.

e. *Construction parameters*. Differences in the way an MCS is constructed will impact the behavior of the structure significantly. The response of the structure to changes of the construction parameters in the analysis will often dictate whether or not cost reducing measures can be taken in the field. Construction parameters can also be varied in an attempt to improve the performance of a structure. The paragraphs below describe the primary construction parameters that can be considered for changes during the thermal analysis for accomplishing cost reductions or improved behavior. Values for the following parameters, depending on the level of thermal analysis, must be selected by the design team prior to the initial analysis. The requirements for construction parameters in a Level 1 analysis are minimal. Levels 2 and 3 thermal analyses depend on specific data regarding the construction operation.

(1) Geometry. The geometry of the structure is a major factor in the thermal behavior of the structure. This information includes section thickness, monolith length, and location and size of section changes such as galleries or culverts. A Level 2 or 3 thermal analysis should not be performed until the structural geometry is at a stage where only minor changes to the geometry are expected. A change in

the geometry will generally require some type of revision to the temperature analysis model.

(2) Lift height. Since the heat escape from a mass is inversely proportional to the square of its least dimension and since the height of a lift will usually be the smallest dimension, the height of a lift can become an important factor in the thermal behavior of an MCS. Lift heights to be used in initial analyses will typically be selected by the engineer based on previous experience and practical limits. If the initial analyses indicate that the behavior of the structure is satisfactory, then analyses may be performed with increased lift heights as a measure for reducing cost. Likewise, if results indicate unacceptable behavior, a decrease in lift height may be considered to alleviate problems in the structure.

(3) Lift placement rate. The time between the placement of lifts has an effect on the thermal performance of the structure due to the insulating effect a new lift has on the previous lift(s). The time between placement of lifts must be included in the thermal analysis. Usually, shorter time intervals between lifts, i.e., higher placement rates, cause higher internal temperatures in an MCS. A 5-day interval between lift placements is typically assumed for traditional concrete. For RCC, the time interval will depend on the placing rate anticipated and the lift surface area, which often varies during construction. The longer the interval between placement of lifts, the longer each lift will have to dissipate the heat that has built up within the lift. When considering the aging characteristic of concrete, however, longer placement intervals may not be desirable, since the previous lift will be much stiffer than the new lift providing more restraint to the new lift. Lift placement interval can have an effect on the construction cost if the change increases the length of the contract.

(4) Concrete placement temperature. For many mass concrete structures, the temperature of the concrete at the time of placement is limited to control the temperature level within the mass due to the heat of hydration, as well as to control temperature at the MCS surface. Without control measures implemented, concrete placement temperature is a function of the annual ambient temperature cycle. In thermal analysis, the placement temperature is the starting point for concrete temperature rise. Placement temperatures are affected by concrete constituent materials temperatures, heat added or lost due to ambient conditions, and heat added or lost from material processing and handling. The placing temperature for the initial analysis should be established by the materials engineer. As with lift heights, if behavior is acceptable then consideration may be given to increasing the placing temperature. Increasing the allowable placing temperature can lead to cost savings due to decreased cooling requirements. EM 1110-2-2201 and ACI 207.4R contain information and guidance on precooling of mass concrete.

(5) Construction start date. The time of year when construction is started can have a significant effect on the MCS temperatures. The selection of start dates is structure and site dependent and should be evaluated by the design team based on past experience and engineering judgement. The objective in selection of start dates is to chose those among the possible start dates that may produce the worst conditions in the MCS. Usually a single start date is inadequate for identifying the worst conditions at most locations within the structure, especially since the structure is built in lifts over a significant period of time. Different start dates may yield temperature problems at different locations in the MCS. The start dates should be chosen to create the largest temperature gradients. Often a start date representing each of the four annual seasons is selected for preliminary analysis.

(6) Formwork. Removal times of formwork must be established for Levels 2 and 3 thermal analyses, because the insulating effects of formwork can significantly affect surface temperature gradients and surface cracking. This information is used to calculate the surface heat transfer coefficient, a thermal boundary condition for surface gradient thermal analysis.

(7) Insulation. Insulation of the concrete during cold weather may be necessary during construction and, if used, must be accounted for in the analysis. The time that insulation is in place and the amount

of insulation (the *R* value) to be used will depend on the project location and should be selected by the engineer for the initial analysis. Both of these parameters may be varied during subsequent analyses to achieve cost savings or to improve performance. The effects of insulation are included in the surface heat transfer coefficient calculations.

(8) Postcooling. Embedded cooling coils to control heat generation within an MCS have been used in some large gravity and arch dam projects, as well as some smaller specialized placements such as tunnel plugs (to shorten time for joint grouting), but have typically not been needed on navigation-type structures. Postcooling of mass concrete is very costly in terms of both installation and maintenance and has seldom been used in recent years. If placing temperatures have been reduced to their lower limit, lift heights have been reduced to a practical minimum, and temperatures within the structure remain excessive, then the addition of cooling coils may be considered. Because postcooling is so seldom used, it's use is not included in the thermal analysis procedures. Guidance on postcooling is provided in EM 1110-2-2201 and in ACI 207.1R.

(9) Reinforcement. Reinforcement is generally not used in the MCS being analysed for thermal concerns but may be used in smaller structures such as powerhouses and large foundations. Since excluding reinforcing from an analysis provides conservative results, initial analyses can be performed without the effects of reinforcement. The effects of reinforcing on resulting structural behavior are small, if no cracking occurs, but if cracking does develop, modeling of the reinforcement can be very beneficial for control of the cracking. ACI 207.2R provides information on thermal analysis and reinforcement.

(10) Roller-Compacted Concrete (RCC). Techniques and design of RCC structures are discussed in EM 1110-2-2006 and ETL 1110-2-343. Although concrete placement using RCC is fundamentally different than traditional mass concrete placement, similar construction parameters are used for thermal analysis, although the individual numbers may differ.

A-4. Analytical Methods For Temperature Calculation

All thermal studies require computation of temperature or temperature distribution changes in a structure. Depending upon the type and function of a structure, less rigorous thermal studies may be adequate for "acceptable" evaluation of thermal performance. Temperature calculation requirements for thermal studies may range from very simple to reasonably complex. ACI 207.1R discusses several approximate methods that are appropriate for simple evaluations. The Carlson (Carlson 1937) and Schmidt (Rawhouser 1945) methods are step-by-step integration techniques, adaptable to spreadsheet solutions on personal computers, that can be used for computing temperature gradients when 1-D heat flow and reasonably simple boundary conditions are assumed. FE programs for computing temperatures (Wilson 1968; Polivka and Wilson 1976; Hibbitt, Karlsson, and Sorensen 1994) are appropriate for thermal studies when aspects of the analysis exceed the capabilities of simpler methods or when application of the FE method is as easy to implement as the simple methods. The following are descriptions of the range of analytical methods that can be used for Levels 1 and 2 thermal analyses.

a. Simple maximum and final temperature calculations. This "quick and dirty" method is used to compute peak temperatures due to heat of hydration and final stable temperature in the MCS. Computation usually results in a conservative approximation of peak temperature. Peak temperature is simply the sum of the placing temperature and the adiabatic temperature rise of a concrete mixture less heat (+ or -) due to ambient conditions. The structure cools over a long period of time to a stable temperature dependent primarily on annual ambient air temperature. In small structures, internal temperatures may not stabilize at a single temperature but at a temperature cycle dependent upon the annual air temperature cycle. Computation of temperature variation in an MCS as a function of depth and ambient temperature cycle is discussed in ACI 207.1R. This method is appropriate for a Level 1 analysis and is described in Annex 2.

b. Heat dissipation methods. The time required for dissipation of heat and the resultant cooling of MCS can be calculated by the use of heat loss charts or by simple computation as described in ACI 207.1R for solid bodies, such as slabs, cylinders, and spheres. These charts provide an approximate method of calculating the time for the concrete to cool from a peak temperature to some stable temperature. Peak concrete temperature must be determined using other means. Strain and resultant cracking analysis must also be performed by other methods. These heat dissipation methods can be of use in Level 1 analyses.

c. Step-by-step integration methods.

(1) Carlson method. The Carlson method is a step-by-step integration method for determining temperature distribution in a concrete structure. Carlson (1937)(Department of the Interior, U.S. Bureau of Reclamation (USBR) 1965) provides detailed discussions for implementing this method. It is readily adapted to modern computer spreadsheet computations and provides reasonable approximations of temperature distributions in simple structures. Properly applied, this method permits modeling of incremental construction, heat flow between dissimilar materials such as foundations and concrete, and adiabatic temperature rise of concrete. This method can be used in Level 2 analysis.

(2) Schmidt method. The Schmidt or Schmidt-Binder method is one of the earliest computation methods for incrementally determining temperature distributions in a structure. Rawhouser (1945), ACI 207.1R, and USBR (1965) provide comprehensive and illustrated discussions of the method. Although most easily adapted for 1-D heat flow, the simplicity of this method permits adaptation to 2-D and three-dimensional (3-D) thermal analysis. Because of the iterative approach, the method is time-consuming when performed manually. Especially when used in 1-D analyses, this method is easily adapted to modern computer spreadsheet computations. This method also provides for incorporating internally generated heat into the process. The Schmidt Method can be used in Level 2 analyses.

d. FE methods. An FE analysis can be described as a numerical technique for the determination of temperature distribution or stress analysis in which structures are mathematically represented by a finite number of separate elements, interconnected at a finite number of points called nodes, where behavior is governed by mathematical relationships. All the boundary conditions are then applied to the model, including material thermal properties, ambient conditions, and construction schedule. The model is run, and a temperature history for the model is generated. Temperature is calculated for specified times for each node. The FE method is the preferred methodology for computing temperatures in mass concrete structures. Information on building a data file to run an FE analysis must be obtained from manuals provided by the developer of the FE code being used. To use the FE method, an FE model must first be prepared. The model is divided into a grid of finite elements in which element boundaries coincide with material interfaces, lift interfaces, and structural boundaries. Generally, smaller elements are used in areas of greatest thermal gradient. The methodology permits detailed modeling of virtually all applicable parameters. Few FE programs have been written to compute temperature histories modeling incremental construction of MCS. Few, if any, programs have been written to model solar gain on lift surfaces. ETL 1110-2-332 and ETL 1110-2-254 provide guidance on FE analysis.

(1) One of the earliest FE temperature analysis computer programs was developed by Wilson (Wilson 1968) for the U.S. Army Engineer District, Walla Walla, followed by an improved version (Polivka and Wilson 1976). Temperature histories using such programs have compared very favorably with actual measured temperatures. These programs were written to support incremental construction thermal analysis, and they are reasonably easy for new users familiar with FE analysis to implement.

(2) More recently, the U.S. Army Corps of Engineers has developed user-defined subroutines to supplement ABAQUS (Hibbitt, Karlsson, and Sorensen 1994), a modern, general-purpose FE program. ABAQUS is used with associated user-supplied subroutines DFLUX and HETVAL for modeling heat generation in incremental construction thermal analyses, with user subroutine UMAT, or with the ANACAP-U subroutine to implement a time-dependent material/cracking model for thermal stress analysis of MCS. ABAQUS has been used to perform Level 3 NISA and is the basis for ETL 1110-2-365. ABAQUS can also be readily used for performing temperature calculations for Level 2 analyses, especially by experienced ABAQUS users. This program requires a high level of computer experience and expertise, as well as an advanced computer.

A-5. Temperature Analysis

a. General. This section provides general methodology for MCS temperature analyses conducted at Levels 1 and 2, once objectives have been developed, input data has been collected, a parametric analysis plan has been prepared for the temperature analysis, and a method of temperature analysis has been selected. Since the FE method is widely used for determination of temperature distribution histories in thermal analyses of MCS, a description of required FE thermal model development is also presented. The information is generic in that it is not directed for use by a specific FE program.

b. Levels and methods of temperature analysis. Methods of temperature analysis for each level of analysis are described below.

(1) Level 1 temperature analysis.

(a) Simplified peak temperature analysis. Temperature analysis at this level involves only very basic hand calculations to determine approximate peak temperature and ultimate operating temperature of the MCS. Peak temperature is the sum of the placing temperature and the adiabatic temperature rise of a concrete mixture and a correction for heat lost or gained due to ambient conditions. Peak temperature in most MCS is higher than the average ambient temperature. Thus, the structure cools over a long period of time to a stable temperature equal to the average ambient air temperature. This very simple analysis usually estimates temperatures higher than actual peak temperatures. The exception may be for very hot climates where the peak temperature may be higher than estimated. For small or relatively thin structures, internal temperatures can be assumed to stabilize at an average annual temperature cycle. Computation of temperature variation in smaller MCS as a function of depth and ambient temperature cycle is discussed in ACI 207.1R, including a figure for determining temperature variation with depth. A step-by-step procedure and example of this level of analysis is included in Annex 2.

(b) Heat dissipation methods. Using the above type of peak temperature analysis, simple computations or heat loss charts may be used to evaluate the time required to cool simple mass concrete structures from the peak temperature. The use of heat loss charts is described in detail in ACI 207.1R.

(2) Level 2 temperature analysis. Temperature analyses for Level 2 thermal studies may be implemented in two types of analytical methods, namely, step-by-step integration methods or FE methods.

(a) Step-by-step temperature integration methods. The Carlson (Carlson 1937)(USBR 1965) and Schmidt (USBR 1965) methods of temperature analysis are tabular methods of computing approximate temperature distribution in a structure that can be adapted to modern computer spreadsheets. These similar methods provide temperature distributions that are sufficiently accurate for many noncomplex structures. The methods are limited to temperature distribution; other methods must be used to determine cracking as a result of the temperature distribution. Field measurements have confirmed the validity of these methods for simple structures. The methods divide the concrete into "space intervals," computing the temperature after the completion of one time interval, then computing another temperature after the next time interval, and so on. Time and space intervals are chosen to meet certain criteria, ensuring validity of model

assumptions. Using tabular techniques, the tables essentially solve a large number of simultaneous equations, resulting in progressive temperature distribution. The computations require the structure dimensions, ambient temperature, the temperature distribution at some initial time, the material diffusivity, and the adiabatic temperature rise. The methods will accomodate the presence of forms and insulation, if desired. These methods can be used effectively for parametric analysis of thermal conditions. Although these methods are effective temperature analysis techniques for structures with simple geometry and conditions, current FE analysis computer software often allows development of FE temperature analysis with about the same level of effort to perform a step-by-step analysis.

(b) FE models. Due to the ease in creating and using FE models for temperature analysis, FE methodology is preferred for a Level 2 thermal analysis and is required for a Level 3 analysis. Level 3 temperature analysis is NISA, described previously, and is not covered further in this document. Even when 2-D or 3-D FE analysis is used for the final thermal analysis, 1-D FE analysis can be a productive screening tool for parametric analyses.

- 1-D strip models. In many larger structures, a model consisting of a "strip" or "line" of elements oriented within the transverse section of a monolith can be used to provide reasonably accurate temperature distributions without complete modeling of the section. The strip is a 1-D heat flow representation. The strip may represent the vertical temperature distribution that models incremental construction used in mass gradient cracking analysis. Horizontal strips produce temperature distributions that may be used to evaluate temperatures for surface gradient cracking. The Schmidt and Carlson Methods may be implemented for these calculations, if a desk-top computer and spreadsheet software are available. Otherwise, an FE code which employs or can be adapted for incremental construction capability is recommended. The FE method provides the best modeling of construction parameters and boundary conditions characteristic of mass concrete construction. A step-by-step procedure and example of this level and type of analysis is included in Annex 3.

- 2-D full-section models. Thermal analysis with full-section models must be performed with one of the FE programs which employs or can be adapted for incremental construction capability. A 2-D, FE model representing 2-D heat flow in an appropriate section(s) of a monolith is used. More complex structure geometry, materials properties, construction parameters, and boundary conditions are used in these analyses. The results of a Level 2 full-section 2-D temperature analysis are temperature distributions in the entire plane of the monolith that was modeled. These data are used as the basis for more refined mass gradient and surface gradient analyses anywhere in the model. A step-by-step procedure and example of this level and type of analysis is included in Annex 3.

- 3-D-full section models. These more complex FE models can be used for MCS with complex geometry and may develop into NISA models.

c. FE thermal analysis considerations. Information on developing FE temperature analysis models follows.

(1) FE mesh. Conventional FE modeling techniques apply to most temperature analyses. The meshes comprising the model should be adequately fine to describe 1-D or 2-D heat flow appropriate for 1-D strip or 2-D full-section analysis. ETL 1110-2-332 provides relevant information for modeling MCS for FE analysis. A 1-D strip mesh for vertical temperature distribution and a 2-D full-section mesh must both account for incremental construction by lifts. The meshes should include a depth of foundation so that the lowest elevation remains at the constant foundation temperature for the locale. This is usually 2 to 9 m (10 to 30 ft) depending upon the thermal conductivity of the foundation and size of the structure. Horizontal

strip meshes entirely contained in one lift usually extend from the surface to the middle of the monolith. Lift boundaries and boundaries between different concrete mixtures or other materials must only exist at element boundaries. Various programs are available that may be used to provide preprocessing capabilities in developing a mesh. If a decision is made to use a preprocessor, users should select a preprocessor which is fully compatible with the FE program and with which they are familiar or feel they can learn easily. Element aspect ratios should follow ETL 1110-2-365 recommendations, and element size will generally depend on geometry and temperature gradients. Time increments must be small enough to capture early age temperature changes that occur more rapidly than later cooling, with 0.25 day often used.

(2) Surface heat transfer coefficients. Surface heat transfer coefficients (film coefficients) are applied to all exposed surfaces to represent the convection heat transfer effect between a fluid (air or water) and a concrete surface, in addition to the conduction effects of formwork and insulation. The following equations are taken from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) (1977). These equations may be used for computing the surface heat transfer coefficients to be included in any of the FE codes for modeling convection.

(a) For surfaces without forms, the coefficients should be computed based on the following:

for $V > 17.5$ *km/h* (10.9 *mph*):

$$h = aV^b \ W/m^2\text{-}K \ (\text{Btu/day-in.}^2\text{-deg F}) \qquad \text{(A-1)}$$

for $V < 17.5$ *km/h* (10.9 *mph*):

$$h = c + d(V) \ W/m^2\text{-}K \ (\text{Btu/day-in.}^2\text{-deg F}) \qquad \text{(A-2)}$$

where

$a = 2.6362$ (0.1132)

$b = 0.8$ (0.8)

$c = 5.622$ (0.165)

$d = 1.086$ (0.0513)

h = surface heat transfer coefficient or film coefficient

V = wind velocity in km/h (mph)

The wind velocity may be based on monthly average wind velocities at the project site. Data can be obtained for a given location and then generalized over a period of several months for input into the analysis.

(b) If forms and insulation are in place, then the values for h computed in the equations above should be modified as follows:

$$h' = \frac{1}{\left(\frac{b}{k}\right)_{\text{formwork}} + \left(\frac{b}{k}\right)_{\text{insulation}} + \left(\frac{1}{h}\right)}$$

$$h' = \frac{1}{R_{\text{formwork}} + R_{\text{insulation}} + \left(\frac{1}{h}\right)} \qquad \text{(A-3)}$$

where

h' = revised surface heat transfer coefficient

b = thickness of formwork or insulation

k = conductivity of formwork or insulation

R_{formwork} = R value of formwork

$R_{\text{insulation}}$ = R value of insulation

(3) Foundation temperature stabilization. Foundation temperatures at the start of a vertical strip thermal analysis or a 2-D thermal analysis must be defined. The temperature distribution in the foundation for the start of concrete placement can be determined by performing a thermal analysis

on the foundation for an arbitrary time period up to 1 year immediately preceding the construction start date(s). The time period selected is usually a function of the depth of foundation in the model. During this analysis, the lower boundary of the foundation is fixed at the stable foundation temperature, usually mean, annual air temperature. The foundation surface is exposed to the normal, annual ambient temperature cycle. Appropriate adjustments should be made for possible surface thermal conditions during the analysis period, such as snow cover or very hot weather.

(4) Output interpretation. This section is intended to give insight into the various methods that have proven useful in presentation of analysis results. The engineer must sufficiently process results to comprehend the behavior of the structure and provide the necessary data (plots, diagrams, tables, etc.) to support cracking analysis and conclusions based on this understanding.

(a) Temperature contours. Temperature contours should be smooth throughout a lift and across lift interfaces. Temperature contours should never abruptly intersect free surfaces of the model where surface heat transfer coefficients are applied, except for locations where a very low coefficient is used to model an enclosed void. This indicates the application of an incorrect thermal boundary condition. Contour plots of temperature, stress, net strain, and/or crack potential are useful in selecting zones in the structure for more detailed investigation.

(b) Time-history plots. Time-history plots of temperature, stress, and strain results at a single location or multiple points across a section of significance are useful in showing the response of that location throughout the time of the analysis. These are useful in determining the critical material property combination when parametric analyses are performed. To assist reviewers and persons unfamiliar with the model, a locator section is often provided to show the location in the model where the results are presented. Selection of locations for presentation of time-history results may be determined from contour plots, the determination of locations of maximum values of results, or locations of particular interest. The latter may be places where similar structures have experienced problems, places where previous analyses have presented results, or places which help explain the overall response of the structure.

(c) Section plots. Plots of results (i.e., stress, temperature, net strain) across a specified section or location at a specific time are useful in determining the behavior of the section or location. Determination of the maximum value of a specific result (i.e., stress, strain) and its time of occurrence is useful in determining which section or location to plot and the corresponding time.

A-6. Cracking Analysis

a. General. The ability of concrete to resist thermal cracking is dependent on the magnitude of the thermal shrinkage or volume change, the degree of restraint imposed on the concrete, and the tensile strain capacity of the concrete. This section discusses restraint in MCS that leads to strain in the concrete mass or near the MCS surface and possible cracking if the tensile strain capacity of the concrete is exceeded. Strain due to other loading conditions oftens needs to be considered with thermal strain to evaluate cracking potential. The consequences of cracking may be structural instability, seepage, durability, and maintenance problems or may be relatively inconsequential, depending on the MCS design and function. Depending on the orientation of cracking, sliding or overturning stability of a structure may be impaired. Typically, transverse cracking in a gravity dam does not directly affect stability. However, such cracking may affect assumptions concerning uplift by allowing reservoir water under pressure into the interior of the dam along cracks and lift joints. Longitudinal or diagonal crack orientation can separate a dam into separate, unstable sections. Thermal shock, when warm mass concrete is suddenly subjected to much colder temperature, can cause significant surface cracking and occasionally can contribute to cracking in the concrete mass. This can occur with the removal of forms or the filling of a deep reservoir with cold runoff. Abrupt, large drops in temperature at the concrete surface can create steep temperture gradients, leading to high strains and stresses at the

surface, and result in cracking if the tensile capacity of the concrete exterior is exceeded.

b. Thermal volume change. Volume change in MCS is primarily due to cement hydration heat generation and subsequent cooling. However, additional volume change may result from autogenous shrinkage or other mechanisms. Volume change for analysis of thermal cracking is normally discussed in terms of 1-D length change and is determined by multiplying the coefficient of thermal expansion by the effective temperature change induced by cooling of the mass concrete from a peak temperature. This is discussed further under mass gradient and surface gradient cracking subjects below. If concrete is unrestrained, it is free to contract as a result of cooling from a peak temperature, no tensile strain is induced, and it will not crack. However, since most MCS are restrained to some degree, tensile strain is generally induced, leading to cracking if tensile strain capacity is exceeded.

c. Restraint in mass concrete. Cracking in mass concrete is primarily caused by restraint of volume change. Restraint that prevents free volume change or contraction after mass concrete has reached a peak temperature and cools to an ultimate temperature is of primary concern in mass concrete structures. Restraint prevents the free volume change of concrete, which causes tensile strain and stress in the concrete. Restraint may be either external or internal, corresponding to mass gradient and surface gradient strain-stress, respectively. ACI 207.2R discusses restraint in some detail.

(1) Mass gradient restraint. Mass gradient or external restraint is caused by bond or frictional forces between the MCS and its foundation, by underlying and adjacent lifts, or by other portions of a massive concrete section. The degree of external restraint depends upon the relative stiffness of the newly placed concrete, the restraining material, and the geometry of the section. Large variations in mass or thickness which cause abrupt dimensional changes in a structure, such as wall offsets, culvert valve shafts, gallery entrances, and offsets, induce external restraint of volume change that has resulted in cracking. The foundation or lower lift is viewed as a restraining surface, with high strain-stress at the restraining surface, decreasing with increasing distance from that surface.

(2) Surface gradient restraint. Surface gradient, or internal restraint, is caused by changes in temperature within the concrete. This condition exists soon after placement when heat loss from the surface stabilizes the temperature of near-surface concrete, while the temperature of interior concrete continues to rise due to heat of hydration. This temperature gradient also continues later, when the temperature of the surface concrete cools more rapidly than interior concrete. These temperature gradients result in relatively larger volume changes (temperature shrinkage) at the surface relative to the interior. The result is strain-stress at the surface, shown in Figure A-1, decreasing in magnitude with increasing distance from the surface to eventually a zero strain-stress region at some point in the interior. Strain is generated nearer the surface because the adjacent more interior concrete is changing volume at a slower rate. This is sometimes described as the interior concrete "restraining" the exterior concrete. As can be seen in Figure A-1, the interior is not "restraining" the surface as the foundation "restrains" an MCS, since the strain-stress buildup due to surface gradients is at the surface, not in the interior. The restraint formulas used for mass gradient strain calculation are also applied to surface gradient restraint strain calculation, with some differences. In this case, no "restraining" surface exists at the interior. Rather, a point of zero strain-stress exists in the interior, with increasing strain-stress as the concrete surface is approached. The thermal strain important for surface gradient analysis is the net or effective strain due to temperature change at the surface relative to the temperature change in the interior of the mass.

d. Types of thermal cracking. The analysis of thermal cracking can be categorized by two general types: mass gradient cracking and surface gradient cracking.

(1) Mass gradient cracking. Mass gradient cracking is generally caused by classical external restraint, discussed previously and in ACI 207.1R. Mass gradient cracking is described as cracking that occurs when the tensile strains of the mass exceed

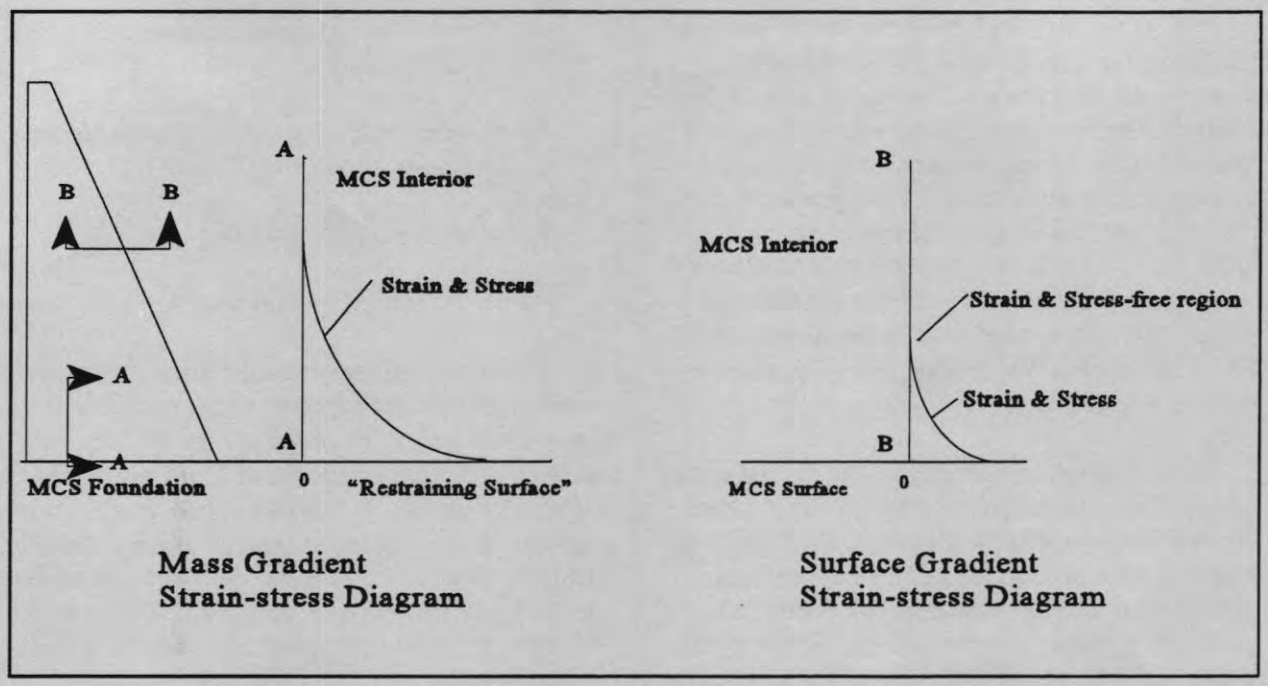


Figure A-1. Mass and surface gradient strain-stress "model" comparison

the tensile strain capacity of the concrete. The orientation of the cracking, if fully developed, can separate the structure into discrete sections. In some cases, cracking in a dam that occurs normal to the monolith joints could affect the stability of a monolith. In dams where monoliths are very wide, this cracking can be longitudinal or parallel to the axis of the dam. This procedure for analysis of external restraint mass gradient cracking is based upon ACI 207.2R, which can be adapted for a stress-or a strain-based methodology, as seen in the two examples at the end of this appendix.

(2) Surface gradient cracking. When the surface of a structure cools faster than the interior, a temperature gradient exists from the interior to a maximum at or near the surface. This causes a gradient of tensile strain and stress and can cause cracking at the exterior surface. It may also cause tension to develop or reduce the compression across lift joints. Surface cracking may not cause great concern if cracking is localized, but it cannot be assumed that cracking will be localized. Once cracks are initiated, the energy required to propagate cracks is much less than the energy required to initiate a crack. Surface gradient cracking is observable on concrete surfaces as pattern cracking and often extends into the structure from a few inches to several feet. This problem is less prevalent in temperate climates and more exaggerated in locations with greater temperature variations. However, under some circumstances, this cracking can lead to more serious cracking conditions. Thermal shock can induce steep surface temperature gradients leading to cracking. This occurs when warm concrete surfaces are suddenly subjected to considerably lower air or water temperatures, creating steep surface temperature gradients and potential cracking. This can occur when wooden or insulated forms are removed during periods of cold weather. Since steel forms provide less insulation, the concrete surface may be near ambient temperatures already when forms are removed, hence causing smaller surface gradients. Sudden cold fronts can also generate steep surface gradients, potentially causing cracking. The procedure for analysis of internal restraint surface gradient cracking in this ETL is based upon ACI 207.2R and can be adapted to a stress- or a strain-based methodology, as seen in the examples at the end of the appendix.

(3) Mass/surface gradient interaction cracking. Cracking may not occur due to mass or surface gradient cracking alone. However, if the mass has built up significant mass gradient tensile strains and stress near the threshold of cracking, the additional tensile strain or stress from surface gradients may propagate a crack through the mass. Additionally, other loading, such as hydrostatic pressures from a reservoir, temperature effects from unusually cold water in deep reservoirs, or differential settlement of the foundation, may propagate a surface crack through the structure.

(4) Longitudinal cracking. Longitudinal cracking has long been a concern for large dams, since the occurrence of significant longitudinal cracking has the potential to affect the stability of the dam. In traditional dam construction, precooling and postcooling techniques were used to eliminate this concern. With the predominance of RCC in the construction of dams, longitudinal cracking is again a concern for large dams. This is due to the high cost and difficulty with using postcooling in RCC. Hence, precooling of the materials is the primary method of controlling RCC temperature. In large dams, those methods may not be sufficient to prevent longitudinal cracking.

e. Mass gradient cracking analysis. Although strain is used as a basis for the following cracking analyses and is the recommended approach, stress has been historically and can still be used to evaluate cracking. The principle of superposition of incremental strains or stress is assumed to apply to these cracking analyses. This means that each increment of strain or stress generated by each incremental change in temperature gradient can be added to each other to determine the total thermal strain or stress at any given time. The following equation may be used to determine the strain due to mass thermal gradients in concrete (ACI 207.2R):

$$\epsilon = (C_{th})(dT)(K_R)(K_f) \qquad \text{(A-4)}$$

where

ϵ = induced strain-millionths

C_{th} = coefficient of thermal expansion-millionths/deg C (millionths/deg F)

dT = temperature change in the mass concrete causing strain - deg C (deg F)

K_R = structure restraint factor

K_f = foundation restraint factor

(1) Mass gradient restraint factors. A concrete mass is commonly restrained by the foundation, other structures, or by previous lifts. Full restraint seldom exists in a structure and then, only at very specific locations. The induced strain in a structure can be calculated using the restraint formula, modified by factors based upon the geometry and relative internal stiffness of the structure, K_R, and upon the relative stiffness of the structure compared to the foundation, K_f.

(a) Structure restraint factor (K_R). The structure restraint factor is determined by Equations A-5 and A-6 from ACI 207.2R. The restraint model (Figure A-2) is a representation of the external restraint geometry which is applied to mass gradient cracking due to foundation restraint. It relates the

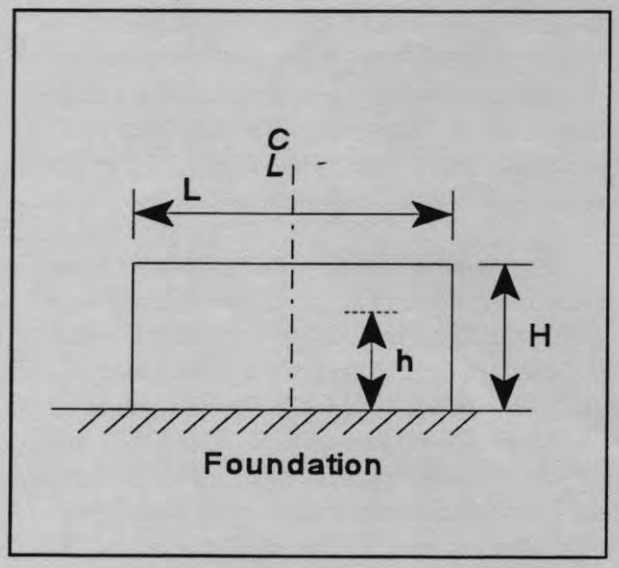


Figure A-2. External restraint model used in mass gradient analysis

magnitude of restraint to the shape of a simple structure where L is length, H is height, and h is the distance from the restraining interface (or restraining plane) at the base of the structure to any location of interest where strain is to be determined. L should be selected with care, since some large structures may be susceptible to mass gradient cracking in more than one direction. This model provides for a structure restraint factor, K_R, for external restraint at locations, h, away from the restraining plane. K_R is determined by one of the following two equations:

for L/H greater or equal to 2.5

$$K_R = \left(\frac{\frac{L}{H} - 2}{\frac{L}{H} + 1} \right)^{h/H} \tag{A-5}$$

and for L/H less than 2.5

$$K_R = \left(\frac{\frac{L}{H} - 1}{\frac{L}{H} + 10} \right)^{h/H} \tag{A-6}$$

These formulas from ACI 207.2R are reasonable approximations of figures shown in ACI 207.2R, but Equation A-6 is a somewhat inaccurate representation of the ACI figures for values of L/H approaching 1.0, where $h/H > 0.6$. For $L/H \leq 1.0$, of course, the formula breaks down and cannot be used.

(b) Foundation restraint factor (K_f). A second factor for induced mass gradient strain is provided by K_f, the foundation restraint or multiplication factor, used to modify K_R. This factor accounts for the difference in the elasticity of the foundation compared to the elasticity of the concrete mass. This relationship is expressed as:

$$K_f = \frac{1}{1 + \frac{A_g E_c}{A_f E_f}} \tag{A-7}$$

where

A_g = gross area of concrete cross section at foundation plane

A_f = area of foundation or zone restraining contraction of concrete (recommended maximum value is 2.5 A_g).

E_f = modulus of elasticity of foundation or restraining element

E_c = modulus of elasticity of mass concrete

f. Surface gradient cracking analysis. Cracking due to temperature gradients from the relatively stable interior temperatures to the exterior of an MCS is analyzed based on the restraint model described below and in ACI 207.2R. This model is similar in nature to that used for mass gradient cracking analysis. Although strain is used as a basis for the following cracking analyses, and is the recommended approach, stress has been historically and can still be used to evaluate cracking. The principle of superposition of incremental strains or stress is assumed to apply to these cracking analyses. This means that each increment of strain or stress generated by each incremental change in temperature gradient can be added to each other to determine the total thermal strain or stress at any given time. Figure A-3 illustrates the concept of surface gradient analysis.

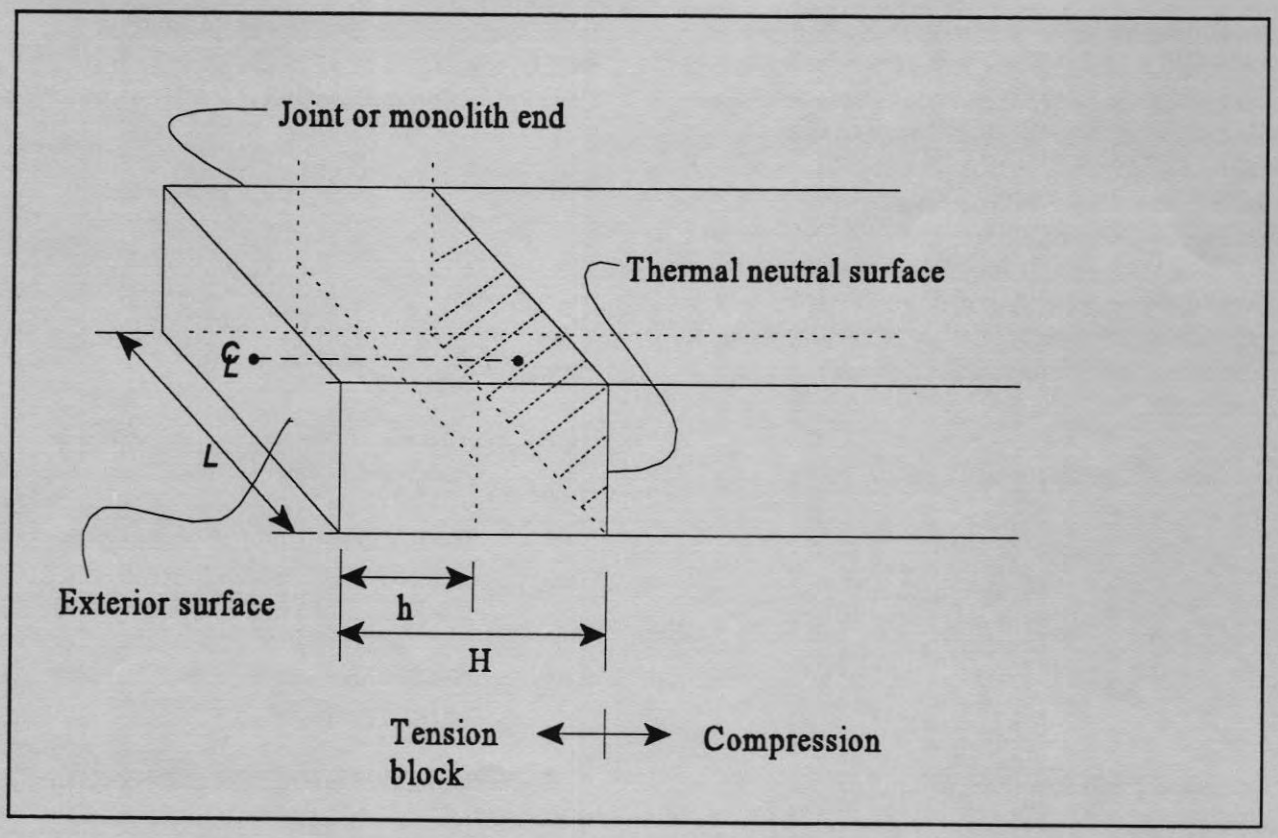


Figure A-3. Internal restraint model used in surface gradient analysis

The following equation may be used to determine the strain due to surface thermal gradients in concrete (based on ACI 207.2R):

$$\epsilon = (C_{th})(dT)(K_R) \qquad \text{(A-8)}$$

where

ϵ = induced tensile strain (millionths)

C_{th} = coefficient of thermal expansion - millionths/deg C (millionths/deg F)

dT = temperature difference with respect to interior temperature difference - deg C (deg F)

K_R = internal restraint factor

Determination of K_R and dT are described in the following.

(1) Surface gradient restraint factor. The degree of restraint is not easily determined but can be estimated based on the thickness of the exterior surface layer being restrained. The restraint factor, K_R, is computed in a manner similar to mass gradient restraint factor, from Equations A-5 or A-6 depending upon the value of L/H, where L is the monolith width (between joints or between ends of the monolith) and H is the distance from the interior strain and stress-free surface (thermal neutral surface) to the exterior surface, as shown in Figure A-3:

for L/H greater or equal to 2.5

$$K_R = \left(\frac{\frac{L}{H} - 2}{\frac{L}{H} + 1} \right)^{h/H} \qquad \text{(A-5bis)}$$

and for L/H less than 2.5

$$K_R = \left(\frac{\frac{L}{H} - 1}{\frac{L}{H} + 10} \right)^{h/H} \qquad \text{(A-6bis)}$$

Values of L/H less than 2.5 will rarely be applied for surface gradient analysis, since the surface gradient tensile region can be visualized as a flat slab lying along the exterior surface, with large L and small H. Values of K_R may be determined at various distances, h, from the interior surface of zero strain-stress, to determine restraint at specific locations. A maximum value of $K_R = 1.0$ will always exist at the exterior surface.

(2) Determining temperature gradients, the surface gradient tension block and H. Surface gradient strain computations are performed using temperature differences, dT, which is the temperature change at the point of interest in the mass minus the temperature change in the interior. These temperature differences represent the temperature gradient from the surface to the interior of the mass concrete that generates thermal strains and stresses. If the exterior and interior concrete underwent the same temperature change during initial temperature rise and later cooling, no surface gradient strains and stresses would be generated. The fact that the exterior and interior concrete undergo temperature changes at different rates gives rise to surface gradient strains and stresses. The starting temperatures for computing temperature differences are always the temperatures present when the concrete begins hardening and has measurable, but small, mechanical properties.

(a) The temperature differences determine the location of the thermal neutral surface (and "H") and are used to compute dT. Figure A-4 shows a graph of temperature differences distributed across a typical mass concrete lock wall characterized by surface concrete that is cooler than the interior concrete. Note the zero temperature difference at the exterior surface. This temperature difference distribution induces tension near the surface and compression in the interior concrete. ACI 207.2R states that for sectional stability, the summation of tensile stresses (and strains) induced by a temperature gradient in a cross section must be balanced by equal compressive stresses (and strains). Assuming that the modulus of elasticity and coefficient of thermal expansion are constant across the section and that stresses and strains are balanced, the implication is that temperature differences contributing to tensile and compressive strain must also be balanced.

(b) Figure A-5 shows the temperature differences from Figure A-4 adjusted to provide equal tension and compression in the section, providing a graphical representation of the surface gradient restraint model. This figure shows the locations of negative temperature differences relative to a thermal balance line at $\Delta T = 0$. Areas with negative temperature differences are in tension, corresponding to the tension block shown in Figure A-3. Areas with positive temperature differences are in compression. The location of $\Delta T = 0$ determines the location of the tension block relative to the exterior surface and the distance H for the K_R calculation. A variety of methods are used to determine the temperature differences, the tension block location, and H, some of which are shown in the examples in Annex 3.

(3) Determining dT. To calculate strain, dT must be determined for that location. dT is simply the temperature difference for that location of interest relative to the interior temperature difference where the tension and compression zones are balanced, or where ΔT=0 on Figure A-5.

g. Cracking calculations. To evaluate cracking, tensile strains are compared to tensile strain capacity of the concrete. Stress-based comparisons can be made in a similar way, but strain-based evaluations are usually preferred.

(1) General. To evaluate cracking of an MCS, the calculated tensile strains are compared with appropriate values of slow load ϵ_{tc} of the concrete. Where the ϵ_{tc} is exceeded, the portion of the tensile strains exceeding the ϵ_{tc} are distributed through the MCS section as cracks. If mass gradients induce

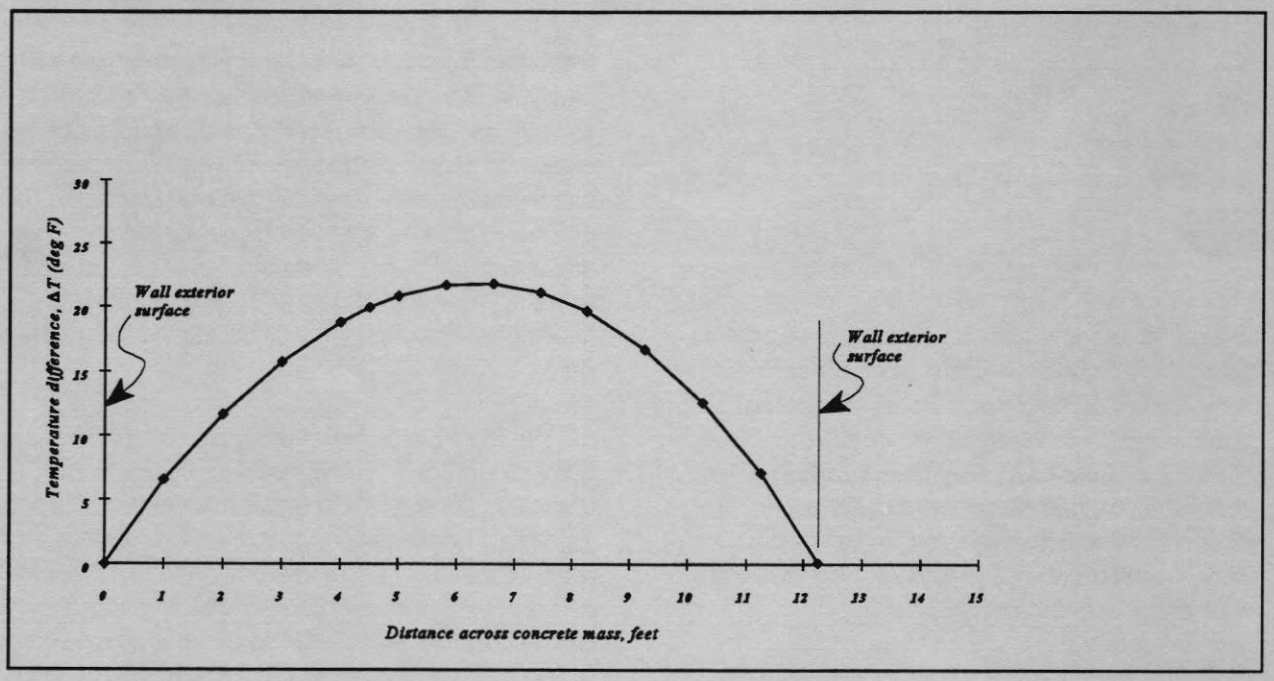


Figure A-4. Example of temperature difference distribution for surface gradient analysis of lock wall

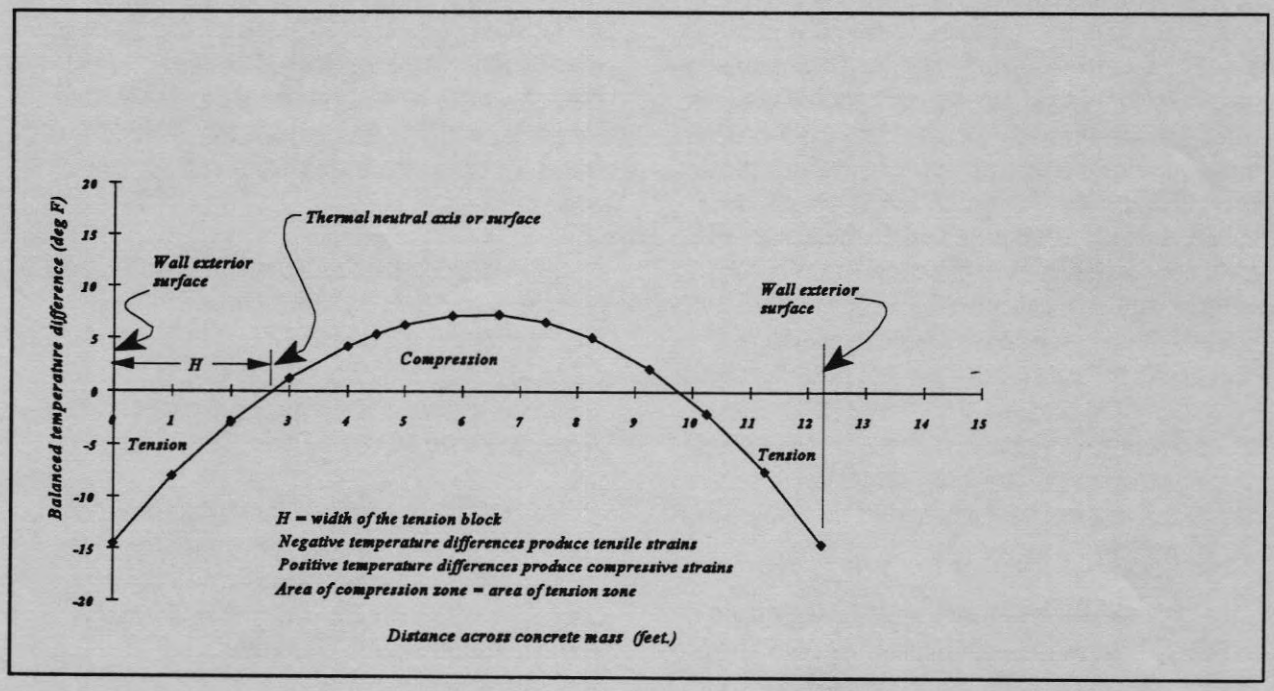


Figure A-5. Example of temperature balance computed from temperature differences in Figure A-4

strains in the mass above allowable ϵ_{tc} values, cracking of that mass is probable. This cracking is typically full cross section transverse cracking of the monolith. However, longitudinal cracking may also occur if the monolith is sufficiently large. If the surface gradient values exceed allowable ϵ_{tc}, surface cracking is probable. The spacing and widths of the cracks depend on restraint conditions and are determined based on judgement and experience.

(2) Cracking calculation. The thermal strain is distributed across the length of the analyzed section. Tensile strain capacity data from slow-loading tests are used to define the capacity of the concrete to "absorb" strain. For example, if a fully restrained dT temperature change occurred over 1 year:

dT = 17 deg C (30 deg F)

C_{th} = 9 millionths/deg C (5 millionths/deg F)

$K_R = K_f = 1$

Using Equation A-4,

$$\epsilon_{\text{induced}} = (C_{th})(dT)(K_r)(K_f) = 150 \text{ millionths.}$$

If

ϵ_{tc} = 100 millionths (when loaded from 7 to 365 days),

then the remaining strain to be distributed as cracks is

$$\epsilon - \epsilon_{tc} = 50\text{-millionths.}$$

The remaining 50 millionths of strain is distributed into cracks totaling 15mm (0.6 in.) over a structure 305 m (1,000 ft) long.

Cracks = (305 m)(1,000 mm/m)(50 millionths)
= 15 mm

[Cracks = (1,000 ft)(12 in./ft)(50 millionths)
= 0.6 in.]

The example shown resulted in the length change distributed to cracks of 15 mm (0.6 in.). Based on experience, three to six cracks of 2-to 5-mm (0.1-to 0.2-in.) width might be expected, if no joints are installed and the fractured rock foundation is somewhat flexible.

