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API-653 Engineering Inspection Report
Tank # 2111 (Tank #7)

Prepared for

US Air Force - McGuire AFB; McGuire AFB, NJ

February 22, 2018

API Standard 653 recommends this document containing valuable historical information be retained for the life of the tank.

Signature(s):

Richard M. Bailey, Inspector, API-653 # 30241, STI SP-001 AC 13608, NACE # 10312

General Conditions

The information referenced in this engineering report is based solely upon the area or areas agreed upon and contracted for inspection on the date of the inspection and under those present, known, same, and current conditions. This report was prepared using retrievable data from those areas that were properly cleaned and prepared and made available and accessible during the inspection. Areas not contracted for inspection and/or made available and accessible are not included in this report.

The methods, standards and regulations used by InterSpec, LLC during the inspection and in preparing this engineering report comply with the most current and widely accepted standards and regulations in the industry, in which these standards and regulations make no representation, warranty or guarantee. The professional opinions and recommendations stated in this report, including predictability of life, maximum length of time for re-inspection, suitability for product storage, and safe fill height are conclusive approximations and are intended to serve mainly as guidelines for obtaining the utmost in spill prevention and environmental protection. The listed recommendations may not necessarily be mandatory actions, but corrective actions that InterSpec, LLC suggests would better preserve the owners'/operators' facility components and may contribute to a safer and more convenient operation. Failure to comply with these could result in, but may not be limited to, reduction of service life, tank mishap, legal consequences and/or fines for owners/operators. It is best advised that the recommended repairs, corrective actions and procedures be fully and accurately complied with in order to meet the required and applicable federal, state and local regulations, and to have the necessary repairs and up-grades performed prior to making any change in service, product and/or current conditions. Some recommendations and requirements are necessary to bring the component(s) into compliance with federal, state, and local regulations. InterSpec, LLC recommends re-inspection after any corrective action, repair or change in usage when the change is to a more severe service. Any change in facility conditions that are applicable to this inspection report, such as, but not limited to, a change in service or usage could result in outdating this report. The predictability of any component in this report is a result of following the procedures in the applicable industry standard. InterSpec, LLC accepts absolutely no responsibility or liability for any mishap or failure, including any subsequent clean-up costs or legal ramifications, resulting from owners'/operators' failure to perform the required repairs, inspections and re-inspections, as they apply.

Executive Summary

An API Standard 653 In-Service inspection of Tank # 2111 (Tank #7) was completed on February 22, 2018 to evaluate the tank's integrity, collect data, and establish a database for future inspections and evaluations. A service life evaluation performed on the tank shows it as having greater than 30 years of remaining shell life under current conditions. Inspection Results are listed in section 4.1. Maintenance Recommendations are listed in section 4.2. Compliance Requirements are listed in section 4.3. All engineering calculations are provided in Appendix A.

The tank does not meet the compliance requirements mandated by federal, state, and/or local regulatory bodies and requires that corrective action(s) be taken; however, the tank does meet requirements for structural integrity in accordance with the API-653 standard. The owner/operator may follow the schedule(s) in section 4.4. Refer to Compliance Requirements section 4.3 for details.

Table of Contents

1.0 Introduction

1.1 Purpose

2.0 References

2.1 Code of Federal Regulations (CFR)
2.2 American Petroleum Institute (API)
2.3 American Society of Mechanical Engineers Codes (ASME)
2.4 National Fire Protection Association (NFPA)
2.5 American Society of Nondestructive Testing (ASNT)
2.6 New Jersey Administrative Code (NJAC)

3.0 Description

3.1 Job Description
3.2 Tank Description
3.3 Service Description
3.4 Part Description
3.5 Joint Type Description
3.6 Inspection Description
3.7 Equipment Description

4.0 Inspection

4.1 Results
4.2 Maintenance Recommendations
4.3 Compliance Requirements
4.4 Serviceability

Appendices

A Engineering Calculations
B Engineering Data
C Engineering Drawings
D API Checklist
E Photographs

1.0 Introduction

1.1 Purpose:

1.1.1 This report presents an analysis of data collected during an inspection conducted on February 22, 2018 for Tank # 2111, servicing Jet-A, located at McGuire AFB facility in Wrightstown, NJ. The inspection was performed by a certified API-653 inspector. This report summarizes the results of the inspection meeting the requirements of API Standard 653 and API-12C. The primary and secondary containments including the supports, foundation, vents, gauges, and appurtenances were evaluated. The inspection was conducted by *InterSpec, LLC.*

2.0 References

2.1 Code of Federal Regulations (CFR):

United States Department of Labor, Occupational Safety & Heath Administration

2.1.1 CFR, Title 29, Subtitle B, Volume 5, Chapter XVII, Part 1910, Subpart H, Section 