(3) Crack spacing and width. Theoretically, there are an infinite number of combinations of crack spacing and crack widths that will equal a calculated thermal length change. However, there are some general rules of thumb for crack spacing and width based on experience. Foundation conditions of restraint often control the spacing of cracks, and the number of cracks tends to control the crack widths. Mass gradient crack spacing in large MCS usually ranges from 30 to 91 m (100 to 300 ft). Crack widths typically range from 2 to 5 mm (0.01 to 0.2 in.). Surface gradient cracking is highly dependent on the restraint conditions and is usually more closely spaced and narrower than mass gradient cracking. Surface gradient crack widths may range from 0.5 to 2 mm (0.02 to 0.1 in.) (Tatro and Shrader 1992). Hairline cracks of about 0.0005 mm (0.002 in.) may leak initially if water under pressure is available to one side of the crack, but will often heal from calcification. Such leakage is expected to stain the exposed concrete face.

A-7. Limitations of Thermal Studies

a. General. The analytical methods described in this ETL for Levels 1 and 2 thermal studies provide reasonable approaches to the analysis of thermal effects in mass concrete. These thermal analyses do not consider other loading conditions that may be present and that may contribute additional strain and stress leading to cracking. Good engineering judgement must be applied to evaluate the effects of additional loading conditions or of remnant thermal strains contributing to structural strains and stresses. The thermal models discussed in this ETL are based on a number of broad assumptions of conditions and behavior which generally lead to conservative analyses. Good engineering judgement must be applied to these analyses at all stages and levels of thermal evaluation.

b. Verification. All thermal analyses, particularly the temperature model, should be benchmarked

or verified in some way to assure the engineer of the appropriateness and accuracy of the methods used. The design team must use every available means to verify the correctness and accuracy of the input data for thermal analysis, including climatological, structural, material, and construction input parameters. The design team should use any means available to help verify the validity of the results. Using the experience and judgement of the materials engineer, an initial check of the results can be made on a qualitative basis. Exploring previously analyzed structures and their results, performing a simple ambient condition analysis (no creep, shrinkage, aging modulus, or adiabatic temperature rise), and performing simplified analyses are all possible methods for providing confidence and a check on the validity of the analysis.

A-8. Documentation of Thermal Study Results

a. General. Thermal studies are performed during various phases of project design. Generally, Level 1 studies are performed during a feasibility study for a major project or for a complex structure where thermal cracking issues may require subsequent design changes and more complex analysis. Detailed thermal analysis is often performed during the feature design phase of the project. The format of the documentation will depend on the design stage and the level of thermal study.

b. Feasibility studies. The thermal study and results should be described in a section of the engineering appendix to the Feasibility Report and not in a separate report. The information should include input data such as geometry, FE model, material properties, parameter combinations, loads, ambient temperature, surface heat transfer coefficients, and other information. Plots of results should be included to illustrate the behavior of the structure. These plots could include temperature, stress and crack potential contours at critical times, plus temperature and stress time-histories at critical locations. There should be a narrative interpretation of the results. This should explain any potential for cracking, whether it is acceptable, what special design or construction procedure changes might be required, and what cost adjustment was made because of these changes.

c. PED studies. PED thermal studies results should be presented in a separate design report and should include a statement of objectives of the study, information on the model(s) used in the analysis, information on all input parameters, presentation of the model and analysis results, verification of the model and analysis results, and conclusions and recommendations for design and construction. Presentation of results is critical in providing the proper understanding of how the structure behaved and for supporting any conclusions or recommendations that will be made as a result of the thermal analysis. Results may be displayed in tables, graphs, contour plots, or color plots. Discussion of results should include cracking potential, acceptability of cracking, and possible corrective measures for thermal problems. The thermal model results must be verified in a manner that illustrates the validity of the model results, either through independent analysis, correlation with field data, or correlation with field experience. Conclusions and recommendations for improved performance or cost savings should be discussed in the thermal studies design report.

ANNEX 1: DETERMINATION OF TENSILE STRAIN CAPACITY

A1-1. Purpose

Tensile strain capacity (TSC) is the change in length per unit length that can be sustained in concrete prior to cracking. This property is used with the results of temperature analysis to determine whether a mass concrete structure (MCS) will crack and the extent of cracking. This annex describes testing to determine TSC, methods to estimate TSC, and methodology for its use in thermal analysis.

A1-2. Background

The Corps of Engineers introduced TSC testing of concrete several decades ago to provide a basis for evaluating crack potential for strain-based thermal studies of MCS (Houghton 1976). This property is also used to compare different aggregates and different concrete mix proportions in MCS. TSC varies primarily based on age, strength, aggregate type, shape, and texture. TSC tests are conducted on large concrete beams instrumented to measure strain to failure. TSC is determined in a series of tests, including rapid and slow loading of beams. The slow-load test was designed to simulate the strain conditions occurring in a mass concrete structure during long-term cooling. By conducting tests at several loading ages, TSC data can be used to evaluate mass gradient cracking resistance in a structure under long-term cooling. Surface gradients generally develop during the first several days or weeks after placement of concrete, particularly following the removal of insulated forms. Hence, strains due to surface gradients develop more rapidly than tested using the slow-load TSC test, and more slowly than a standard TSC test failed at a normal loading rate. This annex describes one method used to estimate TSC for surface gradient analyses.

A1-3. Description of Test Method

Tensile strain capacity is determined according to CRD-C 71 (WES 1949). The test method requires a minimum of three beams for each test, and generally a minimum of three tests is recommended for each test set to allow for variation in the test results. Rapid-load (0.28 Mpa/min)(40 psi/min) and slow-load (0.17 MPa)(25 psi/week) tests are usually conducted in test series consisting of three beam tests each. TSC test specimens are 300-mm by 300-mm by 1,680-mm-long (12-in. by 12-in. by 66-in.-long) beams tested in third-point loading. Strain gauges are located at or near the top and bottom (compression and tension) surfaces to measure strain during the tests. At the age of test, a rapid-load test is conducted and a slow-load test is begun. Loading continues at the prescribed rate until failure. During the slow-load beam test, strain measurements are made on the beam under load. In addition, measurements of autogenous strain are made on the third beam. The autogenous shrinkage strains are used to correct the strain measurements on the beam under slow load. Upon failure of the slowly-loaded beam, a rapid-load test is performed on the third beam. A TSC test series usually contains a suite of rapid- and slow-load tests typically initiated at 3, 7, 28 days, and/or other ages. The differences in TSC capacity from the slow- and rapid-load beams provide an indication of the cumulative creep strain during the slow-load test. The strains measured in the slow-load beam test containing both elastic and creep strains are expressed in millionths (1×10^{-6} in./in).

A1-4. Tensile Strain Capacity Test Results

TSC test results can vary widely depending on a variety of factors. Use of test results for the specific materials and mixture(s) to be used in an MCS should be used whenever possible. Actual values for TSC of mass concrete for slow-load tests for specimens loaded at 7 days and failing at about 90 days range from 88 to 237 millionths. Corresponding values for rapid-load tests conducted at 7 days range from 40 to 105 millionths. For tests conducted upon failure of the slow-load beam, rapid-load results range from 73 to 136 millionths. Ratios of slow-load tensile strain capacity to

rapid-load tensile strain capacity tested at the same age as the slow-load specimens range from 1.0 to 2.0 and averages 1.4. This average is relatively insensitive to age.

A1-5. Use of Tensile Strain Capacity for Mass Gradient Cracking Analyses

Mass gradient tensile loading in an MCS occurs over an extended period of time. The standard slow-load tensile strain capacity test was specifically designed for this condition. Standard slow-load TSC tests provide a reasonable limiting strain in mass gradient cracking analyses for the condition of restrained slow loading of mass concrete which occurs in a slowly cooling mass. Using an appropriate loading time period, the slow-load tensile strain capacity can be used directly for mass gradient cracking analysis.

A1-6. Use of Tensile Strain Capacity for Surface Gradient Cracking Analyses

a. Surface gradient strains. Surface gradient strains can be initiated at a very early age, particularly after the removal of insulated formwork, and can develop over a few days or weeks of loading due to the initial temperature rise and subsequent development of the surface temperature gradient. Because loading under surface gradient conditions is more rapid than the standard tensile strain capacity slow-load test, the results of that test may not well represent surface gradient conditions. Very accurate tensile strain capacity values may not be necessary for surface gradient analysis, except for critical situations. For most situations, the standard test values will suffice for surface gradient cracking analysis as well as mass gradient cracking analysis. In some structures, concrete placed near the surface of the MCS may differ significantly from internal concrete mixtures. Tests for TSC used in surface gradient analysis should be conducted on the appropriate concrete mixture(s).

b. Simulated surface gradient strains. For critical situations, slow-load TSC tests conducted at more rapid rates of loading than the standard slow-load test may be conducted to simulate the development of surface gradient thermal strains. In lieu of such special load rate testing, an estimate can be made of TSC for use in preliminary surface gradient TSC determinations, using the ratio of 1.4 described above. An estimate of TSC for surface gradient analysis is determined by testing TSC at the rapid load rate and at the age of interest. This value is then multiplied by 1.4, to determine a TSC under the slow loading reflective of surface gradient strain development. This estimate is believed to be reasonably conservative at ages from 1 to 14 days. Because creep rates are greatest at early ages, it is possible that slow-load TSC may be considerably higher especially from 1 to 7 days. Until test data are available, this may be used for developing surface gradient tensile strain capacity values.

ANNEX 2: LEVEL 1 THERMAL STUDY MASS GRADIENT ANALYSIS PROCEDURE AND EXAMPLE

A2-1. Procedure

a. General. This Annex summarizes each step in a Level 1 thermal study mass gradient analysis of a mass concrete sheetware (MCS) and provides an example of how this procedure was applied for a modest-size MCS. Although alternative approaches can be used, this method is in common use for this level MCS thermal analysis. Surface gradient thermal analysis is seldom conducted at this level of analysis.

b. Input properties and parameters.

(1) Step 1: Determine ambient conditions. Simple analyses conducted for a Level 1 analysis are typically based on average monthly temperature data.

(2) Step 2: Determine material properties. Laboratory test results on material properties are seldom available for this level of thermal analysis. Material properties are generally estimated from published data in sources such as American Concrete Institute (ACI) documents, technical publications, and engineering handbooks. Often known information such as compressive strength and aggregate type is used to predict other material properties from published data. The minimum properties required are the coefficient of thermal expansion (C_{th}), the adiabatic temperature rise (ΔT_{ad}), and the tensile strain capacity (ϵ_{tc}).

(3) Step 3: Determine construction parameters. Concrete placement temperature is the essential construction parameter needed for this level of thermal analysis. A first approximation is to assume that concrete placement temperatures (T_p) directly parallel the average monthly temperature. A more accurate method is to modify the average monthly temperature based upon production time period and extent of production or to use actual placement temperature data from similar projects.

c. Temperature analysis.

(1) Step 4: Mass gradient temperature analysis. For Level 1 mass gradient analysis, no elaborate "model" is used to develop temperature history. The long-term temperature change is simply calculated as the peak concrete temperature minus the ultimate stable concrete temperature.

(a) Determine peak temperature. This is the sum of the concrete placement temperature and the adiabatic temperature rise.

(b) Determine ultimate stable temperature. Large structures cool to a stable temperature equal to the average ambient temperature. However, smaller concrete structures cool to a stable annual temperature cycle, since there is insufficient mass to provide complete insulation of the interior. ACI 207.1R provides a figure relating temperature variation with depth to determine this internal temperature cycle. It is assumed that the concrete temperature cycles about the average annual temperature.

(c) Determine long-term temperature change. The sum of the placing temperature plus adiabatic temperature rise provides a quick peak temperature of the MCS. Then subtracting the ultimate stable temperature provides the long-term temperature change used for strain and cracking evaluation.

d. Cracking analysis.

(1) Step 5: Mass gradient cracking analysis. Using long-term temperature change and ACI formulas, mass gradient strain is approximated. These strains are compared to estimates of tensile strain capacity to determine if and when cracking may occur.

(a) Determine mass gradient restraint conditions. The structure restraint factor (K_R) and the

foundation restraint factor (K_f)(in ACI 207.2R termed "Multiplier for foundation rigidity") are determined as described in Appendix A, and in ACI 207.2R.

(b) Determine mass gradient thermal strain. The total induced strain is the product of the long-term temperature change, the coefficient of thermal expansion and restraint factors. Use Equation A-4 (Appendix A).

$$\text{Total strain} = (C_{th})\,(dT)\,(K_R)\,(K_f) \qquad \text{(A-4bis)}$$

where

Total strain = induced strain (millionths)

C_{th} = coefficient of thermal expansion

dT = temperature differential

K_R = structure restraint factor

K_f = foundation restraint factor

Cracking strain is computed by subtracting tensile strain capacity from the total strain. The remainder is the strain that must be accomodated in cracks at some spacing and width across the MCS.

(c) Estimate mass gradient cracking. Foundation conditions (restraint) control the spacing of cracks and the crack width. If the foundation is stiffer, tightly spaced cracks of small width can be expected. If the foundation is relatively soft (low restraint), widely spaced and wider cracks can be anticipated. Multiply the MSC length by the cracking strain to determine the total width of cracking to be accomodated in the MCS. Estimate a crack width based on foundation conditions and divide the total width of cracking by the assumed crack width to determine the total number of cracks.

e. Conclusions and recommendations. These typically include expected maximum temperatures for starting placement in different seasons, expected transverse and longitudinal cracking without temperature or other controls, recommended concrete placement temperature limitations, anticipated concrete precooling measures, need for adjustment in concrete properties, joint spacing, and sensitivity of the thermal analysis to changes in parameters.

A2-2. Example

a. Introduction. This example, based on a thermal study for the Cache Creek Detention Basin Weir, illustrates one way to estimate concrete placing temperature based on ambient air temperatures and material processing schemes and schedules. The study evaluates mass gradient cracking only. The Cache Creek Detention Basin in California is a roller-compacted concrete (RCC) overflow weir section in a levee system. The structure is 8 m (15 ft) high, 3.6 m (12 ft) wide at the top, has 0.8 to 1 slopes upstream and downstream, and is 530 m (1,740 ft) long. Compacted sands and silts were placed against the full height of the upstream face. The purpose of the study was to determine the adequacy of contraction joints spaced at 30-m (100-ft) intervals and, if necessary, provide recommendations for alternate configurations. Also addressed is the adequacy of a maximum placing temperature of 29 deg C (85 deg F) for the RCC. The following paragraphs provide explanation on the selection criteria and determination of the parameters used to summarize thermal study.

b. Input properties and parameters.

(1) Step 1: Determine ambient conditions. Data were provided from climatological data summaries for Woodland, CA, prepared by the National Oceanic and Atmospheric Administration (NOAA), shown in Table A2-1. The average annual temperature used was 16.1 deg (61 deg F), and monthly mean and average monthly maximum and minimum temperatures were used for other computations.

(2) Step 2: Determine material properties.

(a) Coefficient of thermal expansion. Coefficient of thermal expansion was estimated using handbook data (Fintel 1985) for the sandstone and

Table A2-1
NOAA Temperature Data, Woodland, CA

Month	Monthly avg. max. - deg C (deg F)	Monthly avg. min. - deg C (deg F)	Monthly avg. -deg C (deg F)
Jan	11.7 (53)	2.8 (37)	7.2 (45)
Feb	15.5 (60)	4.4 (40)	10.0 (50)
Mar	18.9 (66)	5.5 (42)	12.2 (54)
Apr	23.3 (74)	7.2 (45)	15.0 (59)
May	27.8 (82)	10.0 (50)	18.9 (66)
Jun	32.2 (90)	12.8 (55)	22.8 (73)
Jul	35.5 (96)	13.9 (57)	25.0 (77)
Aug	34.4 (94)	13.3 (56)	23.9 (75)
Sep	32.2 (90)	12.2 (54)	22.2 (72)
Oct	26.1 (79)	9.4 (49)	17.8 (64)
Nov	18.3 (65)	5.5 (42)	11.7 (53)
Dec	12.2 (54)	2.8 (37)	7.8 (46)
Annual	-	-	16.1 (61)

meta-sandstone aggregate concrete planned for the project:

C_{th} = 9.9 millionths/deg C (5.5 millionths/deg F)

(b) Adiabatic temperature rise. The study was performed using an RCC mixture with a Type I/II cement content of 119 kg/m^3 (200 lb/cy) and a Class F pozzolan content of 39 kg/m^3 (66 lb/cy). ACI 207.1R suggests that pozzolan can be assumed to have a heat generating capacity about one-half that of cement. Using ACI 207.1R adiabatic temperature rise curves and an equivalent cement content of 138 kg/m^3 (233 lb/cy), this mixture should produce an adiabatic temperature rise of about 22.2 deg C (40 deg F). From ACI 207.1R:

Δt_{ad} for 223 kg/m^3 (376 lb/cy) cement at 28 days = 36.1 deg C (65 deg F)

Δt_{ad} for 138 kg/m^3 (233 lb/cy) equiv. cement at 28 days = (36.1 deg C)(138)/(223) = 22.2 deg C (40 deg F)

(c) Tensile strain capacity. ACI 207.5R suggests that values of tensile strain capacity ranging from 50 to 200 millionths are achievable for early age, slow-load testing. Lean RCC mixes typically range from 60 to 90 millionths. Since the cement content of 119 kg/m^3 (200 lb/cy) is higher than most lean RCC mixes and the coarse aggregate is crushed, a value of 80 millionths was selected.

(3) Step 3: Determine construction parameters. RCC placing temperature was calculated using the average annual temperature modified by rule-of-thumb temperature effects during construction, as shown in Table A2-2. In Table A2-2, the placing temperature is the composite temperature of the aggregate source, (assumed to be the average annual temperature), plus the added heat during aggregate production, plus the added heat during RCC production. Stockpile aggregate temperatures are the base temperature, plus the ambient addition, plus crushing and production energy. Similarly, RCC production temperatures are the stockpile temperature plus ambient additions and mixer energy additions. The ambient temperature additions are calculated as 0.67, an empirical correction factor, times the differential temperature of the aggregates and the air. The complete thermal study is summarized in Table A2-3. A May placing temperature was used for following calculations:

T_p = 18.9 deg C (66 deg F)

c. Temperature analysis.

(1) Step 4: Mass gradient temperature analysis.

(a) Determine peak temperature. This is the sum of the initial RCC placement temperature and the adiabatic temperature rise:

$T_p + \Delta T_{ad}$ = 18.9 + 22.2 = 41.1 deg C (106 deg F)

(b) Determine ultimate stable temperature. Since the weir is a relatively thin MCS, it is expected to develop a stable temperature cycle, rather than a single stable temperature as in larger MCS's. The temperatures below were determined using the methodology in ACI 207.1R ("Temperature variation with depth"). Typical distance from the RCC surface to the interior was determined to be 4.6 m (15 ft). From ACI 207.1R figure:

$$\frac{\text{Temp change through concrete}}{\text{Temp range at surface}} = 0.24$$

Temp range at surface = 24.8 - 7.3 = 17.5 deg C (31.5 deg F)

Temp change in concrete interior = (0.24) (17.5 deg C) = 4.2 deg C (7.6 deg F)

Temp range in concrete interior = 16.2 ± 4.2 deg C (61.1 ± 7.6 deg F)

T_{min} = minimum interior concrete temp. = 16.2 - 4.2 = 12 deg C (53.5 deg F)

(c) Determine long-term temperature change. This value is simply the peak RCC placement temperature less the stable minimum temperature. Assuming a May placement:

$\Delta T = T_p + T_{ad} - T_{min}$ = 41.1-11.9 = 29.2 deg C (53 deg F)

d. Cracking analysis.

(1) Step 5: Mass gradient cracking analysis.

(a) Determine mass gradient restraint conditions. Geometric restraint is conservatively set at K_R=1.0, since the structure has a low profile. Foundation restraint is set at K_f= 0.65, since the base is not rock but rather compacted structural backfill.

$K_R = 1.0 \qquad K_f = 0.65$

(b) Determine mass gradient thermal strain. The total induced strain in the mass RCC is the product of the long-term temperature change, the coefficient of thermal expansion and restraint factors:

Total induced strain = $(C_{th})(\Delta T)(K_R)(K_f)$
= (9.9 millionths/deg C)(29.2 deg F)(1.0)(0.65)
= 189 millionths

(c) Estimate mass gradient cracking. The strain that results in cracking of the structure is the total induced strain less the tensile strain capacity (ϵ_{sc}) of the material. The total crack width in the length of the structure is the cracking strain multiplied by the length of the structure. The estimated number of cracks are based on the assumed crack widths. Typical crack widths range from 0.002 to 5 mm(0.01 to 0.2 in.). The larger crack widths are typical of structures founded on flexible or yielding foundations. Since such a foundation exists here, a typical crack width of 4 mm (0.15 in.) was assumed:

Cracking strain = total induced strain - ϵ_{sc}
= 189 - 80 = 109 millionths

Total crack width = (weir length)(cracking strain) = (530 m)(1,000 mm/m)(109 millionths) = 58 mm (2.3 in.)

Assumed crack widths = 4 mm (0.15 in.)

Estimated cracks = 58 mm/4 mm = 15 cracks

Estimated crack spacing = 530 m/15 cracks = 35 m (116 ft)

Since contraction joints will be installed at 30-m (100-ft) spacing, additional cracking is not expected. Occasional center cracks can be expected where conditions and restraint factors vary from those assumed.

e. Conclusions and recommendations.

(1) Conclusions. Based on calculations similar to that shown above, on previous temperature analysis figures, and experience, the following conclusions were provided:

(a) May placement schedule. RCC placement temperatures should be 19.4 to 21.1 deg C (67 to

70 deg F) if aggregates are produced the preceding month. If aggregate processing is performed earlier, lower placement temperatures may result. Crack spacing in an unjointed structure is calculated to be 35 m (116 ft). The 30-m (100-ft) contraction joint interval easily accommodates this volume change with joint widths of approximately 3 mm (0.13 in.).

(b) June placement schedule. RCC placement temperatures should be 22.2 to 23.9 deg C (72 to 75 deg F) if aggregates are produced the preceding month. If aggregate processing is performed earlier, lower placement temperatures may result. Crack spacing in an unjointed structure is calculated to be 29 m (97 ft). The 30-m (100-ft) contraction joint interval just accommodates this volume change with joint widths of approximately 4 mm (0.15 in.).

(c) July and August placement schedules. RCC placement temperatures should be 23.9 to 26.7 deg C (75 to 80 deg F) if aggregates are produced the preceding month. If aggregate processing is performed earlier, lower placement temperatures may result. Crack spacing in an unjointed structure is calculated to be 26 m (87 ft). The 30-m (100-ft) contraction joint interval is not quite adequate to accommodate this volume change at a fixed joint width of 4 mm (0.15 in.). Joint widths will increase or additional cracking will occur.

(d) Since the anticipated period for RCC construction is during the late spring or summer months, the 29.4-deg C (85-deg F) placement temperature limitation specified could be a factor if unusually hot weather should occur. Under normal weather conditions, uncontrolled placing temperatures should range from 19.4 to 24.4 deg C (67 to 76 deg F) from May through August. In the event that abnormal weather causes average daily ambient temperature in excess of 29.4 deg C (85 deg F), RCC temperatures could exceed 29.4 deg C (85 deg F). Aggregate stockpile cooling and possible use of batch water chillers would be the most expedient solutions to this problem.

(e) The current joint spacing of 30 m (100 ft) is adequate for RCC placements during May and June. Later placements in July and August will result in occasional centerline cracking of monoliths, possibly in as many as three or four monoliths. Lesser cracking is very probable since material properties were conservatively estimated.

(f) Several material properties were applied conservatively. Small reductions of adiabatic temperature rise and coefficient of thermal expansion and small increases in tensile strain capacity could improve thermal cracking performance. If each of these properties were individually changed 10 percent, summer crack spacing would be around 30 m (100 ft). If these changes were cumulative, crack spacing would be over 40 m (130 ft).

(2) Recommendations.

(a) Maintain current 29.4-deg C (85-deg F) maximum placement temperature limitation. Consider allowing minor temperature violations so long as the time weighted average of the RCC placement temperature is maintained below 26.7 deg C (80 deg F).

(b) Maintain current contraction joint spacing of 30 m (100 ft). The current contraction joint configuration of 30-m (100-ft) joint intervals is sufficient to accommodate the total anticipated axial contractions due to cement induced temperature fluctuations during May and June placements. Some transverse cracking will occur during the July and August placement schedule, however the extent of cracking should not be of concern considering the upstream backfill and the frequency of use.

f. Field performance compared to predicted performance. During construction, RCC placement temperature was maintained at about 29.4 deg C (85 deg F), and transverse contraction joints were spaced at 30-m (100-ft) intervals. All the contraction joints opened properly during the first few months after construction, with no intermediate cracking. Crack widths varied from 1.5 to 6 mm (0.06 to 0.25 in.).

Table A2-2
Cache Creek Weir Placing Temperature Computation

	Temperature (deg C)				
Factor	May	Jun	Jul	Aug	Comments
Avg. annual temperature(deg C)	16.1	16.1	16.1	16.1	Base temperature, from NOAA data
Previous month temperature	15.0	18.9	22.6	24.8	From NOAA data
Added ambient temperature	-1.1	2.8	6.5	8.7	(0.67)(Annual temp. - prev. month temp.)
Aggregate subtotal temperature	15.4	18.0	20.5	21.9	Avg. annual temp. + added amb. temp.
Added processing temperature	+1.1	+1.1	+1.1	+1.1	Processing and crushing energy
Aggregate stockpile temperature	16.5	19.1	21.6	23.0	N/A
Current ambient temperature	18.9	22.6	24.8	23.9	From NOAA data
Added ambient temperature	+1.7	+2.3	+2.1	+0.6	(0.67)(Curr. Temp.-agg. stock. temp.)
Added mixer energy	+1.1	+1.1	+1.1	+1.1	N/A
Placement temperature	19.3	22.6	24.8	24.8	Agg. stockpile temp. + added effects
	Temperature (deg F)				
Avg. annual temperature (deg F)	61.1	61.1	61.1	61.1	Base temperature, from NOAA data
Previous month temperature	59.0	66.1	72.7	76.6	From NOAA data
Added ambient temperature	-1.4	3.3	7.8	10.4	(0.67)(Annual temp. - prev. month temp.)
Aggregate subtotal temperature	59.7	64.5	68.9	71.5	Avg. annual temp. + added amb. temp.
Added processing temperature	+2.0	+2.0	+2.0	+2.0	Processing and crushing energy
Aggregate stockpile temperature	61.7	66.5	70.9	73.5	N/A
Current ambient temperature	66.1	72.7	76.6	75.1	From NOAA data
Added ambient temperature	+3.0	+4.2	+3.8	+1.1	(0.67)(Curr. Temp.-Agg. Stock. Temp.)
Added mixer energy	+2.0	+2.0	+2.0	+2.0	N/A
Placement temperature	66.7	72.7	76.7	76.6	Agg. stockpile temp. + added effects

Table A2-3
Cache Creek Weir Thermal Analysis Summary

Parameter	Spring (May)	Late Spring (Jun)	Summer (Jul-Aug)
Temperature (deg C)			
Temperatures			
RCC placement temperature (deg C)	19.4	22.8	25.0
Adiabatic temperature rise (deg C)	22.2	22.2	22.2
Peak internal temperature (deg C) (Place temp. + adiabatic temp.)	41.7	45.0	47.2
Minimum temperature (deg C) (Based on annual temp. cycle)	12.2	12.2	12.2
Differential temperature (deg C) (Peak temp. - min. temp.)	29.4	32.8	35.0
Strain development			
Induced strain (millionths) (C_{th}=9.9 millionths/deg C, K_f=0.65, K_R=1.0)	189	211	225
Strain capacity (millionths)	80	80	80
Excess strain (millionths)	109	131	145
Crack distribution (length of weir = 530 m) (crack width = 4mm)			
Axis length contraction (mm)	51	76	76
Number of cracks (Contraction/crack width)	15	18	20
Avg. crack spacing (m) (Weir length/number of cracks)	35	29	26
Temperature (deg F)			
Temperatures			
RCC placement temperature (deg F)	67	73	77
Adiabatic temperature rise (deg F)	40	40	40
Peak internal temperature (deg F) (Place temp. + adiabatic temp.)	107	113	117
Minimum temperature (deg F) (Based on annual temp. cycle)	54	54	54
Differential temperature (deg F) (Peak temp. - min. temp.)	53	59	63
Strain development			
Induced strain (millionths) (C_{th}=5.5 millionths, K_f=0.65, K_R=1.0)	189	211	225
Strain capacity (millionths)	80	80	80
Excess strain (millionths)	109	131	145
Crack distribution (length of weir=1,740 ft.) (crack width=0.15 in.)			
Axis length contraction (in.)	2	3	3
Number of cracks (Contraction/crack width)	15	18	20
Avg. crack spacing (ft) (Weir length/number of cracks)	114	95	86

ANNEX 3: LEVEL 2 THERMAL STUDY MASS GRADIENT AND SURFACE GRADIENT ANALYSIS PROCEDURE AND EXAMPLES

A3-1. Procedure

a. General. This Annex summarizes typical steps in a Level 2 mass gradient and surface gradient thermal analysis of a mass concrete structure (MCS) and provides two examples of the procedure. Example 1 covers a simple one-dimensional (1-D) (strip model) finite element (FE) mass gradient and surface gradient thermal analysis. Example 2 presents a more complex two-dimensional (2-D) mass gradient and surface gradient thermal analysis. This procedure and the examples use FE methodology only because of the widespread availablility and use of this technology. Although other methods of conducting a Level 2 thermal analysis are available, these procedures are most commonly used.

b. Input properties and parameters. The level of data detail depends on the complexity of a Level 2 thermal analysis. Parametric analysis should be routinely conducted at this level, using a rational number and range of input properties and parameters to evaluate likely thermal problems.

(1) Step 1: Determine ambient conditions. Level 2 analyses may be based upon average monthly temperatures for a less complex analysis, or on average expected daily temperatures for each month for a complex analysis. Wind velocity data are generally needed for computing heat transfer coefficients. Extreme ambient temperature input conditions, such as cold fronts and sudden cold reservoir temperatures, can and should be considered when appropriate to identify possible problems.

(2) Step 2: Determine material properties. Thermal properties required for FE thermal analysis include thermal conductivity, specific heat, adiabatic temperature rise of the concrete mixture(s), and density of the concrete and foundation materials. Coefficient of thermal expansion is required for computing induced strain from temperature differences. Modulus of elasticity of concrete and foundation materials are required for determination of foundation restraint factors. Tensile strain capacity test results are important for cracking evaluation. When tensile strain capacity data are not available, the methodology presented in Annex 1 may be used to estimate probable tensile strain capacity performance of the concrete. Creep test results are necessary to determine the sustained modulus of elasticity (or an estimate of E_{sus} is made) if stress-based cracking analysis is used.

(3) Step 3: Determine construction parameters. Construction parameters must be compiled which include information about concrete placement temperature, structure geometry, lift height, construction start dates, concrete placement rates, and surface treatment such as formwork and insulation that are possible during construction of the MCS. To determine concrete placement temperature, a first approximation is to assume that concrete placement temperatures directly parallel the mean daily ambient temperature curve for the project site. Actual placement temperature data from other projects can be used for prediction, modified by ambient temperature data differences between the different sites. The temperature of the aggregate stockpiles may change more slowly than does the ambient temperature in the spring and fall. Hence, placement temperatures during spring months may lag several degrees below mean daily air temperatures, while placement temperatures in the fall may lag several degrees above mean daily air temperatures.

c. Temperature analysis

(1) Step 4: Prepare temperature model. Various temperature analysis methods suitable for Level 2 thermal analysis are discussed in Appendix A. Either step-by-step integration methods or FE models may be used for Level 2 temperature analysis or mass and surface gradients. If step-by-step integration methods are used, the computation or numerical model should be programmed into a personal computer spreadsheet. The decision on whether to use FE 1-D strip models or 2-D section analysis is generally based on complexity of the structure,

complexity of the construction conditions, and on the stage of project design. Often 1-D strip models are used first for parametric analyses to identify concerns for more detailed 2-D analysis.

(2) Compute temperature histories. Once computed, temperature data should be tabulated as temperature-time histories and temperature distributions to obtain good visual representations of temperature distribution in the structure. ETL 1110-2-536 has examples of temperature distribution plots. Appropriate locations can then be selected for temperature distribution histories at which mass gradient and surface gradient analysis will be conducted.

(a) Step 5: Mass gradient temperature analysis. Temperature-time histories, showing the change in temperature with time at specific locations after placing, are generally used to calculate temperature differences for mass gradient cracking analysis. Temperature differences for mass gradient cracking analysis are generally computed as the difference between the peak concrete temperatures and the final stable temperatures that the cooling concrete will eventually reach.

(b) Step 6: Surface gradient temperature analysis. The objective of surface gradient temperature analysis is to determine at desired critical locations the variation of surface temperatures with depth and with time. This can be performed effectively with 1-D strip models or with 2-D analysis. Thinner sections may require temperature distributions entirely across the structure, while large sections often only require temperature to be evaluated to some depth where temperature changes are relatively slow. Ideally, temperature distribution histories are generated for a single lift, tabulated from one surface to the other (or a stable interior) with each distribution representing temperatures for a specific time after placement.

d. Cracking analysis.

(1) Step 7: Mass gradient cracking analysis. The mass gradient temperature differences are used with C_{th} and restraint factors (K_f and K_R) to evaluate mass gradient cracking potential, using Equation A-4 in Appendix A. Computed mass gradient strains are compared against tensile strain capacity to evaluate cracking potential. For a stress-based mass gradient cracking analysis, the sustained modulus of elasticity corresponding to the time frame of the analysis is used to convert strains calculated by Equation A-4 to stresses. The use of the sustained modulus allows for the relief of temperature-induced stress due to creep. These stresses are compared to the tensile strength of the concrete at the appropriate age to determine where and when cracking may occur.

(2) Step 8: Surface gradient cracking analysis. Surface gradient cracking analysis is based on higher temperature differences in the surface concrete compared to the more slowly cooling interior which creates areas of tension in the surface to some depth, H. Tensile strain is calculated based on C_{th}, the temperature difference at some depth of interest, and the degree of restraint based on H.

(a) Temperature differences are calculated using as a basis the temperature when the concrete first begins hardening, rather than a peak temperature as used in mass gradient computations. These temperature differences, with time and depth, allow determination of tensile and compression zones near the concrete surfaces. The point at which tension and compression zones balance is considered a stress-strain free boundary (located at H from the surface) used to compute restraint for surface gradient analysis. This point is generally calculated by evaluating temperature differences at depth with respect to temperature differences at the surface.

(b) Reference or initial temperatures for a surface gradient analysis are defined as the temperatures in the structure at the time when the concrete begins to harden and material properties begin to develop. Generally, this time is established at concrete ages of 0.25, 0.5, or 1.0 day. This age is dependent upon the rate at which the concrete achieves final set, the rate of subsequent cement hydration, and the properties of the mixture. For very lean concrete mixtures at normal temperature, a baseline time of 1.0 days may be reasonable. Mixtures that gain strength more rapidly at early ages may be

better approximated by an earlier reference time of 0.25 or 0.33 days (6 or 8 hours).

(c) Internal restraint factors, K_R, are computed using Equation A-5 or A-6 in Appendix A, depending upon the ratio of L/H, where L is the horizontal distance between joints or ends of the structure, and H is the depth of the tension block. Induced tensile strains are computed at each analysis time from Equation A-8 in Appendix A using the coefficient of thermal expansion, the temperature differences between the surface and interior concrete, and the computed internal restraint factors. These strains are compared with slow load tensile strain capacity (selected or tested to correspond to the time that strains are generated) to determine cracking potential.

(d) Stress-based surface gradient cracking analysis is often handled in a slightly different way, particularly in the way creep is accounted for in the analysis. Commonly, incremental temperature differences at different depths and times are computed. These incremental temperature differences are converted to incremental stresses, including creep effects, using the C_{th}, E_{sus}, and K_R. The incremental stresses generated during each time period are summed to determine the cumulative tensile stress in the surface concrete at various depths. These stresses are compared to the tensile strength of the concrete at the appropriate age to determine cracking potential.

e. Conclusions and recommendations. These typically include expected maximum temperatures for starting placement in different seasons, expected transverse and longitudinal cracking without temperature or other controls, recommended concrete placement temperature limitations, anticipated concrete precooling measures, need for adjustment in concrete geometry, properties, joint spacing, and the sensitivity of the thermal analysis to changes in parameters. Typical temperature control measures evaluated might include reduced lift heights, use of insulated forms, and reduction in mix cement content. The potential for thermal shock may be addressed. In addition, recommendations for further or more advanced thermal analysis should be provided and justified.

A3-2. Example 1: One-Dimensional Mass Gradient and Surface Gradient Thermal Analysis

a. General. An example of a 1-D mass gradient and a surface gradient analysis in a Level 2 thermal study of an MCS is presented below. This example is based on preliminary 1-D analyses performed during feasibility studies on a proposed large flood control RCC gravity dam on the American River in California. This dam was planned to be 146 m (480 ft) high, 792 m (2,600 ft) long, with a downstream face slope of 0.7H:1.0V.

(1) The 1-D analysis was used as a screening tool only, to provide preliminary evaluation of several concerns and to develop information for more detailed analyses. These studies were conducted to ascertain the general extent of thermal cracking (cracking due to mass thermal gradients and surface thermal gradients), for guidance in selecting an appropriate joint spacing to accommodate transverse thermal cracking, to evaluate the possibility of longitudinal cracking in the structure, and for early planning and cost-estimating purposes. Figure A3-1 illustrates the 1-D strip models employed in this analysis and the overall dam proportions.

(2) FE analysis in this study was used only to determine temperature history for the various schedule alternatives, using the Fortran program "THERM." Stresses were determined by manual computational methods, based on temperature change computed by the FE temperature analysis, the coefficient of thermal expansion, the sustained modulus of elasticity, and the degree of restraint. To account for stress relief due to creep and because the mass concrete modulus of elasticity is very low at early ages, the analysis is segmented into several time spans, 1 to 3 days, 3 to 7 days, and 7 to 28 days. This allows use of changing material properties (modulus and creep) to be used for each time span, as well as changing h and H dimensions of the surface gradient tension block with time. Consequently, temperature changes were determined for each time span.

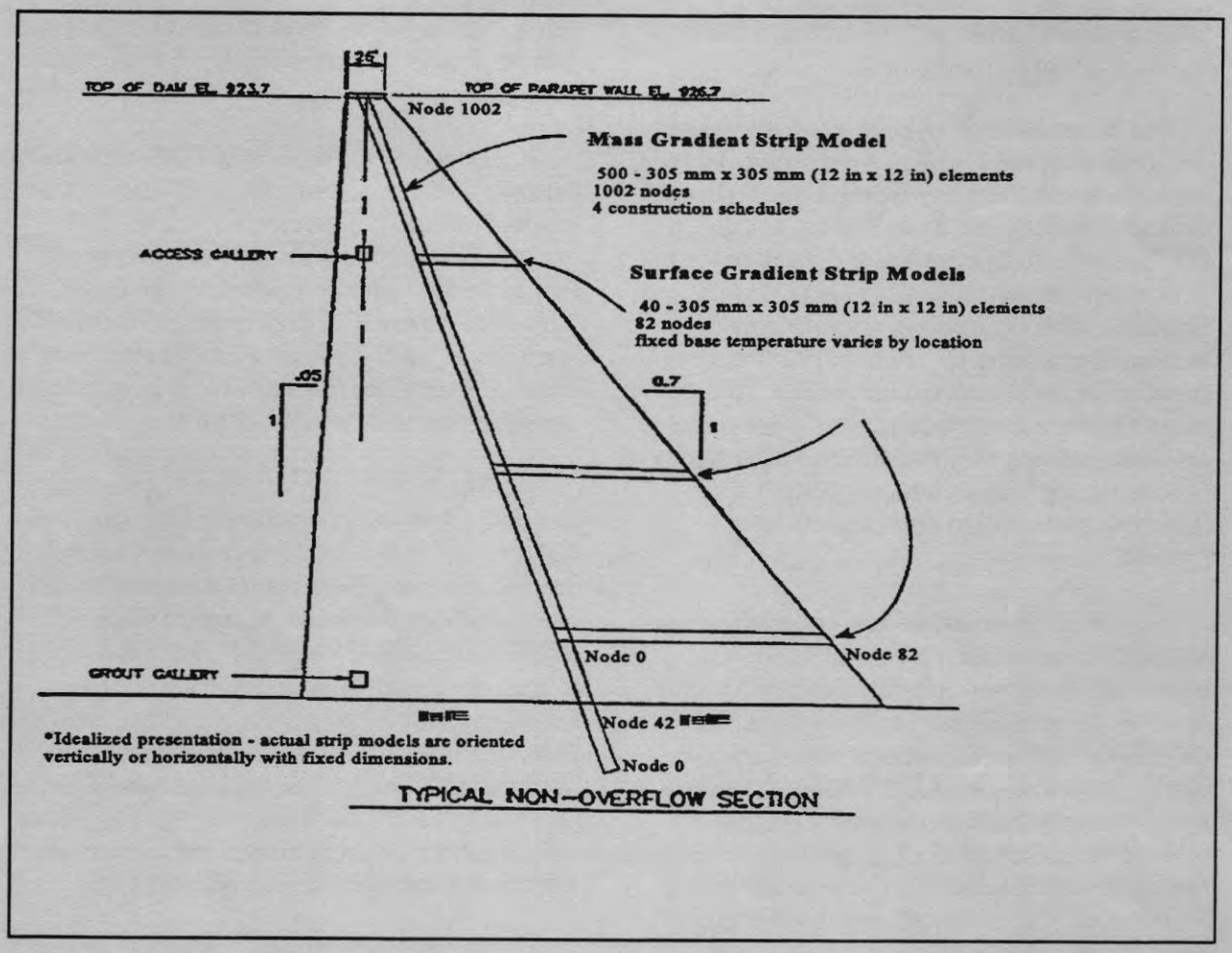


Figure A3-1. FE strip models

b. Input properties and parameters. At this early stage in the planning process, many of the details of the structure, materials performance, and placement constraints have not been determined and can only be approximated. It was decided that it would be prudent to make a reasonable estimate of those unknown parameters, and limit the study to evaluating the effects of variations of only a few items. In this study, those items subject to variations are certain material properties and the placing schedule.

(1) Step 1: Determine ambient conditions. Ambient air temperature data were produced from National Oceanic and Atmospheric Administration (NOAA) local climatological data. From these data, seven series of daily air temperature curves (shown in Figure A3-2) were developed, each representing the daily temperature cycle for one or more months. No data were available on how temperatures vary during each day. The curves are an estimate of the daily profile as it varies for each month throughout the year. No means of incorporating heat from solar gain was included in this analysis.

(2) Step 2: Determine material properties. Table A3-1 summarizes the applicable thermal and elastic properties of the materials considered for use in the structure. Most of the properties for the RCC and the foundation rock were estimated, or were the product of laboratory testing. Approximated values used for the modulus of elasticity, tensile strength, and creep rate are shown on Figure A3-3. Three materials were utilized for the analysis of the

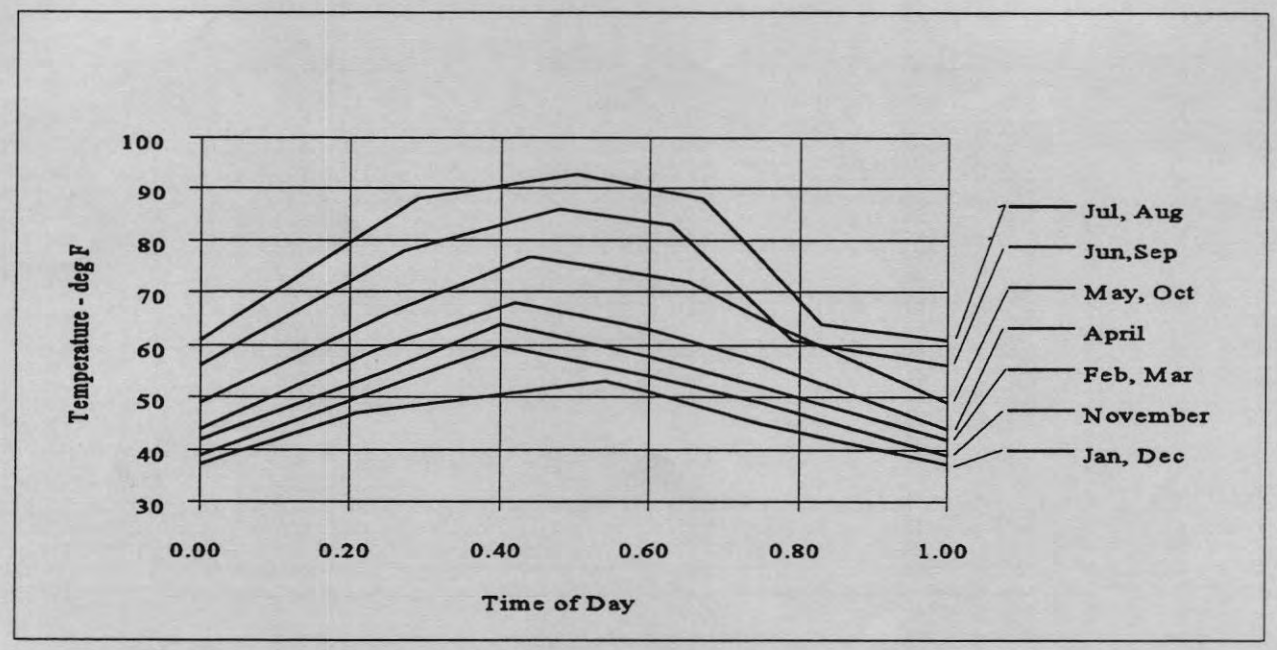


Figure A3-2. Daily ambient temperature cycles

Table A3-1
The RCC Material Properties for Mixtures

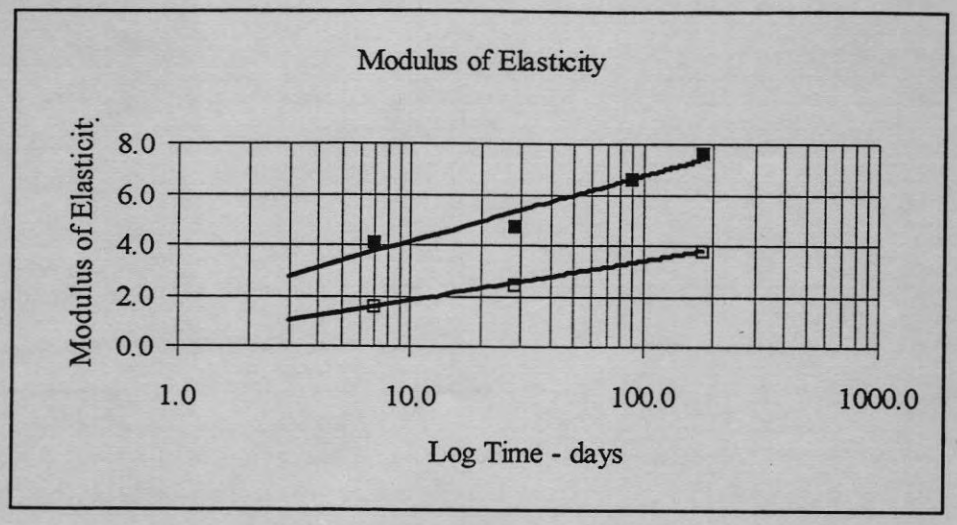
Property	Units	Damsite Alluvium	Damsite Amphibolite
Coefficient of thermal expansion (C_{th})[1]	millionths/deg C (millionths/deg F)	7.2 (4.00)	6.9 (3.86)
Thermal conductivity (K)	W/m-K (Btu/ft-hr-deg F)	2.42 (1.4)	2.77 (1.6)
Diffusivity (h^2)	m^2/hr (ft^2/hr)	0.038 (0.041)	0.0039 (0.042)
Specific heat ©	kJ/kg-K (Btu/lb-deg F)	0.92 (0.22)	0.92 (0.22)
Cement content[1]	kg/m^2 (lb/cy)	107 (180)	107 (180)
Flyash content[1]	kg/m^2 (lb/cy)	53 (90)	53 (90)
Adiabatic temperature rise (ΔT_{ad})	deg C (deg F)	15 (27)	15 (27)
Density[1]	kg/m^3 (lb/ft^3)	2,483 (155)	2,643 (165)
Tensile strain cap. (ϵ_{tc}) @ 7-90 day	millionths	100	100

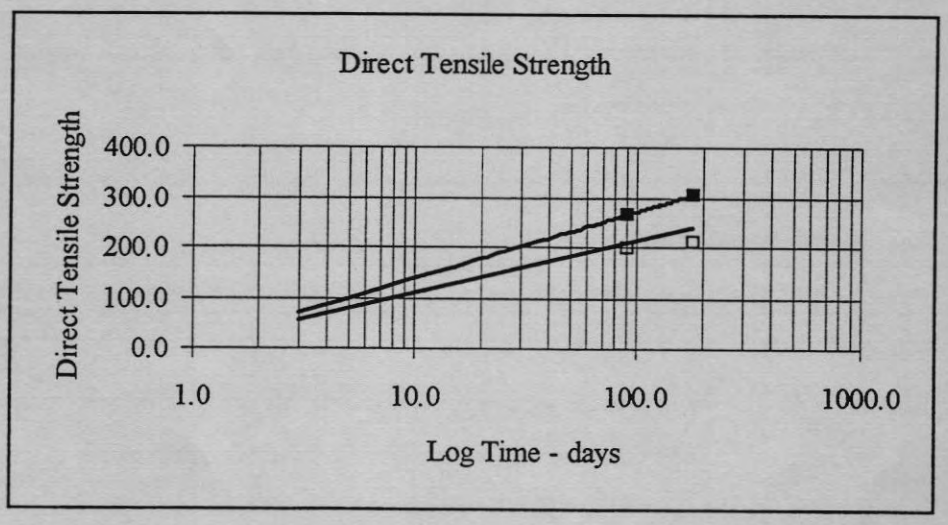
[1] From test results

foundation and the dam construction. The foundation rock was assumed to provide thermal behavior similar to the amphibolite aggregate. The first 200 lifts of the dam use an RCC mixture with damsite alluvium aggregates. The remaining 280 lifts utilize an RCC mixture with amphibolite (metamorphosed sandstone) aggregate from the damsite.

(3) Step 3: Determine construction parameters.

(a) Construction start dates. To evaluate the effects of different construction start dates, the placement of concrete was evaluated during four time intervals. The initiation of RCC placements was set at 1 January, 1 April, 1 July, and 1 October





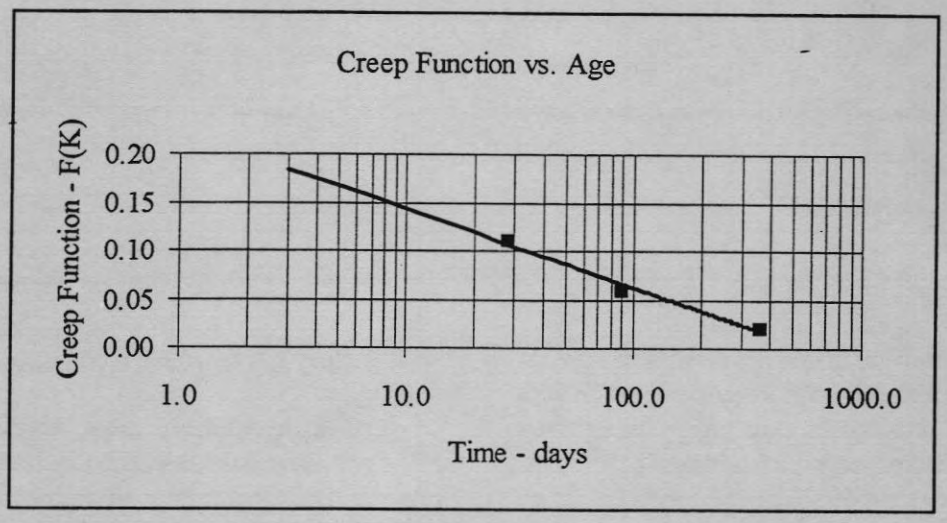


Figure A3-3. Estimated elastic and creep properties

of each year for the mass gradient analysis. For the surface gradient analysis, a 1 January start date was assumed.

(b) Concrete placing temperature. The temperature of the concrete aggregates has the greatest influence on the initial temperature of the fresh RCC. Because of the low volume of mix water, and the minor temperature differential of the water compared to the aggregate, the water temperature has a much less significant effect on overall temperature. Figure A3-4 provides the basis for the placing temperatures used in this study. Since aggregate production will be done concurrently by with RCC placement and regional temperatures tend to be moderate, stockpile temperatures should closely parallel the average monthly ambient temperatures. Some heat is added because of screening, crushing, and transportation activities, as shown in the figure, based on experience.

(c) Placement Assumptions. The RCC structure will be composed of two RCC mixtures, as previously described. The RCC placement will be in a 610-mm (24-in.) lift operation. The FE model is dimensioned having elements 305 mm (12 in.) in height. This allows future evaluations of 305-mm (12-in.) placing schemes, if desired. The RCC placement was assumed to occur on a schedule of 6 days per week, 20 hours per day, for the duration of the placement.

c. *Temperature analysis.*

(1) Step 4: Prepare temperature model (FE).

(a) The Fortran FE program "THERM", developed originally by Wilson (Wilson 1968), was used on a PC for the temperature analysis in this example. An Excel spreadsheet was used for development of an input file for THERM. Output nodal temperatures were imported into Excel spreadsheets for further analysis of cracking and graphical output. The FE grid, termed the mesh, provides more realistic results as it more accurately simulates the geometry of the structure. Since 1-D models (strip models) were used for the mass gradient analysis, heat only flowed vertically in or out of the model. Lateral heat flow in the upstream or downstream direction was not modeled. It is anticipated that actual heat dissipation in the dam over the long term will be at a more rapid rate than the model predicts. Since RCC construction is the continuous placement of relatively thin lifts, it is best modeled with elements of a height equivalent to the lift height or less. Unfortunately, since the American River Dam is a very massive structure, a mesh that provides ample detail would be monumental. A mesh of this magnitude is not necessary for the extent of evaluations to be done at this stage. Consequently, it was determined that a reasonable determination of internal temperatures could be done using strip models. A strip model is simply a vertical or horizontal "strip" of elements, usually only one element wide. Heat flows through the ends of the strip, but no heat flows from the sides. The model is located where necessary to simulate the thermal activity at that location. While the effects of many factors cannot be easily modeled using this method, generalized behavior can be determined.

(b) The primary mesh for mass gradient analysis, shown in Figure A3-1, is composed of 500 elements and 1,002 nodes. It simulates a strip through a cross section of the dam originating 6 m (20 ft) in the foundation rock. Elements 1 to 20 form the rock foundation with the bottom row of nodes set at a fixed temperature of 115.5 deg C (60 deg F), the mean annual air temperature for the area. An arbitrary time of 30 days is allowed to elapse prior to concrete placement to allow the rock temperatures to stabilize.

(c) The RCC at about dam midheight was evaluated for a surface temperature gradient. The surface gradient strip model spans from the exposed surface along a single lift to a point inside the structure where temperatures are assumed to not be influenced by ambient conditions. A small FE model was generated of approximately 82 nodes and 40 elements. Temperature histories of these nodes were then determined. The exterior surface of the surface gradient strip model was assumed to be fully exposed, with no insulation, using a heat transfer coefficient of 28.45 W/m^2-K (5.011 Btu/ft^2-hr-deg F).

Month	Mean Temp	Mean Annual	Diff	2/3 Diff	Sub Total	Crush Add	Stock Temp	Mixing Add	Trans Add	Final Temp
	degC (degF)	degC (degF)	degC (degF)	degC (degF)	degC (degF)	degC (degF)	degC (degF)	degC (degF)	degC (degF)	degC (degF)
Jan	7.1 (44.8)	15.5 (60.0)	-8.4 (-15.2)	-5.6 (-10.1)	9.9 (49.9)	1.1 (2.0)	11.1 (51.9)	1.1 (2.0)	-0.6 (-1.0)	11.7 (53)
Feb	9.2 (48.6)	15.5 (60.0)	-6.3 (-11.4)	-4.2 (-7.6)	11.3 (52.4)	1.1 (2.0)	12.4 (54.4)	1.1 (2.0)	0	13.3 (56)
Mar	10.5 (50.9)	15.5 (60.0)	-5.1 (-9.1)	-3.4 (-6.1)	12.2 (53.9)	1.1 (2.0)	13.3 (55.9)	1.1 (2.0)	0.6 (1.0)	15.0 (59)
Apr	13.2 (55.8)	15.5 (60.0)	-2.3 (-4.2)	-1.6 (-2.8)	14.0 (57.2)	1.1 (2.0)	15.1 (59.2)	1.1 (2.0)	0.6 (1.0)	16.7 (62)
May	17.0 (62.6)	15.5 (60.0)	1.4 (2.6)	0.9 (11.7)	16.5 (61.7)	1.1 (2.0)	17.6 (63.7)	1.1 (2.0)	1.1 (2.0)	20.0 (68)
Jun	21.4 (70.5)	15.5 (60.0)	5.8 (10.5)	3.9 (7.0)	19.4 (67.0)	1.1 (2.0)	20.6 (69.0)	1.1 (2.0)	1.1 (2.0)	22.8 (73)
Jul	25.1 (77.2)	15.5 (60.0)	9.6 (17.2)	6.4 (11.5)	21.9 (71.5)	1.1 (2.0)	23.1 (73.5)	1.1 (2.0)	1.7 (3.0)	25.6 (78)
Aug	24.5 (76.1)	15.5 (60.0)	8.9 (16.1)	5.9 (10.7)	21.5 (70.7)	1.1 (2.0)	22.6 (72.7)	1.1 (2.0)	1.7 (3.0)	25.6 (78)
Sep	22.1 (71.8)	15.5 (60.0)	6.5 (11.8)	4.4 (7.9)	19.9 (67.9)	1.1 (2.0)	21.1 (69.9)	1.1 (2.0)	1.1 (2.0)	23.3 (74)
Oct	17.4 (63.4)	15.5 (60.0)	1.9 (3.4)	1.3 (2.3)	16.8 (62.3)	1.1 (2.0)	17.9 (64.3)	1.1 (2.0)	0.6 (1.0)	19.4 (67)
Nov	11.5 (52.7)	15.5 (60.0)	-4.1 (-7.3)	-2.7 (-4.9)	12.8 (55.1)	1.1 (2.0)	13.9 (57.1)	1.1 (2.0)	0	15.0 (59)
Dec	7.7 (45.9)	15.5 (60.0)	-7.8 (-14.1)	-5.2 (-9.4)	10.3 (50.6)	1.1 (2.0)	11.4 (52.6)	1.1 (2.0)	-0.6 (-1.0)	12.2 (54)

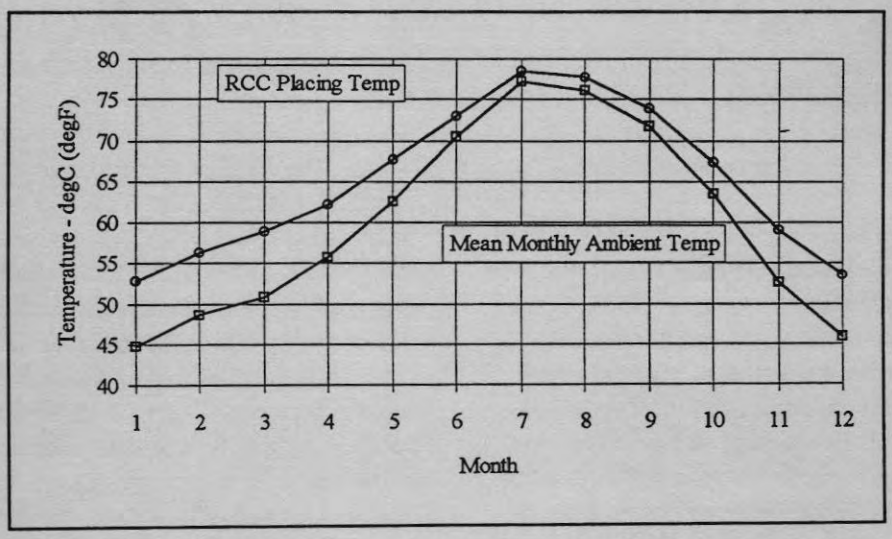


Figure A3-4. RCC placing temperature

(2) Compute temperature histories.

(a) Step 5: Mass gradient temperature analysis. Graphical representations for each of the four cases analyzed (one for each season) are shown in Figures A3-5 through A3-12. The first graph in each set is a time-history of nodal temperatures for selected nodes in the structure. This graph is useful to determine the time when certain zones in the structure reach certain temperatures. The second graph displays the maximum and minimum temperature experienced by each node. Note that these maximums and minimums occur at different times. The minimum temperatures of adjacent nodes fluctuate approximately 4 deg C (8 deg F) because of ambient temperature fluctuations. This graph is useful in determining the maximum temperature differentials, as well as determining the critical zones.

(b) Step 6: Surface gradient temperature analysis. Graphical representation of the single start date case analyzed is shown in Figure A3-13, and is comprised of families of curves representing temperature change with time for different depths from the exterior surface of the MCS. Figure A3-14 shows these temperatures converted to a family of curves of time versus distance from the surface on the x-axis. This conversion is done to ease the subsequent cracking analysis computations.

d. Cracking analysis. It is assumed for the purposes of this study that the initial (baseline) temperatures of the hardened RCC are those temperatures when the RCC is 24 hours old. Any subsequent change in temperature from this base forms the temperature gradient. For surface gradient analysis, the shallowest interior nodes where

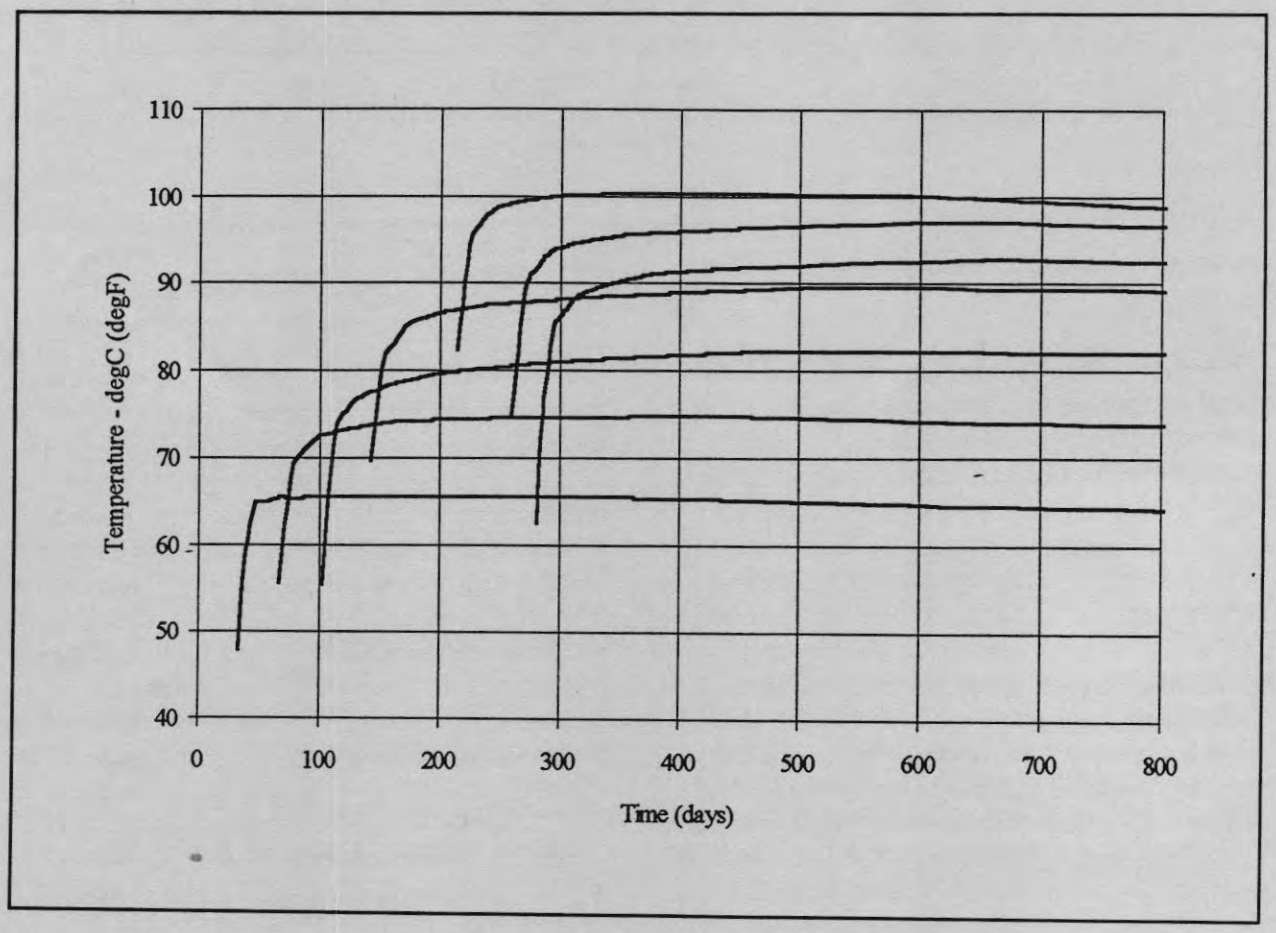


Figure A3-5. Mass gradient temperature histories for 1 January start

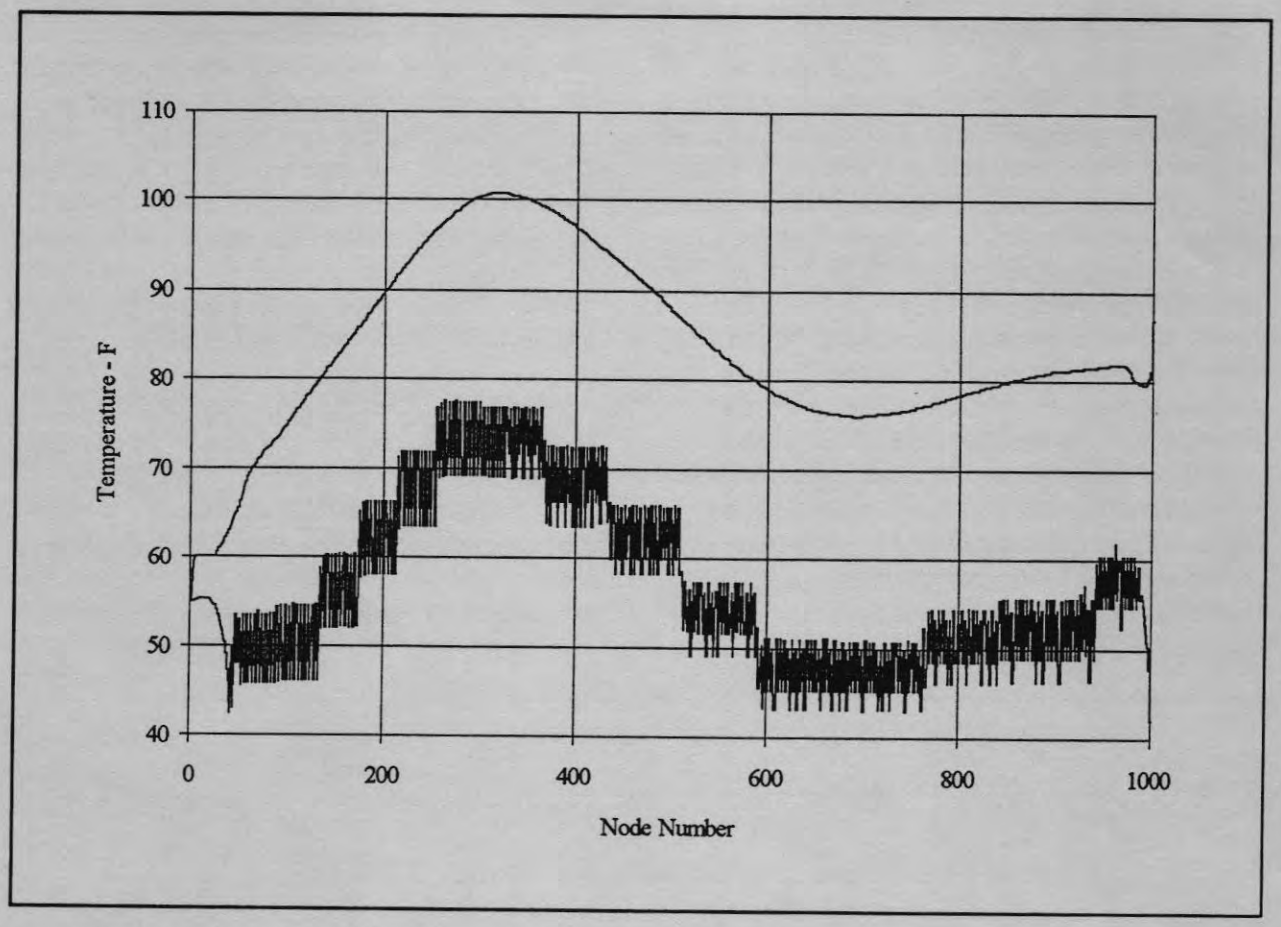


Figure A3-6. Mass gradient peak temperatures for 1 January start

temperatures do not change are assumed to be the location of the stress and strain-free surface. The distance from the surface to the location under consideration is used to calculate restraint factors (K_R) for both surface and mass gradient analysis.

(1) Step 7: Mass gradient cracking analysis. Several general statements can be made regarding the data. At locations low in the structure near the foundation, restraint conditions are the greatest. Consequently, allowable temperature differentials are at a minimum there. Progressing up and away from the foundation, restraint decreases, allowing a greater temperature differential before the onset of cracking. The graphs (Figures A3-6, 8, 10, and 12) in each of the analysis sets represent sections for the full height of the structure. However, the data can be applied to dam sections founded at higher elevations (*e.g.*, the abutments) by merely moving the y-axis to the right to a point corresponding to the appropriate foundation elevation. In this manner, the performance of the entire structure can be evaluated. In general, no cracking is expected if peak temperatures, low in the structure, do not exceed 29.4 deg C (85 deg F); because long-term cooling of the structure to 15.5 deg C (60 deg F) results in a 13.9-deg C (25-deg F) differential. Where nodal temperatures approach 37.8 deg C (100 deg F), they can be expected to remain above 29.4 deg C (85 deg F) for at least 5 years, and final cooling of the interior to 15.5 deg C (60 deg F) may take 15 to 20 years.

(a) Placement start on 1 January (Figures A3-5 and 6). Peak temperatures of 29.4 to 37.8 deg C (85 to 100 deg F) are realized in the part of the structure represented by nodes 200 to 500. This peak occurs during the month of July, after

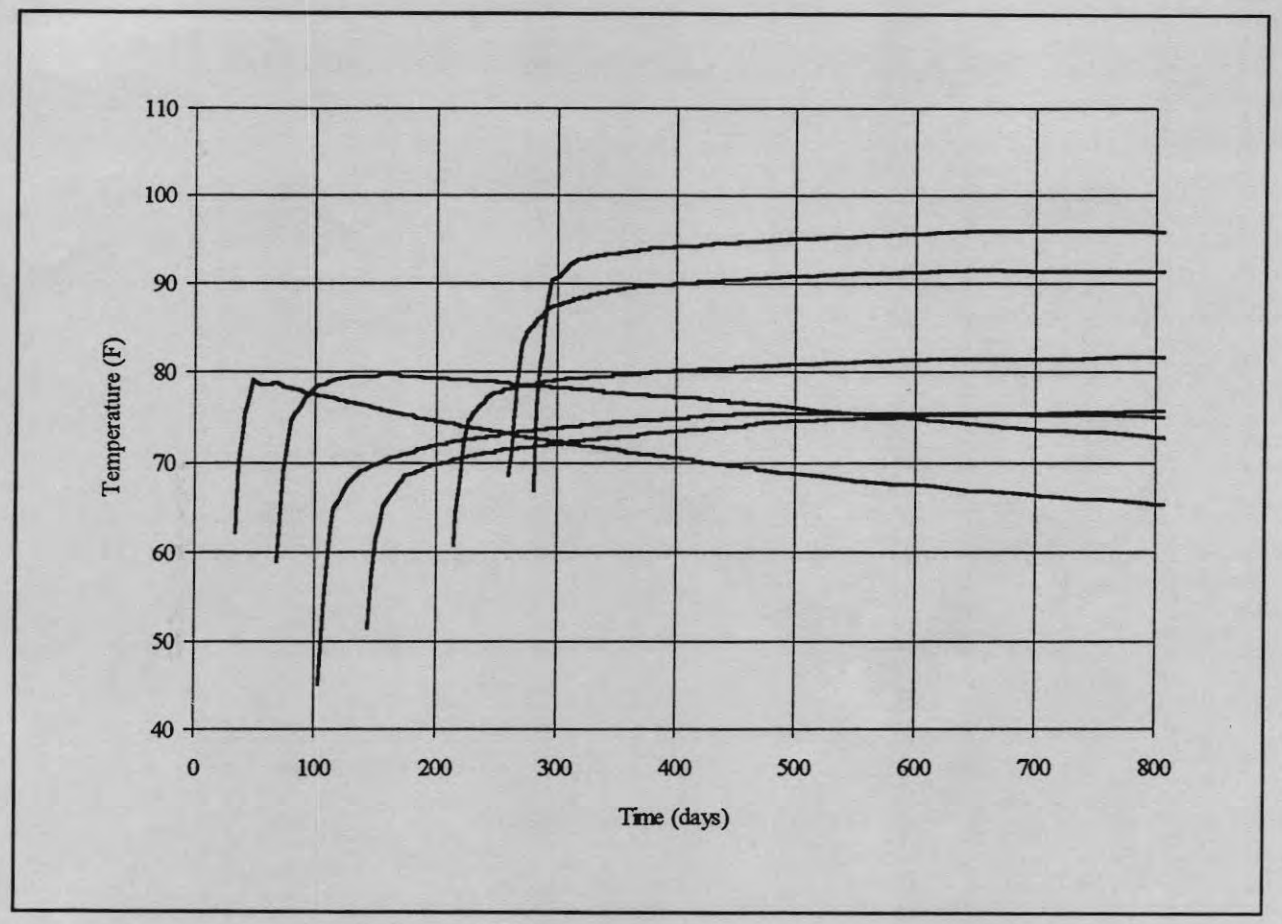


Figure A3-7. Mass gradient temperature histories for 1 October start

approximately 200 days of placement. Initial placements for the large monoliths are performed during the cool part of the year (winter and early spring), resulting in crack-free performance. Higher in the structure, where peak temperatures exceed 29.4 deg C (85 deg F), cracking does not occur because foundation restraint is reduced. The placements generating peak temperatures and resultant strains that may initiate cracking are those placements on the abutments between elevation 90 and 240 for a January start. This can be seen on Figure A3-6. Nodes 200 to 500 exceed 29.4 deg C (85 deg F). These nodes are located 27 to 73 m (90 to 240 ft) above the deepest foundation elevation.

(b) Placement start on 1 October (Figures A3-7 and 8). Peak temperatures of 29.4 to 37.8 deg C (85 to 100 deg F) are realized in the part of the structure represented by nodes 300 to 900. This peak occurs during the month of July, after approximately 300 days of placement. Initial placements for the large monoliths are performed during the cooler part of the year (fall, winter, and early spring), and peak temperatures never reach the critical level of 29.4 deg C (85 deg F). However, higher in the structure, where temperatures do exceed 29.4 deg C (85 deg F), cracking does not occur because foundation restraint is reduced. For an October start, the placements generating peak temperatures and resultant strains that may initiate cracking are those placements on the abutments at elevations 43 to 134 m (140 to 440 ft) from the lowest foundation elevation.

(c) Placement start on 1 July (Figures A3-9 and 10). Peak temperatures of 29.4 to 37.8 deg C (85 to 100 deg F) are realized in the part of the structure represented by nodes 50 to 200 and 500 to 1000.

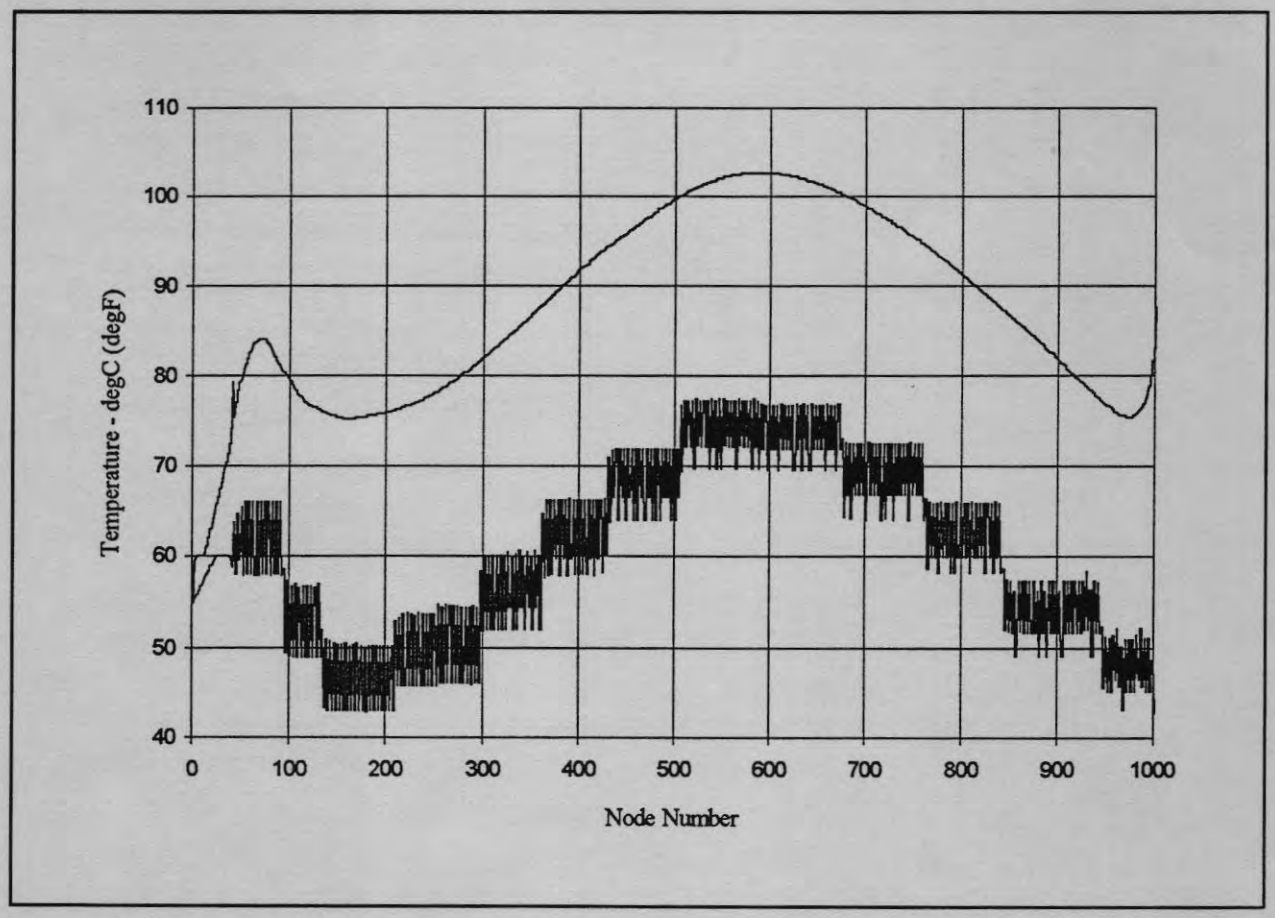


Figure A3-8. Mass gradient peak temperatures for 1 October start

This peak occurs after approximately 100 days of placement (during the month of July) for the early placements; and 1 year later for the upper dam placements. Initial placements for the large monoliths are performed during the warmest part of the year (the summer and early fall months), and peak temperatures exceed the critical level of 29.4 deg C (85 deg F). However, higher in the structure, where temperatures do exceed 29.4 deg C (85 deg F), cracking does not occur because foundation restraint is reduced. For a July start, the additional placements generating peak temperatures and resultant strains that may initiate cracking are those placements on the abutments at elevations 73 to 146 m (240 to 480 ft) above the lowest foundation elevation.

(d) Placement start on 1 April (Figures A3-11 and 12). Peak temperatures of 29.4 to 37.8 deg C (85 to 100 deg F) are realized in the part of the structure represented by nodes 100 to 400 and 800 to 1000. This peak occurs during the month of July, after approximately 100 days of placement for the early placements; and 1 year later for the upper dam placements. Initial placements for the large monoliths are performed during the moderate part of the year (the spring), avoiding cracking. Higher in the structure, where temperatures exceed 29.4 deg C (85 deg F), cracking does not occur because foundation restraint is reduced. Additional placements generating peak temperatures and resultant strains that may initiate cracking are those placements on the abutments from an elevation 12 to 49 m (40 to 160 ft) above the lowest foundation elevation and placements near the top of the dam.

(e) Mass gradient cracking analysis results. The following table summarizes, for each placing

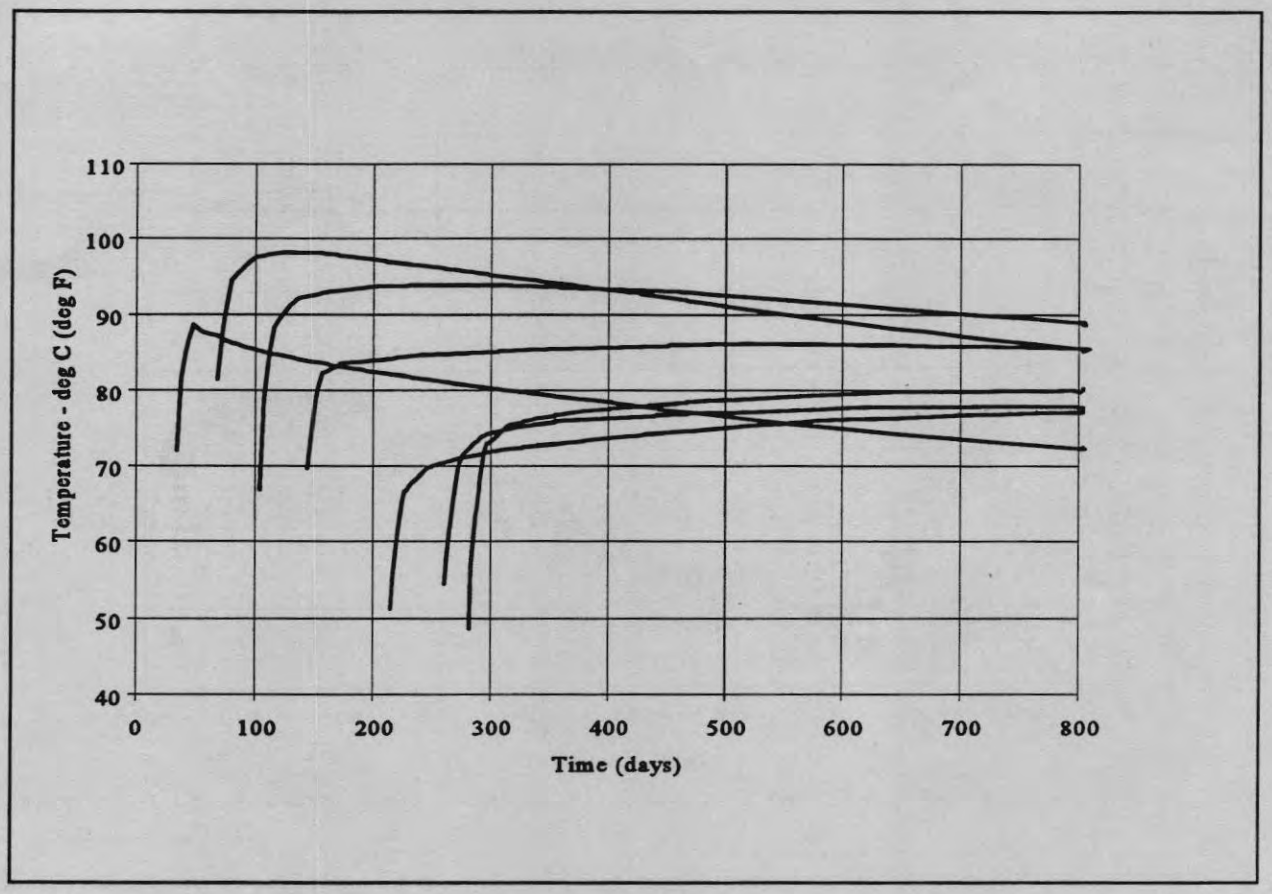


Figure A3-9. Mass gradient temperature histories for 1 July start

schedule evaluated, the nodes and the node locations where mass gradient thermal cracking is expected. The "Height Above Foundation" refers to those abutment foundation locations at elevations above the lowermost foundation elevation. For example, a January-start schedule results in probable cracking of nodes 200 to 400, and foundation elevations located 27 to 73 m (90 to 240 ft) above the lowest foundation elevation.

Uncontrolled RCC placing temperatures will result in peak temperatures of 37.8 deg C (100 deg F) and ultimate temperature differentials of 22.2 deg C (40 deg F). The maximum temperature differential calculated from tensile strain capacity and the coefficient of thermal expansions is 13.9 deg C (25 deg F) for the near term, increasing to near 16.7 deg C (30 deg F) for cooling periods of 15 years. Fall and winter placements result in cool placing temperatures, with peak temperatures for those placements of less than 29.4 deg C (85 deg F). Spring and summer placements result in peak temperatures exceeding 29.4 deg C (85 deg F), making cracking very probable. Cracking is generally induced at the foundation, where full restraint occurs and progresses up until restraint conditions lessen to the point where the driving force behind the crack is reduced. Since the force to propagate an existing crack is less than the force necessary to initiate the crack, it seems appropriate to assume that existing cracks may propagate further. The values shown in Table A3-2 do not include this extra crack height. Longitudinal cracking of the RCC in the large sections is not expected to be a problem when placement is done during the cool periods of the year. If these placements are done during the hot periods of the year, longitudinal

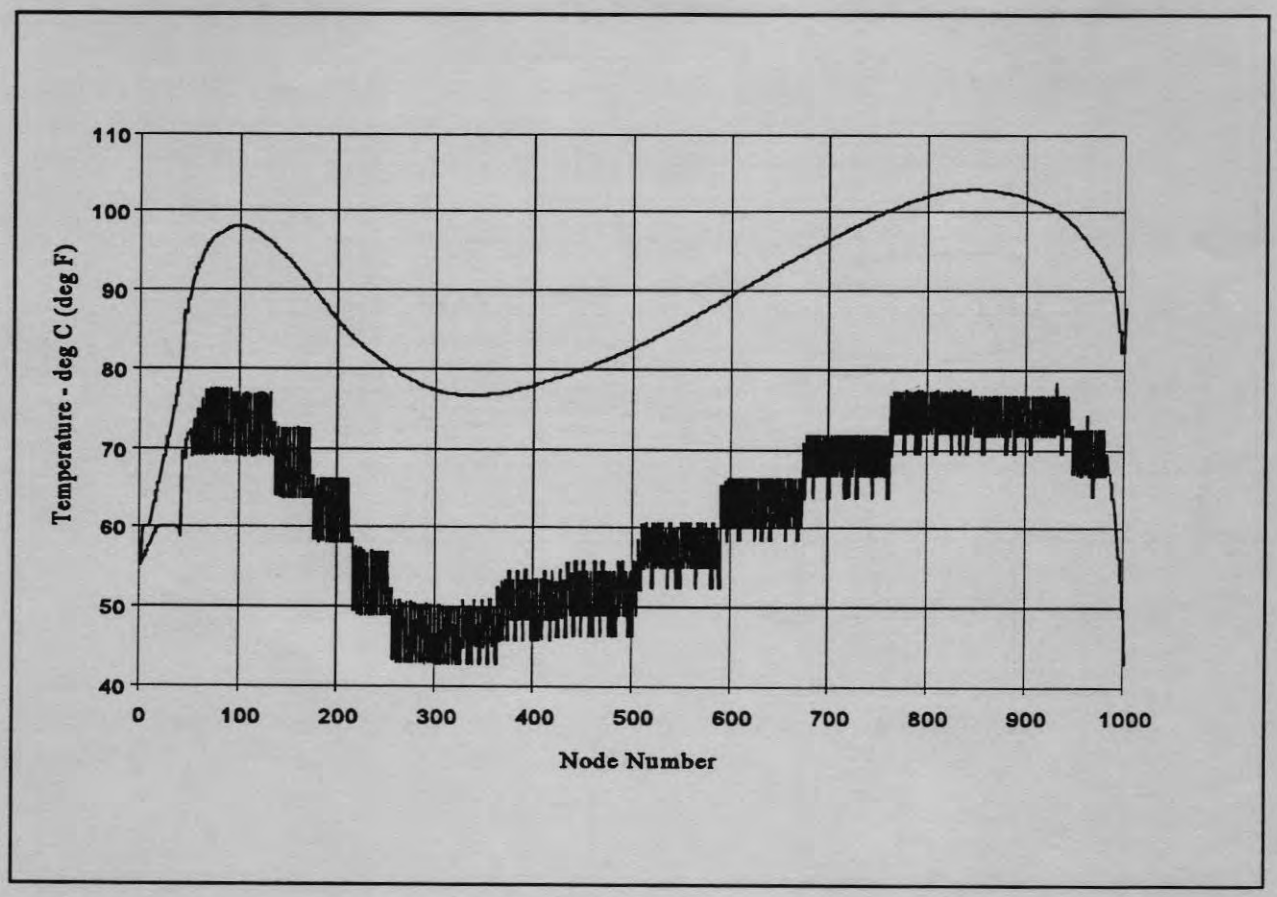


Figure A3-10. Mass gradient peak temperatures for 1 July start

cracking may occur. As construction progresses, placement of smaller RCC sections (those placements founded on rock at higher elevations) during hot periods is unavoidable. Longitudinal cracking of RCC placed against higher elevation foundation areas during these periods may occur. The conditions that may initiate longitudinal cracking may also initiate transverse cracking. The occurrence of transverse cracks can be reduced by installing transverse joints, thereby reducing the restraint.

(2) Step 8: Surface gradient cracking analysis. Surface gradient analysis was performed for several concrete placement start times, including the 1 January start time shown in this example. The effects of transverse joints at three different spacings were evaluated, including 30 m (100 ft), 61 m (200 ft), and 91 m (300 ft). The amphibolite aggregate RCC mixture was used in the evaluation. The procedure described here allows for consideration of changing concrete properties with age, such as E and creep, as well as changing h and H dimensions of the surface gradient tension block with time.

(a) Figure A3-13 presents the temperature data as a time-history plot for the conditions that should create the greatest surface gradient. Replotting the same data, based on nodal locations, yields Figure A3-14. Note that each curve represents the temperature cross section of the structure for a specific time. Each curve extends into the structure until the temperature becomes constant. Temperature differentials at specific locations are selected from Figure A3-14 and listed in Figure A3-15 (for 91-m (300-ft) joint spacing. Two basic assumptions are made in this analysis. First, temperatures of the RCC, at an age of 24 hours, are the baseline temperatures against which temperature change is determined. Second, the stress-strain free surface is assumed to be the depth at which the temperature

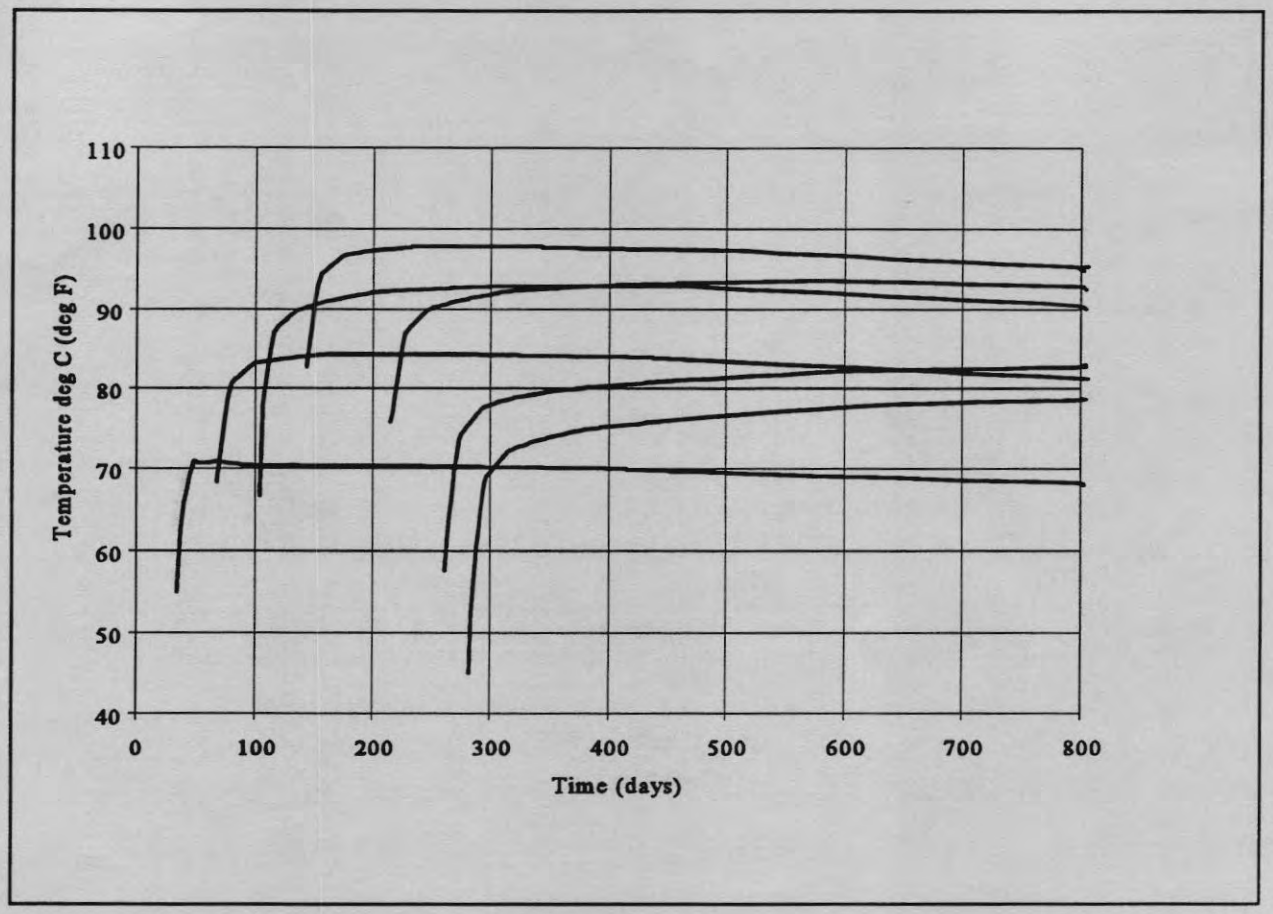


Figure A3-11. Mass gradient temperature histories for 1 April start

change, measured from the baseline temperature, approaches 0. Figure A3-15 shows the temperature deviations (*dT*) from the baseline temperature, as well as the depth at which the temperature gradient approaches 0. The Sum *dT* temperature differences are included on Figure A3-15 as a starting point for calculating induced stresses. "Induced *dT*," or the individual increments of temperature gradient induced with each age period, is calculated from the "Sum *dT*'s." Sustained modulus of elasticity (E_{sus}) is determined in Figure A3-15 for each age increment. To calculate incremental stress generated by temperature gradients:

$$\text{Incremental Stress} = (Ind\ dT)(C_{th})(E_{sus})$$

To determine K_R, Equation A-5 (Appendix A) is used, requiring calculation of *H*, *L*, and *h*. *H* is the distance from the exterior surface to the stress and strain-free surface at each incremental time period and is determined from the Temperature Differential Table in Figure A3-15 (note *H* for each age increment is the same). *L* is the joint spacing. *h* is the distance from the surface to the depth of interest (near surface, 0.6 , 1.5, 3, and 6 m (2, 5, 10, and 20 ft) in the figures), and *h/H* is the proportion of *H* from the surface to the depth of interest. *h/H* largely determines the amount of restraint at any location. K_R is calculated from Equation A-5 (Appendix A) for $L/H \geq 2.5$. The "Adj Stress" is calculated by:

$$\text{Adj Stress} = (K_R)(\text{Incremental Stress})$$

Cumulative stresses are then summed by superposition of stress from each age interval. Crack development is judged by whether the cumulative stress exceeds the tensile strength.

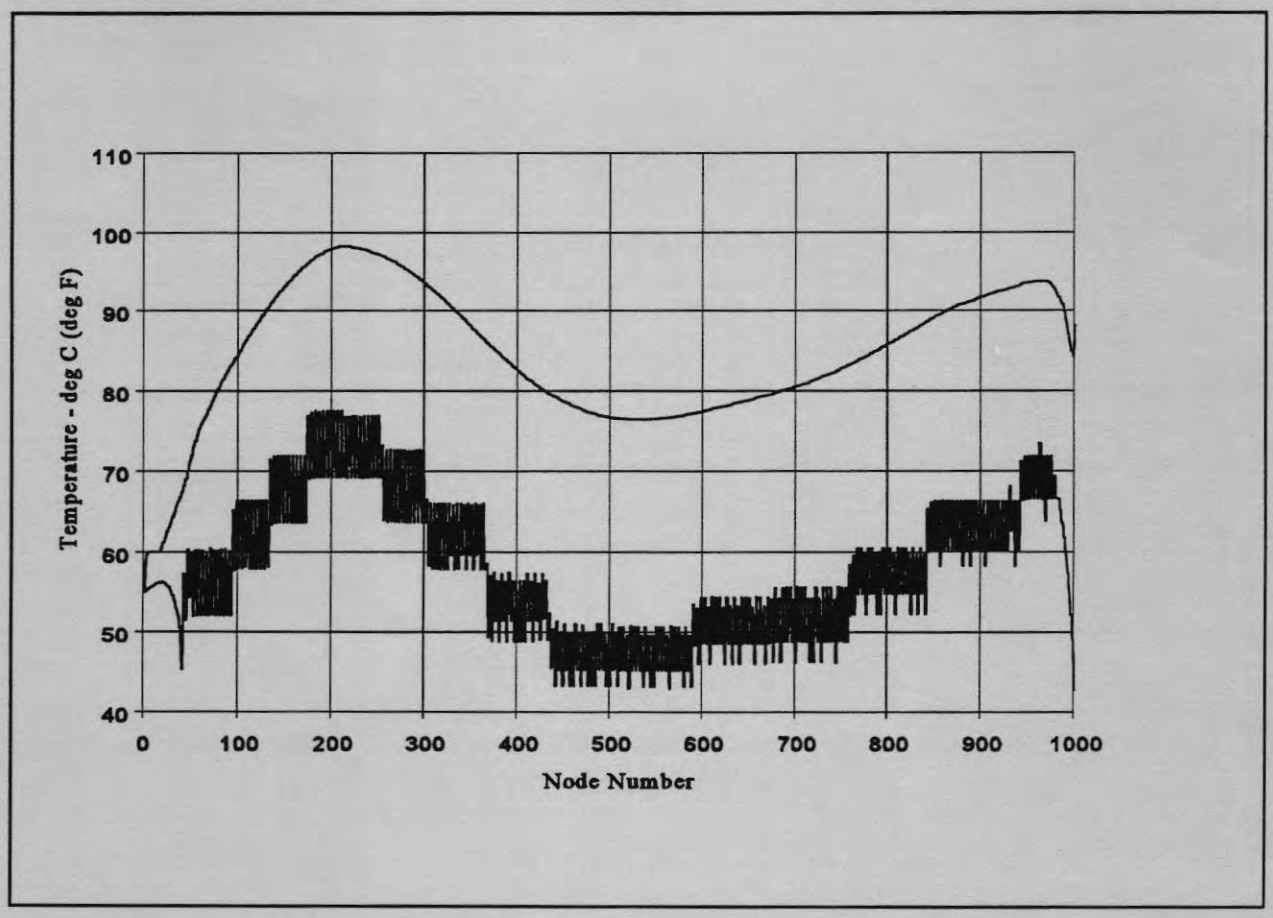


Figure A3-12. Mass gradient peak temperatures for 1 April start

From Figure A3-15 and similar computations for 30-and 61-m (100- and 200-ft) joint spacings, the computations indicate that surface cracking is not likely for a 30-m (100-ft) joint spacing. Surface cracking may increase to a depth of 0.6 m (2 ft) for joint spacings up to 61 m (200 ft) and up to 1.5 m (5 ft) for joint spacings of 91 m (300 ft). The full extent of surface cracking is controlled by the formation of the initial surface cracks. For example, at a joint spacing of 91 m (300 ft), the surface may crack at the midpoint. The analysis shows that this crack may propagate to a depth of 1.5 m (5 ft) after several weeks to months. However, the occurrence of this crack forms a new joint pattern at a spacing of 46 m (150 ft). While the depth of cracking may not be sufficient to change the restraint conditions (L/H), it may be enough to relieve induced stresses and stabilize the crack growth to depths of 0.6 m (2 ft). A joint spacing of 61 m (200 ft) may be an optimum spacing for this project based on the occurrence of surface cracking. Evaluation of the combined effects of surface gradient strains with mass gradient strains was not pursued, since the surface gradient strain contribution is not considered to be significant to the overall cracking performance of the structure using joint spacings of 30 and 61 m (100 and 200 ft).

e. Conclusions and recommendations. The maximum temperature differential under full restraint conditions ($K_R = 1.0$) that will not result in cracking of the RCC is 13.9 deg C (25 deg F). Since the final temperature of the RCC will be 15.5 deg C (60 deg F) (the average annual temperature), a crack-free peak RCC temperature is 29.4 deg C (85 deg F). This allowable differential of 13.9 deg C (25 deg F) increases as the distance of the RCC placements from the foundation

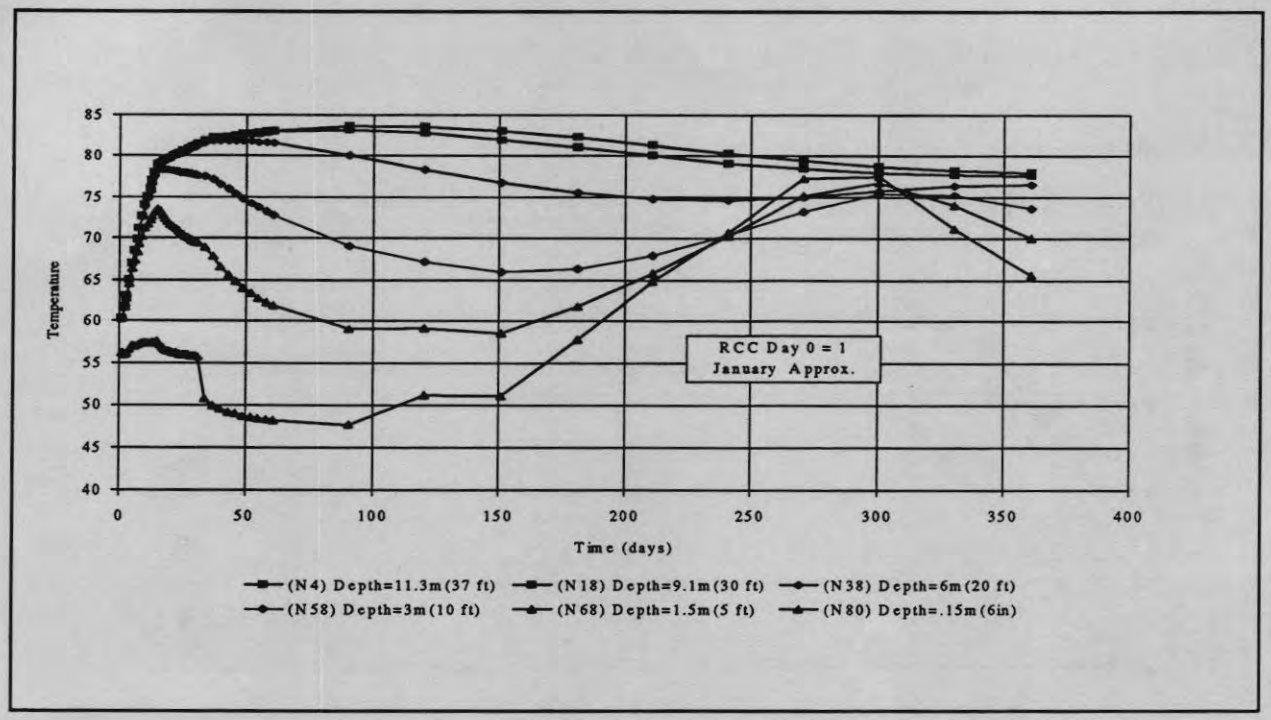


Figure A3-13. Temperature history for selected nodes from surface gradient model

increases. After evaluating several placing schedules, it was apparent that the most beneficial conditions occurred when the RCC placement of the lower third of the dam commenced in the fall of the year and was completed during late spring. This means that, for the larger dam sections, the upper two-thirds would then be placed during a hotter time period. The reduction in foundation restraint at this height in the structure, however, more than offset the effects of the higher temperatures.

Surface gradients were evaluated for several transverse joint intervals. Because the site is located in a relatively temperate area, where cold temperatures are rare, stresses from surface gradients were of little consequence for joint spacings up to 61 m (200 ft). Greater joint spacings increase the depth of surface cracking.

For contraction joints set at a spacing of approximately 61 m (200 ft), transverse cracking of the structure may occur in the lower 6 to 12 m (20 to 40 ft) of the structure. Similarly, longitudinal cracking may occur in the lower 6 to 12 m (20 to 40 ft) of the structure for sections of the dam having an upstream-downstream dimension greater than 61 m (200 ft). Since the occurrence of a longitudinal crack could create serious stability concerns, more rigorous analyses coupling the effects of other simultaneous loadings are necessary to better evaluate the extent of cracking.

An alternate rock source, a nearby quarried limestone aggregate, provides an RCC with a very low coefficient of thermal expansion of 4.5 millionths/deg C (2.5 millionths/deg F). The net effect of using this aggregate instead of the damsite amphibolite is to raise the allowable maximum peak temperature from 29.4 to 37.8 deg C (85 to 100 deg F). It appears that if this aggregate is used, no further control of aggregate temperatures may be necessary. Without this aggregate, measures are necessary to control placing temperatures so that peak temperatures do not exceed 29.4 deg C (85 deg F). This requires a 15.5-deg C (60-deg F) placing temperature for certain placements. This placing temperature could be raised to 23.9 deg C (75 deg F), if the limestone aggregate was used.

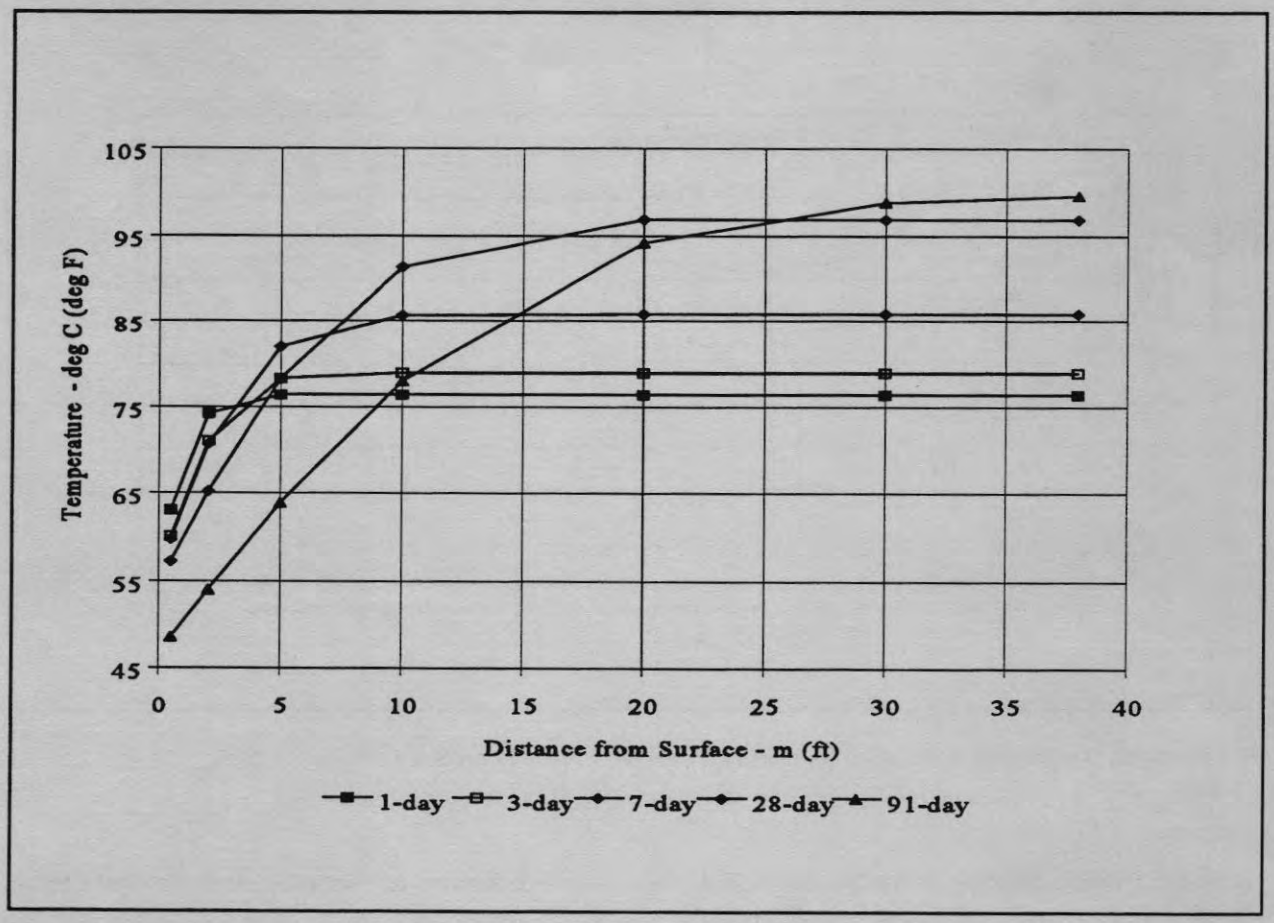


Figure A3-14. Surface gradient temperature distribution

Completion of RCC placements up to a minimum elevation during a fall and winter time period should be required in the construction contract. Otherwise, if these low elevation placements are placed during the spring and summer period, the RCC placing temperature should be specified not to exceed 26.7 to 29.4 deg C (80 to 85 deg F). This will require the use of additional cooling measures. Stockpile sprinkling, water chilling, and possible shading may be sufficient to achieve these temperatures.

The scope of this study was of a limited nature: to identify the potential extent of thermal cracking in the structure. Only generalized conclusions are possible. For a structure of this height, volume, and seismic loadings, a more rigorous study should be performed during design of the structure.

Full-section modeling, incorporating foundation properties, restraint conditions, and early-age material properties (time- and temperature-dependent properties) should be done. The structure should be analyzed in sections to ascertain the strain development that may lead to longitudinal cracking and in elevation to ascertain strain development that may lead to transverse cracking. The results of these studies should guide the designer as to whether a three-dimensional (3-D) model is necessary. It is presumed that a 3-D analysis will indicate better cracking performance of the structure than a two-dimensional (2-D) model would indicate. This analysis should quantify the effects of several load conditions in addition to the thermal loads. It may be that the combined action of these factors will initiate cracking.

Table A3-2
Summary of Locations of Mass Gradient Thermal Cracks

Schedule	Peak Temp deg C (deg F)	Critical Nodes	Height Above Foundation, m (ft)
Jan	37.8 (100)	200-400	27 - 73 (90-240)
Oct	37.8 (100)	300-900	43 - 134 (140-440)
July	37.8 (100)	50-200 and 500-1000	73 - 146 (240-480)
April	37.8 (100)	100-400 and 800-1000	12 - 49 (40-160) and near top of dam

A3-3. Example 2: Two-Dimensional Mass Gradient and Surface Gradient Thermal Analysis

a. General. An example of each step in the performance of a relatively complex mass gradient and a surface gradient analysis in a Level 2 thermal study of an MCS is presented. This example is based on 2-D analyses performed during design studies for locks and dam facilities on the Monongahela River in Pennsylvania. These studies were conducted to maximize lift heights and determine optimum placement temperatures, to expedite construction and minimize costs. Although numerous lock monolith configurations exist in the project, the most massive section was selected for analysis. Conclusions and recommendations from this analysis could be applied to the other project monoliths. Figure A3-16 shows a cross section representation of the geometry of a river wall monolith with nominal 3-m (10-ft) lifts used in this example analysis. Two-dimensional FE analysis was used to determine temperature histories and temperature distribution during and following construction. FE analysis was not applied for cracking analysis. Cracking analysis was performed using a strain-based criteria similar to procedures described in ACI 207.2R. Slow-load tensile strain capacity test results (which include creep effects) were used to determine the extent of cracking. Analysis was performed on 15 combinations of several parameters, including three lift heights, two maximum concrete placement temperatures, three construction start times, two lift placement rates, and insulated forms for fall placement.

b. Input properties and parameters.

(1) Step 1: Determine ambient conditions. These data were gathered from local records. Ambient temperature data are shown in Figure A3-17.

(2) Step 2: Determine material properties. Table A3-3 contains thermal properties used in the example thermal analysis. Adiabatic temperature rise is shown in Figure A3-18. This adiabatic temperature rise is characteristic of the heat generation of an exterior concrete in a mass concrete structure and is not characteristic of interior mass concrete. The foundation material is assumed to be limestone of moderate strength. Table A3-4 contains mechanical properties used in the example thermal analysis modulus of elasticity of concrete and foundation materials are required for determination of foundation restraint factors. Slow-load tensile strain capacity values were developed using Annex 1 methodology for use in mass and surface gradient cracking analysis as discussed later in this annex.

(3) Step 3: Determine construction parameters. Figure A3-17 shows the concrete placement temperatures used in the example thermal analysis. Maximum placement temperature during the summer is 15.5 deg C (60 deg F), and minimum placement temperature during the winter is 4.4 deg C (40 deg F), based on previous specification experience. Placement temperatures are expected to

Sustained Modulus of Elasticity (x 10E6 psi)

Age (T)		E2	E1	Eave	F(k)	Esus
1	3	1.20	2.70	1.95	0.20	1.72
3	7	2.70	4.00	3.35	0.17	2.42
7	28	4.00	5.20	4.60	0.14	2.31
28	90	5.20	6.70	5.95	0.11	2.51

Data from Figure B3

1/Esus=(1/((E1+E2)/2)+F(k)*ln(T2-T1)/2
Esus = Sustained Modulus
F(k) = Creep Function

Temperature Differential (degF)

Surface	.5-ft	2-ft	5-ft	10-ft	20-ft	30-ft
3-day						
dT	3	3	-2	-3	-3	-3
Sum-d	6	6	1	0	0	0
7-day						
dT	3	3	-6	-10	-10	-10
Sum-d	13	13	4	0	0	0
28-day						
dT	6	9	-2	-14	-20	-20
Sum-d	26	29	18	6	0	0
91-day						
dT	15	20	12	-2	-18	-22
Sum-d	37	42	34	20	4	0

Data from surface geadient temperature distribution Figure
dT = temperature differential between baseline and specific time curve
Sum-dT = dT adjusted to the difference from the constant interior temperature

Induced Stress at each Depth for 300-foot Joint Spacing

Age days	Sum dT	Ind dT	Incre. Stress	H	L/H	h/H	KR	Adj Stress	Age Range	Cumm Stress	Tensile Str.	Crack
		Cth =	3.86		Length btw Joints=			300 feet				
Near Surface (0.5 ft)												
0-3	6	6	40	10	30	1.00	0.90	36	0-3	36	70	no
3-7	13	7	65	10	30	1.00	0.90	59	0-7	95	140	no
7-28	26	13	116	20	15	1.00	0.81	94	0-28	189	200	no
28-90	37	11	106	30	10	1.00	0.73	77	0-90	266	260	yes
2-Ft												
0-3	6	6	40	10	30	0.80	0.92	37	0-3	37	70	no
3-7	13	7	65	10	30	0.80	0.92	60	0-7	97	140	no
7-28	29	16	142	20	15	0.90	0.83	118	0-28	215	200	yes
28-90	42	13	126	30	10	0.93	0.74	93	0-90	309	260	yes
5-Ft												
0-3	1	1	7	10	30	0.50	0.95	6	0-3	6	70	no
3-7	4	3	28	10	30	0.50	0.95	27	0-7	33	140	no
7-28	18	14	125	20	15	0.75	0.86	107	0-28	140	200	no
28-90	34	16	155	30	10	0.83	0.77	119	0-90	258	260	yes
10-Ft												
0-3	0	0	0	10	30	0.00	1.00	0	0-3	0	70	no
3-7	0	0	0	10	30	0.00	1.00	0	0-7	0	140	no
7-28	6	6	53	20	15	0.50	0.90	48	0-28	48	200	no
28-90	20	14	135	30	10	0.67	0.81	109	0-90	158	260	no
20-Ft												
0-3	0	0	0	10	30	-1.00	1.11	0	0-3	0	70	no
3-7	0	0	0	10	30	-1.00	1.11	0	0-7	0	140	no
7-28	0	0	0	20	15	0.00	1.00	0	0-28	0	200	no
28-90	4	4	39	30	10	0.33	0.90	35	0-90	35	260	no

KR calculated from earlier Figure. Tensile strength (psi) from earlierFigure.
Sum dT transferred from temp. diff. Table. Ind dT = incremental induced temp. gradient
Incre. stress = (Ind dT)(Cth)(Esus)
H = dist. from face to zero temp. diff. region (from temp. diff. table) L = joint spacing
h = depth of interest (0.5, 2, 6, 10, and 20 ft)
Adj stress = (KR)(Incre. stress)

Figure A3-15. Surface gradient cracking analysis

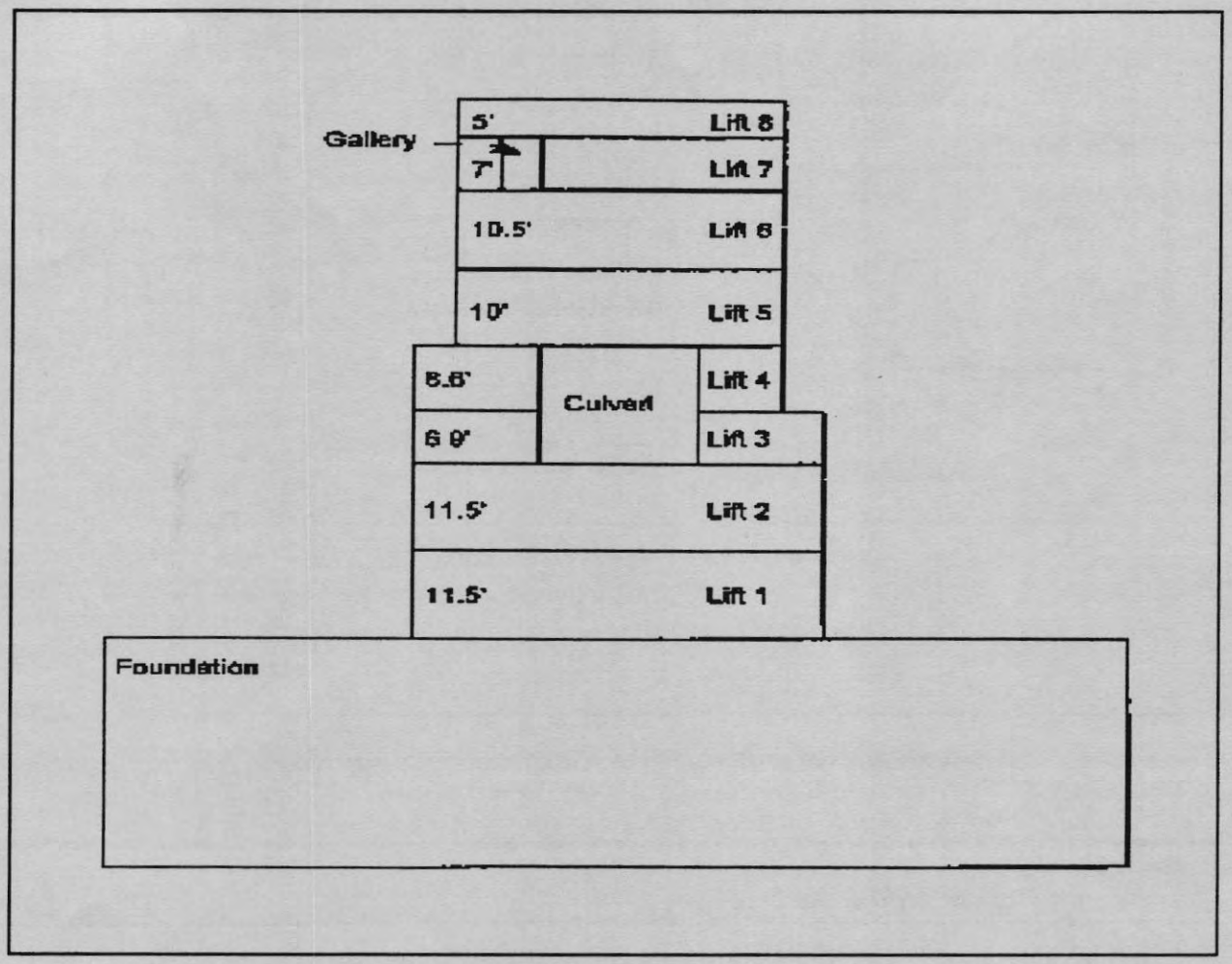


Figure A3-16. Lock wall section used in example

follow mean daily temperatures, except during summer and winter, when temperature controls are typically imposed. Placement temperatures lag mean daily ambient temperatures in the fall by 2.8 deg C (5 deg F), until the 4.4-deg C (40-deg F) minimum placement temperature permitted is reached. Other construction parameters assumed are a nominal lift height of 3 m (10 ft), a construction start date of 1 July, a concrete placement rate of 5 days/lift, with plywood forms removed 2 days after placement, and no insulation.

c. Temperature Analysis.

(1) Step 4: Prepare temperature model. The ABAQUS FE program was used in this example. Details regarding the use of ABAQUS and various ABAQUS and general FE program setup considerations in thermal analyses can be found in ETL 1110-2-365. Figure A3-19 shows the FE model used for the example. These analyses were performed on the Cray at the U.S. Army Engineer Waterways Experiment Station (WES). A time-step of 0.25 days was used to compute

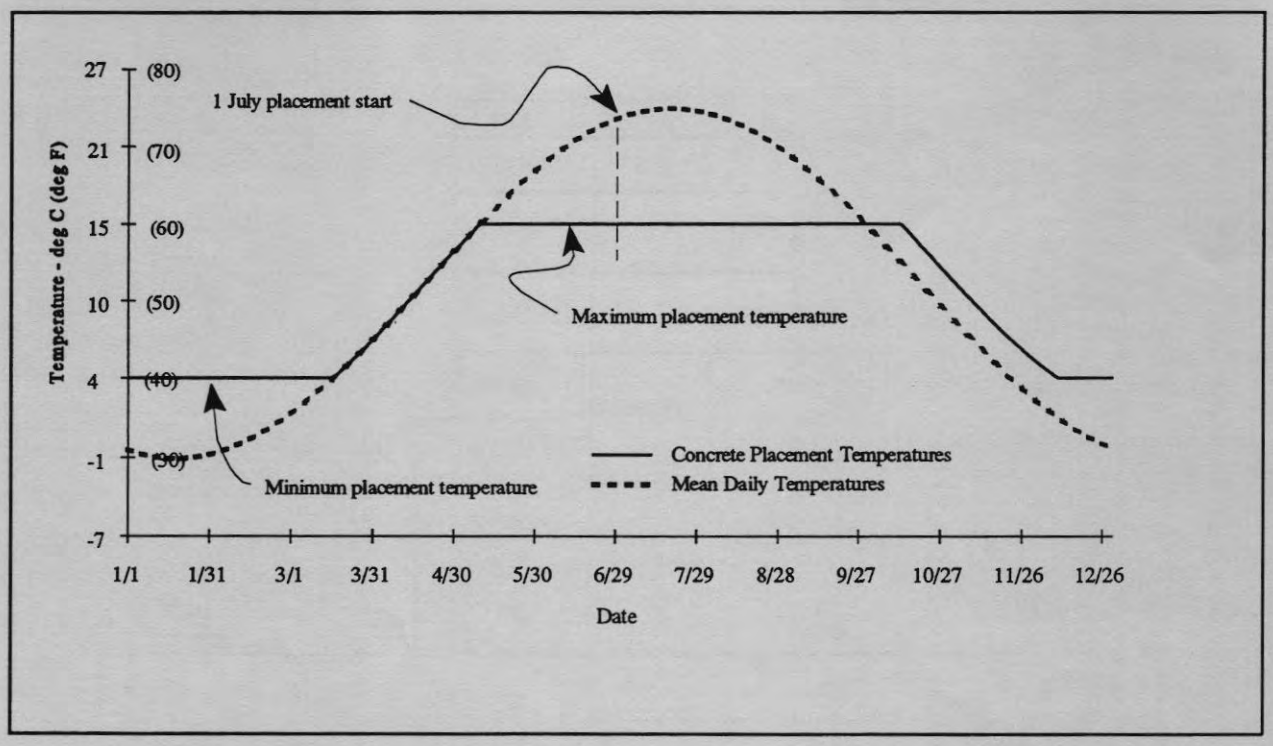


Figure A3-17. Mean daily ambient temperatures and concrete placement temperatures

Table A3-3
Concrete and Foundation Thermal Properties

Material	Thermal Conductivity W/m-K (Btu/hr-ft-deg F) (Btu/day-in-deg F)	Specific Heat kJ/kg-K (Btu/lb-deg F)	Coefficient of Thermal Expansion millionths/ deg C (millionths/deg F)
Limestone foundation	0.86 (0.500)(1.000)	0.96 (0.230)	9.90 (5.50)
Exterior concrete mixture	1.75 (1.012)(2.025)	0.98 (0.235)	10.46 (5.81)

temperature changes, primarily to capture temperature changes during the first 2 days after placement.

(a) Surface heat transfer coefficients computations. Equations A-2 and A-3 from Appendix A were used for computing the surface heat transfer coefficient. Table A3-5 shows surface heat transfer coefficients computed for various surface treatments at several time periods during the year. The heat transfer coefficients used in this example were those computed for wind only or for wind and plywood forms.

(b) Compute temperature histories. Figure A3-16 shows locations of mass gradient and surface gradient analysis in the structure used in the example. A July 1 start date was assumed for placement of the first lift of mass concrete.

(2) Step 5: Mass gradient temperature analysis. Figure A3-20 shows temperature histories at the locations of mass gradient analysis in the example.

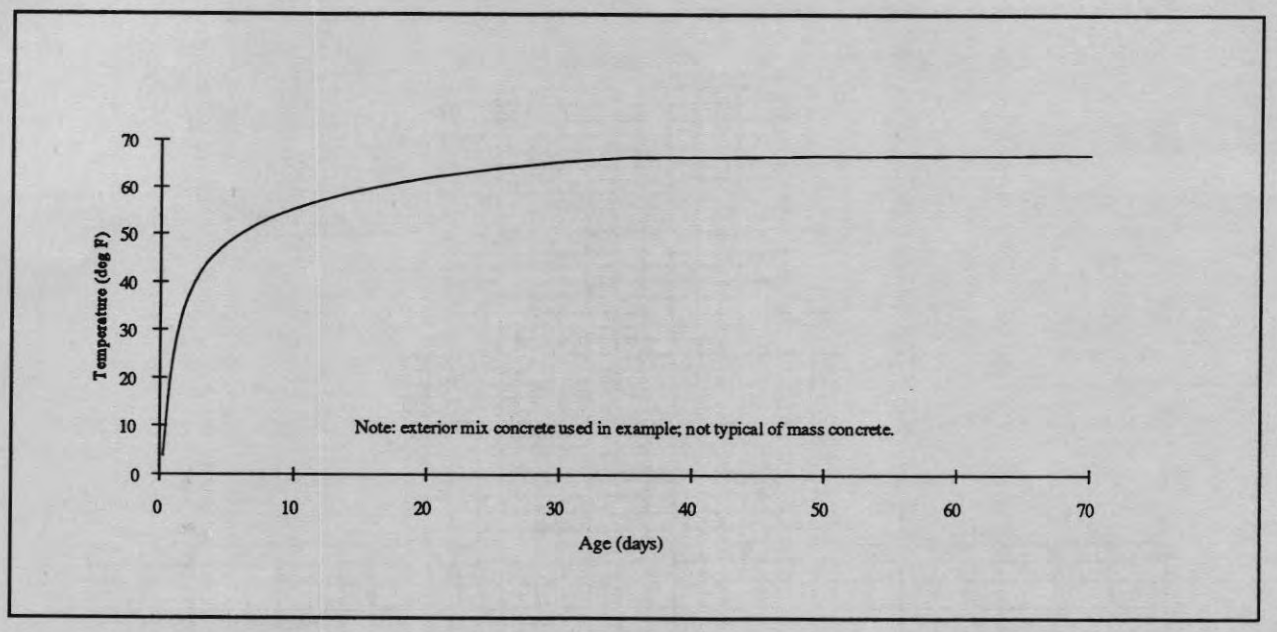


Figure A3-18. Adiabatic temperature rise for Level 2 thermal analysis 2-D example

Table A3-4
Concrete and Foundation Mechanical Properties

Material	Density	Compressive Strength	Modulus of Elasticity
	kg/m³ (lb/ft³)	Mpa (psi)	GPa (x 10⁶ psi)
Limestone	2,563 (160)	103.4 (15,000)	48.26 (7.00)
Exterior concrete @ 1 day	2,243 (140)	3.93 (570)	12.41 (1.80)
Exterior concrete @ 3 days	same	7.65 (1,110)	20.20 (2.93)
Exterior concrete @ 7 days	same	11.24 (1,630)	23.44 (3.40)
Exterior concrete @ 28 days	same	22.48 (3,260)	33.65 (4.88)
Exterior concrete @ 90 days	same	31.10 (4,510)	35.51 (5.15)

(3) Step 6: Surface gradient temperature analysis. Surface gradient cracking in the example was analyzed at nominal ages of 0.5, 1, 2, 3, 5, 7, 14, 28, 60, 90, 120, 150, and 180 days after placement in lift 6 for this example. Table A3-6 and Figure A3-21 show the surface gradient temperature distributions across lift 6 in the upper portion of the mass concrete structure, determined from FE temperature analysis. Placement time for this lift was 25 days after placement of lift 1.

(a) Calculate surface gradient strains. To calculate surface gradient strains requires determination of the depth from the surface of effective interior restraint. This is performed by evaluating the magnitude of temperature change in the interior versus the surface concrete, thereby defining a surface "tension block" described in Appendix A and earlier in this annex. The following steps illustrate a procedure for determining the distance from the surface where tensile and compressive forces balance, thereby determining the distance from the surface to the point of zero strain, defining the tension block depth. A series of manipulations of temperature history results are used to define the depth, "*H*," of the tension block, where temperature

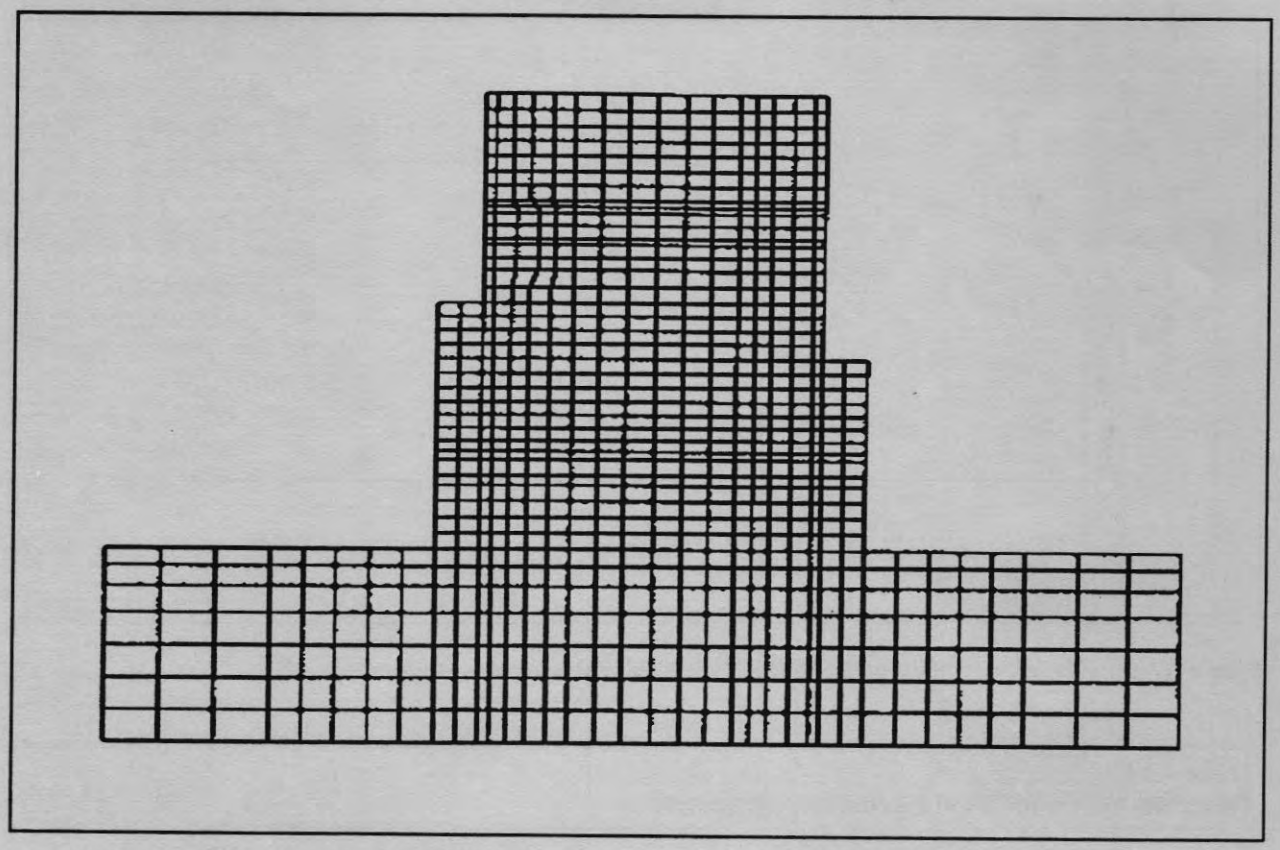


Figure A3-19. Finite element model of lock wall example

Table A3-5
Summary of Surface Heat Transfer Coefficients For FE Thermal Analyses

	Wind Velocity	Surface Heat Transfer Coefficient - *h* W/m²-K (Btu/day-in²-deg F)			
Time Span Months	km/h (mi/hr)	Wind Velocity Only	Wind Velocity & Plywood	Wind Velocity & Insulation	Air, Plywood, & Insulation
Nov. - Apr.	16 (10)	25.72 (0.7548)	4.913 (0.1442)	1.345 (0.03949)	1.101 (0.03233)
May - June	13 (8)	22.01 (0.6460)	4.763 (0.1398)	1.333 (0.03914)	1.094 (0.03210)
July - Sept.	11 (7)	19.71 (0.5785)	4.644 (0.1363)	1.324 (0.03887)	1.087 (0.03191)
Oct.	13 (8)	21.88 (0.6423)	4.756 (0.1396)	1.333 (0.03913)	1.093 (0.03209)

changes causing tension and compression are balanced.

(b) Determine reference temperatures. In the example, the reference time was established as 0.5 days after placement of lift 6 (25.5 days after concrete placement start at lift 1). Because the concrete attained a 1-day modulus of elasticity of 12.4 Gpa (1.8×10^6 psi), it was assumed that elastic strains were sustainable in this concrete at an age of 0.5 days.

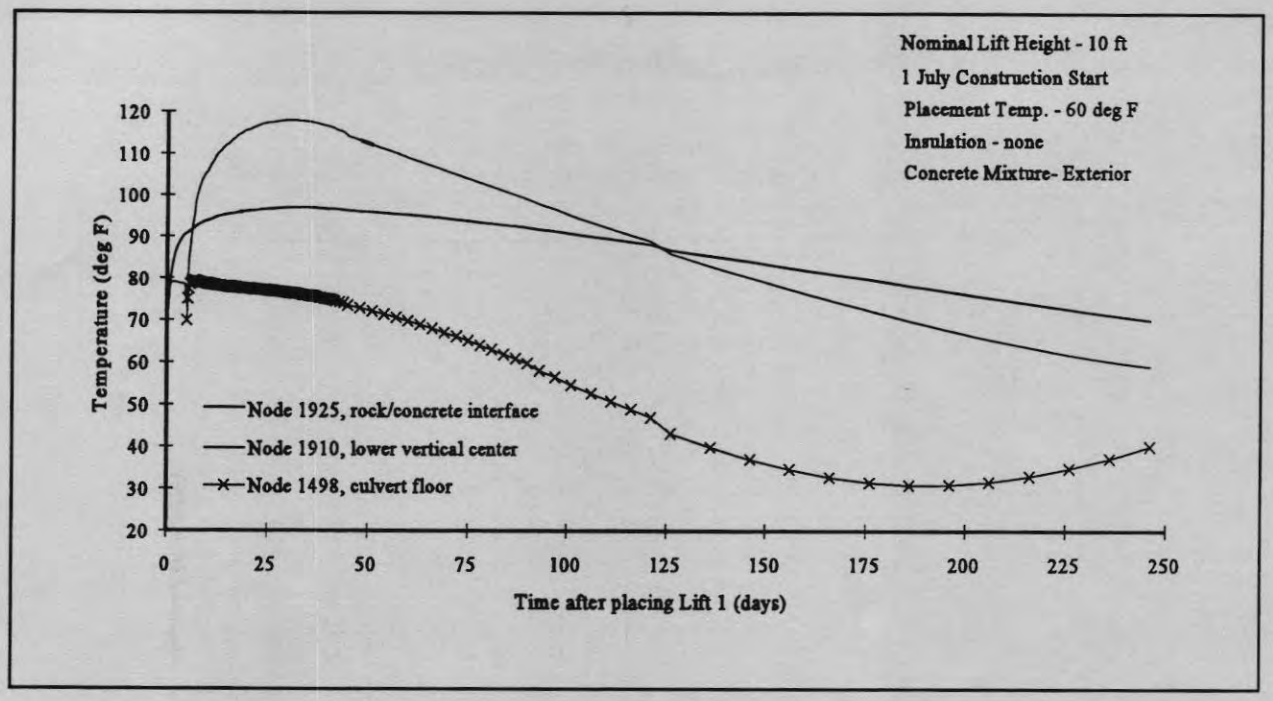


Figure A3-20. Typical temperature histories at locations of mass gradient analysis

(c) Determine temperature change or differences relative to the reference temperatures. Table A3-7 shows distributions of temperature difference at all analysis times relative to the reference temperatures at 0.5 days age of lift 6 (25.5 days after lift 1). These are developed by subtracting all of the temperatures in Table A3-6 from the respective 0.5-day temperatures at the same horizontal coordinates.

(d) Determine temperature differences relative to surface temperature differences, or "normalized" temperature differences. Table A3-8 and Figure A3-22 show temperature differences normalized relative to the surface temperature differences. These normalized temperature differences were developed by subtracting the surface temperature differences (along coordinates 4.0 and 36.0) in Table A3-7 from the corresponding interior temperature differences at the same time intervals in Table A3-7, producing the Table A3-8 normalized temperature differences.

(e) Determine offset balance temperatures. To balance tension and compression zones, a balance temperature, T_0, is determined such that the areas of the normalized temperature distribution above and below T_0 are equal. Table A3-9 and Figure A3-23 show balanced, normalized temperature differences.

(f) The depth of T_0 defines the depth of "*H*" of the tension block. A formula for the sums of individual areas between temperature points of the normalized temperature difference distribution across a section above and below T_0 was used for the determination of *H*. These calculations were solved by extensive computer spreadsheet analysis, resulting in tension block "*H*" values.

d. Cracking analysis.

(1) Step 7: Mass gradient cracking analysis. Mass gradient thermal strains are computed from Equation A-4 in Appendix A. Table A3-10 summarizes the computations.

(a) Foundation restraint factor (K_f). Foundation restraint, based upon relative differences in the

Table A3-6
Temperature Distributions in Lift 6 for Surface Gradient Analysis

Degrees C

Horizontal Coordinate (m)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
1.2	23.3	27.8	30.5	26.6	25.8	25.4	24.4	22.3	17.0	10.1	4.1	0.1	-0.9
1.4	23.0	28.5	32.4	30.3	29.2	28.5	26.8	24.1	18.2	11.2	5.1	0.9	-0.4
1.5	22.6	29.2	34.2	34.1	32.7	31.6	29.2	25.8	19.4	12.4	6.2	1.8	0.1
1.8	22.4	29.2	35.4	37.2	37.2	36.2	33.3	28.9	21.6	14.5	8.1	3.3	1.0
2.1	22.4	29.2	35.6	38.3	39.7	39.3	36.5	31.7	23.7	16.3	9.8	4.7	1.9
2.4	22.4	29.2	35.7	38.7	41.0	41.2	39.0	34.0	25.5	18.0	11.4	6.0	2.8
2.7	22.4	29.2	35.7	38.8	41.5	42.3	40.8	36.0	27.2	19.6	12.9	7.3	3.7
3.0	22.4	29.2	35.7	38.8	41.7	42.7	41.9	37.5	28.6	20.8	14.0	8.2	4.4
3.2	22.4	29.2	35.7	38.8	41.8	43.0	42.7	38.8	29.9	22.0	15.1	9.2	5.1
3.5	22.4	29.2	35.7	38.8	41.9	43.1	43.4	40.0	31.2	23.2	16.2	10.2	5.8
3.7	22.4	29.2	35.7	38.8	41.9	43.2	43.9	41.1	32.4	24.3	17.3	11.1	6.6
4.1	22.4	29.2	35.7	38.8	41.9	43.3	44.3	42.6	34.3	26.0	18.9	12.5	7.7
4.5	22.4	29.2	35.7	38.8	41.9	43.3	44.9	44.0	36.0	27.6	20.4	13.9	8.7
4.9	22.4	29.2	35.7	38.8	41.9	43.3	45.2	45.0	37.5	29.1	21.7	15.1	9.7
5.3	22.4	29.2	35.7	38.8	41.9	43.3	45.4	45.9	38.8	30.3	22.9	16.1	10.5
5.7	22.4	29.2	35.7	38.8	41.9	43.3	45.4	46.5	39.9	31.4	23.8	17.0	11.2
6.1	22.4	29.2	35.7	38.8	41.9	43.3	45.5	47.0	40.6	32.1	24.5	17.6	11.7
6.5	22.4	29.2	35.7	38.8	41.9	43.3	45.5	47.2	41.0	32.5	24.9	17.9	12.0
6.9	22.4	29.2	35.7	38.8	41.9	43.3	45.5	47.1	41.0	32.5	24.9	17.9	12.0
7.3	22.4	29.2	35.7	38.8	41.9	43.3	45.4	46.9	40.7	32.2	24.6	17.7	11.8
7.7	22.4	29.2	35.7	38.8	41.9	43.3	45.3	46.4	39.9	31.5	24.0	17.2	11.5
8.1	22.4	29.2	35.7	38.8	41.9	43.3	45.2	45.7	38.8	30.5	23.0	16.2	10.6
8.5	22.4	29.2	35.7	38.8	41.9	43.2	44.7	44.5	37.3	29.1	21.7	15.1	9.7
8.7	22.4	29.2	35.7	38.8	41.9	43.2	44.3	43.6	36.2	28.0	20.7	14.2	9.0
9.0	22.4	29.2	35.7	38.8	41.8	43.0	43.7	42.4	34.8	26.7	19.5	13.1	8.2
9.2	22.4	29.2	35.7	38.8	41.7	42.8	42.9	41.0	33.3	25.3	18.2	12.0	7.3
9.4	22.4	29.2	35.7	38.8	41.5	42.3	41.7	39.3	31.6	23.8	16.8	10.7	6.4
9.8	22.4	29.2	35.7	38.7	41.0	41.2	39.7	36.8	29.3	21.6	14.8	9.0	5.1
10.1	22.4	29.2	35.6	38.3	39.7	39.3	37.1	34.0	26.7	19.2	12.5	7.1	3.7
10.4	22.4	29.2	35.4	37.2	37.2	36.2	33.7	30.6	23.8	16.5	10.0	5.0	2.3
10.7	22.6	29.2	34.2	34.1	32.7	31.6	29.4	26.8	20.7	13.6	7.3	2.7	0.8
10.8	22.9	28.9	32.8	31.8	29.5	28.7	27.0	24.7	19.0	12.0	5.8	1.3	0.0
11.0	23.3	27.8	30.5	26.6	25.8	25.4	24.4	22.6	17.2	10.3	4.3	0.3	-0.7

Degrees F

Horizontal Coordinate (ft)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
4.00	73.9	82.1	87.0	79.8	78.5	77.7	75.9	72.2	62.5	50.2	39.4	32.2	30.4
4.50	73.3	83.4	90.3	86.6	84.6	83.3	80.2	75.4	64.7	52.2	41.3	33.7	31.3
5.00	72.7	84.6	93.6	93.3	90.8	88.8	84.6	78.3	66.9	54.3	43.2	35.2	32.1
6.00	72.3	84.6	95.7	99.0	99.0	97.2	91.9	84.1	70.9	58.0	46.6	37.9	33.8
7.00	72.3	84.5	96.2	101.0	103.5	102.8	97.7	89.0	74.6	61.4	49.7	40.5	35.4
8.00	72.3	84.5	96.3	101.6	105.8	106.2	102.1	93.2	77.9	64.4	52.5	42.8	37.0
9.00	72.3	84.5	96.3	101.8	106.7	108.1	105.4	96.8	81.0	67.3	55.1	45.1	38.6
9.81	72.3	84.5	96.3	101.9	107.1	108.9	107.4	99.5	83.5	69.5	57.2	-- 46.8	39.9
10.63	72.3	84.5	96.3	101.9	107.3	109.4	108.9	101.9	85.8	71.6	59.2	48.6	41.2
11.44	72.3	84.5	96.3	101.9	107.4	109.7	110.1	104.0	88.1	73.7	61.1	50.3	42.5
12.25	72.3	84.5	96.3	101.9	107.4	109.8	111.0	106.0	90.3	75.8	63.1	52.0	43.8
13.50	72.3	84.5	96.3	101.9	107.4	109.9	112.1	108.8	93.7	78.9	66.0	54.5	45.8
14.75	72.3	84.5	96.3	101.9	107.4	109.9	112.8	111.1	96.7	81.8	68.7	57.0	47.7
16.00	72.3	84.5	96.3	101.9	107.4	109.9	113.3	113.1	99.3	84.4	71.1	59.1	49.4
17.25	72.3	84.5	96.3	101.9	107.4	109.9	113.6	114.6	101.8	86.6	73.2	61.0	50.9
18.58	72.3	84.5	96.3	101.9	107.4	109.9	113.8	115.8	103.8	88.5	74.9	62.6	52.2
19.92	72.3	84.5	96.3	101.9	107.4	109.9	113.9	116.5	105.1	89.8	76.1	63.6	53.1
21.25	72.3	84.5	96.3	101.9	107.4	109.9	113.9	116.9	105.8	90.4	76.8	64.2	53.5
22.58	72.3	84.5	96.3	101.9	107.4	109.9	113.9	116.8	105.8	90.5	76.8	64.3	53.6
23.88	72.3	84.5	96.3	101.9	107.4	109.9	113.8	116.4	105.2	89.9	76.3	63.8	53.2
25.17	72.3	84.5	96.3	101.9	107.4	109.9	113.6	115.6	103.9	88.7	75.2	62.8	52.3
26.46	72.3	84.5	96.3	101.9	107.4	109.9	113.3	114.2	101.9	86.9	73.4	61.2	51.1
27.75	72.3	84.5	96.3	101.9	107.4	109.8	112.5	112.1	99.2	84.3	71.1	59.1	49.4
28.56	72.3	84.5	96.3	101.9	107.4	109.7	111.8	110.4	97.1	82.4	69.3	57.5	48.2
29.38	72.3	84.5	96.3	101.9	107.3	109.4	110.7	108.3	94.7	80.1	67.2	55.7	46.8
30.19	72.3	84.5	96.3	101.9	107.1	109.0	109.1	105.7	92.0	77.6	64.8	53.6	45.2
31.00	72.3	84.5	96.3	101.8	106.8	108.1	107.0	102.7	89.0	74.8	62.2	51.3	43.5
32.00	72.3	84.5	96.3	101.6	105.8	106.2	103.5	98.3	84.8	70.9	58.6	48.2	41.2
33.00	72.3	84.5	96.2	101.0	103.5	102.8	98.8	93.1	80.1	66.6	54.5	44.7	38.7
34.00	72.3	84.6	95.7	99.0	99.0	97.2	92.6	87.1	74.9	61.8	50.0	41.0	36.1
35.00	72.7	84.6	93.6	93.3	90.8	88.8	85.0	80.2	69.2	56.4	45.1	36.9	33.4
35.50	73.3	84.0	91.0	87.8	85.2	83.6	80.7	76.5	66.2	53.6	42.5	34.8	32.1
36.00	73.9	82.1	87.0	79.8	78.5	77.7	76.0	72.6	63.0	50.6	39.7	32.5	30.7

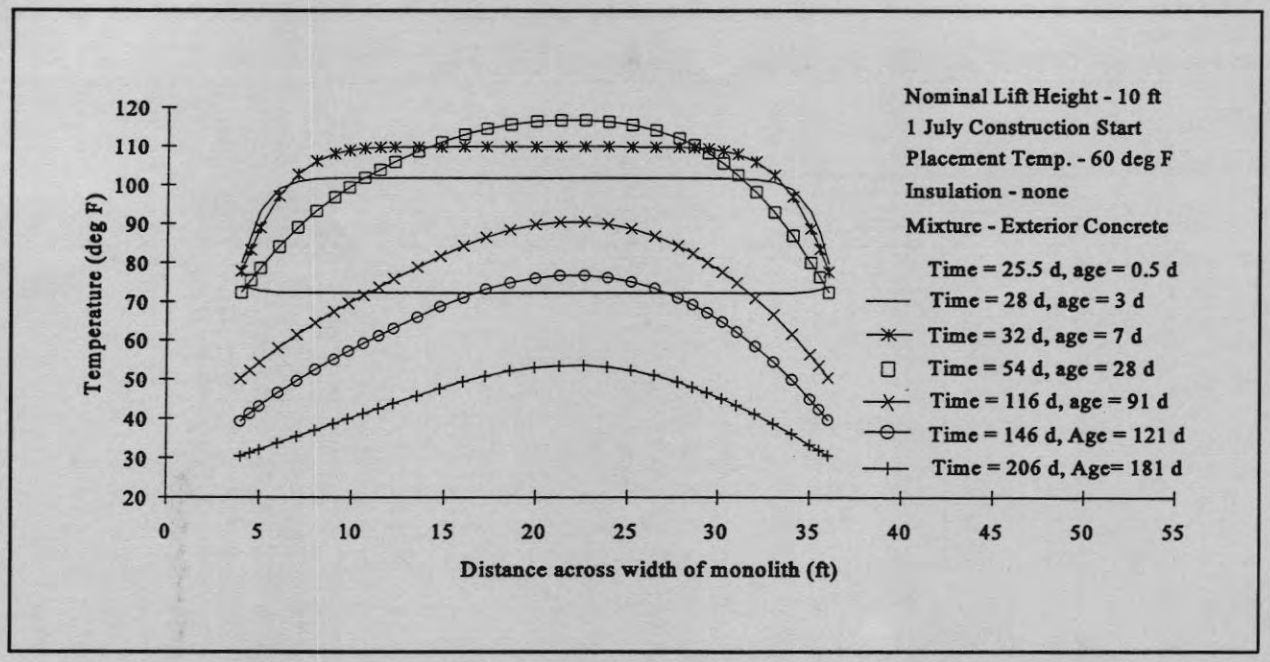


Figure A3-21. Temperature distributions across lift 6 used in surface gradient analysis

stiffness of the foundation material and the concrete, is computed from Equation A-7 in Appendix A as shown below.

$$K_f = \frac{1}{1 + \frac{A_g E_c}{A_f E_f}} = 0.64$$

where

A_g = gross area of concrete cross section (relative value) = 1

A_f = 2.5 (area of foundation or zone restraining contraction of concrete, generally as a plane surface at contact, recommended maximum value is 2.5)

E_f = modulus of elasticity of foundation = 48.3 Gpa (7.0×10^6 psi)

E_c = modulus of elasticity of mass concrete (mean value during cooling period) = 34.5 Gpa (5.0×10^6 psi)

(b) Structure restraint factor (K_R). Structure restraint factors are computed at distances, h, along the vertical centerline of the structure at h = 3.5 m (11.5 ft) and at $h = H = 7.0$ m (23 ft) at the base of the culvert. The length, L, of the structure is assumed to be 13.4 m (44 ft) in the axial direction. Note that the mass gradient analysis shown below assumes that the foundation restraint is applied by the foundation material adjacent to the concrete. Therefore, the foundation temperatures used in the analysis are taken at the foundation-concrete interface rather than at the location of constant foundation temperature at a depths of 6.1 m (20 ft) or more.

Using Equation A-6 (Appendix A) for L/H less than 2.5

$$K_R = K_f \left(\frac{\frac{L}{H} - 1}{\frac{L}{H} + 10} \right)^{h/H} = 0.28$$

Table A3-7
Temperature Differences Referenced to Temperature at 0.5 Days

Degrees C

Horizontal Coordinate (m)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
1.2	0.0	4.6	7.2	3.3	2.5	2.1	1.1	-1.0	-6.3	-13.2	-19.2	-23.2	-24.2
1.4	0.0	5.6	9.4	7.4	6.3	5.5	3.9	1.1	-4.8	-11.7	-17.8	-22.0	-23.4
1.5	0.0	6.6	11.6	11.4	10.1	9.0	6.6	3.2	-3.2	-10.2	-16.4	-20.8	-22.6
1.8	0.0	6.8	13.0	14.8	14.8	13.8	10.9	6.5	-0.8	-7.9	-14.3	-19.1	-21.4
2.1	0.0	6.8	13.3	16.0	17.4	17.0	14.1	9.3	1.3	-6.1	-12.5	-17.7	-20.5
2.4	0.0	6.8	13.3	16.3	18.6	18.9	16.6	11.6	3.1	-4.4	-11.0	-16.4	-19.6
2.7	0.0	6.8	13.3	16.4	19.2	19.9	18.4	13.7	4.9	-2.8	-9.5	-15.1	-18.7
3.0	0.0	6.8	13.3	16.4	19.4	20.4	19.5	15.1	6.2	-1.5	-8.4	-14.1	-18.0
3.2	0.0	6.8	13.3	16.5	19.5	20.6	20.4	16.4	7.5	-0.4	-7.3	-13.2	-17.2
3.5	0.0	6.8	13.3	16.5	19.5	20.8	21.0	17.6	8.8	0.8	-6.2	-12.2	-16.5
3.7	0.0	6.8	13.3	16.5	19.5	20.9	21.5	18.8	10.0	2.0	-5.1	-11.3	-15.8
4.1	0.0	6.8	13.3	16.5	19.5	20.9	22.1	20.3	11.9	3.7	-3.5	-9.8	-14.7
4.5	0.0	6.8	13.3	16.5	19.5	20.9	22.6	21.6	13.6	5.3	-2.0	-8.5	-13.6
4.9	0.0	6.8	13.3	16.5	19.5	20.9	22.8	22.7	15.1	6.7	-0.6	-7.3	-12.7
5.3	0.0	6.8	13.3	16.5	19.5	20.9	23.0	23.5	16.4	8.0	0.5	-6.3	-11.9
5.7	0.0	6.8	13.3	16.5	19.5	20.9	23.1	24.2	17.5	9.0	1.5	-5.4	-11.2
6.1	0.0	6.8	13.3	16.5	19.5	20.9	23.1	24.6	18.2	9.7	2.2	-4.8	-10.7
6.5	0.0	6.8	13.3	16.5	19.5	20.9	23.1	24.8	18.6	10.1	2.5	-4.5	-10.4
6.9	0.0	6.8	13.3	16.5	19.5	20.9	23.1	24.8	18.6	10.1	2.5	-4.4	-10.4
7.3	0.0	6.8	13.3	16.5	19.5	20.9	23.1	24.6	18.3	9.8	2.3	-4.7	-10.6
7.7	0.0	6.8	13.3	16.5	19.5	20.9	23.0	24.1	17.6	9.1	1.6	-5.3	-11.1
8.1	0.0	6.8	13.3	16.5	19.5	20.9	22.8	23.3	16.5	8.1	0.7	-6.1	-11.8
8.5	0.0	6.8	13.3	16.5	19.5	20.9	22.4	22.2	15.0	6.7	-0.6	-7.3	-12.7
8.7	0.0	6.8	13.3	16.5	19.5	20.8	22.0	21.2	13.8	5.6	-1.7	-8.2	-13.4
9.0	0.0	6.8	13.3	16.5	19.5	20.7	21.3	20.0	12.5	4.4	-2.8	-9.2	-14.2
9.2	0.0	6.8	13.3	16.4	19.4	20.4	20.5	18.6	11.0	3.0	-4.1	-10.4	-15.0
9.4	0.0	6.8	13.3	16.4	19.2	19.9	19.3	16.9	9.3	1.4	-5.6	-11.6	-16.0
9.8	0.0	6.8	13.3	16.3	18.6	18.9	17.4	14.5	7.0	-0.7	-7.6	-13.4	-17.3
10.1	0.0	6.8	13.3	16.0	17.4	16.9	14.7	11.6	4.3	-3.2	-9.9	-15.3	-18.6
10.4	0.0	6.8	13.0	14.8	14.8	13.8	11.3	8.2	1.4	-5.9	-12.4	-17.4	-20.1
10.7	0.0	6.6	11.6	11.4	10.1	9.0	6.8	4.2	-1.9	-9.0	-15.3	-19.9	-21.8
10.8	0.0	6.0	9.9	8.1	6.6	5.7	4.1	1.8	-3.9	-10.9	-17.1	-21.4	-22.9
11.0	0.0	4.6	7.2	3.3	2.5	2.1	1.2	-0.7	-6.0	-12.9	-19.0	-23.0	-24.0

Degrees F

Horizontal Coordinate (ft)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
4.00	0.0	8.2	13.0	5.9	4.5	3.8	2.0	-1.7	-11.4	-23.8	-34.6	-41.7	-43.5
4.50	0.0	10.1	16.9	13.2	11.3	10.0	6.9	2.0	-8.6	-21.1	-32.0	-39.6	-42.0
5.00	0.0	11.9	20.9	20.6	18.1	16.1	11.9	5.8	-5.8	-18.4	-29.5	-37.5	-40.6
6.00	0.0	12.3	23.4	26.7	26.6	24.8	19.5	11.8	-1.4	-14.3	-25.7	-34.4	-38.6
7.00	0.0	12.3	23.9	28.7	31.2	30.5	25.4	16.7	2.3	-10.9	-22.6	-31.8	-36.9
8.00	0.0	12.3	24.0	29.4	33.5	33.9	29.9	20.9	5.7	-7.8	-19.7	-29.4	-35.2
9.00	0.0	12.3	24.0	29.6	34.5	35.8	33.2	24.6	8.8	-5.0	-17.1	-27.2	-33.6
9.81	0.0	12.3	24.0	29.6	34.9	36.7	35.2	27.2	11.2	-2.8	-15.1	-25.4	-32.3
10.63	0.0	12.3	24.0	29.6	35.0	37.1	36.7	29.6	13.6	-0.6	-13.1	-23.7	-31.0
11.44	0.0	12.3	24.0	29.6	35.1	37.4	37.9	31.8	15.8	1.4	-11.1	-22.0	-29.7
12.25	0.0	12.3	24.0	29.6	35.1	37.5	38.8	33.8	18.1	3.5	-9.2	-20.3	-28.4
13.50	0.0	12.3	24.0	29.6	35.2	37.6	39.8	36.5	21.4	6.6	-6.3	-17.7	-26.4
14.75	0.0	12.3	24.0	29.6	35.2	37.7	40.6	38.9	24.5	9.5	-3.6	-15.3	-24.5
16.00	0.0	12.3	24.0	29.6	35.2	37.7	41.1	40.8	27.2	12.1	-1.2	-13.1	-22.8
17.25	0.0	12.3	24.0	29.6	35.2	37.7	41.4	42.4	29.6	14.3	0.9	-11.3	-21.3
18.58	0.0	12.3	24.0	29.6	35.2	37.7	41.6	43.5	31.5	16.2	2.7	-9.7	-20.1
19.92	0.0	12.3	24.0	29.6	35.2	37.7	41.6	44.3	32.8	17.5	3.9	-8.6	-19.2
21.25	0.0	12.3	24.0	29.6	35.2	37.7	41.6	44.6	33.5	18.2	4.5	-8.0	-18.7
22.58	0.0	12.3	24.0	29.6	35.2	37.7	41.6	44.6	33.6	18.3	4.6	-8.0	-18.7
23.88	0.0	12.3	24.0	29.6	35.2	37.7	41.6	44.2	32.9	17.7	4.1	-8.5	-19.1
25.17	0.0	12.3	24.0	29.6	35.2	37.7	41.4	43.4	31.6	16.5	2.9	-9.5	-19.9
26.46	0.0	12.3	24.0	29.6	35.2	37.6	41.0	42.0	29.7	14.6	1.2	-11.0	-21.2
27.75	0.0	12.3	24.0	29.6	35.1	37.6	40.3	39.9	27.0	12.1	-1.2	-13.1	-22.8
28.56	0.0	12.3	24.0	29.6	35.1	37.4	39.5	38.2	24.9	10.1	-3.0	-14.7	-24.1
29.38	0.0	12.3	24.0	29.6	35.0	37.2	38.4	36.0	22.5	7.9	-5.1	-16.6	-25.5
30.19	0.0	12.3	24.0	29.6	34.9	36.7	36.9	33.5	19.7	5.4	-7.4	-18.6	-27.1
31.00	0.0	12.3	24.0	29.6	34.5	35.9	34.8	30.5	16.7	2.6	-10.0	-20.9	-28.8
32.00	0.0	12.3	24.0	29.4	33.5	34.0	31.3	26.1	12.5	-1.3	-13.7	-24.1	-31.1
33.00	0.0	12.3	23.9	28.7	31.3	30.5	26.5	20.8	7.8	-5.7	-17.7	-27.5	-33.5
34.00	0.0	12.3	23.4	26.7	26.6	24.8	20.3	14.8	2.6	-10.6	-22.3	-31.3	-36.2
35.00	0.0	11.9	20.9	20.6	18.1	16.1	12.3	7.5	-3.5	-16.3	-27.6	-35.8	-39.3
35.50	0.0	10.8	17.8	14.5	11.9	10.3	7.4	3.2	-7.1	-19.7	-30.8	-38.5	-41.2
36.00	0.0	8.2	13.0	5.9	4.5	3.8	2.1	-1.3	-10.9	-23.3	-34.2	-41.4	-43.2

Table A3-8
Temperature Differences Normalized in Reference to Surface Temperature Differences For Surface Gradient Analysis

Degrees C

Horizontal Coordinate (m)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.4	0.0	1.0	2.2	4.1	3.8	3.4	2.8	2.1	1.6	1.5	1.4	1.2	0.8
1.5	0.0	2.1	4.3	8.2	7.6	6.9	5.5	4.2	3.1	3.0	2.8	2.3	1.6
1.8	0.0	2.3	5.7	11.6	12.3	11.7	9.8	7.5	5.6	5.3	4.9	4.0	2.7
2.1	0.0	2.3	6.0	12.7	14.8	14.9	13.0	10.2	7.6	7.1	6.7	5.5	3.7
2.4	0.0	2.3	6.1	13.1	16.1	16.8	15.5	12.6	9.5	8.8	8.2	6.8	4.6
2.7	0.0	2.3	6.1	13.2	16.6	17.8	17.3	14.6	11.2	10.4	9.7	8.1	5.5
3.0	0.0	2.3	6.1	13.2	16.8	18.3	18.4	16.1	12.6	11.6	10.8	9.0	6.2
3.2	0.0	2.3	6.1	13.2	16.9	18.5	19.3	17.4	13.9	12.8	11.9	10.0	6.9
3.5	0.0	2.3	6.1	13.2	17.0	18.7	19.9	18.6	15.1	14.0	13.0	11.0	7.6
3.7	0.0	2.3	6.1	13.2	17.0	18.8	20.4	19.7	16.4	15.1	14.1	11.9	8.4
4.1	0.0	2.3	6.1	13.2	17.0	18.8	21.0	21.2	18.2	16.9	15.7	13.3	9.5
4.5	0.0	2.3	6.1	13.2	17.0	18.8	21.5	22.6	19.9	18.5	17.2	14.7	10.5
4.9	0.0	2.3	6.1	13.2	17.0	18.8	21.7	23.6	21.5	19.9	18.6	15.9	11.5
5.3	0.0	2.3	6.1	13.2	17.0	18.8	21.9	24.5	22.8	21.2	19.7	16.9	12.3
5.7	0.0	2.3	6.1	13.2	17.0	18.8	22.0	25.1	23.8	22.2	20.7	17.8	13.0
6.1	0.0	2.3	6.1	13.2	17.0	18.8	22.0	25.5	24.6	22.9	21.4	18.4	13.5
6.5	0.0	2.3	6.1	13.2	17.0	18.8	22.0	25.7	24.9	23.3	21.7	18.7	13.7
6.9	0.0	2.3	6.1	13.2	17.0	18.8	22.0	25.7	25.0	23.3	21.7	18.7	13.8
7.3	0.0	2.3	6.1	13.2	17.0	18.8	22.0	25.5	24.6	23.0	21.5	18.5	13.5
7.7	0.0	2.3	6.1	13.2	17.0	18.8	21.9	25.0	23.9	22.3	20.8	17.9	13.1
8.1	0.0	2.3	6.1	13.2	17.0	18.8	21.7	24.3	22.8	21.3	19.9	17.0	12.4
8.5	0.0	2.3	6.1	13.2	17.0	18.8	21.3	23.1	21.3	19.9	18.6	15.9	11.5
8.7	0.0	2.3	6.1	13.2	17.0	18.7	20.9	22.1	20.1	18.8	17.5	15.0	10.8
9.0	0.0	2.3	6.1	13.2	16.9	18.6	20.2	21.0	18.8	17.6	16.4	13.9	10.0
9.2	0.0	2.3	6.1	13.2	16.8	18.3	19.4	19.6	17.3	16.2	15.1	12.8	9.1
9.4	0.0	2.3	6.1	13.2	16.6	17.8	18.2	17.9	15.6	14.6	13.6	11.5	8.2
9.8	0.0	2.3	6.1	13.1	16.1	16.8	16.3	15.4	13.3	12.5	11.6	9.8	6.9
10.1	0.0	2.3	6.0	12.7	14.8	14.9	13.6	12.5	10.7	10.0	9.3	7.9	5.5
10.4	0.0	2.3	5.7	11.6	12.3	11.7	10.2	9.1	7.8	7.3	6.8	5.7	4.1
10.7	0.0	2.1	4.3	8.2	7.5	6.9	5.7	5.1	4.4	4.2	3.9	3.3	2.3
10.8	0.0	1.4	2.6	4.8	4.1	3.6	3.0	2.7	2.4	2.3	2.1	1.8	1.3
11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.2	0.2	0.2	0.1

Degrees F

Horizontal Coordinate (ft)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.50	0.0	1.9	3.9	7.4	6.8	6.2	5.0	3.8	2.8	2.7	2.5	2.1	1.4
5.00	0.0	3.7	7.8	14.7	13.6	12.4	9.9	7.5	5.6	5.4	5.0	4.2	2.9
6.00	0.0	4.1	10.3	20.8	22.1	21.1	17.6	13.5	10.0	9.5	8.8	7.3	4.9
7.00	0.0	4.1	10.8	22.8	26.7	26.7	23.5	18.4	13.7	12.9	12.0	9.9	6.6
8.00	0.0	4.1	11.0	23.5	29.0	30.2	27.9	22.7	17.1	15.9	14.8	12.3	8.2
9.00	0.0	4.1	11.0	23.7	30.0	32.1	31.2	26.3	20.2	18.8	17.5	14.5	9.8
9.81	0.0	4.1	11.0	23.7	30.3	32.9	33.2	28.9	22.6	21.0	19.5	16.3	11.1
10.63	0.0	4.1	11.0	23.7	30.5	33.4	34.7	31.3	24.9	23.1	21.5	18.0	12.4
11.44	0.0	4.1	11.0	23.7	30.6	33.6	35.9	33.5	27.2	25.2	23.5	19.7	13.7
12.25	0.0	4.1	11.0	23.7	30.6	33.8	36.8	35.5	29.5	27.3	25.4	21.4	15.0
13.50	0.0	4.1	11.0	23.8	30.6	33.9	37.9	38.2	32.8	30.4	28.3	24.0	17.0
14.75	0.0	4.1	11.0	23.8	30.6	33.9	38.6	40.6	35.9	33.3	31.0	26.4	18.9
16.00	0.0	4.1	11.0	23.8	30.6	33.9	39.1	42.5	38.6	35.9	33.4	28.6	20.7
17.25	0.0	4.1	11.0	23.8	30.6	33.9	39.4	44.1	41.0	38.1	35.5	30.4	22.1
18.58	0.0	4.1	11.0	23.8	30.6	33.9	39.6	45.2	42.9	40.0	37.2	32.0	23.4
19.92	0.0	4.1	11.0	23.8	30.6	33.9	39.6	46.0	44.2	41.3	38.4	33.1	24.3
21.25	0.0	4.1	11.0	23.8	30.6	33.9	39.7	46.3	44.9	41.9	39.1	33.7	24.7
22.58	0.0	4.1	11.0	23.8	30.6	33.9	39.6	46.3	44.9	42.0	39.1	33.7	24.8
23.88	0.0	4.1	11.0	23.8	30.6	33.9	39.6	45.9	44.3	41.4	38.6	33.2	24.4
25.17	0.0	4.1	11.0	23.8	30.6	33.9	39.4	45.1	43.0	40.2	37.5	32.2	23.6
26.46	0.0	4.1	11.0	23.8	30.6	33.9	39.0	43.7	41.1	38.4	35.8	30.7	22.3
27.75	0.0	4.1	11.0	23.7	30.6	33.8	38.3	41.6	38.4	35.8	33.4	28.6	20.7
28.56	0.0	4.1	11.0	23.7	30.6	33.6	37.5	39.9	36.3	33.9	31.6	26.9	19.4
29.38	0.0	4.1	11.0	23.7	30.5	33.4	36.4	37.8	33.9	31.6	29.5	25.1	18.0
30.19	0.0	4.1	11.0	23.7	30.3	32.9	34.9	35.2	31.1	29.1	27.1	23.0	16.4
31.00	0.0	4.1	11.0	23.7	30.0	32.1	32.8	32.2	28.1	26.3	24.5	20.7	14.7
32.00	0.0	4.1	11.0	23.5	29.0	30.2	29.3	27.8	23.9	22.4	20.9	17.6	12.4
33.00	0.0	4.1	10.9	22.8	26.7	26.7	24.5	22.6	19.2	18.1	16.8	14.2	9.9
34.00	0.0	4.1	10.3	20.8	22.1	21.1	18.3	16.5	14.0	13.2	12.3	10.3	7.3
35.00	0.0	3.7	7.8	14.7	13.6	12.4	10.3	9.2	7.9	7.5	7.0	5.9	4.2
35.50	0.0	2.6	4.7	8.6	7.4	6.5	5.4	4.9	4.3	4.1	3.7	3.2	2.3
36.00	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5	0.4	0.4	0.3	0.2

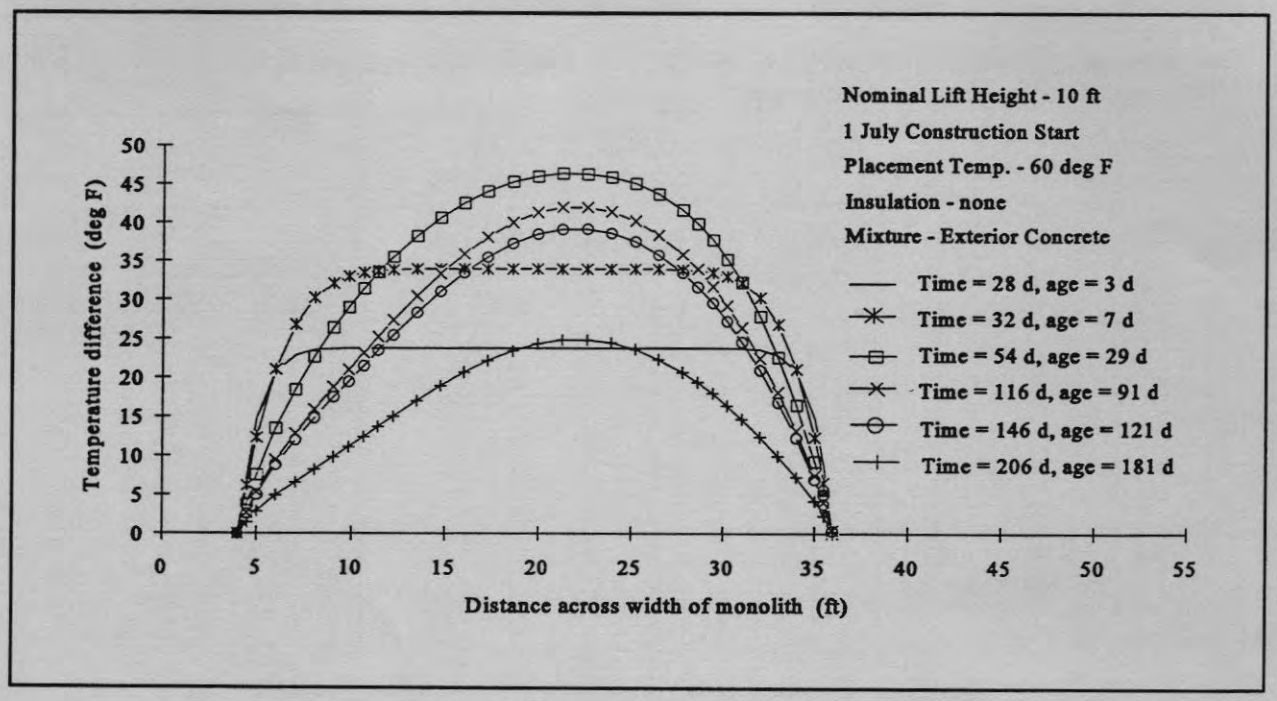


Figure A3-22. Temperature differences in lift 6 for surface gradient analysis

where

L/H = 13.4 m/7.0 m [44 ft / 23 ft] = 1.9

h/H = 3.5 m/ 7.0 m [11.5 ft / 23 ft] = 0.5

(c) Calculate tensile strains.

$\epsilon = (C_{th})(dT)(K_R) = 41$ millionths

where

C_{th} = 10.5 millionths/deg C
(5.81 millionths/deg F)

dT = 13.9 deg C (25 deg F)

K_R = 0.28

(d) Estimate cracking. TSC information is shown in Table A3-11 for various ages. Comparison of mass gradient tensile strains with the slow-load TSC for equivalent time periods indicates no anticipated cracking under the given conditions.

(2) Step 8: Surface gradient cracking analysis. Table A3-11 presents the surface gradient cracking calculations. The upper portion of the table shows the determination of restraint factors based on time and location. The lower portion shows calculation of strains using Equation A-8 from Appendix A, and comparison of calculate strains with slow-load TSC values for the appropriate time period. Figure A3-24 compares the development of tensile strains at the lock wall surface and concrete TSC with time.

(a) Internal restraint factor (K_R). Internal restraint factors are based on the depth of the tension block, "*H*." "*H*" is determined from Table A3-9 by observing the depth where temperatures change from negative to positive, which shows where effective strains are balanced between tension and compression. These depths are shown in Table A3-11 as the tension block width. K_R is calculated based on Equation A-5, as shown in the table.

Table A3-9
Balanced or Effective Temperature Differences to Determine "*H*" and Surface Gradients Strains

Degrees C

Horizontal Coordinate (m)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
1.2	0.0	-2.2	-5.8	-12.3	-15.4	-16.6	-17.9	-18.5	-16.6	-15.5	-14.4	-12.3	-8.8
1.4	0.0	-1.2	-3.6	-8.2	-11.6	-13.1	-15.1	-16.4	-15.1	-14.0	-13.0	-11.1	-8.0
1.5	0.0	-0.1	-1.4	-4.2	-7.8	-9.7	-12.4	-14.3	-13.5	-12.5	-11.7	-10.0	-7.2
1.8	0.0	0.1	0.0	-0.8	-3.1	-4.9	-8.1	-11.0	-11.1	-10.2	-9.5	-8.3	-6.1
2.1	0.0	0.1	0.2	0.3	-0.5	-1.7	-4.8	-8.3	-9.0	-8.4	-7.8	-6.8	-5.2
2.4	0.0	0.1	0.3	0.7	0.7	0.2	-2.4	-5.9	-7.1	-6.7	-6.2	-5.5	-4.3
2.7	0.0	0.1	0.3	0.8	1.3	1.2	-0.5	-3.9	-5.4	-5.1	-4.7	-4.2	-3.4
3.0	0.0	0.1	0.3	0.8	1.5	1.7	0.6	-2.4	-4.1	-3.9	-3.6	-3.3	-2.7
3.2	0.0	0.1	0.3	0.9	1.6	2.0	1.4	-1.1	-2.8	-2.7	-2.5	-2.3	-1.9
3.5	0.0	0.1	0.3	0.9	1.6	2.1	2.1	0.1	-1.5	-1.5	-1.4	-1.3	-1.2
3.7	0.0	0.1	0.3	0.9	1.6	2.2	2.6	1.2	-0.2	-0.4	-0.3	-0.4	-0.5
4.1	0.0	0.1	0.3	0.9	1.6	2.3	3.2	2.7	1.6	1.4	1.3	1.0	0.6
4.5	0.0	0.1	0.3	0.9	1.6	2.3	3.6	4.0	3.3	3.0	2.8	2.4	1.7
4.9	0.0	0.1	0.3	0.9	1.6	2.3	3.9	5.1	4.8	4.4	4.1	3.6	2.6
5.3	0.0	0.1	0.3	0.9	1.6	2.3	4.0	6.0	6.1	5.7	5.3	4.6	3.5
5.7	0.0	0.1	0.3	0.9	1.6	2.3	4.1	6.6	7.2	6.7	6.2	5.5	4.2
6.1	0.0	0.1	0.3	0.9	1.6	2.3	4.2	7.0	7.9	7.4	6.9	6.1	4.6
6.5	0.0	0.1	0.3	0.9	1.6	2.3	4.2	7.2	8.3	7.8	7.3	6.4	4.9
6.9	0.0	0.1	0.3	0.9	1.6	2.3	4.2	7.2	8.4	7.8	7.3	6.4	4.9
7.3	0.0	0.1	0.3	0.9	1.6	2.3	4.1	7.0	8.0	7.5	7.0	6.2	4.7
7.7	0.0	0.1	0.3	0.9	1.6	2.3	4.0	6.5	7.3	6.8	6.4	5.6	4.3
8.1	0.0	0.1	0.3	0.9	1.6	2.3	3.8	5.8	6.2	5.8	5.4	4.7	3.6
8.5	0.0	0.1	0.3	0.9	1.6	2.2	3.4	4.6	4.7	4.4	4.1	3.6	2.6
8.7	0.0	0.1	0.3	0.9	1.6	2.1	3.0	3.6	3.5	3.3	3.1	2.7	1.9
9.0	0.0	0.1	0.3	0.9	1.6	2.0	2.4	2.5	2.2	2.1	1.9	1.6	1.1
9.2	0.0	0.1	0.3	0.8	1.5	1.7	1.5	1.0	0.7	0.7	0.6	0.5	0.3
9.4	0.0	0.1	0.3	0.8	1.3	1.3	0.4	-0.6	-1.0	-0.9	-0.8	-0.8	-0.7
9.8	0.0	0.1	0.3	0.7	0.7	0.2	-1.6	-3.1	-3.3	-3.0	-2.8	-2.5	-1.9
10.1	0.0	0.1	0.3	0.4	-0.5	-1.7	-4.2	-6.0	-5.9	-5.5	-5.1	-4.4	-3.3
10.4	0.0	0.1	0.0	-0.8	-3.1	-4.9	-7.7	-9.4	-8.9	-8.2	-7.6	-6.6	-4.8
10.7	0.0	-0.1	-1.4	-4.2	-7.8	-9.7	-12.1	-13.4	-12.2	-11.3	-10.6	-9.0	-6.5
10.8	0.0	-0.8	-3.1	-7.5	-11.3	-12.9	-14.9	-15.8	-14.2	-13.2	-12.4	-10.5	-7.6
11.0	0.0	-2.2	-5.8	-12.3	-15.4	-16.6	-17.8	-18.3	-16.3	-15.3	-14.2	-12.1	-8.7

Negative temperature differences produce tensile strain.

Degrees F

Horizontal Coordinate (ft)	Age of Concrete in Lift 6 placed 25 days after Lift 1 (days)												
	0.5	1	2	3	5	7	14	29	59	91	121	151	181
	Elapsed Time (T) after Placement of Lift 1 (days)												
	25.5	26	27	28	30	32	39	54	84	116	146	176	206
4.00	0.0	-3.9	-10.4	-22.2	-27.7	-29.8	-32.2	-33.3	-29.9	-27.9	-26.0	-22.1	-15.9
4.50	0.0	-2.1	-6.5	-14.8	-20.9	-23.6	-27.2	-29.6	-27.1	-25.2	-23.5	-20.1	-14.5
5.00	0.0	-0.2	-2.6	-7.5	-14.1	-17.5	-22.2	-25.8	-24.3	-22.5	-21.0	-18.0	-13.0
6.00	0.0	0.2	-0.1	-1.4	-5.6	-8.8	-14.6	-19.8	-19.9	-18.4	-17.2	-14.9	-11.0
7.00	0.0	0.1	0.4	0.6	-1.0	-3.1	-8.7	-14.9	-16.2	-15.0	-14.0	-12.3	-9.3
8.00	0.0	0.1	0.6	1.3	1.3	0.4	-4.2	-10.7	-12.9	-12.0	-11.2	-9.9	-7.7
9.00	0.0	0.1	0.6	1.5	2.3	2.2	-1.0	-7.0	-9.7	-9.1	-8.5	-7.6	-6.1
9.81	0.0	0.1	0.6	1.5	2.7	3.1	1.0	-4.4	-7.3	-6.9	-6.5	-5.9	-4.8
10.63	0.0	0.1	0.6	1.5	2.8	3.6	2.6	-2.0	-5.0	-4.8	-4.5	-4.1	-3.5
11.44	0.0	0.1	0.6	1.5	2.9	3.8	3.7	0.2	-2.7	-2.7	-2.5	-2.4	-2.2
12.25	0.0	0.1	0.6	1.5	2.9	4.0	4.7	2.2	-0.4	-0.6	-0.6	-0.7	-0.9
13.50	0.0	0.1	0.6	1.5	3.0	4.1	5.7	4.9	2.9	2.5	2.3	1.8	1.1
14.75	0.0	0.1	0.6	1.5	3.0	4.1	6.5	7.3	6.0	5.4	5.0	4.2	3.0
16.00	0.0	0.1	0.6	1.5	3.0	4.1	7.0	9.2	8.7	8.0	7.4	6.4	4.7
17.25	0.0	0.1	0.6	1.5	3.0	4.1	7.3	10.7	11.0	10.2	9.5	8.3	6.2
18.58	0.0	0.1	0.6	1.5	3.0	4.1	7.4	11.9	13.0	12.1	11.2	9.8	7.5
19.92	0.0	0.1	0.6	1.5	3.0	4.1	7.5	12.7	14.3	13.4	12.5	10.9	8.4
21.25	0.0	0.1	0.6	1.5	3.0	4.1	7.5	13.0	15.0	14.0	13.1	11.5	8.8
22.58	0.0	0.1	0.6	1.5	3.0	4.1	7.5	13.0	15.0	14.1	13.2	11.6	8.9
23.88	0.0	0.1	0.6	1.5	3.0	4.1	7.4	12.6	14.4	13.5	12.6	11.1	8.5
25.17	0.0	0.1	0.6	1.5	3.0	4.1	7.2	11.7	13.1	12.3	11.5	10.1	7.7
26.46	0.0	0.1	0.6	1.5	3.0	4.1	6.9	10.4	11.1	10.5	9.8	8.5	6.4
27.75	0.0	0.1	0.6	1.5	2.9	4.0	6.1	8.3	8.4	7.9	7.4	6.4	4.7
28.56	0.0	0.1	0.6	1.5	2.9	3.8	5.4	6.5	6.3	6.0	5.6	4.8	3.5
29.38	0.0	0.1	0.6	1.5	2.8	3.6	4.3	4.4	3.9	3.7	3.5	3.0	2.1
30.19	0.0	0.1	0.6	1.5	2.7	3.1	2.8	1.9	1.2	1.2	1.1	0.9	0.5
31.00	0.0	0.1	0.6	1.5	2.3	2.3	0.7	-1.1	-1.8	-1.6	-1.5	-1.4	-1.2
32.00	0.0	0.1	0.6	1.3	1.3	0.4	-2.9	-5.5	-6.0	-5.5	-5.1	-4.5	-3.5
33.00	0.0	0.1	0.5	0.6	-1.0	-3.1	-7.6	-10.8	-10.7	-9.8	-9.2	-8.0	-6.0
34.00	0.0	0.2	-0.1	-1.4	-5.6	-8.8	-13.8	-16.9	-15.9	-14.7	-13.7	-11.8	-8.6
35.00	0.0	-0.2	-2.6	-7.5	-14.1	-17.5	-21.8	-24.1	-22.0	-20.4	-19.0	-16.3	-11.7
35.50	0.0	-1.4	-5.7	-13.6	-20.3	-23.3	-26.7	-28.4	-25.6	-23.8	-22.2	-19.0	-13.7
36.00	0.0	-3.9	-10.4	-22.2	-27.7	-29.8	-32.1	-32.9	-29.4	-27.5	-25.6	-21.8	-15.7

Negative temperature differences produce tensile strain

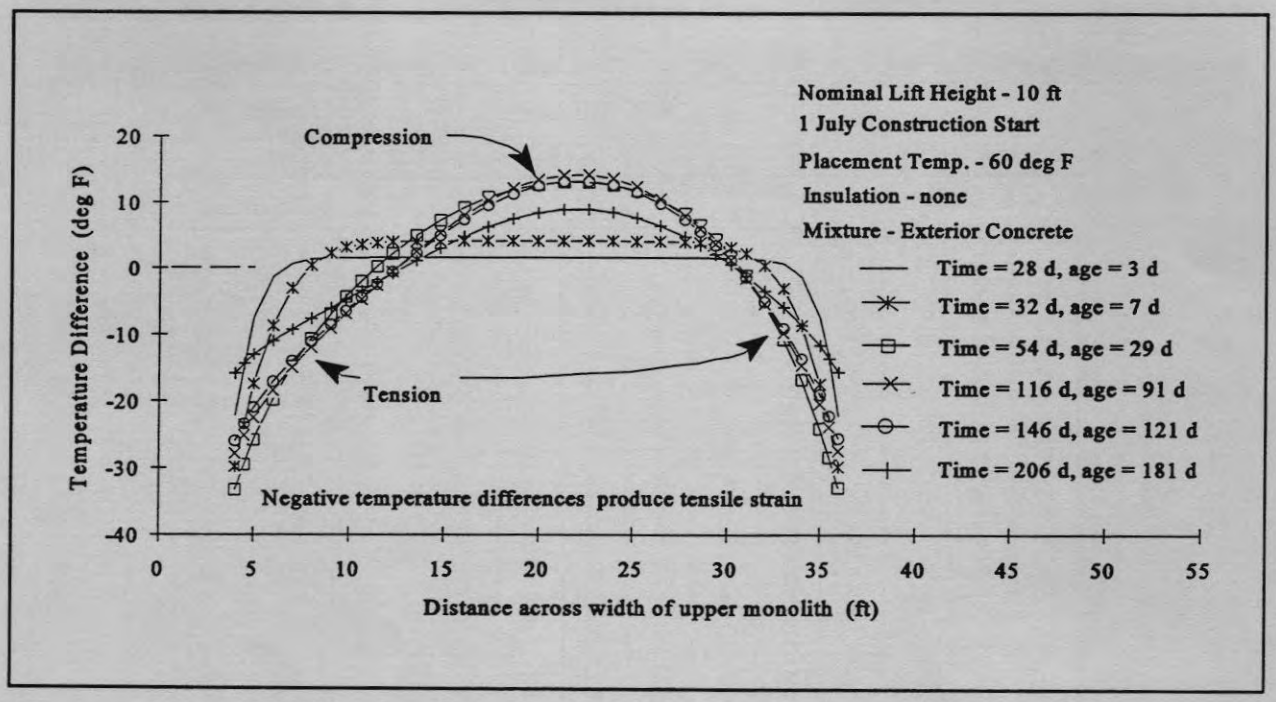


Figure A3-23. Balanced temperature difference distributions in lift 6 for surface gradient analysis

(b) Calculate tensile strains. Surface gradient tensile strains shown on Table A3-11, are based on the use of Equation A-8 (Appendix A), shown below:

$$\epsilon = (C_{th})(dT)(K_R) \qquad \text{(A-8)}$$

where

ϵ = induced tensile strain

C_{th} = coefficient of thermal expansion

dT = temperature difference with respect to interior temperature difference

K_R = internal restraint factor

dT is taken from the surface effective temperature differences in Table A3-9, at the exterior surfaces at each time period. These are shown on Table A3-11 for each lock wall face. For this example, only strains at the exterior surface are calculated and are hown on Table A3-11. Exterior surface strains are shown in this Table for $K_R = 1.0$, for comparison assuming the surface is completely restrained, and for various lengths (L = 11.0, 12.2, and 13.4 m)(L = 36, 40, and 44 ft) between vertical joints in the lock wall, where the surface restraint is less than 1.0. Strain variation with depth from the surface could be developed using corresponding K_R for interior locations.

(c) Estimate cracking. Comparison of strains with slow load TSC provides an estimation of where and when surface gradient cracking may develop, as shown in Table A3-11. The estimated depth of cracking could be evaluated using K_R at varying depths from the surface, and comparing with slow load TSC.

Table A3-10
Mass Gradient Cracking Aanalysis

1 July start, 15.5 deg C (60 deg F) placement temperature, no insulation, exterior mix

Analysis Location/ Node No.				Rock/Concrete Interface (Node 1925)			dT= dT(c)- dT(r)	Restraint Factor K_r	Thermal Strain	Slow Load TSC	Cracking yes/no
	T(max)	T(min)	dT©	T(max)	T(min)	dT(r)					
	deg C (deg F)	deg C (deg F)	deg C (deg F)	deg C (deg F)	deg C (deg F)	deg C (deg F)	deg C (deg F)	K_r = 0.64	millionths	millionths	
A / 1910	47.8 (118)	12.8 (55)	35.0 (63)	36.1 (97)	15.0 (59)	21.1 (38)	13.9 (25)	0.28	41	144	no
B / 1498	26.1 (79)	-0.6 (31)	26.7 (48)	33.3 (92)	25.5 (78)	7.8 (14)	18.9 (34)	0.08	16	144	no

Table A3-11
Surface Gradient Cracking Analysis

Example of Surface Gradient Analysis using Temperature Difference Distributions through Center of Lift 6												
3 m (10 ft) lifts, 1 July Start, 15.5 degC (60F) Placement Temperature, No Insulation, Cth = 10.5 millionths/degC (5.81 millionths/degF)												
Construction (days)		27	28	30	32	39	54	84	116	146	176	206
Concrete age (days)		2	3	5	7	14	29	59	91	121	151	181
Tension Block Width:			See Figure A3-9									
H(left)	m (ft)	0.6 (2.1)	0.8 (2.7)	1.0 (3.4)	1.2 (3.9)	1.6 (5.4)	2.2 (7.4)	2.6 (8.4)	2.6 (8.5)	2.6 (8.5)	2.6 (8.6)	2.7 (8.8)
H(right)	m (ft)	0.6 (2.1)	0.8 (2.7)	1.0 (3.4)	1.2 (3.9)	1.5 (4.8)	1.6 (5.3)	1.7 (5.5)	1.7 (5.5)	11.7 (5.5)	1.7 (5.5)	1.7 (5.6)
Monolith	Joint		RESTRAINT FACTORS KR AT SURFACES FOR L									
Analysis	Spacing											
Location	m (ft)		For L/H >= 2.5, Use equation Kr = [(L/H-2)/(L/H+1)]exp(h/H), where h=H at surface									
Left-side	11.0 (36)	0.83	0.79	0.74	0.71	0.61	0.49	0.43	0.43	0.43	0.42	0.41
Outer	12.2 (40)	0.85	0.81	0.76	0.73	0.64	0.53	0.48	0.47	0.47	0.47	0.46
Surface	13.4 (44)	0.86	0.83	0.78	0.76	0.67	0.57	0.52	0.51	0.51	0.51	0.50
Right-side	11.0 (36)	0.83	0.79	0.74	0.71	0.65	0.61	0.60	0.61	0.61	0.60	0.60
Outer	12.2 (40)	0.85	0.81	0.76	0.73	0.68	0.65	0.64	0.64	0.64	0.64	0.63
Surface	13.4 (44)	0.86	0.83	0.78	0.76	0.70	0.68	0.67	0.67	0.67	0.67	0.66
			EFFECTIVE TEMPERATURE DIFFERENCES AT SURFACE									
Eff. Temp. Diff. (Table A3-9)												
dT(left) (deg F)		-5.5 (-10)	-12.2 (-22)	-15.5 (-28)	-16.7 (-30)	-17.8 (-32)	-18.3 (-33)	-16.7 (-30)	-15.6 (-28)	-14.4 (-26)	-12.2 (-22)	-7.8 (-14)
dT(right) (deg F)		-5.5 (-10)	-12.2 (-22)	-15.5 (-28)	-16.7 (-30)	-17.8 (-32)	18.3 (-33)	-16.1 (-29)	-15.0 (-27)	-14.4 (-26)	-12.2 (-22)	-7.8 (-14)
			SLOW LOAD TENSILE STRAIN CAPACITY									
concrete age (days)		2	3	5	7	14	28	61	90	125	155	185
slow load TSC (millionths)		86	95	104	108	116	124	134	140	144	146	149
Monolith	Joint			SURFACE TENSILE STRAIN CORRECTED FOR INTERNAL RESTRAINT (KR)								
Analysis	Spacing											
Location	m (ft)	(Assume cracking when tensile strains exceed slow-load tensile strain capacity(TSC) for respective age, indicated in bold)										
Left-side	11.0 (36)	50	**102**	**119**	**122**	**114**	95	75	69	64	54	38
Outer	12.2 (40)	51	**105**	**123**	**127**	**120**	103	83	77	71	60	42
Surface	13.4 (44)	52	**107**	**126**	**131**	**126**	110	90	83	78	66	46
Right-side	11.0 (36)	50	**102**	**119**	**122**	**121**	119	105	98	91	78	55
Outer	12.2 (40)	51	**105**	**123**	**127**	**127**	**126**	111	104	97	82	59
Surface	13.4 (44)	52	**107**	**126**	**131**	**132**	**131**	116	108	101	86	61

e. Conclusions and recommendations. Some of the recommendations from this thermal study included the following:

(1) Maximum lift height = 1.5 m (5 ft).

(2) Maximum concrete placement temperature = 15.5 deg C (60 deg F) producing a 35.0 deg C (95 deg F) interior temperature.

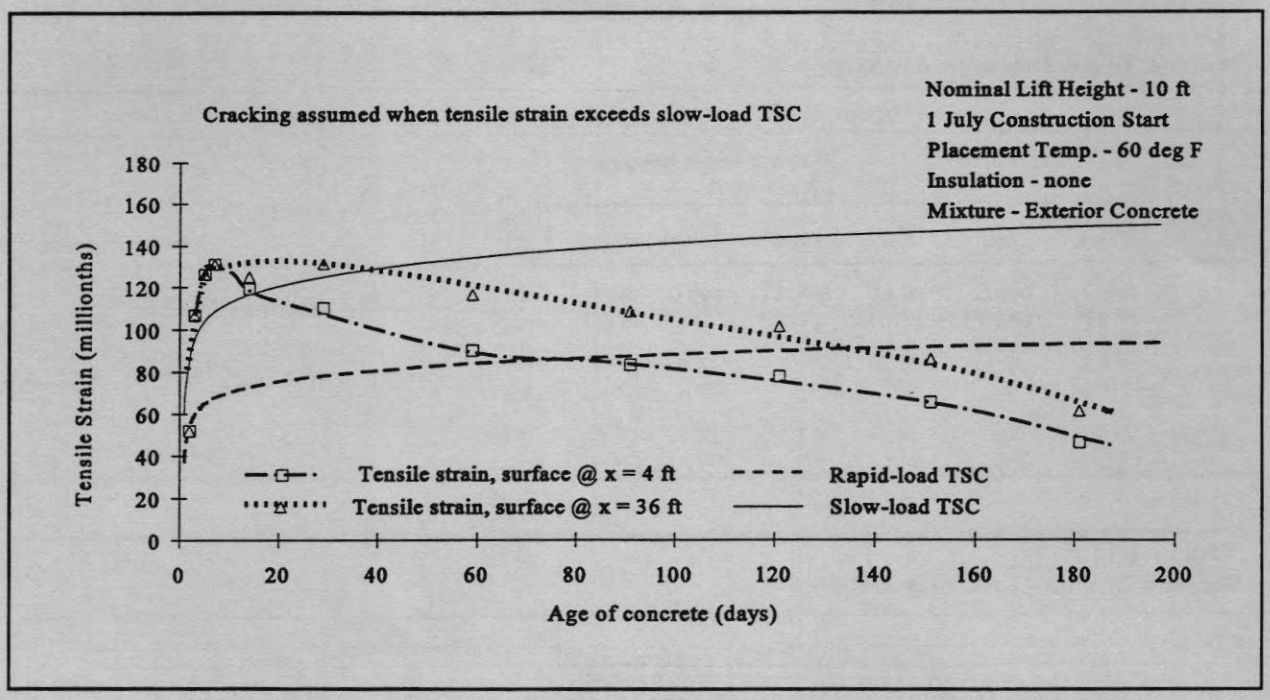


Figure A3-24. Evaluation of surface gradient cracking potential by comparing induced tensile strain with slow load tensile strain capacity

(3) Conduct additional mixture proportioning studies to further reduce the cement content.

(4) Insulate all exposed concrete surfaces placed between 15 October and 1 March.

(5) Remove insulation only when ambient temperatures are above mean daily temperatures, to aid thermal shock.

(6) Open culvert space to cool air slowly, to avoid thermal shock.

ANNEX 4: LIST OF REFERENCES

A4-1. Cited References

a. U.S. Army Corps of Engineers.

ER 1110-2-1150
ER 1110-2-1150, Engineering and Design for Civil Works Projects.

EM 1110-2-2000
EM 1110-2-2000, Standard Practice for Concrete for Civil Works Structures.

EM 1110-2-2006
EM 1110-2-2006, Roller Compacted Concrete.

EM 1110-2-2200
EM 1110-2-2200, Gravity Dam Design.

EM 1110-2-2201
EM 1110-2-2201, Arch Dam Design.

ETL 1110-2-254
ETL 1110-2-254, Finite Element Analysis-Interpretation and Documentation Guidelines.

ETL 1110-2-332
ETL 1110-2-332, Modeling of Structures For Linear Elastic Finite Element Analysis.

ETL 1110-2-343
ETL 1110-2-343, Structural Design Using the Roller-Compacted Concrete (RCC) Construction Process.

ETL 1110-2-365
ETL 1110-2-365, Nonlinear, Incremental Structural Analysis of Massive Concrete Structures.

ETL 1110-2-536
ETL 1110-2-536, Nonlinear Incremental Structural Analysis of Zintel Canyon Dam.

ETL 1110-8-16
ETL 1110-8-16 (FR), Fracture Mechanics Analysis of Concrete Hydraulic Structures.

U.S. Army Engineer Waterways Experiment Station 1949
U.S. Army Engineer Waterways Experiment Station. 1949. *Handbook for Concrete and Cement* (with periodic supplements), Vicksburg, MS.

Designation CRD C 16-94
Designation CRD C 16-94, "Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)." (ASTM C 78-94)

Designation CRD C 19-94
Designation CRD C 19-94, "Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression." (ASTM C 469-94)

Designation CRD C 23-91
Designation CRD C 23-91, "Standard Test Method for Specific Gravity, Absorption and Voids in Hardened Concrete." (ASTM C 642-90)

Designation CRD C 36-73
Designation CRD C 36-73, "Method of Test for Thermal Diffusivity of Concrete."

Designation CRD C 37-73
Designation CRD C 37-73, "Method of Test for Thermal Diffusivity of Mass Concrete."

Designation CRD C 38-73
Designation CRD C 38-73, "Method of Test for Temperature Rise in Concrete."

Designation CRD C 39-81
Designation CRD C 39-81, "Test Method for Coefficient of Linear-Thermal Expansion of Concrete."

Designation CRD C 44-63
Designation CRD C 44-63, "Method of Calculation of Thermal Conductivity of Concrete."

Designation CRD C 54-94
Designation CRD C 54-94, "Standard Test Method for Creep of Concrete in Compression." (ASTM C 512-87(94))

Designation CRD C 71-80
Designation CRD C 71-80, "Standard Test Method for Ultimate Tensile Strain Capacity of Concrete."

Designation CRD C 77-91
Designation CRD C 77-91, "Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens." (ASTM C 496-90)

Designation CRD C 124-73
Designation CRD C 124-73, "Method of Test for Specific Heat Aggregates, Concrete, and other Materials (Method of Mixtures)."

Designation CRD C 158-93
Designation CRD C 158-93, "Standard Test Method for Determining the Mechanical Properties of Hardened Concrete Under Triaxial Loads."

Designation CRD C 164-92
Designation CRD C 164-92, "Standard Test Method for Direct Tensile Strength of Cylindrical Concrete or Mortar Specimens."

U.S. Army Engineer Waterways Experiment Station 1990
U.S. Army Engineer Waterways Experiment Station. 1990. Rock Testing Handbook (with periodic supplements), Vicksburg, MS.

American Concrete Institute
American Concrete Institute. 1993. *ACI Manual of Concrete Practice; Detroit, MI.*

ACI 116R-90
ACI 116R-90, "Cement and Concrete Terminology," Part 1.

ACI 207.1R-87
ACI 207.1R-87, "Mass Concrete for Dams and Other Massive Structures," Part 1.

ACI 207.2R-90
ACI 207.2R-90, "Effect of Restraint, Volume Change, and Reinforcement of Cracking of Massive Concrete," Part 1.

ACI 207.4R-93
ACI 207.4R-93, "Cooling and Insulating Systems for Mass Concrete," Part 1.

ACI 207.5R-89
ACI 207.5R-89, "Roller Compacted Mass Concrete," Part 1.

American Society for Testing and Materials 1992
American Society for Testing and Materials. 1992. *1992 Annual Book of ASTM Standards*, Philadelphia, PA.

Designation D 3148-86
Designation D 3148-86, "Test Method for Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression."

Designation D 4535-85
Designation D 4535-85, "Test Method for Measurement of the Thermal Expansion of Rock Using a Dilatometer."

Other cited references.

American Society of Heating, Refrigerating and Air-Conditioning Engineers 1977
American Society of Heating, Refrigerating and Air-Conditioning Engineers. 1977. *ASHRAE Handbook and Product Directory - 1977 Fundamentals*, New York, NY.

Carlson 1937
Carlson, R. 1937. "A Simple Method for the Computation of Temperatures in Concrete Structures," *ACI Journal Proceedings*, Vol 34, No. 2, pp 89-102.

Fintel 1985
Fintel, M. 1985. *Handbook of Concrete Engineering - 2nd Edition*, Van Nostrand Reinhold, New York, NY.

Hibbitt, Karlsson, and Sorensen 1994
Hibbitt, Karlsson, and Sorensen. 1994. *ABAQUS User's Manual, Version 5.3.*, Pawtucket, RI.

Houghton 1976
Houghton, D. L. 1976. "Determining Tensile Strain Capacity of Mass Concrete." *ACI Journal Proceedings,* Vol 73, No. 12, 1976, pp 691-700.

Hunt 1986
Hunt, R. E. 1986. *Geotechnical Engineering Techniques and Practices,* McGraw-Hill, New York.

Jumikis 1977
Jumikis, A. R. 1977. *Thermal Geotechnics,* Rutgers University Press, New Brunswick, NJ.

Kersten 1949
Kersten, M. S. 1949. *Laboratory Research for the Determination of the Thermal Properties of Soils*, Engineering Experiment Station, University of Minnesota, Minneapolis, MN.

Polivka and Wilson 1976
Polivka, R. M., and Wilson, E. L. 1976. "Finite Element Analysis of Nonlinear Heat Transfer Problems," *SESM Report* No. 76-2, University of California, Berkeley.

Rawhouser 1945
Rawhouser, C. 1945. "Cracking and Temperature Control of Mass Concrete," *ACI Journal Proceedings*, Vol 41, No. 4, pp 305-348.

U.S. Army Engineer Waterways Experiment Station 1996
U.S. Army Engineer Waterways Experiment Station. 1996. "Concrete Thermal Study, Locks and Dam 2, 3, and 4, Monongahela River Project," Vicksburg, MS.

U.S. Department of the Interior, Bureau of Reclamation 1965
U.S. Department of the Interior, Bureau of Reclamation. 1965. "Control of Cracking in Mass Concrete Structures," *USBR Engineering Monograph 34*, Denver, CO.

Wilson 1968
Wilson, E. L. 1968. "The Determination of Temperatures within Mass Concrete Structures," SESM Report No. 68-17, University of California, Berkeley, 33 pp.

A4-2. Supplemental References.

Barrett, Foadian, James, and Rashid
Barrett, P. R., Foadian, H., James, R. J., Rashid, Y. R. "Thermal-Structural Analysis Methods for RCC Dams," *Roller Compacted Concrete - III*, American Society of Civil Engineers, New York, pp 407-422.

Burks 1947
Burks, S.D. 1947. "Five-Year Temperature Records of a Thin Concrete Dam, " *ACI Journal Proceedings*, Vol 44, No. 1, Detroit, MI, pp 65-76.

Calvo, Sudón, and Pfeiffer 1995
Calvo, J., Sudón, J., and Pfeiffer, G. 1995. "Thermal Analysis of RCC Dams Methodology - Application to Cenza Dam," *Roller Compacted Concrete Dams, Proceedings of the International Symposium,* pp 575-589.

Carlson, Houghton, and Polivka 1979
Carlson, R. W., Houghton, D. L., and Polivka, M. 1979. "Causes and Control of Cracking in Unreinforced Mass Concrete," *ACI Journal Proceedings*, Vol 76, No. 7, pp 821-837.

Carlson and Thayer 1959
Carlson, R. W., and Thayer, D. P. 1959. "Surface Cooling of Mass Concrete to Prevent Cracking," *ACI Journal Proceedings*, Vol 56, No. 2, Aug 1959, pp 107-120.

Ditchey and Schrader 1988
Ditchey, E. J., and Schrader, E. K. 1988. "Monksville Dam Temperature Studies, " *Transactions 16th International Congress on Large Dams (San Francisco 1988)*, International Commission on Large Dams, Paris, pp 379-395.

Dusinberre, 1945
Dusinberre, D.M. 1945. "Numerical Methods for Transient Heat Flow," *Transactions American Society of Mechanical Engineers*, Vol 67, pp 703-772.

Fujisawa and Nagayama 1985
Fujisawa, T., and Nagayama, I. 1985. "Cause and Control of Cracks By Thermal Stress in Concrete Dams," *Transactions 15th International Congress on Large Dams (Lausanne 1985)*, International Commission on Large Dams, Paris, pp 117-142.

Garner and Hammons 1991
Garner, S., and Hammons, M. 1991. "Development and Implementation of Time-Dependent Cracking Material Model for Concrete, " *Technical Report SL-91-7*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, pp 44.

Giménez and Fernández 1995
Giménez, E. C., and Fernández, J. 1995. "Prediction of the Thermal State of Dams Using Mathematical Models - Application to the Algar Dam (Valencia, Spain), " *Roller Compacted Concrete Dams, Proceedings of the International Symposium,* pp 591-609.

Hinks and Copley 1995
Hinks, J. L., and Copley, A. F. 1995. "Thermal Analysis For RCC Dams," *Roller Compacted Concrete Dams, Proceedings of the International Symposium,* pp 473-484.

Houghton 1969
Houghton, D. L. 1969. "Concrete Volume Change for Dworshak Dam," *Proceedings ASCE*, Vol 95, PO2, New York, pp 153-166.

Houghton 1970
Houghton, D. L. 1970. "Measures Being Taken for Prevention of Cracks in Mass Concrete at Dworshak and Libby Dams," *Transactions, 10th International Congress on Large Dams (Montreal 1970)*, International Commission on Large Dams, Paris.

Klein, Pirtz, and Adams, 1963
Klein, A., Pirtz, D., and Adams, R. 1963. "Thermal Properties of Mass Concrete During Adiabatic Curing," *Symposium on Mass Concrete*, ACI Special Publication SP-6, American Concrete Institute, Detroit, MI, pp 199-218.

Liu and McDonald 1978
Liu, T. C., and McDonald, J. E. 1978. "Prediction of Tensile Strain Capacity of Mass Concrete," *ACI Journal Proceedings*, Vol 75, No. 5, Detroit, MI, pp 192-197.

Mead
Mead, A. R. "Temperature-Instrumentation Observations at Pine Flat Dam and Folsom Dams," *Symposium on Mass Concrete*, ACI Special Publication SP-6, American Concrete Institute, Detroit, MI, pp 151-178.

Neville 1981
Neville, A. M. 1981. *Properties of Concrete*, Wiley, New York.

Norman and Anderson 1985
Norman, C. D., and Anderson, F. A. 1985. "Reanalysis of Cracking in Large Concrete Dams in the US Army Corps of Engineers," *Transactions 15th International Congress on Large Dams (Lausanne 1985), Proceedings,* International Commission on Large Dams, Paris, pp 157-171.

Polivka, Pirtz, and Adams 1963
Polivka, M., Pirtz, D., Adams, R. 1963. "Studies of Creep in Mass Concrete," *Symposium on Mass Concrete*, ACI Special Publication SP-6, American Concrete Institute, Detroit, MI, pp 257-285.

Raphael 1984
Raphael, Jerome M. 1984. "Tensile Strength of Concrete," *ACI Journal Proceedings,* Vol 81, No.2, Detroit, MI, pp 158-165.

Rhodes, 1978
Rhodes, J. A. 1978. "Thermal Properties," *Significance of Tests and Properties of Concrete and Concrete Making Materials*, STP-169B, American Society for Testing and Materials, Philadelphia, PA, pp 242-266.

Ross and Bray 1949
Ross, A. D., and Bray, J. W. 1949. "The Prediction of Temperatures in Mass Concrete by Numerical Computation," *Magazine of Concrete Research*, Vol 1, No. 1, London, pp 9-20.

Saetta, Scotta, and Vitaliani 1995
Saetta, A., Scotta, R., and Vitaliani, R. 1995. "Stress Analysis of Concrete Structures Subjected To Variable Thermal Loads," *Journal of Structural Engineering*, Vol 121, No. 3, American Society of Civil Engineers, New York, pp 446-457.

Salete, Lancha, and Marco 1995
Salete, E., Lancha, J. C., and Marco, C. 1995. "Sensibility of Thermal Transfer Analysis of Dams on the Convection Coefficient," *Roller Compacted Concrete Dams, Proceedings of the International Symposium*, pp 611-624.

Sánchez and Gonzalez-Elipe 1995
Sánchez, E. A., and Gonzalez-Elipe, J. M. 1995. "Thermal Analysis and Behavior of the Arriaran Dam," *Roller Compacted Concrete Dams, Proceedings of the International Symposium*, pp 1069-1081.

Sereno and Peloche 1995
Sereno, M. G., and Peloche, J. 1995. "A Thermal Study of the Sierra Brava Dam - A Comparison of a Mathematical Model With Real Temperature Recordings," *Roller Compacted Concrete Dams, Proceedings of the International Symposium*, pp 1105-1124.

Tatro and Schrader 1992
Tatro, Stephen B., and Schrader, Ernest K. 1992. "Thermal Analysis of RCC - A Practical Approach," *Roller Compacted Concrete - III*, American Society of Civil Engineers, New York, pp 389-406.

Tennessee Valley Authority 1950
Tennessee Valley Authority. 1950. "Measurements of the Structural Behavior of Norris and Hiwassee Dams," *Technical Monograph No. 67*, Knoxville, TN.

Touloukian, et al. 1970
Touloukian, Y., et al. 1970. *Thermophysical Properties of Matter*, Purdue University Thermophysical Properties Research Center, West Lafayette, IN.

Townsend
Townsend, C. L. "Control of Temperature Cracking in Mass Concrete," *Causes, Mechanism, and Control of Cracking in Concrete*, ACI Special Publication SP-20, American Concrete Institute, Detroit, pp 119-139.

Waugh and Rhodes 1959
Waugh, W. R., and Rhodes, J. A. 1959. "Control of Cracking in Concrete Gravity Dams," *Proceedings ASCE*, Vol. 85, PO5, New York, pp 1-20.

Yamazumi, Harita, Jikan, and Kido 1995
Yamazumi, A., Harita, K., Jikan, S., and Kido, K. 1995. "A Study of Thermal Control on RCD Dam," *Roller Compacted Concrete Dams, Proceedings of the International Symposium*, pp 493-507.

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WELDING, STRUCTURAL

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WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(2006) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(2001; Errata 2001) Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying
AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E 165	(2009) Standard Test Method for Liquid Penetrant Examination
ASTM E 709	(2008) Standard Guide for Magnetic Particle Examination

1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0. The following classifications indicate the project's class(es) of weld joints.

1.2.1 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.2 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.3 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices, steel connection devices, and inserts and anchors required in concrete construction.

1.2.4 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. When possible, perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; G, STR

Welder, Welding Operator, and Tacker Qualification; G, STR

Inspector Qualification; G, STR

Previous Qualifications; G, STR

Pre-qualified Procedures; G, STR

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control; G, STR

Nondestructive Examination; G, STR

A quality assurance plan and records of tests and inspections. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

SD-07 Certificates

Certified Welding Procedure Specifications (WPS); G, STR

Certified Procedure Qualification Records (PQR); G, STR

Certified Welder Performance Qualifications (WPQ); G, STR

1.5 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the certified welding procedure specifications and the results of the certified procedure qualification records for each type of welding which requires procedure qualification. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

To perform this work provide an organization certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category (BU) Building Fabricator.

a. For Structural Projects, provide documentation of the following:

1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test results, including those of test welds that failed to meet the requirements, with the welding procedure.

1.5.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.5.5.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and Certified Welder Performance Qualifications (WPQ). State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.5.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.5.6 Inspector Qualification

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.5.7 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe welding practices and safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or

welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E 165, ASTM E 709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection, ultrasonic, magnetic particle or dye penetrant methods. All weldments shall undergo visual examination. The minimum extent of nondestructive testing must be random 50% of all fillet welds shall undergo magnetic particle examination, and all full penetration groove welds shall receive ultrasonic examination, and as indicated on the drawings. Submit all records of nondestructive testing.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present. Submit all records of nondestructive testing in accordance with paragraph STANDARDS OF ACCEPTANCE.

3.3.1.1 Extent of Non-Destructive Testing

All weldments shall undergo visual examination, 50% of all fillet welds shall undergo magnetic particle examination, and all full penetration groove welds shall receive ultrasonic examination.

3.3.1.2 Flaw Acceptance Size Criteria

Rejectable flaw sizes in structural weldments shall conform to AWS D1.1/D1.1M static criteria.

3.3.1.3 NDT Re-Test Reports

If a rejectable flaw is discovered the weld or portion of the weld so affected shall be re-tested after repair. A post repair test report shall be included and shall accompany the original test report which detected the rejectable flaw.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

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MISCELLANEOUS METAL FABRICATIONS

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SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.2.6	(2010; Supp 2011) Fasteners for Use in Structural Applications
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes

ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A420/A420M	(2020) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A519/A519M	(2017) Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM C882/C882M	(2020) Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F594	(2009; R 2020) Standard Specification for Stainless Steel Nuts
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Materials

Fabrication and Erection Drawings; G

Installation Drawings; G

Fabrication Drawings; G

Fabrication Finishes

Templates, Erection and Installation Drawings; G

SD-07 Certificates

Qualified Welders; G, STR

Certified Mill Test Reports for Chemistry and Mechanical Properties; G

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of

dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

2.1.1 Structural Carbon Steel

Wide flange and WT shapes shall be ASTM A992/A992M Gr. 50. Angle, Channels, Bars and Plates shall be ASTM A36/A36M.

2.1.2 Steel Pipe

Provide in accordance with ASTM A53/A53M, Type E or S, Grade B.

2.1.3 Fittings for Steel Pipe

Provide standard malleable iron fittings in accordance with ASTM A47/A47M.

2.1.3.1 Bolts, Nuts, and Washers

Provide bolts, nuts, and washers conforming to the requirements of ASME B18.2.6 with galvanized zinc-coated finish. Provide bolts nuts and washers conforming to ASME B18.2.6 of the material, grade, type, class, style and finish indicated or best suited for intended use.

2.1.3.1.1 High-Strength Bolts, Nuts and Washers

ASTM F3125/F3125M, grade A325, Type 1, with carbon steel nuts conforming to ASTM A563, Grade DH. Washers for high-strength bolts shall conform to ASTM F436/F436M.

2.1.3.1.2 Bolts, Nuts, and Washers (Other than High-Strength)

a. Bolts and Nuts - ASTM A307, Grade A, hot-dip galvanized

b. Bolts - ASME B18.2.1

c. Nuts - ASME B18.2.2

d. Washers

(1) Plain Washers - ASME B18.21.1, Type B.

(2) Lock Washers - ASME B18.21.1

(3) Beveled Washers - ASTM F436/F436M, Type I, Beveled.

2.1.4 Anchors

2.1.4.1 Expansion Anchors

Unless indicated otherwise, all expansion anchors shall be stainless steel stud type expansion anchors with a single piece wedge that performs as three independent wedges if necessary to provide consistent performance in a wide variety of medium-duty applications. Each expansion anchor shall be provided with a nut and washer. The stud shall consist of a stainless steel bar conforming to ASTM A276/A276M or ASTM A493 with chemical

composition of either AISI 304 or 316. The wedge shall be manufactured from wither AISI 304 or 316 stainless steel conform to the stud material. The nut shall be of stainless steel conforming to ASTM F594 with chemical composition of either AISI 304 or 316 and meeting the dimensional requirements of ASME B18.2.2 to conform to the stud material. The washer shall be AISI 304 or 316 stainless steel conforming to ASTM A420/A420M conforming to the stud material. Expansion anchors shall be of diameter indicated with anchor and thread lengths suitable to provide the indicated minimum embedment and meet the required tensile pull out and shear loads. Install expansion anchors in accordance with the manufacturer's recommendations.

2.1.4.2 Adhesive Anchors

Anchor adhesives shall be two-component (A and B). Adhesive shall be furnished in side-by-side refill packs which keep component A and component B separate. Side-by-side packs shall be designed to compress during use to minimize waste volume. Side-by-side packs shall also be designed to accept a static mixing nozzle which thoroughly blends component A and component B and allows injection into drilled holes. Only injection tools and static mixing nozzles as recommended by the manufacturer shall be used. Manufacturer's instructions shall be followed. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness. Typical curing time at 68 degrees Fahrenheit shall be approximately 12 hours. The anchor adhesive shall have a minimum bond strength of 1,800 psi in 2 days cure as tested in accordance with ASTM C882/C882M and a minimum tensile strength of 6,310 psi in 7 days as tested in accordance with ASTM D638.

2.1.4.3 Accessories for Precast Concrete Placement

Threaded rod for placement of precast elements shall be all-threaded rebar meeting the requirements of ASTM A615/A615M and having a minimum yield strength of 100 kips per square inch. Spacer nuts and plates for use with threaded rod shall be from the same manufacturer. Sizes and dimensions of these components shall be as shown or as recommended by the manufacturer.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the

stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust preventor.

2.2.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.3 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide with connections.

Provide angles and plates in accordance with ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with ASTM A123/A123M.

2.4 WALL ARMOR

Fabricate wall armor as shown. Provide curved T-sections for rub armor and curved plates for corner protection. Provide joints in armor as shown. Use full length pieces between joints. All other joints shall be flush cut butt joints with spacing as shown. Anchors for wall armor shall be as shown.

2.5 LADDERS

Fabricate vertical ladders as shown on the plans. Use 3 by 3/8 inch steel flats for stringers and 1 inch diameter steel rods for rungs. Rungs must not be less than 16 inches wide, spaced one foot apart, plug welded into stringers. Install ladders so that the distance from the centerline of rungs to the finished wall surface will not be less than 8 inches. Provide bent bar angles welded to the stringer as indicated. Provide bent bar angles not over 48 inches on centers. The top rung of the ladder must be level with the top of the access level served by the ladder. Extend the side rails above the access level as shown on the plans. Provide ladder access protective swing gates at the top of access/egress level as shown on plans.

2.6 CHECK POSTS

Fabricate and install check posts as shown. Steel tubing for check post shall conform to ASTM A519/A519M, Grade 4130, Condition SR.

2.7 OUTDRAFT SIGN

The outdraft sign shall be relocated to the end cell as shown.

2.8 LIGHT POST

The new light post shall match existing and shall be located on the end cell as shown.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Exposed fastenings shall be compatible materials and shall generally match in color and finish. Poor matching of holes for fasteners shall be cause for rejection. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide countersunk rivets where exposed. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise. Test a minimum of 2 bolt, nut, and washer assemblies from each certified mill batch in a tension measuring device at the job site prior to the beginning of bolting start-up.

3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry or provide with suitable anchoring devices as indicated or required. Furnish metal work in ample time for securing in place as the work progresses. Submit installation drawings shown layout(s), connections to structural system, and anchoring details.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

3.8 INSTALLATION MISCELLANEOUS PLATES AND SHAPES

Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners or welds. Construct to have at least 8 inches bearing on masonry at each end.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 52 00

METAL RAILINGS

-- End of Section Table of Contents --

SECTION 05 52 00

METAL RAILINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A467/A467M	(2020) Standard Specification for Machine Coil Chain
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within 45 days of contract award, submit fabrication drawings for the following items:

a. Aluminum railings and handrails

b. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

c. Concrete inserts

d. Masonry anchorage devices

e. Protective coating

f. Aluminum railings and handrails

g. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

SD-03 Product Data

Concrete Inserts; G

Masonry Anchorage Devices; G

Protective Coating; G

Aluminum Railings and Handrails; G

Anchorage and Fastening Systems; G

SD-07 Certificates

Welding Procedures; G

Welder Qualification; G

SD-08 Manufacturer's Instructions

Installation Instructions

Hardware

1.4 QUALITY CONTROL

1.4.1 Welding Procedures

Section 05 05 23.13 WELDING, STRUCTURAL applies to work specified in this section.

Submit results of welding procedures testing in accordance with AWS D1.2/D1.2M Structural Aluminum Welding Code, made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.2/D1.2M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, conduct an immediate retest of two test welds and ensure

that each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

PART 2 PRODUCTS

2.1 FABRICATION DRAWINGS

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning, treating, and applying surface finishes, including zinc coatings.

Provide railing and handrail detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce adequate strength and durability in the finished product for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and straight sharp edges. Ensure that all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M or AWS D1.2/D1.2M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form the exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use countersunk Phillips flathead screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

2.1.1 Aluminum Railings

Fabrication: Provide fabrication jointing by one of the following methods:

a. Use flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8 inch recessed-head set screws.

b. Ensure that mitered and welded joints made by fitting; post to top

rail; intermediate rail to post; and corners, are groove welded and ground smooth. Where allowed by the Contracting Officer, provide butt splices reinforced by a tight-fitting dowel or sleeve not less than 6 inches in length. Tack-weld or epoxy-cement the dowel or sleeve to one side of the splice.

c. Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8 inch stainless-steel recessed-head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B26/B26M.

Provide removable railing sections as indicated. Provide toe-boards and brackets where indicated, using flange castings as appropriate.

2.2 COMPONENTS

2.2.1 Aluminum Railings And Handrails

Provide railings and handrails consisting of 2 inch nominal schedule 40 pipe ASTM B429/B429M for railing and schedule 80 for posts. Provide anodized aluminum railings. Ensure that all fasteners are Series 300 stainless steel.

2.2.2 Safety Chains

Provide safety chains of galvanized steel, straight-link type, 3/16 inch diameter, with at least 12 links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Provide bolts and nuts as indicated, conforming to the requirements of ASTM A307. Locate safety chain where indicated. Mount the top chain three feet 6 inches above the floor or ground and mount the lower chain 2 feet above the floor or ground.

PART 3 EXECUTION

3.1 PREPARATION

Space posts not more than 8 feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

a. Anchor posts to steel with oval steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members. Provide non-metallic isolation pad to prevent galvanic corrosion between dissimilar metals.

b. Anchor rail ends to steel with oval or round steel flanges welded to tail ends and bolted to the structural-steel members. Provide non-metallic isolation pad to prevent galvanic corrosion between dissimilar metals.

Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends.

3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of aluminum hand rail work:

a. Aluminum railings and handrails

b. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all hardware, and for all used in accordance with the design specifications cited in this section.

3.2.1 Aluminum Handrail

Affix to base structure by flanges anchored to concrete or other existing masonry by expansion anchors or base plates or flanges bolted to stringers or structural-steel framework. Provide Series 300 stainless-steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, provide a rubber isolation pad or spacer.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

-- End of Section Table of Contents --

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

MASTER PAINTERS INSTITUTE (MPI)

MPI ASM	(2019) Architectural Painting Specification Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment List; G

SD-03 Product Data

Polyurethane Coatings; G

SD-04 Samples

Color Chips; G

SD-07 Certificates

Polyurethane Coatings; G

Manufacturer's Printed Instructions; G

1.3 QUALITY CONTROL

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started. Submit an equipment list consisting of a list of proposed equipment to be used in performance of construction work.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver special coating materials to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Store special coating materials in tightly closed containers in a covered, well-ventilated area where they are not exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Store solvents, thinners, and equipment cleaners with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Submit manufacturer's catalog data including manufacturer's name and identification. Include detailed data analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Also provide manufacturer's data concerning application, thinning, and average coverage per gallon

2.2 MATERIALS

2.2.1 Polyurethane Coatings

Ensure polyurethane coatings conform to MPI ASM for each substrate indicated.

Resins for finish coats are based on a two-part, prepolymer, catalytic-cured, polyurethane material. Apply catalytic-cured coatings with a total dry-film thickness of not less than 10 mils per coat. Indicate finish color and gloss on the schedules.

2.2.1.1 Ferrous and Galvanized Metal Surface Coatings

Apply a polyurethane, pigmented coating system in conformance with MPI ASM, No. 72, MPI ASM, No. 77, and MPI ASM, No. 101 Apply a prime coat with a dry-film thickness of not less than 2 mils. Finish coats are polyurethane-based material as specified.

2.2.1.2 Aluminum Surface Coatings

Apply a water base, light industrial coating system in conformance with MPI ASM, No. 80 for polyurethane coats on aluminum surfaces. Prime coat is a polyurethane-resin material as recommended by the coating manufacturer for the substrate to be coated. Apply prime coat with a dry-film thickness of not less than 2 mils. Finish coats are polyurethane-based material as specified.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surface Preparation

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Leave clean building materials and equipment with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Contracting Officer, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching with water and placing them in a covered metal container

3.1.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Clean application equipment promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

3.1.3 Coating Material Preparation

Mix and prepare coating materials in accordance with the coating manufacturer's printed instructions for applying the particular material and coat. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker are allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

3.1.3.1 Thinning

Thinning is done in accordance with coating manufacturer's printed directions for the particular material and coat.

3.1.3.2 Tinting

Ensure prime and intermediate coats of paint are slightly different tints from the finish coat to facilitate identification of each coat. Tinting is done by the coating manufacturer and clearly identified as to color and coat.

3.2 APPLICATION

Do not perform exterior painting in damp or rainy weather. Interior

painting is not allowed until the building is enclosed and has thoroughly dried out. Painting is not allowed below 50 degrees F or above 95 degrees F. Apply paint in accordance with the coating manufacturer's recommendations, and as specified.

Ensure coating application is done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Sand and dust surfaces between coatings, as required, to produce a surface free of visible defects. Lightly sand high gloss coatings and clear finishes between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections are not acceptable. Remove defective coating applications and re-coat as directed.

Ensure coating lines such as wainscots are sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Ensure surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, meet the dry-film thickness not less than specified.

3.2.1 Brush Application

Use clean, proper size brushes for high-quality application of the specified coating materials. Brush out slow-dry coatings. Brush out quick-dry coatings only enough to spread out evenly.

3.2.2 Roller Application

Use clean roller covers of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.

Ensure roller application is equivalent in all respects to the same coats applied by high-quality brush application.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Test

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

3.3.2 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 97 02

PAINTING: HYDRAULIC STRUCTURES

-- End of Section Table of Contents --

SECTION 09 97 02

PAINTING: HYDRAULIC STRUCTURES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D7091	(2013) Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nondestructive Coatings Applied to Non-Ferrous Metals

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2020) Occupational and Educational Personal Eye and Face Protection Devices
ANSI/ISEA Z358.1	(2014) American National Standard for Emergency Eyewash and Shower Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 2003-154	(2003; 4th Ed; Supple 3) NIOSH Manual of Analytical Methods

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 2	(2015; E 2018) Procedure for Determining Conformance to Dry Coating Thickness Requirements
SSPC SP 1	(2015) Solvent Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1910.94	Ventilation
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1926.62	Lead
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste

1.2 SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS

Perform work in accordance with all applicable health, safety, and environmental requirements as well as EM 385-1-1. Submit matters of interpretation of these requirements to the Contracting Officer for resolution before starting work. If no clarifications are sought, then the submittal is not necessary. Where the regulations conflict, the most stringent requirements apply. This paragraph supplements the health, safety, and environmental requirements of EM 385-1-1.

1.2.1 Safety

Submit an Accident Prevention Plan in accordance with the requirements of Section 01 of EM 385-1-1, including, but not limited to, each of the topic areas listed in Appendix A therein and the specified requirements. Develop each topic in a concise manner to include management and operational aspects. Submit a Ventilation Assessment Plan complying with all applicable safety standards.

1.2.1.1 Abrasive Blasting

For abrasive blasting comply with the requirements in Section 06.I of EM 385-1-1. In addition to the requirements in Section 20 of EM 385-1-1, use hoses and hose connections of a type to prevent shock from static electricity. Join hose lengths together by approved couplings of a material and type designed to prevent erosion and weakening of the couplings. The couplings and nozzle attachments must fit on the outside of the hose and be designed to prevent accidental disengagement.

1.2.1.2 Workers Other Than Blasters

Protect workers, other than blasting operators working in close proximity to abrasive blasting operations. Use MSHA/NIOSH-approved half-face or full-face air purifying respirators equipped with high-efficiency particulate air (HEPA) filters and eye protection meeting ANSI/ISEA Z87.1. Use hearing protectors (ear plugs and/or ear muffs) providing a noise reduction rating of at least 20 dBA or as needed to provide adequate protection. Provide personal protective equipment where required by

29 CFR 1910.146 and in accordance with 29 CFR 1910, Subpart I.

1.2.1.3 Cleaning Before and After Abrasive Blasting

Cleaning with compressed air must be in accordance with Section 20.B.5 of EM 385-1-1 and personnel protected as specified in 29 CFR 1910.134. When cleaning with solvents, provide ventilation where required by 29 CFR 1910.146 or where the concentration of solvent vapors exceeds 10 percent of the Lower Explosive Limit (LEL). Ventilation must be in accordance with 29 CFR 1910.94, paragraph (c)(5).

1.2.1.4 Paint Mixing

Provide local exhaust ventilation in the area where coatings are mixed. This ventilation system must be capable of providing at least 100 linear fpm of capture velocity in the mixing zone. Avoid exposure of skin and eyes by wearing appropriate chemically resistant gloves, safety goggles, and face shields meeting the requirements of ANSI/ISEA Z87.1. Provide a personal eyewash unit within close proximity to the mixing operation in accordance with ANSI/ISEA Z358.1, paragraph (9). All powered mixing equipment must be either pneumatic or double insulated (intrinsically safe), in order to guard against fire or explosion. Individuals who have a history of, or develop a sensitivity to epoxy or polyurethane resin systems, must not conduct work tasks or otherwise be exposed to such chemicals.

1.2.1.5 Paint Spraying

Submit a comprehensive written Respiratory Protection Plan in accordance with 29 CFR 1910.134, 29 CFR 1926.62, and EM 385-1-1, Section 05.G. During all spray painting operations, spray painters must use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations compatible with the Assigned Protection Factor (APF) of an air-purifying respirator. Persons with facial hair that may interfere with the seal or valve function of a half or full facepiece style respirator may wear a hood or helmet respirator provided the APF is sufficient for the exposure. Air-purifying chemical cartridge/canister respirators that have a particulate prefilter and are suitable for the specific type(s) of gas/vapor and particulate contaminant(s) may be used for nonconfined space painting, mixing, and solvent cleaning. These respirators may be used provided the measured or anticipated concentration of the contaminant(s) in the breathing zone of the exposed worker does not exceed the APF for the respirator and the gas/vapor has good warning properties or the respirator assembly is equipped with a NIOSH-approved end of service life indicator for the gas(es)/vapor anticipated or encountered. Where paint contains toxic elements that may become airborne during painting in nonconfined spaces, air-purifying half- and full-facepiece respirators or powered air-purifying respirators equipped with appropriate gas vapor cartridges, in combination with a high-efficiency filter, or an appropriate canister incorporating a high-efficiency filter, must be used.

1.2.1.6 Explosion Proof Equipment

Electrical wiring, lights, and other equipment located in the paint spraying areas must be of the explosion proof type designed for operation in Class I, Division 1, Group D, hazardous locations as required by the NFPA 70. Electrical wiring, motors, and other equipment, outside of but within 20 feet of any spraying area, must not spark and must conform to

the provisions for Class I, Division 2, Group D, hazardous locations. Electric motors used to drive exhaust fans must not be placed inside spraying areas or ducts. Fan blades and portable air ducts must be constructed of nonferrous materials. Properly maintain and ground motors and associated control equipment. Electrically bond and ground the metallic parts of all air-moving devices, spray guns, connecting tubing, and duct work.

1.2.1.7 Further Precautions

a. Workers must wear nonsparking safety shoes.

b. Solvent drums taken into the spraying area must be grounded. Maintain metallic bonding between containers and drums when materials are being transferred.

c. Inspect insulation on all power and lighting cables to ensure that the insulation is in excellent working condition and is free of all cracks and worn spots. Ensure that no connections are within 50 feet of the operation, that lines are not overloaded, and that they are suspended with sufficient slack to prevent undue stress or chafing.

1.2.1.8 Ignition Sources

Ignition sources, including lighted cigarettes, cigars, pipes, matches, or cigarette lighters, and electronic smoking devices are prohibited in areas of solvent cleaning, paint storage, paint mixing, or paint application.

1.2.2 Health

Prepare and submit a Medical Surveillance Plan and a statement from the examining physician indicating the name of each employee evaluated and any limitations which will preclude the employee from performing the work required. The statement must include the date of the medical evaluation, the physician's name, signature, and telephone number.

1.2.2.1 Air Monitoring

Prepare and submit an Air Monitoring Test Plan. Perform air sampling and testing as needed to assure that workers are not exposed to contaminants above the permissible exposure limit. In addition, provide the Contracting Officer with a copy of the Air Monitoring Test Report from the laboratory within five working days of the sampling date, including records of air monitoring plans and tests performed. Submit reports as soon as information is available. Also provide results from direct-reading instrumentation on the same day the samples are collected. Prepare and submit an Airborne Sampling Plan detailing the NIOSH 2003-154, Factory Mutual, or Underwriters Laboratories approved equipment, equipment calibration procedures, sampling methods, sampling to be performed, and analytical procedures to be used based on the type of work to be performed and anticipated toxic contaminants to be generated. Include the name of the accredited laboratory, listed by the American Industrial Hygiene Association (AIHA), that will be used to conduct the analysis of any collected air samples.

1.2.2.2 Medical Status

Prior to the start of work, and annually thereafter, submit a Medical Status Report. Medically evaluate all Contractor employees working with

or around paint systems, thinners, blast media, those required to wear respiratory protective equipment, and those who will be exposed to high noise levels for the particular type of exposure they may encounter. The Report must include the employee's name, the tests performed and the name of the physician responsible for performing the tests, and a physician's statement that medical status would permit specific task performance. Maintain medical records as required by 29 CFR 1910.20. The evaluation must include:

a. Audiometric testing and evaluation of employees who will work in a noise environment with a time weighted average greater than or equal to 85 dBA.

b. Vision screening of employees who will require eye protection (employees who use full-facepiece respirators cannot wear contact lenses).

c. Medical evaluation of employees who will be required to wear respiratory protection must include, but is not limited to, the following:

(1) Medical history including, but not limited to, alcohol use, with emphasis on liver, kidney, and pulmonary systems, and sensitivity to chemicals to be used on the job.

(2) General physical examination with emphasis on liver, kidney, and pulmonary system.

(3) Determination of the employee's physical and psychological ability to wear respiratory protective equipment and to perform job-related tasks.

(4) Determination of baseline values of biological indices for later comparison to changes associated with exposure to paint systems and thinners or blast media, which include: liver function tests to include SGOT, SGPT, GGPT, alkaline phosphates, bilirubin, complete urinalysis, EKG (employees over age 40), blood urea nitrogen (bun), serum creatinine, pulmonary function test, FVC, and FEV, chest x-ray (if medically indicated), blood lead and ZPP (for individuals where it is known there will be an exposure to materials containing lead), other criteria that may be deemed necessary by the Contractor's physician.

1.2.2.3 Change in Medical Status

Any employee whose medical status has changed negatively due to work related chemical and/or physical agent exposure while working with or around paint systems and thinners, blast media, or other chemicals must be evaluated by a physician, and obtain a physicians statement as described in paragraph MEDICAL STATUS prior to allowing the employee to return to those work tasks. Submit a Change in Medical Status Report detailing any negative changes in employee medical status and the results of the physicians reevaluation statement.

1.2.3 Environmental Protection

In addition to the requirements of Section 01 57 19 TEMPORARY

ENVIRONMENTAL CONTROLS, prepare an Environmental Protection Plan incorporating the submittals for Water Quality Plan, Containment Plan, Waste Disposal Plan, Soil Quality Plan, TSP Monitoring Plan, PM-10 Monitoring Plan, and Visible Emissions Monitoring Plan. The submitted plan must also address all aspects of establishing and demarcating regulated areas, ventilation/containment system performance verification, and reporting of accidental releases. Comply with the following environmental protection criteria.

1.2.3.1 Waste Classification, Handling, and Disposal

Prepare and submit a Waste Disposal Plan in accordance with the requirements of 40 CFR 261 and 40 CFR 262 including classification and handling. The Contractor is responsible for assuring the proper disposal of all hazardous and nonhazardous waste generated during the project. Store nonhazardous waste in closed containers separate from hazardous waste storage areas. Transport all nonhazardous waste in accordance with local regulations regarding waste transportation.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Safety, Health, and Environmental Requirements; G

Accident Prevention Plan; G

Respiratory Protection Plan; G

Airborne Sampling Plan; G

Medical Surveillance Plan; G

Waste Disposal Plan; G

Waste Manifest; G

SD-03 Product Data

Manufacturer's SDS Product Data Sheet; G

SD-04 Samples

Product Samples; G

Special Paint Formulas; G

Solvent and Thinners; G

Samples of solvents and thinners used to reduce the viscosity of the paint.

SD-06 Test Reports

Inspection Reports

Medical Status Report

Change in Medical Status Report

Air Monitoring Test Plan; G

Air Monitoring Test Report

SD-07 Certificates

Certified EHS Professional

Coating Thickness Gage Qualification

1.4 QUALIFICATIONS

Qualifications and experience must comply with the following.

1.4.1 Certified Environmental, Health, and Safety (EHS) Professionals

Provide a certificate for each Certified EHS Professional; submit qualifications and experience of qualified and competent persons employed to provide preconstruction and onsite environmental, safety, and health services. Obtain acceptance of this submission prior to the submission of other required environmental, safety, and health submittal items. Utilize a qualified and competent person as defined in EM 385-1-1, Section 01 to develop the required safety and health submittal and to provide onsite safety and health services during the contract period. The person must be a Certified Industrial Hygienist (CIH), an Industrial Hygienist (IH), or a Certified Safety Professional (CSP) with a minimum of 3 years of demonstrated experience in similar related work. The CIH, IH, or CSP may utilize other qualified and competent persons, as defined in EM 385-1-1, to conduct on-site safety and health activities as long as these persons have a minimum of 2 years of demonstrated experience in similar related work and are under the direct supervision of the CIH, IH, or CSP.

1.4.2 Coating Thickness Gage Qualification

Submit Coating Thickness Gage Qualification documentation of manufacturer's certification for all coating thickness gages. Use magnetic flux thickness gages as described in ASTM D7091 to make all coating thickness measurements on ferrous metal substrates. . Gages to be used on the job must have an accuracy of 3 percent or better and be certified by the manufacturer as meeting this requirement.

1.4.3 Certified Coating Inspector

Provide a certified coating inspector who is listed as either SSPC-PCI Level 2, or NACE CIP Level 2 for all surface preparation and painting activities. Submit a copy of the applicable SSPC or NACE Certificates. Submit all renewals if they occur during the contract performance period. Renewals must be achieved prior expirations occurring.

1.5 DELIVERY, STORAGE, AND HANDLING

Process and package paints to ensure that within a period of one year from date of manufacture, they will not gel, liver, or thicken deleteriously, or form gas in the closed container. Paints, unless otherwise specified or permitted, must be packaged in standard containers not larger than 5 gal, with removable friction or lug-type covers. . Each container of paint or separately packaged component thereof must be labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name, and formula or specification number of the paint together with special labeling instructions, when specified. Paint must be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather must be stored in ventilated, heated shelters. All paints must be stored under cover from the elements and in locations free from sparks and flames.

1.6 AMBIENT CONDITIONS

Paint must be applied in accordance with the manufacturers written instructions or to the special requirements contained herein. Surfaces that are less than 5 degrees F above the dew point temperature must be monitored closely to assure that are completely free of moisture as determined by sight and touch. Paint must not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, paint must not be applied if the temperature of the surfaces to be painted and of air in contact therewith is less than 45 degrees F during paint application nor if the surfaces can be expected to drop to 32 degrees F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and utilizing climate control equipment (e.g. dehumidification, heaters, etc.), provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint must not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

PART 2 PRODUCTS

Submit Product Samples of each batch of thinner, solvent, and paint to the Government for testing. Submit Manufacturer's SDS Product Data Sheet for each type of paint used; for products that are specified to be applied in accordance with the manufacturer's recommendations, submit the paint manufacturer's product data sheet or other written instructions for those products. Allow at least 30 days from time of delivery to the contracting officer for testing of samples of paints and thinners. Sampling may be at the jobsite or source of supply. Coordinate sampling and submission of all samples of paint and thinner with the Contracting Officer. Standard sample size for liquid paints and thinners is 1-quart; powders and other additives for multi component paints may be of appropriately smaller size. The sample must be labeled to indicate formula or specification

number and nomenclature, batch number, batch quantity, color, date made, and applicable project contract number. Testing will be performed by the Government. Costs for retesting rejected material will be deducted from payments to the Contractor.

2.1 SPECIAL PAINT FORMULAS

Special paints must have the composition as indicated in the formulas listed herein. Where so specified, package paint formulation components in separate containers for mixing on the job. If not specified or otherwise prescribed, the color must be that naturally obtained from the required pigmentation.

2.2 PAINT FORMULATIONS

Special paint formulas must comply with the following:

2.2.1 Solvent and Thinners

2.2.1.1 Xylene

Xylene shall conform to ASTM D843.

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

3.1.1 General Requirements

Clean surfaces to be painted before applying paint or surface treatments. Remove deposits of grease or oil in accordance with SSPC SP 1, prior to mechanical cleaning. Perform solvent cleaning with mineral spirits or other low toxicity solvents having a flash point above 100 degrees F. Use clean cloths and clean fluids to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Protect items not to be prepared or coated from damage by the surface preparation methods. Protect machinery and electrical components against entry of blast abrasive and dust into working parts. Program cleaning and painting such that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces. Protect surfaces not intended to be painted from the effects of cleaning and painting operations. Conduct welding of, or in the vicinity of, previously painted surfaces in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum. Restore any paint damaged by welding operations to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed must be painted before they become inaccessible.

3.2 PAINT APPLICATION

3.2.1 General

Unless otherwise specified, the finished coating must be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Do not initiate the application of initial or subsequent coatings until the Contracting Officer has verified that atmospheric conditions and the

surfaces to be coated are satisfactory. Each paint coat must be applied in a manner that will produce an even, continuous film of uniform thickness. Provide special attention to edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities to ensure that they receive an adequate thickness of paint. Spray equipment must be equipped with traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles must be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. The use of airless-type equipment is not allowed for the application of vinyl paints.

3.2.2 Time between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting must be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface.

3.2.3 Method of Paint Application

Unless otherwise specified, paint must be applied by brush, roller, or spray to ferrous and nonferrous metal surfaces. Special attention must be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces are subject to the specific approval of the Contracting Officer. Paint on plaster, concrete, or other nonmetallic surfaces must be applied by brush, roller, and/or spray.

3.2.4 Coverage and Film Thickness

Film thickness or spreading rates must be as specified hereinafter. Where no spreading rate is specified, apply the paint at a rate consistent with the manufacturer's written instructions. In any event, the combined coats of a specified paint system must completely hide base surface and the finish coats must completely hide undercoats of dissimilar color.

3.2.5 Coating Thickness Measurement on Metal

Where dry film thickness requirements are specified for coatings on metal surfaces, make measurements with a gage qualified in accordance with paragraph Coating Thickness Gage Qualification and calibrated and used in accordance with ASTM D7091. Prior to each use, establish the Base Metal Reading (BMR) for the gage as specified in the test method. Verify the accuracy of the gage using plastic shims as specified by the test method both prior to and following each set of measurements. Perform dry film measurements on all areas of the structure being coated in accordance with SSPC PA 2 with Level 1 thickness restrictions. Perform a sufficient number of thickness measurements to ensure that every area on every member is in compliance with the requirements of this contract. Report all thickness measurements as the mean for each spot determination.

3.2.6 Progress of Painting Work

Where field painting on any type of surface has commenced, complete the entire painting operation on that portion of the work, including priming

and finishing coats, as soon as practicable and without prolonged delays. Allow sufficient time between successive coats to permit them to dry properly for recoating, modifying this period as necessary to suit adverse weather conditions. Paint is considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces must be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, clean undercoats of dust, grease, overspray, or foreign matter by means of air blast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, must be brush-off blast cleaned and completely repainted as required. If necessary for establishment of good adhesion, scuff sand high gloss undercoats, and, solvent wipe, or otherwise treat prior to application of a succeeding coat. Apply field coats on metal after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.7 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted, but any resulting crevices must subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections must not be painted. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of the metal must be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, must not be painted.

3.2.8 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures must be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted must not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. Store all metalwork coated in the shop or field prior to final erection out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets; soiling, contamination, and deterioration of the paint film. Damaged areas of paint on such metalwork must be cleaned and touched up without delay. Apply the first field coat of paint within a reasonable period of time after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.3 PAINT SYSTEMS APPLICATION

The required paint systems and the surfaces to which they are to be applied are shown in this paragraph, and/or in the drawings. Supplementary information follows.

3.3.1 Surface Preparation

The method of surface preparation and pretreatment shown in the tabulation of paint systems is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting must be accomplished in

accordance with detailed requirements previously described.

3.3.2 Protection of Nonpainted Items and Cleanup

Maintain walls, equipment, fixtures and all other items in the vicinity of the surfaces being painted free from damage by paint or painting activities. Promptly repair any paint spillage and painting activity damage.

3.4 INSPECTION

Surface preparation and painting inspections must be conducted by an inspector certified as meeting one of the following designations: SSPC-PCI Level 2, NACE-CIP Level 2. The inspector will inspect and document all work phases and operations on a daily basis and submit daily Inspection Reports. As a minimum the daily report must contain the following:

a. Inspections performed, including the area of the structure involved and the results of the inspection.

b. Surface preparation operations performed, including the area of the structure involved, the mode of preparation, the kinds of solvent, abrasive, or power tools employed, and whether contract requirements were met.

c. Thinning operations performed, including thinners used, batch numbers, and thinner/paint volume ratios.

d. Application operations performed, including the area of the structure involved, mode of application employed, ambient temperature, substrate temperature, dew point, relative humidity, type of paint with batch numbers, elapsed time between surface preparation and application, elapsed time for recoat, condition of underlying coat, number of coats applied, and if specified, measured dry film thickness or spreading rate of each new coating.

3.5 PAINTING SCHEDULES

-- End of Section --

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COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	(1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2009) Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2020) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI/NEMA OS 1	(2013; R 2020) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA PB 1	(2011) Panelboards
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC)

	Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2021) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2016) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jan 2020) UL Standard for Safety Flexible Metal Conduit
UL 5	(2016; Reprint Aug 2020) UL Standard for Safety Surface Metal Raceways and Fittings
UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 20	(2018; Reprint Jan 2021) UL Standard for Safety General-Use Snap Switches
UL 44	(2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 67	(2018; Reprint Jul 2020) UL Standard for Safety Panelboards
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 360	(2013; Reprint Aug 2021) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 486A-486B	(2018; Reprint May 2021) UL Standard for Safety Wire Connectors
UL 486C	(2018; Reprint May 2021) UL Standard for Safety Splicing Wire Connectors
UL 489	(2016; Rev 2019) UL Standard for Safety

	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2017; Reprint Feb 2021) UL Standard for Safety Attachment Plugs and Receptacles
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint Mar 2020) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 817	(2015; Reprint Jul 2021) UL Standard for Safety Cord Sets and Power-Supply Cords
UL 869A	(2006; Reprint Jun 2020) Reference Standard for Service Equipment
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminary, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand150 mph wind loading in accordance with ASCE 7-16.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Marking Strips; G

SD-03 Product Data

Conduits and Raceways; G

Wire and Cable; G

Splices and Connectors; G

Switches; G

Receptacles; G

Outlet Boxes, Pull Boxes and Junction Boxes; G

Circuit Breakers; G

Timer Switch; G

Automatic Remote Temperature Switch; G

Panelboards; G

Heater Lampholder; G

Heating Lamp; G

Luminaries; G

SD-06 Test Reports

Continuity Test; G

600-Volt Wiring Test; G

Ground-Fault Receptacle Test; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.4 QUALITY CONTROL

1.4.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.4.2 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide the standard cataloged materials and equipment of manufacturers regularly engaged in the manufacture of the products. For material, equipment, and fixture lists submittals, show manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Dark Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.1.1 Conduits and Raceways

2.1.1.1 Rigid Steel Conduit

Provide polyvinylchloride (PVC) coated, hot dipped galvanized rigid steel conduit complying with NEMA RN 1, ANSI C80.1, UL 6 and UL 5 as applicable. .

Use threaded fittings for rigid steel conduit.

Use solid gaskets. Ensure conduit fittings with blank covers have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Provide covers with captive screws and are accessible after the work has been completed.

2.1.1.2 Flexible Metallic Conduit

Ensure flexible metallic conduit is galvanized steel and complies with UL 1 and UL 360.

Ensure fittings for flexible metallic conduit are specifically designed for such conduit.

Provide HTUA type, liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Ensure fittings for liquidtight flexible metallic conduit are specifically designed for such conduit.

2.1.1.3 Rigid Nonmetallic Conduit

Ensure rigid nonmetallic conduit complies with NEMA TC 2, NEMA TC 3, and UL 651 as applicable with a wall thickness not less than Schedule 40.

2.1.2 Outlet Boxes, Pull Boxes and Junction Boxes

Ensure outlet boxes for use with conduit systems are in accordance with NEMA FB 1 UL 514A, UL 514B, UL 514C and ANSI/NEMA OS 1 and are not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

Provide cast steel or iron outlet boxes, condulets, and junction boxes rated for heavy duty outdoor use, with threaded built-in hubs for conduits. The boxes must have a tri-coat finish of electrozinc, chromate sealant, and electrostatically applied powder coating. The boxes must be available with feed through hubs and deep and shallow types. Covers must be cast with weatherproof gaskets and captive screws.

For volumes greater than 200 cubic inches, UL 50, NEMA 4X stainless steel.

2.1.3 Panelboards

Provide panelboards in accordance with NEMA PB 1, UL 67, and UL 50. Ensure panelboards for use as service equipment are also in accordance with UL 869A. Ensure panelboards have current rating, number of phases, and number of wires as indicated or specified herein. Ensure panelboards are rated for 240-volt (maximum), single-phase, 60-hertz. Ensure each panelboard, as a complete unit, has a short-circuit current rating equal to or greater than the integrated equipment rating indicated, but in no case less than 10,000 amperes symmetrical.

Provide panelboards with bolt-on circuit breakers only. Use of plug-in style breaker is not permitted. Ensure panelboards are designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining required clearance.

Submit detail drawings and manufacturer's standard product data for panelboards. Detail drawings consist of fabrication and assembly drawings for all parts of the work in sufficient detail to verify conformity with

all requirements. Ensure drawings for panelboards indicate details of bus layout, overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Provide tinned copper buses of the rating indicated, with main lugs or main circuit breaker. Provide all panelboards for use on grounded ac systems with a separate grounding bus in accordance with UL 67 bonded to the panelboard enclosure. Ensure grounding bus is a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors. Provide three-phase, four-wire and single-phase, three-wire panelboards with an isolated full-capacity bus providing spaces for single-pole circuit breaker switches and spaces indicated as spare.

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping.

2.1.3.1 Circuit Breakers

Provide circuit breakers that conform to UL 489 and NEMA AB 3 with frame a trip ratings as indicated.

Provide bolt-on type, molded-case, manually operated, trip-free circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection. Completely enclose circuit breakers in a molded case, with a factory-sealed, calibrated sensing element to prevent tampering. Plug-in type, tandem, and half-size circuit breakers are not permitted.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 A and that conform to NEMA AB 3. Series rating of circuit breakers or overcurrent protective devices to achieve indicated interrupt rating is not permitted.

Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective-type tripping (time delay, magnetic, thermal, or ground fault).

2.1.4 Timer Switch

Provide 125 VAC, 20 Amp, 60 HZ, spring wound SPST timer switch with normally open contacts and adjustable 0-30 minute cycle on-time.

2.1.5 Automatic Remote Temperature Switch

Provide 125 VAC, 20 Amp temperature switch with an adjustable operating range of -30 to 60 degree Fahrenheit with a fixed deadband, SPST and stainless steel, water tight, wall mounted enclosure. Transducer shall be 12 feet long stainless steel capillary and bulb within armor protection.

2.1.6 Well Heater

2.1.6.1 Heater Lampholder

Heater lampholders shall be rated for MED. Base units, not less than 300 W, 120 VAC procelain base rated for wet locations with above and below horizontal aiming.

2.1.6.2 Heating Lamp

Heater shall be 250 W, 120 VAC, bulb type far-infrared ceramic heaters.

2.1.7 Luminaries

UL 1598, NEMA C82.77-10. Provide luminaries as indicated in the luminaries schedule and NL plates or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaries of the same type must be provided by the same manufacturer. Luminaries must be specifically designed for use with the driver and light source provided.

2.2 MATERIALS

2.2.1 Wire And Cable

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

Provide minimum conductor size in accordance with the following:

a. Branch circuits: No. 12 AWG.

Ensure connectors used in wire systems comply with UL 486A-486B and UL 486C as applicable.

Ensure conductors installed in plenums are marked plenum rated.

2.2.1.1 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts,Type XHHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.2.1.2 Multiconductor Cable

Unless otherwise shown or specified, all cables which are installed wholly or partly in any cable tray or wireway, shall be Type TC with NEC type XHHW conductors, a continuous, extruded, corrugated aluminum sheath, and an outer PVC jacket. Aluminum sheathed cables shall comply with UL 1569 as NFPA 70, Type MC cable with sunlight resistant jacket suitabe for direct burial.

2.2.1.3 Cord Sets and Power-Supply Cords

UL 817.

2.2.2 Low Voltage Splices

2.2.2.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material applied in accordance with the manufacturer's written instructions.

2.2.2.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation must not require heat or flame, or any additional materials such as covering or adhesive. It must be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.2.3 Device Plates

Provide the following:

a. UL listed, outdoor rated, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. For nonmetallic boxes and fittings, other suitable plates may be provided.

f. Screws: machine-type with countersunk heads in color to match finish of plate.

g. Sectional type device plates are not be permitted.

h. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.2.4 Switches

2.2.4.1 Toggle Switches

Ensure toggle switches comply with EIA 480, NEMA WD 1, and UL 20 control Light Emitting Diode (LED), and fluorescent lighting fixtures and are the heavy duty, outdoor rated, noninterchangeable flush-type.

Provide commercial grade toggle switches, single-pole, two-position devices rated 20 amperes at 120/277 volts, 60 hertz alternating current (ac) only.

Ensure all toggle switches are products of the same manufacturer.

Toggle switches used outdoors or in the gage house shall be mounted in the gasketed cast steel type boxes described in paragraph Outlet Boxes, Pull

Boxes, and Junction Boxes, and shall be rated for Outdoor use and be gasketed. The switch actuator cover shall be the same material, with stainless steel screws. The switch actuator to be a downward pointing rod with flared end for ease of use.

2.2.5 Receptacles

Provide the following:

a. UL 498, hard use (also designated heavy-duty), grounding-type.

b. Ratings and configurations: as indicated.

c. Bodies: white as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.2.5.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle: switched when installed.

2.2.5.2 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations." Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, die-cast metal/aluminum cover plate.

2.2.5.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, heavy duty, weather resistant, 20 Amp, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.2.6 Identification Nameplates

Nameplates shall be made of brass approximately 1/32-inch thick, stamped to provide indented letters not less than 1/4- inch high. Indented letters shall be physically darkened, per the manufacturer's standard method, to permit easy reading.

PART 3 EXECUTION

3.1 PREPARATION

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special provisions include impedances, hazards and safety precautions.

Clean and paint conduit, supports, fittings, cabinets, pull boxes, and racks as specified in Section 09 96 00 HIGH-PERFORMANCE COATINGS.

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by using approved fittings and treatment. Except where other equivalent protective treatment is specifically approved in writing, provide hot-dip galvanized ferrous metals for items such as, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous items not made of corrosion-resistant steel.

3.2 INSTALLATION

3.2.1 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits.

3.2.1.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.2.1.2 Multiconductor Cable

Install in accordance with NFPA 70, Type MC cable.

3.2.2 Conduits, Raceways and Fittings

Ensure that conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting does not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or replace conduit.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.2.2.1 Rigid Steel Conduit

Make field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use long radius conduit for elbows larger than 2-1/2 inches.

Provide a flush coupling for all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. For conduits installed for future use, terminate with a coupling and plug; set flush with the floor.

3.2.2.2 Electrical Metallic Tubing (EMT)

Ground EMT in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.2.2.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Use bonding wires in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit is not considered a ground conductor.

Make electrical connections to vibration-isolated equipment with flexible metallic conduit.

Use liquidtight flexible metallic conduit in wet and oily locations and to complete the connection to motor-driven equipment.

Provide flexible steel conduit between 3 and 6 feet in length for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.2.2.4 Rigid Nonmetallic Conduit

Install a green insulated copper grounding conductor in conduit with conductors and solidly connect to ground at each end. Size grounding wires in accordance with NFPA 70.

3.2.2.5 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40
Plastic coating: extend minimum 6 inches above floor.

3.2.2.6 Stub Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inchesabove floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.2.2.7 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.2.2.8 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.2.3 Wiring

Color code feeder and branch circuit conductors as follows:

CONDUCTOR	COLOR AC
Phase A	Black (208VAC); Brown (480VAC)

CONDUCTOR	COLOR AC
Phase B	Red (208VAC); Orange (480VAC)
Phase C	Blue (208VAC); Yellow (480VAC)
Neutral	White (208VAC); Natural Gray (480VAC)
Equipment Grounds	Green

Use conductors up to and including AWG No. 2 that are manufactured with colored insulating materials. For conductors larger than AWG No. 2, have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Match terminal and conductor identification as indicated.

Where several feeders pass through a common pullbox, tag the feeders to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.2.3.1 Cable and Control Conductor Identification

Instrumentation, control and power cables shall be identified at all manholes, handholes, junction and termination cabinets, and at 50- foot intervals in cable trays, trenches and wireways. Where cables pass through walls or conduits, one tag for each cable shall be installed on each side of the barrier. Tags shall be 3/4 inches in diameter and fabricated from 1/32-inch thick brass plate. Lettering shall be 1/4-inch minimum height Gothic Style with the letter width as required. Tags shall have a 1/8 inch hole located above the top of the lettering for fastening. Letters shall be machine stamped and filled with black enamel. Cable identification shall correspond to the labels found on the drawings. Tags shall be attached to the cable with stainless steel wire not smaller than 14 AWG so that movement of the tag along the length of the cable is not possible.

3.2.4 Wiring Devices

3.2.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates are aligned vertically to within 1/16 inch.

Bond ground terminal of each flush-mounted receptacle to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.2.5 Splices and Connectors

Where splices are required, install splices only in areas as indicated.

3.2.6 Boxes and Fittings

Provide pullboxes where necessary in the conduit system to facilitate conductor installation. For conduit runs longer than 100 feet or with more than three right-angle bends, install a pullbox at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure using supports that are independent of the conduit entering or leaving the boxes.

Select the mounting height of wall-mounted outlet and switch boxes, as measured between the bottom of the box and the finished floor, in accordance with ICC/ANSI A117.1 unless otherwise indicated.

3.2.7 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.2.8 Panelboards

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within Ensure directory card information is complete and legible.

3.2.9 Identification Plates and Warnings

Provide identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Attach identification plates to process control devices and pilot lights.

Install identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. For circuits 480 volts and above, install conspicuously located warning signs in accordance with OSHA requirements.

Provide brass cable identification tags with stainless steel wire fasteners at each termination point and splice/tap.

3.3 FIELD QUALITY CONTROL

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.

Perform continuity test to insure correct cable connection end-to-end (i.e correct phase conductor, grounded conductor, and grounding conductor wiring). Repair and verify any damages to existing or new electrical equipment resulting from mis-wiring. Receive approval for all repairs prior to commencement of the repair.

Perform 600-volt wiring test on wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance: 250,000 ohms.

Perform ground-fault receptacle test for ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

Submit test reports in accordance with referenced standards in this section.

Final acceptance requires the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved.

-- End of Section --

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DIVISION 26 - ELECTRICAL

SECTION 26 05 26.00 40

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

-- End of Section Table of Contents --

SECTION 26 05 26.00 40

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS A3.0M/A3.0	(2020) Standard Welding Terms and Definitions
AWS B2.1/B2.1M	(2014; Errata 2015) Specification for Welding Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B187/B187M	(2020) Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 780	(2020) Standard for the Installation of Lightning Protection Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-889	(2021; Rev D) Galvanic Compatibility of Electrically Conductive Materials

UNDERWRITERS LABORATORIES (UL)

UL 546	(2008) UL Outline of Investigation for

Conductor Termination Compounds

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Ground Wires; G

Connectors and Fasteners; G

Conductive Corrosion Inhibiting Compounds; G

Ground Buses; G

SD-11 Closeout Submittals

Record Drawings

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

1.3.3 Micro-Ohmmeter Test Equipment

Perform bond resistance tests using a micro-ohmmeter with the following characteristics:

a. Resistance range selectable and capable of measuring to 10 micro-Ohms using a minimum of 1 ampere of test current.

b. Positive and negative test leads of the 2-wire balanced type.

Provide both clamp and probe type connections to allow measurements across all bonded surfaces. Provide long length balanced test lead to allow measurements from a bonding location to the nearest test well.

Submit proof of current equipment calibration with test equipment product data.

PART 2 PRODUCTS

Submit material, equipment, and fixture lists for grounding systems, including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

2.1 MATERIALS

2.1.1 Ground Wires

2.1.1.1 Bare

Provide annealed bare copper, Class "B" stranded ground and bond wires in accordance with ASTM B8 for wires #4 AWG and larger and solid in accordance with ASTM B3 for wires #6 AWG and smaller. Provide conductors with 98 percent conductivity and sized wires in accordance with the requirements of NFPA 70 and NFPA 780.

2.1.1.2 Insulated

Ensure insulated conductors conform to the requirements of Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

Where installed in conduit as part of a complete circuit provide conductors with green insulation for sizes #8 AWG and smaller and with green phase tape at each end and in each junction box for sizes #6 AWG and larger.

2.1.1.3 Straps/Jumpers

Provide copper bonding straps and jumpers with a cross-sectional area of not less thanNo. 6 AWG.

2.1.2 Connectors and Fasteners

2.1.2.1 Exothermic Welds

Ensure the molds, materials and powder charges used to make exothermic welds are the standard product of a single manufacturer and listed by the manufacturer for use on the specific type, size, quantity and configuration of conductors to which the weld is applied.

2.1.2.2 Irreversible Compression Lugs

Provide irreversible compression lug type connectors manufactured from tin-plated copper and installed using a hydraulic compression tool and die to apply correct, uniformly distributed, circumferential pressure. Ensure tools and dies are as recommended by the irreversible compression lug type connector manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed onto the conductor. Apply irreversible compression lug type

connectors in strict accordance with the manufacturer's written instructions and published installation instructions. Use 2-hole lug type connectors for connections to NEMA cable pads and bus bars, and single-hole connectors otherwise.

2.1.2.3 Mechanical

Provide split bolt and clamp style mechanical type connectors manufactured from copper or copper alloy, listed by the manufacturer as suitable for direct burial use. Ensure mechanical type connectors are applied in strict accordance with the manufacturer's published installation instructions.

2.1.2.4 Fasteners

Provide bolts, nuts, washers, lock washers, and associated fasteners used for grounding and bonding connections manufactured of copper. Where fasteners contact dissimilar metals, apply conductive oxide-inhibiting compound.

2.1.3 Conductive Corrosion Inhibiting Compounds

Provide conductive corrosion inhibiting compounds UL Listed in accordance with UL 546, listed by the manufacturer as suitable for the application, and suitable for all aluminum and copper conductor/connector applications. Ensure conductive corrosion inhibiting compounds inhibit oxidation at the conductor/connector interface and have no deleterious effect on the conductor/connector metal or EPDM, natural rubber, or polyethylene insulating materials.

2.1.4 Ground Buses

Provide solid copper ground buses conforming to ASTM B187/B187M with minimum dimensions of 0.25 inches thick, 4 inches wide, and 12 inches in length or as indicated. Ensure ground buses are equipped with two UL Recognized red 1000V rated insulated standoffs and stainless steel mounting brackets.

PART 3 EXECUTION

3.1 INSTALLATION

Install grounding systems in accordance with NFPA 70, NFPA 780 and IEEE C2, and as indicated.

Bond exposed non-current-carrying metallic parts of electrical equipment and metallic raceway systems to ground.

Bond grounding conductors in metallic and non-metallic raceways to ground. Make ground connections at equipment and to ground rods as indicated. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems.

Bond wiring system neutrals to ground in accordance with the requirements of NFPA 70. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation

of fault protection.

3.1.1 Conductors

Install bare or insulated conductors as indicated. Install bare conductors where not specifically identified as bare or insulated except where installed in conduit with associated phase conductors. Install insulated conductors in conduit with insulation of the same material as the associated phase conductors with which it is installed.

Provide straps/jumpers across joints subject to vibration. Install strap/jumper such that vibration will not change its electrical characteristics. Apply strap/jumper to the metallic structure on each side of the joint; do not penetrate any adjacent parts. Install straps/jumpers in areas that are accessible for maintenance. Install strap/jumper such that it does not restrict the movement of the metallic structures to which it is connected. Install strap/jumper such that it does not weaken the metallic structures to which it is attached. Do not connect two or more straps/jumpers in series.

3.1.2 Endcell Ground

Install bare copper ground conductor from concrete encased foundation rebar and sheet pilling. Connect conductors to rebar using mechanical connectors manufactured for such purpose. Install one conductor a minimum of every 60 feet of concrete endcell perimeter. Connect ground conductors to sheet piling using exothermic welds.

3.1.3 Equipment Grounding

Install ground systems for power, telecommunications, and instrumentation. Independently connect each system.

3.1.3.1 Equipment and Enclosure Bonding

Bond each metallic enclosure and all electrical equipment to ground. Make at least one copper connection from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

3.1.3.2 Bonding of Conduit and Raceway Systems

Bond all metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways. Ensure adequate electrical contact at the joints and terminations. Ensure metallic raceway systems have electrical continuity with equipment. Individually and directly connect equipment to the building ground, independent of the raceway system.

For rigid metal conduit and terminations, ensure threaded connections are wrench-tight with no exposed threads. Ream all ends of the conduit to remove burrs and rough edges. Bond conduits entering boxes and enclosures to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

Conduit systems that are interrupted by PVC dielectric links are bonded separately on either side of the link. Do not jumper the dielectric link.

Install flexible metal conduit with an integral grounding conductor.

3.1.4 Bonding Materials And Methods

Accomplish bonding of metal surfaces by welding, clamping, or \structural joining methods.

3.1.4.1 Welding

Weld using the exothermic process with procedures conforming to AWS A3.0M/A3.0, AWS B2.1/B2.1M, and manufacturer's recommendation. Where dissimilar metals are to be joined via exothermic weld, follow the weld kit manufacturer's recommendations and published instructions. Ensure connections between dissimilar metals do not produce galvanic action in accordance with MIL-STD-889.

Use welding processes of the exothermic fusion type that makes a connection without corroding or loosening. Ensure process joins all strands and does not cause the parts to be damaged or weakened. Completed connection or joint is equal or larger in size than the conductors joined and has the same current-carrying capacity as the largest conductor. Paint the buried ground connections with a bitumastic paint.

3.1.4.2 Clamping

In external locations, use clamping only where a disconnect type of connection is required. Connection device may utilize threaded fasteners. Construct device such that positive contact pressure is maintained at all times. Use machine bolts with spring-type lockwashers.

3.1.4.3 Cleaning of Bonding Surfaces

Thoroughly clean surfaces that comprise the bond before joining. Apply an appropriate abrasive with gentle and uniform pressure to ensure a smooth and uniform surface. Do not remove excessive metal from the surface. Clean clad metals in such a manner that the cladding material is not penetrated by the cleaning process. Then clean bare metal with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Bond to the cleaned area within one hour after cleaning. Seal joint and refinish the exposed surfaces within two hours of exposure to prevent oxidation. When additional time is required, apply a corrosion preventive compound until the area can be refinished.

3.1.4.4 Protection of Finished Bonds

Protect finished bonds by painting to match the original finish after the bond is made.

3.2 FIELD QUALITY CONTROL

Perform the following tests in the presence of the Contracting Officer. Furnish test equipment and personnel and submit written results of each test. Notify the Contracting Officer at least 14 calendar working days prior to each test.

Submit written results of each test to Contracting Officer for review and approval. Document each location where test is performed, the field conditions at the time of the test, the measured results of the test, and whether the measured results "PASSED" or "FAILED" relative to specified

pass/fail performance criteria.

Perform rework to correct FAILED conditions at no additional cost to the Government.

3.2.1 Bond Resistance Test

Resistance of any bond connection cannot exceed 0.5 milliohm. Rework bonds that exceed this resistance at no additional cost to the Government.

3.2.2 Equipment Continuity Test

Test connection from electrical distribution equipment including panelboards, switchboards, transformers, substations, and motor control centers to counterpoise. Measure and record the circuit resistance between electrical equipment ground connections. The circuit resistance shall not exceed 5 Ohms.

3.3 CLOSEOUT ACTIVITIES

Submit record drawings indicating the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

-- End of Section --

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DIVISION 31 - EARTHWORK

SECTION 31 23 20

UNDERWATER EXCAVATION

-- End of Section Table of Contents --

SECTION 31 23 20

UNDERWATER EXCAVATION

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations necessary for completing the excavations incidental to the construction of the end cell. Excavation operations shall be performed to allow completion of construction within the work periods as specified in SECTION 01 14 00.00 13 WORK RESTRICTIONS.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation Plan; G

At least 30 days prior to initiating any excavation, submit the plan of operation for performing all excavations specified herein. This plan shall include, but is not necessarily limited to, the Contractor's proposed sequence of work for all excavations, the locations of the Contractor's disposal areas, and the Contractor's methods and types of equipment to be used for excavating, transporting, and disposition of all excavated materials.

SD-05 Design Data

Foundation Survey; G

The Contractor shall submit the Foundation Survey within 3 days after completion of the excavation.

1.3 DEFINITION

1.3.1 Unsatisfactory Materials

Unsatisfactory materials include man-made fills; trash; refuse; backfills from previous construction; and material which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

PART 2 PRODUCTS

2.1 Not used.

PART 3 EXECUTION

3.1 EXCAVATION

3.1.1 General

Excavation operations shall be performed to allow completion of construction within the work periods as specified in SECTION 01 14 00.00 13. Excavation of all materials shall be performed down to the elevation as shown on the drawings. The horizontal limits of the excavation shall be as shown on the drawings to provide a level base for concrete placement.

3.1.2 Overdepth Excavation

Excavations below indicated depths will not be permitted except to remove unsatisfactory material. If unsatisfactory material is encountered below the structural excavation depths indicated, immediately contact the Contracting Officer prior to proceeding with the associated work.

3.1.3 Excavation

Prior to installing the piling and placement of concrete, perform excavation to the lines and grades indicated. During excavation, stockpile material satisfactory for backfilling in a neat and orderly manner to avoid overloading and to prevent slides. The Contractor shall use extreme care in excavating the overburden material and rock so as not to damage the existing concrete lock guide wall or its foundation. Any damage to the existing structure or its foundation shall be repaired to the satisfactory of the Contracting Officer at no additional cost to the Government. Backfill unauthorized over excavation at no additional cost to the Government. Prepare the ground surface in the work area before driving piles to minimize grading requirements after pile installation.

3.1.4 Foundation Survey

The Contractor shall perform all surveying activities necessary to determine if the foundation has been excavated to the proper dimensions and elevation for placement of the end cell in accordance with Section 01 71 23.05 13. The survey shall extend 5 feet beyond the excavation limits. For each survey point the horizontal and vertical measurements shall be reported in both State Plane Coordinate System (SPCS) and Latitude/Longitude to the nearest 0.1 foot.

3.1.4.1 Backfilling

Do not begin backfilling until construction below finish grade has been approved.

3.1.5 Slides

In the event of sliding of any part of the excavation prior to completion of the protective cell, the Contractor shall remove and restore the slide area in a manner approved by the Contracting Officer. The slide restoration shall be performed at no additional cost to the Government.

3.1.6 Disposition of Excavated Material

All excavated material shall be completely removed from the river and stockpiled. Excavated Rip Rap may be used when restoring the excavation outside the sheet pile to pre-construction elevations after construction. Overrun material shall be properly disposed of by the Contractor in accordance with all Federal, State, and local regulations.

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METAL SHEET PILING

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SECTION 31 41 16

METAL SHEET PILING

PART 1 GENERAL

1.1 DESCRIPTION

Design, furnish, install and test metal sheet piles at the locations indicated on the drawings and specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2017a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A572/A572M	(2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

1.3 SYSTEM DESCRIPTION

Submit descriptions of pile driving equipment to be employed in the work. Descriptive information includes manufacturer's name, model numbers, capacity, rated energy, hammer details, cushion material, helmet, templates, and jetting equipment.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G

Existing Wing Wall Footing Location Survey; G, STR

Design of the End Cell is based on the location of the existing retaining wall and footing. The Contractor shall submit a

preconstruction survey of the location of the existing retaining wall and footing prior to starting any pile driving operations. The Contractor shall survey the location of CP100 and compare it to the assumed location used in design.

SD-02 Shop Drawings

Metal Sheet Piling; G

Detail drawings for sheet piling, including fabricated sections, showing complete piling dimensions and details, driving sequence and location of installed piling. Include in the drawings details of top protection, special reinforcing tips, tip protection, splices, fabricated additions to plain piles, cut off method, and dimensions of templates and other temporary guide structures for installing piling. As the templates be supporting workers over water, the Contractor shall have template drawings stamped by a registered professional engineer. Provide details of the method for handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

SD-03 Product Data

Driving; G, STR

Records of the completed sheet piling driving operations, including a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling.

Pile Driving Equipment; G

Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances, prior to commencement of work.

Pulling; G

The proposed method of pulling sheet piling, prior to pulling any piling.

SD-06 Test Reports

Materials Tests; G, STR

Certified materials test reports showing the sheet piling and appurtenant metal materials meet the specified requirements, for each shipment and identified with the specific lots (heat numbers) prior to installing the materials. Material test reports shall meet the requirements of ASTM A6/A6M

Interlocked Joint Strength in Tension Test; G, STR

A certified test report of interlocked joint strength in tension showing results based on approved testing procedures.

SD-07 Certificates

Material Certificates; G

SD-11 Closeout Submittals

Pile Driving Record; G

Record for each sheet pile driven, as specified.

1.5 QUALITY ASSURANCE

1.5.1 Material Certificates

For each shipment, submit certificates identified with specific lots (heat numbers) prior to installing piling. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. Provide the manufacturer's logo and mill identification mark on the sheet pilings as required by the referenced specifications. Store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks; as a minimum, support on level blocks or racks spaced not more than 10 feet apart and not more than 2 feet from the ends. Storage of sheet piling should also facilitate required inspection activities and prevent damage to coatings or corrosion prior to installation. Handle sheet piling over 80 feet in length using a minimum of two pickup points.

PART 2 PRODUCTS

2.1 METAL SHEET PILING

Submit detail drawings for sheet piling, including fabricated sections, showing complete piling dimensions and details, driving sequence and location of installed piling.

Sheet piling shall be hot-rolled steel sections conforming to ASTM A572/A572M, Grade 50. All sheet piling shall be of a design such that when in place they shall be continuously interlocked throughout their entire length. Each type of piling shall be of the same manufacturer. Sheet piling shall be full-length sections of the dimensions shown on the drawings. Sheet piling shall be provided with standard pulling holes as required. Pulling holes shall be located above the finished cut-off elevation so that no holes remain after completion. Sheet piling shall be coated above the mud line with an epoxy zinc prior and coal tar epoxy top coat, system 6-A-Z in accordance with SECTION 09 97 02. The minimum section properties shall be as shown in the following table. (Both minimum section modulus and minimum web thickness are required):

SHEET PILING SECTION PROPERTIES					
Section	Nominal Width (in)	Nominal Web Thickness (in)	Min. Section Modulus per lin. Ft. (in)3	Weight per Sq. Ft. of Wall (Lbs)	Weight Per Lin. Ft. (Lbs)
PS31	19.69	0.500	2.0	31.0	50.9
Z Sheet Piling	18.00	0.375	31.0	27.7	41.5

2.1.1 Interlocks

The interlocks of sheet piling must be free-sliding, provide a swing angle suitable for the intended installation but not less than 10 degrees for PS piling when interlocked, and maintain continuous interlocking when installed. When properly interlocked, PS piling shall develop a minimum ultimate interlock strength of 20 kips per inch. Upon delivery, interlocks shall be inspected for distortion or damage and a minimum of 20 percent of the sheet pile interlocks shall be regaged by the Contractor.

2.1.2 General Requirements

Provide sheet piles with minimum section modulus, moment of inertia, shape, and size as specified in the contract documents. Sheet piling including special fabricated sections must be full-length sections of the dimensions shown. Fabricated tees, wyes and cross pieces must be fabricated of piling sections with a minimum web thickness of 1/2 inch. Sheet piling to be placed in a circular cell must be of the same manufacture. Provide sheet piling with standard lifting holes. Metalwork fabrication for sheet piling must be as specified and in Section 05 05 23.13 WELDING, STRUCTURAL.

2.2 APPURTENANT METAL MATERIALS

Provide metal plates, shapes, bolts, nuts, rivets and other appurtenant fabrication and installation materials conforming to manufacturer's standards and to the requirements specified in the respective sheet piling standards.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

Requirements for material tests, workmanship and other measures for quality assurance must be as specified and in Section 05 02 23.13 WELDING, STRUCTURAL.

2.3.1 Materials Tests

Submit certified materials tests reports showing that sheet piling and appurtenant metal materials meet the specified requirements, for each shipment and identified with specific lots prior to installing materials. Material test reports must meet the requirements of ASTM A6/A6M. Perform materials tests conforming to the following requirements. Sheet piling and appurtenant materials must be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property

requirements prior to delivery to the site. Testing of sheet piling for mechanical properties must be performed after the completion of all rolling and forming operations. Testing of sheet piling must meet the requirements of ASTM A6/A6M.

2.3.2 Interlocked Joint Strength in Tension Test

Submit the procedure for testing sheet piling interlocked joint strength in tension, prior to testing piling. The interlocked joint strength in tension test must conform to the piling manufacturer's standard test, include testing at least two 3 inch long coupons taken randomly from different as-produced pilings of each heat and must be approved. Submit a certified report showing results based on approved testing procedures.

2.4 PILE DRIVING EQUIPMENT

Submit complete descriptions of sheet piling driving equipment including hammers, vibratory hammers, extractors, protection caps and other installation appurtenances, prior to commencement of work. Descriptive information includes manufacturer's name, model numbers, capacity, rated energy, hammer details, cushion material, helmet, and templates. Provide pile driving equipment conforming to the following requirements. Submit descriptions of pile driving equipment, including hammers, power packs, driving helmets, hammer cushions, pile cushions, leads, extractors, jetting equipment, and preboring equipment at least 30 days prior to commencement of work.

2.4.1 Driving Hammers

Hammers must be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type. The Contractor shall determine the proper pile driving energy of the hammers as recommended by the manufacturer for the piling weights and subsurface materials to be encountered. Hammer size shall be evaluated through a wave equation analysis and reviewed by the Government. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

3.1.1 Pile Length Markings

Mark each pile prior to driving with horizontal lines at one foot intervals. Mark the interval number on pile every 5 feet from pile tip.

3.2 EARTHWORK

Perform in accordance with Section 31 23 20 UNDERWATER EXCAVATION. Pre-excavation will be permitted. Backfill as indicated.

3.3 INSTALLATION

3.3.1 Placing and Driving

3.3.1.1 Placing

Submit a written description of the site specific pile installation procedures for Government review and approval. Pile placement

installation drawings and details must also be provided.

Any excavation required within the area where sheet pilings are to be installed must be completed prior to placing sheet pilings. Pilings properly placed and driven must be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.

a. Pilings must be carefully located as shown. Pilings must be placed plumb with out-of-plumbness not exceeding 1/4 inch per per four feet of length and true to line. Place the pile so the face will not be more than 4 inches from vertical alignment at any point. Top of pile at elevation of cut-off must be within 1/2 inch horizontally and 2 inches vertically of the location indicated. Piles receiving precast wall unit shall be cut-off to grade to allow for proper installation. Manipulation of piles to force them into position will not be permitted. Check all piles for heave. Re-drive all heaved piles to the required tip elevation.

c. Provide temporary wales, templates, master pilings or guide structures to ensure that the pilings are placed and driven to the correct alignment. A minimum of four master piles shall be used for cell construction. Use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the sheet piling until design tip elevation is achieved and concrete cell fill is placed to elevation 657.5 feet. Templates shall not move when supporting the sheet piling. Fit templates with wood blocking to bear against the web of each alternate sheet pile and hold the sheet pile as the design location alignment. A minimum of two rings, not more than 20 feet apart, shall be used. Provide outer template rings or other restraints as necessary to prevent the sheets from warping or wandering from the alignment. Mark template for the location of the leading edge of each alternate sheet pile. If in view, also mark the second level to assure that the piles are vertical and in position. If two guide marks cannot be seen, other means must be used to keep the sheet pile vertical along its leading edge.

3.3.1.2 Driving

Submit records of the completed sheet piling driving operations, including a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling. Cell construction shall use a minimum of four master pilings. Prior to driving pilings in water, paint a horizontal line on both sides of each piling at a fixed distance from the bottom so that it will be visible above the water line after installation. This line must indicate the profile of the bottom elevation of installed pilings and potential problem areas can be identified by abrupt changes in its elevation. Drive pilings with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths.

a. Maintain driving hammers in proper alignment during driving operations by use of leads or guides attached to the hammer. Caution must be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock-melt or damages. Discontinue the use of vibratory hammers and impact hammers employed when the penetration rate due to vibratory loading is one foot or less

per minute.

b. Employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. Remove and replace pilings damaged during driving or driven out of interlock at the Contractor's expense.

c. Drive pilings without the aid of a water jet.

d. Take adequate precautions to ensure that pilings are driven plumb. Where possible, drive Z-pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall the piling being driven must be pulled and appropriate measures taken to plumb all piling and driving operations resumed.

e. Pilings in each run or continuous length of piling wall must be driven alternately in increments of depth to the required depth or elevation. No piling will be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. Incrementally sequence driving of individual piles such that the tip of any sheet pile must not be more than 4 feet below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile must not be more than 2 feet below any adjacent sheet pile. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling.

f. If obstructions restrict driving a piling to the specified penetration, the obstructions must be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical, make changes in the design alignment of the piling structure as directed to ensure the adequacy and stability of the structure. Pilings must be driven to depths shown and must extend up to the elevation indicated for the top of pilings. A tolerance of 3 inches above the indicated top elevation will be permitted. Piles receiving precast wall unit shall be cut-off to grade to allow for proper installation. Pilings must not be driven within 100 feet of concrete less than 7 days old.

g. Pre-augering or spudding of piles may be used at no additional cost to the Government.

3.3.2 Cutting-Off and Splicing

Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance must be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving must be extended as required to reach the top elevation by splicing when directed at no additional cost to the Government. Submit procedure for insufficient pile length. Provide pile splicing information and details for Government review and approval prior to installation in the field.

a. Pilings adjoining spliced pilings must be full length unless otherwise approved. Splicing of pilings must be as indicated. Ends of pilings

to be spliced must be squared before splicing to eliminate dips or camber. Pilings must be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings must be free sliding and able to obtain the maximum swing with contiguous pilings. Shop and field welding, qualification of welding procedures, welders, and welding operators must be in accordance with AWS D1.1/D1.1M. Submit welding certifications for all welders and welding operators for Government review and approval.

b. The tops of pilings excessively battered during driving must be trimmed when directed, at no cost to the Government. Piling cut-offs will become the property of the Contractor and must be removed from the site.

c. Cut holes in pilings for bolts, rods, drains or utilities in a neat and workmanlike manner, as shown or as directed. Use a straight edge in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling must be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes must be reasonably smooth and the proper size for rods and other items to be inserted. Do not use explosives for cutting.

3.3.3 Inspection of Driven Piling

Perform continuous inspection during pile driving. Inspect all piles for compliance with tolerance requirements. Bring any unusual problems which may occur to the attention of the Contracting Officer. Inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock must be removed and replaced at the Contractor's expense.

3.4 REMOVAL

The removal of sheet pilings must consist of pulling, sorting, cleaning the interlocks, inventorying and storing previously installed sheet pilings as shown and directed.

3.4.1 Pulling

The method of pulling piling must be approved. Provide pulling holes in pilings, as required. Extractors must be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Contracting Officer determines that adjacent permanent construction has been damaged during pulling, the Contractor will be required to repair this construction at no cost to the Government. Pull pilings one sheet at a time. Pilings fused together must be separated prior to pulling, unless the Contractor demonstrates, to the satisfaction of the Contracting Officer, that the pilings cannot be separated. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

3.4.2 Sorting, Cleaning, Inventorying and Storing

Pulled pilings must be sorted, cleaned, inventoried and stored by type into groups as:

a. Piling usable without reconditioning.

b. Piling requiring reconditioning.

c. Piling damaged beyond structural use.

3.5 INSTALLATION RECORDS

Maintain a pile driving record for each sheet pile driven. Indicate on the installation record: installation dates and times, type and size of hammer, rate of operation, total driving time, pile locations, tip elevations, ground elevations, cut-off elevations, and any reheading or cutting of piles. Record any unusual pile driving problems during driving. Submit complete records to the Contracting Officer.

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STEEL H-PILES

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SECTION 31 62 16.16

STEEL H-PILES

PART 1 GENERAL

1.1 DESCRIPTION

Design, furnish, install and test piles at the locations indicated on the drawings and specified herein. Assume test piles will be directed to be placed in locations that can be incorporated into the work. Drive piles to a minimum depth of approximately 72 feet below the cut-off elevation (top of pile elevation is approximately 662 feet and pile tip elevation is approximately 590 feet), and to such a depth as required to obtain an ultimate bearing capacity of not less than 450 kips in compression and 210 kips in tension.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A572/A572M	(2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM E94/E94M	(2017) Standard Guide for Radiographic Examination Using Industrial Radiographic Film
ASTM E164	(2019) Standard Practice for Contact Ultrasonic Testing of Weldments
ASTM E165/E165M	(2018) Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E329	(2020) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E709	(2015) Standard Guide for Magnetic Particle Examination

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals

1.3 SUBSURFACE DATA

Subsurface soil data logs are provided on the project drawings.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G

Contractor's Geotechnical Consultant; G

Testing Agency Qualification; G

Wave Equation Analysis; G

Instrumentation and Monitoring Program Report; G

SD-02 Shop Drawings

Pile splices; G

Pile placement; G

Pile Reinforcing Tips or Steel Points

Pile Encasements

SD-03 Product Data

Pile Driving Equipment; G

Pile Driving Records; G

Delivery, Storage, and Handling; G

SD-05 Design Data

Wave Equation Analysis

Quantities List; G

Procedure for Insufficient Pile Length; G

SD-07 Certificates

Pile Material Certificates of Compliance; G

Pile Splices; G

Pile Shoes; G

SD-11 Closeout Submittals

Pile Driving Records

1.5 DELIVERY, STORAGE, AND HANDLING

Conform all delivery, storage, and handling of materials to the requirements specified herein. Develop and submit plans for the delivery, storage, and handling of piles. Submit delivery, storage, and handling plans for piles at least 30 calendar days prior to delivery of piles to the job site.

1.5.1 Delivery and Storage

Stack piles during delivery and storage so that each pile is maintained in a straight position and is supported every 10 feet or less along its length (ends inclusive) to prevent exceeding the maximum camber or sweep. Do not stack piles more than 5 feet high.

1.5.2 Handling

Lift piles using a cradle or multiple points pick-up to ensure that the maximum permissible camber or sweep is not exceeded due to insufficient support for lifting piles that are not extremely long into the driving leads. One pick up point can be used for short piles. Point pick-up devices must be of the type that clamp to both pile flanges at each pick-up point. Holes may be burned in the flanges or webs of piles above the cutoff length for lifting piles into the leads. Do not damage piles when dragging piles across the ground.

1.5.3 Excessive Camber, Sweep, and Damage

Inspect piles for excessive camber and sweep and for damage before transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Camber, curvature in the pile in the direction normal to the pile flanges, must be measured with the pile flange base laying on a flat surface and is the distance between the flange base at the mid-length of the pile and the flat surface. Sweep, curvature in the pile in the direction parallel to the pile flanges, must be measured with the pile flange tips laying on a flat surface and is the distance between the flange tips at the mid-length of the pile and the flat surface. The maximum permissible camber or sweep is 2 inches over the length of the pile. Piles having excessive camber or sweep will be rejected.

1.5.4 Damaged Piles

Inspect each pile for straightness and structural damage before transporting them to the project site and immediately prior to placement in the driving leads. Bring any damage to the attention of the Contracting Officer. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Contracting Officer, will be rejected and removed from the project site, or may be repaired, if approved, at no cost to the Government.

Any pile damaged by reason of internal defects or by improper driving must be corrected by one of the following methods approved by the Engineer for the pile in question:

a. The pile is withdrawn, if practicable, and replaced by a new and, if necessary, longer pile.

b. One or more replacement piles are driven adjacent to the defective pile.

c. A Pile Dynamic Analysis and low integrity testing must be performed by the Contractor's Geotechnical Consultant to assess the structural integrity of the driven pile(s).

1.5.5 Pile Butt Location and Elevation

A pile driven below the specified butt elevation must be corrected by one of the following methods approved by the Engineer:

a. One or more replacement piles are driven next to the pile in question.

b. As directed by the structural engineer.

A pile driven out of its proper location or out of plumb as approved by the Engineer, must be corrected by one of the following methods approved by the engineer:

a. One or more replacement piles are driven next to the pile in question.

b. As directed by the structural engineer.

1.5.6 Pile Sweep

Limit sweep to 1/8 inch per 10 feet over the length of the pile. Piles having excessive sweep will be rejected.

PART 2 PRODUCTS

2.1 PILE REQUIREMENTS

Order dynamic test piles 10 feet longer in length than production piles. Drive the additional dynamic test pile length only when approved by the Contracting Officer. The Contracting Officer will use dynamic test pile data to determine "calculated" pile tip elevation and necessary driving resistance. This information will be given to the Contractor no later than 7 days from receipt of complete test data.

2.2 MATERIALS

2.2.1 H-Piles

ASTM A572/A572M, Grade 50. Provide test piles identical to those used elsewhere in the project. Provide square and blunt pile tips, as received from the mill. Provide pile tip reinforcements or cast steel points. Provide H-piles of the shape and sections shown. Submit pile material certificates of compliance certifying that materials meet the requirements specified herein. Determine lengths of piles as specified in paragraph "Installation," subparagraph "Lengths of Production Piles".

2.2.2 Pile Splices

ASTM A572/A572M, Grade 50 for splice plates. Materials for pile splices must be as specified. Submit detail drawings of pile splices prior to

fabrication. Submit Pile Splice Welder Qualifications. Splices will not be allowed in the top 20 feet of each pile.

2.2.3 Pile Points

ASTM A572/A572M, Grade 50 for pile tip reinforcements.

2.2.4 Fabrication

Fabrication must conform to the requirements shown and as specified herein and in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS Section 05 52 00 METAL RAILINGS Section 05 51 00 METAL STAIRS.

2.2.4.1 Pile Splices

Fabricate pile splices as shown. Submit detail drawings of splices in accordance with paragraph SUBMITTALS. Perform all welding in accordance with the requirements for shield metal arc welding of AWS D1.1/D1.1M. Submit welding procedure for shop splices and verification of welder qualifications. Make no more than one field splice per 35 feet of pile, unless directed by the Contracting Officer. Splices will not be allowed within the top 20 feet of any pile. Fabrication drawings must show all shop splices.

2.2.4.2 Pile Points

Attach pile points as shown. Grind the top of piles sufficiently smooth to provide a good welding surface for structural-shape pile caps. Submit Certificates of compliance certifying that materials meet the requirements specified herein.

2.3 PILE DRIVING EQUIPMENT

Select the proposed pile driving equipment, including hammers and other required items, and submit complete descriptions of the proposed equipment in accordance with paragraph SUBMITTALS. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be allowed after the equipment has been approved except as directed. No additional contract time will be allowed for Contractor proposed changes in the equipment.

2.3.1 Pile Driving Hammers

Provide impact or vibratory type pile driving hammers.

2.3.1.1 Impact Hammers

Provide air, hydraulic or diesel-powered impact pile hammers of the single-acting, double-acting, or differential-acting type. The size or capacity of hammers must be as recommended by the hammer manufacturer for the total pile mass (weight) and the character of the soil formation to be penetrated. The rated driving energy of hammers is limited to a minimum of between 65,000 and 69,000 foot-pounds. Hammers must be capable of, and so demonstrated during the development of refusal criteria, hard driving in excess of 20 blows per inch. Provide boiler, compressor, or engine capacity sufficient to operate hammers continuously at the full rated speed. Hammers must have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air hammers. This gage

must be operational during the driving of piles and be mounted in an accessible location for monitoring by the Contractor and the Contracting Officer. Provide two spare operational bounce chamber read out units on site. Provide bounce chamber pressure gage correction tables and charts for the type and length of hose to be used with the pressure gage to the Contracting Officer. Hydraulic hammers must be equipped with a system for measurement of ram energy. The system must be in good working order and the results must be easily and immediately available to the Engineer. Install an energy monitor on the hydraulic hammers and record readings every 12 inches of pile installation. Use wave equation analysis to verify that the hammer will develop stresses within acceptable limits in the piles. Position a pile cap or drive cap between the pile and hammer. Place hammer cushion or cap block between ram and the pile cap or drive cap. Hammer cushion or cap block must have consistent elastic properties, minimize energy absorption, and transmit hammer energy uniformly and consistently during the entire driving period. Do not use a pile cushion block. In accordance with paragraph SUBMITTALS, submit the following information for each impact hammer proposed:

a. Make and model.

b. Ram weight (pounds).

c. Anvil weight (pounds).

d. Rated stroke (inches).

e. Rated energy range (foot-pounds).

f. Rated speed (blows per minute).

g. Air pressure, hammer, and boiler or compressor(psi).

h. Rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch).

i. Pile driving cap, make, and weight (pounds).

j. Cushion block dimensions and material type.

k. Power pack description.

2.3.1.2 Vibratory Hammers

The use of vibratory hammers is dependent upon satisfactory driving and dynamic load testing of piles. Final approval of the proposed hammer and other driving equipment is subject to the satisfactory completion and approval of the pile tests. The size or capacity of hammers must be as recommended by the hammer manufacturer for the total pile weight and the character of the soil formation to be penetrated. The hammer must provide for maintaining a rigid connection between the hammer and the pile. In accordance with paragraph SUBMITTALS, submit the following information for each vibratory hammer proposed:

a. Make and model.

b. Eccentric moment (inch-pounds).

c. Dynamic force (tons).

d. Steady state frequency or frequency range (cycles per minute).

e. Vibrating weight (pounds).

f. Amplitude (inches).

g. Maximum pull capacity (tons).

h. Non-vibrating weight (pounds).

i. Power pack description.

2.3.2 Pile Driving Leads

Support and guide hammers with fixed extended leads or fixed underhung leads. For driving battered piles, support and guide impact hammers with three-axis, fixed-extended leads capable of 1 H and 2-1/2 V before and after batter and 1 H on 6 V side batter, with 30 degree rotation each side of an axis running along the center line of rotation of the crane through the center line of the leads. Provide two intermediate supports for the pile in the leads to reduce the unbraced length of the pile during driving and pulling.

2.3.3 Pile Extractors

Pile extractors may be vibratory or impact pile driving hammers. Impact hammers are required for pulling piles not extractable with vibratory hammers.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

3.1.1 Wave Equation Analysis of Pile Drivability

a. Prior to driving any pile, submit a pile Wave Equation Analysis, performed by Contractor's Geotechnical Consultant, for each size pile and distinct subsurface profile condition. These analyses must take into account the proposed hammer assembly, pile cap block and cushion characteristics, the pile properties and estimated lengths and the soil properties anticipated to be encountered throughout the installed pile length based on static capacity analysis with consideration of driving gain/loss factors. Only one specific model of pile hammer may be used for each pile type and capacity. Provide instructions and procedures on how the Contractor will perform Dynamic Pile Testing, Inspection and Monitoring of piles during installation and testing

b. Demonstrate using the Wave Equation Analysis that the piles will not be damaged during driving, indicate that the driving stresses will be maintained within the limits below and indicate the blow count necessary to achieve the required ultimate static pile capacities.

Allowable Driving Stresses

Steel Piles

Compression - 0.9 fy

Tension - 0.9 fy

Where fy is yield strength of steel

c. Perform a refined Wave Equation Analysis upon completion of the dynamic testing program outlined in this specification section, taking into consideration the evaluated capacities, gain/loss factors and recommended production pile lengths. Develop production pile driving criteria based on the results of the refined Wave Equation Evaluations.

d. All pile driving equipment provided by the Contractor will be subject to the approval of the Contractor's Geotechnical Consultant. Complete the attached pile and driving equipment data form, including hammer information, in full as part of the submittal of the results of the Wave Equation Analyses.

e. Pay for the cost of performing the Wave Equation Analyses and include in the base bid.

3.1.2 Order List

Submit to the Contracting Officer for approval, an itemized quantities list for piles prior to placing the order with the supplier. Indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile in the list.

3.2 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. Cut piles at cutoff grade by an approved method. Where cutoff is below existing ground or mudline elevation, complete excavation, sheeting, and dewatering before driving pile to cutoff elevation.

3.2.1 Lengths of Production Piles

The estimated quantities of piles are given for bidding purposes only. Drive piles to indicated tip elevation to reach a driving resistance established by the wave equation analyses (WEAP) and dynamic testing in accordance with the schedule which the Contractor's Geotechnical Consultant will prepare from the test-pile driving data.

3.2.2 Pile Driving Records

Submit the proposed form for compiling pile driving records 30 calendar days prior to commencement of work.

Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, batter alignment, hammer stroke at each foot of penetration, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof as required for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, splicing, obstructions, and any driving interruptions. Install an energy

monitor on the hammers and record readings during pile installation. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at: https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables

Submit to the Contracting Officer complete and accurate test and job pile driving records as specified in paragraph RECORDS of this section, within 15 calendar days after completion of driving. Make pile driving records available to the Contracting Officer at the job site, within 24 hours after each day of pile driving.

3.2.3 Pile Placement and Tolerances in Driving

Develop and submit a pile placement plan which shows the installation sequence and the methods proposed for controlling the location and alignment of piles. Submit pile placement plan at least 30 calendar days prior to delivery of piles to the job site. Complete all foundation preparation in the area prior to the placement of piles for driving. Accurately place piles in the correct location and alignments, both laterally and longitudinally, and to the vertical or batter lines indicated. Establish a permanent base line to provide for inspection of pile placement by the Contracting Officer during pile driving operations prior to driving production piles and maintain during the installation of the production piles.

A final lateral deviation from the correct location at the cutoff elevation of not more than 3 inches will be permitted for vertical and battered piles. Manipulation of piles will not be permitted. A variation of not more than 0.25 inch per foot of pile length from the vertical for vertical piles nor more than 0.50 inch per foot of pile length from the required angle for batter piles will be permitted. In addition to complying with the tolerances stated herein, the clear distance between the heads of piles and the edges of caps must be not less than 6 inches. Redesign of pile caps or additional work required due to improper location of piles is the responsibility of the Contractor. A vertical deviation of not more than one inch from the correct cutoff elevations shown is permitted. Inspect piles for heave. Redrive heaved piles to the required pile driving criteria. Maintain the correct relative position of all piles by the use of templates or by other approved means. Piles damaged or not located properly or exceeding the maximum limits for lateral and vertical deviation, or variation in alignment must be pulled and new piles redriven, or provide additional piles, at a location directed at no additional cost to the Government.

3.2.3.1 Survey Data

After the driving of each pile group is complete, provide the Contracting Officer with an as-driven survey showing actual location and top elevation of each pile. Do not proceed until the Contracting Officer has reviewed the survey and verified the safe load for the pile group driven. Present a survey in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest half inch.

3.2.4 Pile Penetration Criteria

The controlling driving resistance for production piles will be determined by the Contractor's Geotechnical Consultant. The required initial driving criteria and restrike will be established subsequent to the analysis of

pile tests as specified in paragraph PILE TESTS.

3.2.5 Pile Length Markings

Mark each pile prior to driving with horizontal lines at one foot intervals. Mark the interval number on pile every 5 feet from pile tip.

3.2.6 Pile Driving

Notify Contracting Officer 10 days prior to driving of test piles. Stop foundation excavation at one foot above foundation grade before piles are driven. Do not drive piles within 100 feet of concrete less than 7 days old. Complete excavation to lines and grades shown when pile driving is completed. Drive piles to the terminal driving criteria or below indicated tip elevation to reach a driving resistance established by the dynamic pile driving tests at the end of drive or restrike the Contracting Officer will prepare from the test-pile driving data. During initial driving and until pile tip has penetrated beyond layers of very soft soil or below bottom of predrilled holes, use a reduced driving energy of the hammer as required to prevent pile damage. The controlling refusal blow count (number of blows required to attain the final 1 inch of penetration) for production piles, will be determined by the Contractor with approval by the Contracting Officer. If a pile fails to reach indicated tip elevation, or if a pile reaches tip elevation without reaching required driving resistance, notify Contracting Officer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB.

3.2.7 Protection of Piles

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in leads. Where pile or projecting reinforcement orientation is essential, take precautionary measures to maintain the orientation during driving. Take special care in supporting battered piles to prevent excessive bending stresses in pile. Maintain axial alignment of pile hammer with that of the pile. If the Contractor elects to use a pile head with projecting strands or mild steel reinforcement, prevent direct impact forces from being transmitted through the reinforcement, by using a special driving head.

3.2.8 Rejected Piles

Withdraw piles damaged or impaired for use during handling or driving, mislocated, or driven out of alignment beyond the maximum tolerance. Replace with new piles or cut-off and abandon damaged or impaired piles and drive new piles as directed. Remove excess cut-off from piles and unacceptable piles from the work site. Perform all work in connection with withdrawing and removing rejected piles from the site at no additional cost to the Government.

3.2.8.1 Obstructions

If a pile encounters an underground obstruction within 5 feet of the ground surface of such size as to prevent driving the pile to the required driving criteria, the pile must be pulled or cut off at no cost to the Government. If such an obstruction is encountered more than 5 feet below the ground surface, the pile must be cut off and paid for as if a completed pile. In either event, a replacement pile must be installed at

a location indicated by the Contracting Officer and paid for as a completed pile.

3.2.8.2 Splicing Piles

Splices must be capable of developing the full strength of the member in compression, tension, shear, and bending. Submit detail drawings of splices and design calculations demonstrating the strength of the splice for approval. Splices will not be allowed in the top 20 feet of each pile.

3.3 FIELD QUALITY CONTROL

3.3.1 Test Piles

Order test piles 10 feet longer in length than production piles. Drive the additional test pile length only at the direction of the Contracting Officer. The Contracting Officer will use test pile data to determine "calculated" pile tip elevation or necessary driving criteria. Drive test piles at the locations indicated. Drive test piles to indicated tip elevation. Use test piles, if located properly and offering adequate driving resistance in finished work. Pre-drilling or jetting is not permitted. Provide and operate a pile driving analyzer as specified in specification section 31 62 17.01 13 DYNAMIC PILE TESTING during the driving of each test pile.

3.3.2 Pile Records

Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, batter alignment, hammer stroke at each foot of penetration, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof as required for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, splicing, obstructions, and any driving interruptions. Install an energy monitor on the hammers and record readings every 12 inches of pile installation. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at: https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables

3.3.3 Testing Agency Qualification

Engage an independent testing agency to observe the production piles installation. The testing agency must be qualified according to ASTM E329 for testing indicated. Submit testing agency qualifications to the Contracting Officer for approval.

3.3.4 Welding Inspection

Employ a testing agency to perform the welding inspections as specified in the statement of special inspection.

3.3.5 Weld Testing

In addition to visual inspection, welds must be tested and inspected according to AWS D1.1/D1.1M and inspection procedures listed below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents. Test 50 percent of pile splices, the steel pile cap splice connections and the steel pile insert connection.

a. Liquid Penetrant Inspection: ASTM E165/E165M.

b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

c. Radiographic Inspection: ASTM E94/E94M, minimum quality level "2-2T."

d. Ultrasonic Inspection: ASTM E164.

3.4 TOUCHUP PAINTING

Clean field welds, splices, and abraded painted areas and field-apply paint according to SSPC PA 1. Use same paint and apply same number of coats as specified. Apply touchup paint before driving piles to surfaces that are immersed or inaccessible after driving.

3.5 PRECONSTRUCTION CONDITION SURVEY

Perform preconstruction condition survey of structures and utilities within 200 feet of the pile driving activity. Perform outreach to the owner of the structures 28 days before performing the preconstruction condition survey. The Contractor must obtain written permission from the owner of the structure prior to accessing the structure. The preconstruction condition survey must include video and photographic documentation of the exterior and interior of above ground structures and of the interior of underground structures. Video documentation must be in high definition, and show existing conditions and highlight, where possible, existing cracks, deteriorated concrete, exposed and corroded reinforcement, cracked or broken brick or mortar, and other signs of distress. For utilities, perform the survey when the greatest extent of the interior is exposed. Provide supplementary artificial lighting as needed. The video must include annotation with location and structure nomenclature which describes any areas of distress over the video and time code superimposed on the video. Photographs must be accompanied by sketches or descriptions that indicate the location and direction of each photograph. For each structure surveyed, provide a Pre-Construction Condition Survey Report following completion of the survey. The report must contain all documentation associated with the survey including DVD copies. In the report, include notes, sketches, photographs, and videos. Provide general information, such as location details and structure type, as well as particular information on materials, condition, existing damage, aperture and persistence of cracks, and disrepair observed during visual survey. Provide a graphical depiction of locations of damage or other features of concern. Submit the Preconstruction Condition Survey Reports no later than 28 days before the commencement of pile driving activity. Accept responsibility for damages to existing adjacent or adjoining structures created by pile driving work, and repair any damages to these structures without cost to the Government.

-- End of Section --

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DIVISION 31 - EARTHWORK

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DYNAMIC PILE TESTING

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SECTION 31 62 17.01 13

DYNAMIC PILE TESTING

PART 1 GENERAL

1.1 SCOPE

Dynamic pile testing is to provide data on strain or force and acceleration, velocity or displacement of a pile under impact force, with test methods specified in this section and as described in ASTM D4945. The data shall be used to estimate the static capacity and the integrity of the pile, as well as hammer performance, pile stresses, and soil dynamic characteristics.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4945	(2012) High-Strain Dynamic Testing of Piles

1.3 QUALIFICATIONS

The Contractor shall identify the individual who has the experience in the method of performing dynamic pile testing and whom shall be administering the testing as shown and described. The Contractor shall submit a proven experience record for that individual. As a minimum, the individual shall have the experience of performing dynamic pile testing on at least five (5) projects within the last five years. The individual proposed by the Contractor will be subject to the approval of the Contracting Officer and shall supervise all dynamic pile testing.

1.4 QUALITY CONTROL

1.4.1 General

The Contractor shall establish and maintain quality control for all operations to assure compliance with the contract requirements and maintain records of its quality control for all construction operations including, but not limited to, the following:

(1) Facilities and personnel providing for installation and reading by the Contractor of all measuring devices.

(2) Dynamic Pile Testing (pile number, location); sequence and method of testing; records of measurements, and driving records.

(3) Ensure dynamic pile testing equipment is in good working order and calibrated before, during, and after gauges are attached to the pile.

(4) Perform data quality checks throughout the dynamic pile test and ensure data quality is reasonable, reproducibly consistent and

proportional.

1.4.2 Reporting

The original and three copies of these records and tests, as well as records of corrective action taken, shall be furnished to the Government daily. Electronic *.pda files of Pile Driving Analyzer (PDA) data shall be submitted to the Government within 24 hours of each test.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dynamic Pile Testing Work Plan; G, STR

The Contractor shall submit its plan for conducting dynamic pile testing to the Contracting Officer for approval a minimum of 30 days prior to the beginning of the tests. The Contractor shall submit the items required below for review and approval by the Contracting Officer.

(1) Geotechnical firm and individual in the firm with the stated qualifications for performing dynamic pile testing.

(2) Dynamic Testing Work Plan. The work plan shall include the following information:

a. Number and type of transducers

b. Location and method of installing transducers.

c. A description of sequence and method of dynamic testing during driving steel piles.

SD-03 Product Data

Pile Test Equipment Calibration; G, STR

Descriptions of pile driving equipment, including leads, extractors, shall be submitted for approval at least 30 days prior to commencement of work. The following information for each hammer proposed shall be submitted for each proposed hammer:

(1) make and model
(2) ram weight (pounds)
(3) anvil weight (pounds)
(4) weight of the moving parts of the hammer (pounds)
(5) rated stroke (inches)
(6) rated energy range (foot-pounds)
(7) rated speed (blows per minute)
(8) steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch)
(9) power pack description

(10) pile driving helmet, make, and weight (pounds)
(11) pile cushion material, type, proposed thickness, modulus of elasticity, and coefficient of restitution
(12) the make-up of the proposed cap block, including material type, dimensions, modulus of elasticity, and coefficient of restitution
(13) rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch)

SD-06 Test Reports

Dynamic Driving Stresses; G, STR

DYNAMIC TEST REPORT; G, STR

The Contractor shall furnish all data from each pile tested including the pile driving records within 24 hours after completion of each test. If a test pile fails at or less than the anticipated failure load, preliminary field test data shall be provided to the Contracting Officer within 4 hours of the completion of the test. Blow counts shall be recorded for each foot of each test pile; and copies furnished to the Contracting Officer. The Dynamic Test Report shall include, but not be limited to; unusual driving conditions, interruptions or delays during driving, and any other information considered pertinent. Pile test data shall be recorded for all items shown in paragraph "DYNAMIC TEST REPORT." Copies of these forms shall also be furnished to the Contracting Officer.

1.6 TEST MEASUREMENT

Measurements of strain, force, acceleration, velocity or displacement of a pile under impact force, and reports on all test piles shall be made by the Contractor. Dynamic Driving Stresses of the piles tested shall be supplied to the Contracting Officer within 7 days after the installation of the piles.

1.7 DYNAMIC TEST REPORT

The report of the dynamic pile test shall be in accordance with ASTM D4945 and include the following items where applicable:

1.7.1 General

(1) Project Identification
(2) Location

1.7.2 Test Pile Installation Equipment

(1) Make, model, type, and size of hammer
(2) Weight of hammer and ram
(3) Stroke of ram
(4) Rated energy and operating speed of hammer
(5) Type and thickness of cap blocks and pile cushions
(6) Weight and dimensions of drive-cap and follower

1.7.3 Test Piles

(1) Identification of test pile(s)
(2) Type of piles

(3) Pile material including basic specifications
(4) Dimensions of pile
(5) Pile weight as driven
(6) Measure out of plumbness
(7) Driven length
(8) Embedded length
(9) Tested length, and
(10) Final elevation of piles butt referenced to fixed datum (identify datum)
(11) Location of splices, if applicable
(12) Dimensions and type of corrosion protection if applicable

1.7.4 Test Pile Installation

(1) Date driven
(2) Operation of hammer during final driving
(3) Driving log, blows per foot
(4) Final penetration resistance, blows per inch
(5) Description of special installation procedures used, and
(6) Notation of any unusual occurrences during installation
(7) Cause and duration of interruptions in pile installation, if applicable

1.7.5 Dynamic Pile Testing

(1) Description of all components of the apparatus for obtaining dynamic measurements and apparatus for recording, reducing and displaying data, and of test procedure including description and location of the sensor attachment.
(2) Date tested and sequence of test pile such as "end of driving"
(3) Pile identification
(4) Pile length below sensors, cross sectional area, density, wave speed, and modulus of elasticity of the test pile
(5) Penetration resistance (number of blows per unit penetration) during test
(6) Graphical presentation of velocity and force measurement in the time domain for representative blow of each pile tested
(7) Method(s) and one-dimensional wave propagation theory used to evaluate data (particularly for the capacity evaluation)
(8) Capacity of the pile at the time of testing; and at end of driving. Summarize variables for soil model, including damping factors, quakes, and resistance distribution
(9) Hammer performance as measured by energy transferred into the pile
(10) Driving stresses in the pile
(11) Comments on the integrity of the pile, and
(12) Notation of any unusual occurrences during test

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Dynamic Monitoring Device

The equipment shall conform to the requirements of ASTM D4945. The

apparatus for obtaining dynamic measurements shall include transducers, which are capable of independently measuring strain and acceleration versus time at a specific location along the pile axis during the impact event. A minimum of two strain transducers and two accelerometers, positioned at 90 degrees around the perimeter of the pile, shall be securely attached to the pile to prevent slippage. Transducers and accelerometers shall be bolted to the test pile.

2.1.2 Strain Transducers and Acceleration, Velocity or Displacement Transducers

Transducers shall be as specified in ASTM D4945.

The transducer calibration shall have been within 1 year of the pile test. The transducers shall have been calibrated to an accuracy of 3% throughout the applicable measurement range. If damage is suspected during use, the transducers shall be re-calibrated or replaced.

2.1.3 Apparatus for Recording, Reducing, and Displaying Data

This apparatus shall be as described in ASTM D4945. The apparatus shall allow determination of the force and velocity versus time and determination of the acceleration and displacement of the pile head, and the energy transferred to the pile.

PART 3 EXECUTION

3.1 DYNAMIC TESTING

3.1.1 Dynamic Testing During Driving

Dynamic pile testing shall be performed during the driving of test piles and production piles. Dynamic testing shall be performed in increments of two feet or less. The Contractor shall mark the test piles clearly at appropriate interval for pile installation and dynamic testing. The Contractor shall attach a minimum of two strain transducers and two accelerometers to the pile(s) at a minimum distance of 1.5 pile diameters below the pile head as stated in this Section and in accordance with ASTM D4945. The transducers shall be attached to the pile within 10 feet of the start of driving. Data shall be recorded throughout driving, and sets of time histories and any depth shall be made available to the government at request. The transducers shall be securely attached to the piles by bolting. The Contractor shall connect the sensors on the pile with the pile driving analyzer located at ground level at a safe distance from the pile. The Contractor shall perform the internal calibration check and take the dynamic measurements for the impacts together with routine observation of penetration resistance. The force and velocity signals from the pile driving analyzer shall be calibrated before dynamic testing begins. Driving of the test pile shall continue using routine pile installation procedures with the impact hammer. The impact force applied during dynamic testing shall be applied axially and concentrically with the pile. The Contractor shall take measurements in accordance with ASTM D4945 including but not limited to recording the number of impacts for a specific penetration; record the drop of the ram or ram travel length, if applicable; for hydraulic hammers, record the kinetic energy from the hammer readout when available; record the number of blows per minute delivered by the hammer; and take, record, and display a series of force and velocity measurements. The Contractor shall compare the force and the product of velocity and impedance at the moment of impact as

stated in SUBMITTALS and in accordance with ASTM D4945 for data quality checks.

3.1.1.1 Frequency of Testing Production Piles

Four production piles shall be monitored and tested as part of the dynamic pile testing program. The four test piles are identified on the contract drawings.

3.1.2 Dynamic Testing During Restrike

A dynamic re-strike test shall be performed on all four previously tested piles. The set-up time shall be 48 hours or longer. The Contractor shall attach a minimum of two strain transducers and two accelerometers to the pile(s) at a minimum distance of 1.5 pile diameters below the pile head as stated in this Section and in accordance with ASTM D4945. The transducers shall be securely attached to the piles by bolting. The Contractor shall connect the sensors on the pile with the pile driving analyzer located at ground level at a safe distance from the pile.

The Contractor shall perform the internal calibration check and take the dynamic measurements for the impacts together with routine observation of penetration resistance. The force and velocity signals from the pile driving analyzer shall be calibrated before dynamic testing begins. The impact force applied during dynamic testing shall be applied axially and concentrically with the pile. The restrike driving sequence shall be performed with a warmed up hammer and shall consist of striking the piles until the pile penetrates an additional three inches, or if refusal is met. The Contractor shall take measurements in accordance with ASTM D4945 including but not limited to recording the number of impacts for a specific penetration; record the drop of the ram or ram travel length, if applicable; for hydraulic hammers, record the kinetic energy from the hammer readout when available; record the number of blows per minute delivered by the hammer; and take, record, and display a series of force and velocity measurements. The Contractor shall compare the force and the product of velocity and impedance at the moment of impact as stated in SUBMITTALS and in accordance with ASTM D4945 for data quality checks.

3.1.2.1 Frequency of Testing Production Piles During Restrikes

Restrikes shall be performed on all four dynamically monitored production piles.

3.2 APPLICATION

3.2.1 Impact Force Application

Impact force for the dynamic pile tests shall be the approved impact hammer. The hammer shall be positioned so that the impact is applied axially to the head of the pile and concentric with the pile.

3.2.2 Placement of Transducers and Accelerometers

The two strain transducers and two accelerometers shall be placed, diametrically opposed and on equal radial distances, at the same axial distance from the bottom or from the top of the pile so that the measurements compensate for bending of the pile. The transducers shall be attached at least 1 ½ pile diameters from the pile head. Care shall be taken to ensure that the apparatus is securely attached to the pile so that

slippage is prevented. See ASTM D4945 for typical attachment lay-outs.

3.3 DYNAMIC TESTING REPORTS

3.3.1 Test Pile Program

The Contractor's geotechnical firm shall prepare a written report of the dynamic testing program on the test piles and results. This report shall include a discussion of the pile capacity results obtained from the dynamic testing and correlation between the pile dynamic test results and the pile static test results. The report shall also discuss hammer and driving system performance, driving stress levels, pile integrity and soil characteristics such as soil damping coefficients and quake values.

3.3.2 Signal/Wave Matching Analyses

The Contractor shall perform signal/wave matching analyses of the dynamic pile testing data obtained from the "end of initial driving" and the "beginning of restrike" on all dynamically tested piles. The signal/wave matching analysis shall be included in the report. For initial driving and restrike, *.pda files shall be provided to the Government.

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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

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STONE PROTECTION (RIPRAP)

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SECTION 35 31 19.00 13

STONE PROTECTION (RIPRAP)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 127	(2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 295	(2008) Petrographic Examination of Aggregates for Concrete
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates
ASTM D 4791	(2005e1) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4992	(2007) Evaluation of Rock to be Used for Erosion Control
ASTM D 5312	(2004) Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions
ASTM D 6825	(2002) Placement of Riprap Revetments

CORPS OF ENGINEERS (COE)

EM 1110-2-2302	(1990) Construction with Large Stone

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material Sources; G, GT

The Contractor shall designate in writing only one source or one combination of sources from which it proposes to furnish stone. The Contractor shall state in writing methods of processing and handling riprap, and shall notify the Contracting Officer when production methods are changed.

Survey Plan for Verification of Section; G, GT

The Contractor shall provide a plan for obtaining surveys as defined in the paragraph SURVEYS FOR VERIFICATION OF SECTION. Approval of the plan and initial survey is required before material may be placed in the project.

SD-02 Shop Drawings

Survey Sections for Verification of Section

The Contractor shall provide surveyed cross sections for verification of design section for each step of the work as specified in the paragraph SURVEYS FOR VERIFICATION OF SECTION.

SD-06 Test Reports

Gradation Test;

Gradation Test Results for riprap and bedding. Riprap gradation testing results shall be submitted on the WORKSHEET FOR GRADATION ANALYSIS OF RIPRAP and the gradation curve (ENG FORM 4055). Bedding gradation testing results shall be submitted on Contractor's standard laboratory report form and the gradation curve (ENG FORM 2087). A blank copy of each form is included at the end of this section.

SD-07 Certificates

Certified Weight Scale Tickets;

Copies of all certified weight scale tickets shall be furnished to the Contracting Officer at a frequency as directed. The tickets do not need to be formally submitted through the submittal process.

PART 2 PRODUCTS

2.1 STONE SOURCES AND EVALUATION

Stone shall be furnished from any of the sources listed in the attachments at the end of this section, or at the option of the Contractor may be furnished from any other source designated by the Contractor and accepted by the Contracting Officer, subject to the conditions herein stated. The rock supplied shall be produced from one rock formation to provide a product of uniform appearance. The Contractor shall not supply rock from various formations, or mix field-stone with quarried rock, unless approved by the Contracting Officer. It is the Contractor's responsibility to determine that the stone source or combination of sources selected is capable of providing the quality, quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work.

2.1.1 Alternate Sources

a. Evaluation by Site Inspection. If the Contractor proposes to furnish stone from an unlisted source, the Government will evaluate the alternate source and reply within 30 calendar days. A quarry or pit investigation shall be performed by a Government geologist or engineer to determine whether or not materials with acceptable durability can be produced from the proposed source. If the source is an undeveloped quarry or if the source is a quarry for which the operation has been dormant for more than one year such that the quarry face is weathered, the Contractor shall expose fresh rock for20 feet horizontally and for the full height of the face proposed for production, prior to the field evaluation. The Government will consider service records for stone of a similar size, placed in a similar thickness and exposed to weathering under similar conditions as are anticipated for this contract. The Government may choose to accept the source based on rock classification, geologic evaluation, and service records that show that the stone is durable to the satisfaction of the Government.

b. Evaluation by Test Data. If sufficient information is not available, the Government will reconsider the alternate source if evaluation is supplemented by sampling and testing. This will require an additional 60 day evaluation period. If the Contractor wishes to pursue the alternate source, the Government will notify the Contractor of required testing and evaluation criteria. Requirements for acceptance will consider criteria in EM 1110-2-2302 as well as characteristics of rock found in nearby quarries or pits. Some common test procedures that may be considered include:

Unit Weight and Absorption (ASTM C 127).
Petrographic Examination (ASTM C 295 and ASTM D 4992).
Resistance to Freezing and Thawing (ASTM D 5312).

c. Sampling and Testing. Samples from alternate sources shall be taken by a representative of the quarry or pit under the supervision of the Contracting Officer. Information provided with the samples shall include the location and stratigraphy within the quarry or pit from which the sample was taken. The Contractor shall ship the samples to a laboratory identified by the Contracting Officer. The Government will be responsible for testing costs associated with one quarry or pit per project; and the Contractor shall be responsible for testing costs for additional sources.

2.1.2 Acceptance of Materials

Acceptance of a source of stone is not to be construed as acceptance of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels, when such materials are unsuitable for stone as determined by the Contracting Officer. The Contracting Officer also reserves the right to reject individual units of produced specified materials in stockpiles at the quarry or pit, all transfer points, and at the project construction site when such materials are determined to be unsuitable.

2.2 RIPRAP

Riprap gradation shall meet the requirements for R80 riprap indicated on the attached ENG FORM 4055. The stone shall be well graded within the limits specified.

2.2.1 General

All stone shall be durable material. Stone for riprap shall have a specific gravity not less than 2.55. Stone shall be of a suitable quality to ensure permanence in the structure and in the climate in which it is to be used. It shall be free from cracks, blast fractures, bedding, seams and other defects that would tend to increase its deterioration from natural causes. A crack is considered to be detrimental if it is more than 4 mil wide and is continuous for one-third the dimension of at least two sides of the stone. The stone shall be clean and reasonably free from soil, quarry fines, and shall contain no refuse. Any foreign material adhering to or combined with the stone as a result of stockpiling shall be removed prior to placement. The maximum aspect ratio (greatest dimension:least dimension) of any piece of stone for size ranges shall be not greater than 3:1 when measured across mutually perpendicular axis. ASTM D 4791 shall be used as a guide to perform the test.

2.2.2 Production

Riprap shall be handled and selectively loaded onto trucks in a manner to avoid segregation and provide a distribution of stone sizes consistent with the gradation band and test samples. Each truckload shall be representative of the gradation requirements.

2.3 BEDDING MATERIAL

Bedding material shall be composed of tough, durable particles, adequately free from thin, flat and elongated pieces, and shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Contracting Officer. The aggregates shall meet the quality requirements of ASTM C 33/C 33M. The bedding material shall be well-graded between the limits shown on ENG FORM 2087 for B2 bedding in the attachments at the end of this section.

2.4 SOURCE QUALITY CONTROL

Gradation tests shall be performed by the methods and at the frequency listed below. A satisfactory gradation test shall be obtained prior to any hauling and delivery of materials. All tests, including failing tests shall be submitted. Tests performed on material which do not meet gradation and shape requirements will not be counted as part of the tests required. The Contracting Officer shall be informed immediately of test results and draft copies of test results shall be furnished at the Contracting Officer's request.

2.4.1 Sampling Requirements

The Contracting Officer shall direct the time and location of sampling, unless waived. Samples shall be taken from stockpiles or loaded trucks, and not directly from conveyers or chutes.

2.4.2 Riprap Gradation Testing

a. Notification. The Contracting Officer shall be informed 24 hours before each riprap test.

b. Testing Frequency. One gradation test shall be performed prior

to placement of riprap and one during placement.

c. Sample Size. The sample shall have a minimum gross weight not less than 25 times the maximum stone size in the specified gradation (25 * W_{100}).

2.4.2.1 Riprap Test Method A

Test method A shall consist of weighing all stones larger than 5 pounds in a sample. Five to seven weight classes shall be selected within the range of stone sizes. Each stone shall be weighed and recorded on the Work Sheet for Gradation Analysis of Riprap Method A; and the calculations on the worksheet shall be performed and recorded. A plot of the gradation shall be completed on ENG FORM 4055 in accordance with accepted practice for soil and aggregate gradations.

2.4.2.2 Riprap Test Method B

Test method B shall consist of separating the stones into 5 to 7 piles, ordered by size. The sample shall be separated on a clean, hard surface that is free of smaller stones that could become mixed with the sample. The stones shall be visually screened to place them into appropriate piles. All stones shall be separated and placed into piles before weighing. After separating, the smallest and largest rock in each pile shall be weighed and recorded. The stones shall be adjusted as necessary so that the weight classes do not overlap. After adjustment is adequate and weight classes have been established, each pile of stone shall be weighed and recorded on the Work Sheet for Gradation Analysis of Riprap Method B; and the calculations on the worksheet shall be performed and recorded. A plot of the gradation shall be completed on ENG FORM 4055 in accordance with accepted practice for soil and aggregate gradations.

2.4.3 Bedding Gradation Testing

The bedding and filter materials shall be sampled in accordance with ASTM D 75/D 75M and tested in accordance with ASTM C 136.

b. Testing Frequency. One gradation test shall be performed prior to placement of bedding.

c. Sample Size. Aggregate samples shall have a minimum gross weight not less than 110 pounds per inch of the maximum nominal aggregate size in the specified gradation.

2.5 STOCKPILES

Stockpiles shall be formed by a series of layers or truckload dumps, where the rock essentially remains where it is placed. Subsequent layers shall be started 10 feet from the edge of the previous layer so that the rock will not roll down the edges of the pile. Any stone which has become contaminated with soil or refuse shall not be put into the work unless the contaminating material has been removed prior to placement.

PART 3 EXECUTION

Riprap shall generally be placed in general accordance with ASTM D 6825. Where discrepancies occur, this specification shall govern.

3.1 CONSTRUCTION TOLERANCES

Work shall generally meet the required elevations, slope and grade; and the outer surfaces shall be even and present a neat appearance.

a. Subgrades. Areas on which stone protection will be placed shall be graded and/or dressed to conform to cross sections shown on the contract drawings within 2 inches above or below the neat lines. The surface shall be reasonably smooth to match tolerances normally obtained by rough grading with bladed equipment. For subaqueous construction in greater than 3 feet of water, the tolerance shall be 6 inches.

b. Layer Thickness. Where a layer thickness is specified, areas found to be less than 80% of the specified thickness shall be corrected. This tolerance shall only be exceeded on isolated spot checks, and if the tolerance is commonly exceeded, the Contractor shall change construction methods to improve the quality control. The specified tolerance above the section thickness shall be 12 inches for R80 riprap and 6 inches for B2 bedding. Extreme limits of the tolerances given shall not be continuous in any direction for an area greater than 200 square feet. The average section thickness for the entire area of a specific gradation placed shall be no more than section thickness shown plus 50% of the specified tolerance. If it is necessary to estimate riprap and bedding quantities for changes, the volume shall be based on neat line dimensions and the plan dimension for thickness. A conversion factor of 1.4 tons/CY shall be used to determine quantity requirements for riprap while a conversion factor of 1.5 tons/CY shall be used for bedding, unless otherwise directed by the Contracting Officer.

c. Surface Tolerances. The finished surface tolerance above the neat line shall generally not deviate from the lines and grades shown by more than half (1/2) the average stone dimension of the gradation range. Riprap that has a rough and uneven surface shall be reworked by hand to stabilize stones that wobble and are out of tolerance, except where the Contracting Officer approves use of equipment. Rearranging of individual stones shall be required to the extent necessary to obtain a well-graded distribution of stone sizes. The Contracting Officer may elect to use Contractor surveys as defined in paragraph Surveys for Verification of Design Section in section 01 71 23.05 13 CONTRACTOR SURVEY to verify that tolerance requirements have been met.

3.2 FOUNDATION PREPARATION

Foundation areas shall be excavated or filled to the lines and grades shown. Filling shall be with earth similar to the adjacent material and shall be well compacted. Immediately prior to placing riprap, the prepared subgrade will be inspected by the Contracting Officer unless waived; and no material shall be placed thereon until that area has been approved.

3.3 PLACEMENT OF BEDDING LAYERS

Bedding material shall be spread uniformly on the prepared base to the lines and grades indicated and in such manner as to avoid disturbance to the subgrade. Placing by methods which tend to segregate the particle sizes or cause mixing of the separate layers will not be permitted. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous

mass. Any damage to the surface of the prepared base during placing of the material shall be repaired before proceeding with the work. Compaction of bedding material will not be required, but the surface shall be finished to present an adequately even surface, free from mounds or windrows.

3.4 PLACEMENT OF RIPRAP

3.4.1 Preparation

Prior to placing riprap along the shoreline the Contractor shall remove any existing debris or trash as well as any woody vegetation or other plant material prior to placing any new riprap or bedding on top of existing stone material.

3.4.2 Layer Requirements

Riprap shall be placed in a manner which will produce a well-graded mass of rock with the minimum practicable percentage of voids. The large stones shall be well distributed. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones.

3.4.3 Construction Methods

Unsegregated stone shall be placed in a systematic manner. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid displacing underlying material. Placement shall typically begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Final finish of slope shall be performed as the material is placed.

Placing riprap in layers will not be permitted. Placing riprap by dumping it into chutes, or by any method likely to cause segregation of the various sizes, shall not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope shall not be permitted. No equipment shall be operated directly on the completed stone protection system. Dump trucks shall be equipped with bottom hinged tailgates if rock is directly placed into position with the trucks.

3.4.4 Riprap Placement in Water

Riprap to be placed under water shall be placed in a systematic manner so as to ensure a continuous uniform layer of well-graded stone of the required thickness. Riprap to be placed under water shall be placed with a drop height less than 2 feet. Riprap shall not be cast across the surface of the water. The equipment shall be capable of reaching the placed material to monitor the water depth and surface coverage.

3.5 MAINTENANCE

The Contractor shall maintain the stone protection and underlying works until accepted by the Contracting Officer. When appropriate, the Contractor shall place stone protection in a timely manner to reduce risk of scour. Any material displaced prior to acceptance shall be replaced at the Contractor's expense.

3.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain quality control for all work performed at the job site under this section to assure compliance with contract requirements. The Contractor shall maintain records of quality control tests, inspections and corrective actions. Quality control measures shall cover all construction operations including, but not limited to, the placement of all materials to the slope and grade lines shown and in accordance with this section.

In addition to the Contractor's system to establish and maintain quality control for stone placement operations, the following information shall be recorded and promptly provided to the Contracting Officer on request:

a. Record tonnage of stone placed in completed sections of the work and check quantity for compliance with design sections.

b. Check for uniform thickness and geometry of material layers.

3.7 SURVEYS FOR VERIFICATION OF SECTION

Contractor surveys are required for riprap and bedding to verify that materials are placed to the thickness and geometry required by the contract documents. The Contractor shall make surveys as the work progresses to verify lines, grades and thicknesses established for completed work in accordance with the requirements given in specification section 01 71 23.05 13 CONTRACTOR SURVEYS. Approval of cross sections shall not constitute final acceptance of the work.

3.8 LIST OF ATTACHMENTS

a. Riprap Material Sources

b. Riprap Gradation Testing Worksheets

c. R80 Gradation Curve

D. B2 Bedding Gradation Curve

-- End of Section --

SECTION 35 31 190.00 13

STONE PROTECTION

ATTACHMENTS

RIPRAP MATERIAL SOURCES

CEMVP-EC-G 23 February 2022
Davis/md/5844

MEMORANDUM FOR: District Material Files

SUBJECT: Quarry Inspections for Approved Material Source List at Upper Pool 4 Ecosystem Restoration.

1. From 23 to 24 FEB 2022 the undersigned inspected five quarries in the vicinity of Bay City, Wisconsin across Pierce County, Wisconsin and Goodhue County, Minnesota. The inspection was conducted to assess the capability and quality of the quarry material as part of a rock supply contract for R-45 and R-140 rip rap stone erosion protection and pipe bedding material in the Upper Mississippi River Pool 4 near Bay City, Wisconsin for island streambank protection and ecosystem restoration.

2. The first stop (23 FEB 2022) was at the Morrison Quarry

This quarry is located at: T 25 N, R 18 W, Section 35, NW ¼
Pierce County, Wisconsin
LAT: 44.613315
LONG: -92.530523

The quarry is operated by: Milestone Materials
N2042 County Rd VV
Hager City, WI
54014
715-495-6288

The Morrison Quarry is a large sized operation and the current working quarry faces are north, east, and south of the northeastern corner of the current quarry boundaries and approximately 80' high. The rock exposed is a part of the Ordovician age Prairie du Chien Group known as the Oneota Dolomite.

The quarry facies rock can be classified as:

Dolomite
Hard (medium to high ping)
Moderately cemented
Slightly weathered to unweathered
Thick to massive bedding
Blocky fracture
Slightly vuggy
Moderate to highly crystalline
Some chert nodules

Some fines (silt and clay) on rock facies
Tan to light brown with minor Fe staining
1' to 2' thick, soft silty sandstone unit 20' to 25' below top of ledge. Brown with Fe staining
0.2' to 0.5' thick white-green shale on lateral rock unit contacts

Existing rock production piles of riprap processed at the quarry were inspected. Recent blasting took place in the Fall of 2021 according to Mitch Lee, Quarry Operations Area Manager for Milestone Materials. The formation is moderately jointed. Rock fractures were found to primarily chip randomly upon impact in the dolomite. The Morrison Quarry is **an acceptable** source for riprap production for the R-45, R-140, and pipe bedding material rock supply contract at this time. Any material proposed for the Upper Pool 4 Restoration project from the Morrison quarry would need to be vigorously processed over a vibrating grizzly and inspected for quality. Any future use of this quarry shall require re-inspection prior to approval.

3. The second stop (23 FEB 2022) was at the Kaasa Quarry

This quarry is located at: T 24 N, R 16 W, Section 15, NE ¼
Pierce County, Wisconsin
LAT: 44.564253
LONG: -92.298206

The quarry is operated by: Milestone Materials
N850 County Highway S
Maiden Rock, WI
54750
715-835-2251

The Kaasa Quarry is a small sized operation and the current working quarry faces are southwest, south, and southeast and working facies are approximately 60' (lower ledge) and 40' (upper ledge) with some amounts of overburden above. The rock exposed is a part of the Ordovician age Prairie du Chien Group known as the Oneota Dolomite.

The quarry facies rock can be classified as:

Dolomite
Hard to very hard (high ping)
Moderately cemented
Slightly weathered pockets to unweathered
Thick to massive bedding
Blocky fracture

Vuggy (quartz crystal filled)
Highly crystalline
Some chert nodules and seams
Some fines (silt and clay) on rock facies
Grey to tan to light brown with minor Fe staining
0.2' to 0.4' thick white-green shale on lateral rock unit contacts

No current operations since the purchase of this quarry by Milestone Materials with no known date of recent blasting from the previous owner (Kraemer) but in the Summer of 2022 Milestone Materials will begin using the quarry. Unprocessed material of rip rap sized rock at the base on the last blast was inspected for quality. Met with the Quarry Operations Area Manager, Mitch Lee of Milestone Materials at the time of inspection. The formation is moderately jointed. Rock fractures were found to primarily chip randomly upon impact in the dolomite. The Kaasa Quarry is **an acceptable** source for riprap production for the R-45, R-140, and pipe bedding rock supply contract at this time. Any material proposed for the Upper Pool 4 Restoration project from the Kaasa quarry would need to be vigorously processed over a vibrating grizzly and inspected for quality. It is estimated that this quarry may be capable of producing rock for the next 100 years. Any future use of this quarry shall require re-inspection prior to approval.

4. The third stop (23 FEB 2022) was at the B & S Quarry

This quarry is located at: T 27 N, R 15 W, Section 34, SE ¼
Pierce County, Wisconsin
LAT: 44.773732
LONG: -92.181840

The quarry is operated by: B&S Construction
N6695, WI Highway 72
Elmwood, WI
54740
715-279-0550

The B&S Quarry is a medium sized operation and the current working quarry faces are west and southwest and a single working ledge that is approximately 100' high. The rock exposed is a part of the Ordovician age Prairie du Chien Group known as the Oneota Dolomite Formation of dolostone.

The quarry facies rock can be classified as:

Dolostone and dolomitic limestone

Hard to very hard (medium to high ping)
Moderately cemented
Slightly weathered pockets to unweathered
Medium thick to massive bedding
Blocky fracture
Vuggy
Chert nodules and seams
Very crystalline
Some Fe staining
Some fines (silt and clay) on rock facies
Light grey (dolomitic limestone)
Grey to light brown (dolostone)

There is a zone of solution weathering approximately midway up the working face which should serve as a distinct marker bed. This zone may contain some clay in-filling, but it should be removed through normal processing.

Processed production piles of riprap and boulders were inspected for quality as well as unprocessed rock at the blast face. Current operations are being used for personal use with recent blasting around 2017 on the west and southwest facies. Met with the B & S Construction quarry owner on site at the time of inspection. The quarry owner mentioned difficulty meeting pipe bedding gradation within 0.25' of the specifications on a previous job with USACE. The quarry used a homemade vibrating screen plant to process rock. Riprap, large boulders, and bedding material were inspected for quality on site. The formation is moderately jointed. Rock fractures were found to primarily chip randomly upon impact on the dolostone. The B & S Quarry is **an acceptable** source for riprap production for the R-45, R-140, and pipe bedding material rock supply contract at this time. Any material proposed for the Upper Pool 4 Restoration project from the B & S quarry would need to be vigorously processed over a vibrating grizzly and inspected for quality. Current projects using this quarry include the Colfax project and some DNR work in the area. Any future use of this quarry shall require re-inspection prior to approval.

5. The fourth stop (24 FEB 2022) was at the Luhman Quarry

This quarry is located at:	T 113 N, R 16 W, Section 13, SW ¼ Goodhue County, Minnesota LAT: 44.587785 LONG: -92.683295
The quarry is operated by:	Luhman's Construction 17351 Welch Shortcut Rd Welch, MN

55089
(651) 388-3086

The Luhman Quarry is a small to medium sized operation and the current working quarry faces are north with a single working ledge approximately 110' high. The rock exposed is a part of the Ordovician age Prairie du Chien Group known as the Oneota Dolomite Formation of dolostone.

The north quarry face rock can be classified as:

Sandy dolostone on lower (~5' - 10') and upper (~5' - 10') bounds of working ledge
Soft to moderately hard (soft to medium thud/ping)
Moderately cemented
Vuggy
Slightly laminated
Weathered pockets
Medium thick bedding
Some iron nodules
Some Fe staining
Some fines (fine sand, silt, and clay) on rock facies
Brown to tan color

Dolostone
Hard to very hard (moderate to very high ping)
Moderately cemented
Vuggy
Crystalline
Chert nodules
Weathered pockets
Thin to massive bedding
Minor Fe staining
Some fines (f. sand, silt, and clay) on rock facies
Tan to buff or grey color
Some tan to white to green shale on rock unit facies

Processed production piles of rip rap were inspected as well as unprocessed rip rap sized rock remaining at the base of the last blasting event. The quarry was purchased 11 years ago. Current operations to continue towards power pole (moving north) for next 2 to 3 years then change to move in the opposite direction south above underlying sandstone. The formation is moderately jointed. The soft weathered rock will likely be removed during processing by vibrating grizzly. Rock fractures were

found to primarily chip randomly upon impact in the sandier dolostone. The Luhman Quarry is **an acceptable** source for riprap production for the R-45, R-140, and pipe bedding rock supply contract at this time. Any material proposed for the Upper Pool 4 Restoration project from the Luhman quarry would need to be vigorously processed over a vibrating grizzly and inspected for quality. Any future use of this quarry shall require re-inspection prior to approval.

6. The fifth stop (24 FEB 2022) was at the Bisel Quarry

This quarry is located at:	T 25 N, R 16 W, Section 5, NW ¼ Pierce County, Wisconsin LAT: 44.684641 LONG: -92.353997
The quarry is operated by:	Pierce County Highway Department 621 W Cairns Street Ellsworth, WI 54011 (715) 273-5096 (Ask for Elliot)

The Bisel Quarry is a medium to large sized operation and the current working quarry faces are north with two working ledges approximately 50’ to 60’ high each for a total of 100’ to 120’ of working facies. The rock exposed is a part of the Ordovician age Prairie du Chien Group known as the Oneota Dolomite Formation of dolostone.

The east quarry face rock can be classified as:

Dolostone
Hard to very hard (moderate to very high ping)
Moderately cemented
Vuggy
Highly crystalline
Chert nodules
Some weathered pockets
Thin to massive bedding
Minor Fe staining
Some fines (silt and clay) on rock facies
Tan to buff color
Some tan to white to green shale on lateral rock unit facies
~5’ of mod. hard white-green dolomitic siltstone at top of first ledge

Current operations to continue eastward with yearly blasting. Stockpiles of rip rap, 0.75" and 1.5" rock, 4" break rock, and boulders up to 3' to 4' in diameter were produced from the lower ledge and inspected for quality. The formation is moderately jointed. The white-green dolomitic siltstone may not be removed during processing by vibrating grizzly and its use as riprap will need to be avoided. Rock fractures were found to primarily chip randomly upon impact in the dolostone. The Bisel Quarry is **an acceptable** source for riprap production for the R-45, R-140, and pipe bedding rock supply contract at this time. Any material proposed for the Upper Pool 4 Restoration project from the Bisel quarry would need to be vigorously processed over a vibrating grizzly and inspected for quality. Met with quarry plant operator on site and Elliot (County Engineer) off site. This quarry separates out and stockpiles much of the tabular rock for DNR fishery restoration projects. Any future use of this quarry shall require re-inspection prior to approval.

7. For any questions or comments please contact the undersigned at 651-290-5844 or at the listed email address.

Michael Davis
Dam Safety, Geology & Risk Section
St. Paul District
Michael.m.davis@usace.army.mil

GRADATION TESTING WORKSHEETS

WORK SHEET FOR GRADATION ANALYSIS OF RIPRAP
METHOD A

Project Name:	Date:
Riprap Type:	Test No.
Source, Quarry, or Pit:	
Sample Location:	Test Made By:

Part 1. Weigh all stones larger than 5 pounds and record.

(1) PASSING WT.							5 lbs.
(2) RETAINED WT.						5 lbs.	PAN
(3) -------							-------
-------							-------
-------							-------
-------							-------
-------							-------
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(4) TOTALS							

Rows (1) & (2) Enter 5 to 7 weight classes to yield approx. 75%, 50%, 30%, and 15% finer points.

Row (3) List weight of each stone. Attach additional sheets if necessary.

Row (4) Add all individual stone weights listed in each column.

Part 2. Summary Table.

(5) WEIGHT CLASSES		(6)	(7)	(8)
PASSING (stone wt. in lbs.)	RETAINED (stone wt. in lbs.)	TOTAL WEIGHT EACH CLASS (lbs.)	CUMMULATIVE WEIGHT PASSING (lbs.)	TOTAL PERCENT PASSING (%)
	5 lbs.			
5 lbs.	PAN			
SAMPLE TOTAL			--------	--------

Column (5) Enter same weight classes used in Rows (1) and (2).

Column (6) Enter weights of material from Row (4)

Column (7) Add column (6) from bottom up to get cumulative weight passing.

Column (8) Divide column (7) by sample total to get total percent passing.

WORK SHEET FOR GRADATION ANALYSIS OF RIPRAP
METHOD B

Project Name:	Date:
Riprap Type:	Test No.
Source, Quarry, or Pit:	
Sample Location:	Test Made By:

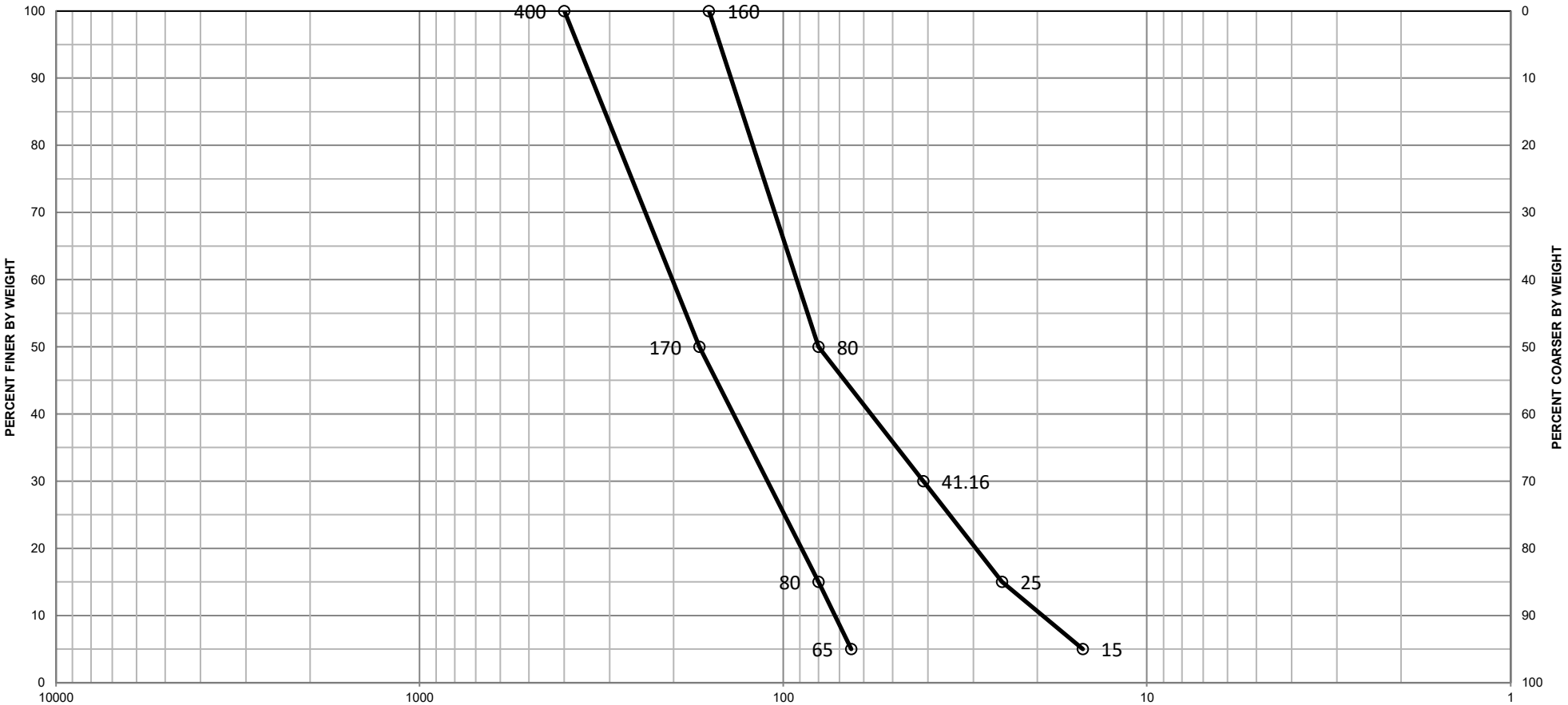
Part 1. Separate rock into 5 to 7 piles, ordered by size. The largest pile should contain 2 to 5 stones. Intermediate piles between the largest stones and those smaller than 5 pounds should be approximately equal in total weight. Separate all stones before weighing.

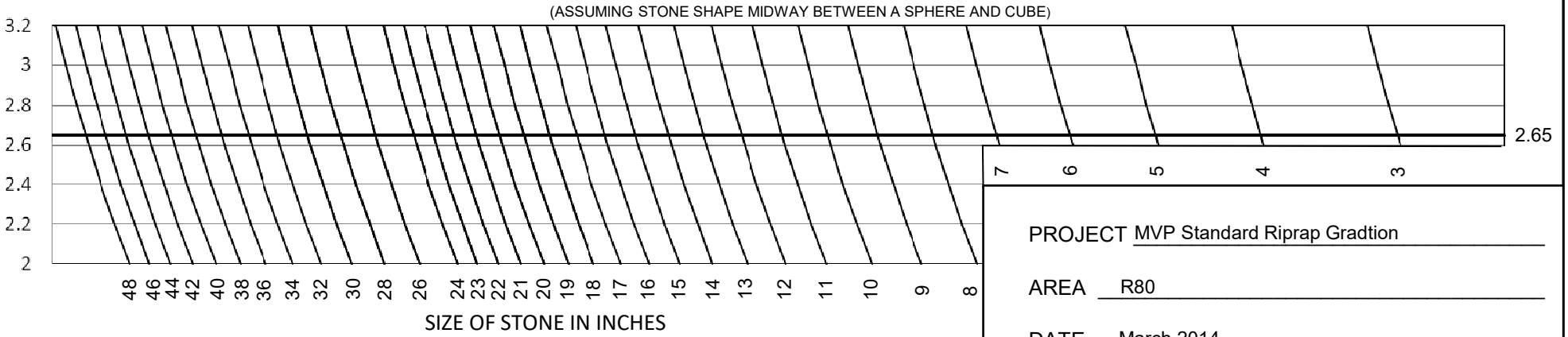
Part 2. Summary Table.

(1) WEIGHT CLASSES		(2)	(3)	(4)
PASSING (stone wt. in lbs.)	RETAINED (stone wt. in lbs.)	TOTAL WEIGHT EACH CLASS (lbs.)	CUMMULATIVE WEIGHT PASSING (lbs.)	TOTAL PERCENT PASSING (%)
	5 lbs.			
5 lbs.	PAN			
SAMPLE TOTAL			--------	--------

Column (1) Weight the smallest and largest stone in each pile. If weight classes overlap, adjust stones as necessary and repeat.
Column (2) Weigh the total amount of rock in each pile and record.
Column (3) Add column (2) from bottom up to get cumulative weight passing.
Column (4) Divide column (3) by sample total to get total percent passing.

R80 GRADATION CURVE





SPECIFIC GRAVITY OF STONE = 2.65

PROJECT MVP Standard Riprap Gradtion

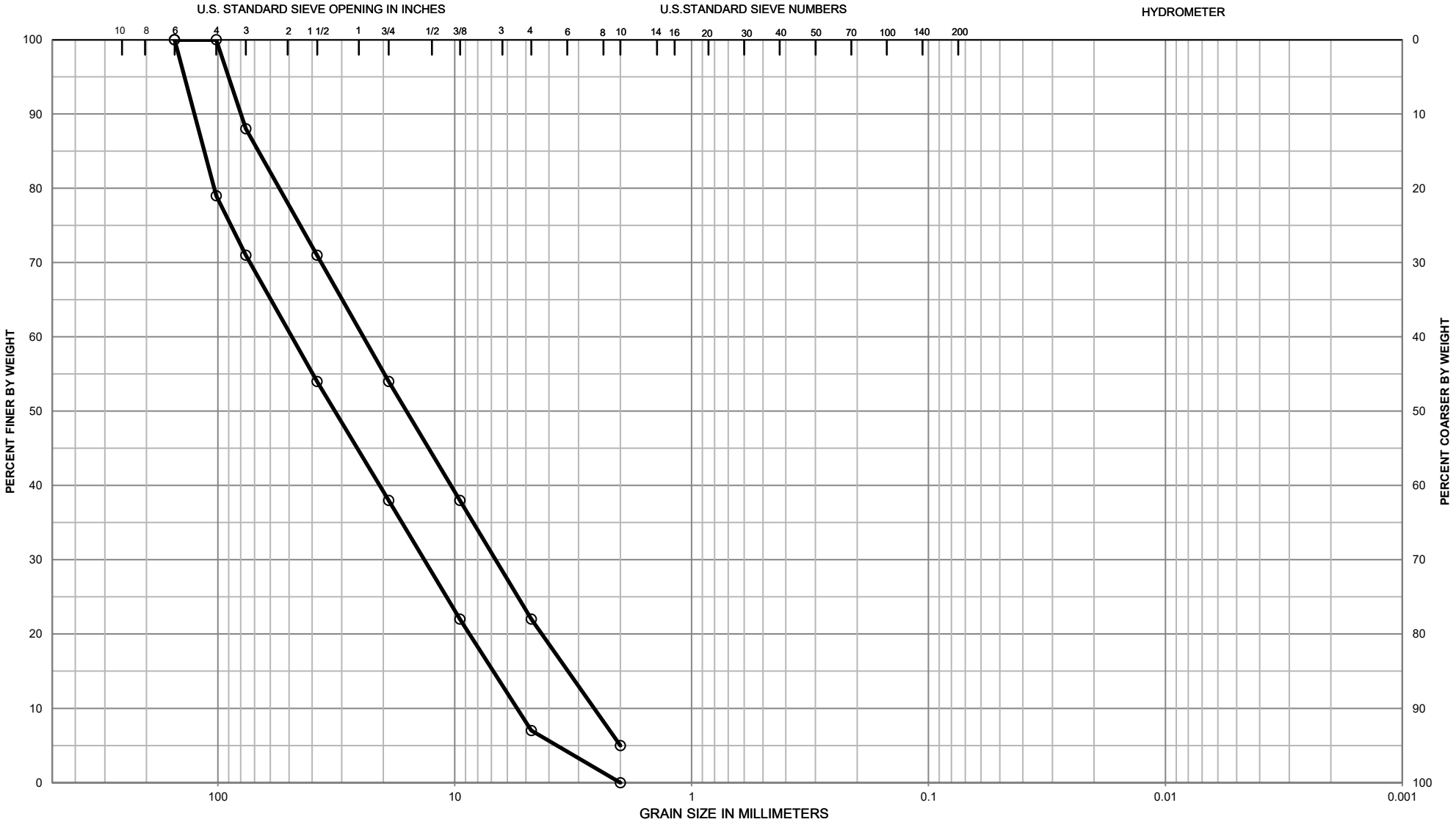
AREA R80

DATE March 2014

RIPRAP/ROCKFILL GRADATION CURVE

ENG FORM 4055 (COMPUTER GENERATED)

B2 BEDDING GRADATION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W %	LL	PL	PI

PROJECT MVP Standard Bedding Gradation

AREA B2

BORING

DATE March 2014

GRADATION CURVES

ENG FORM 2087 (COMPUTER GENERATED)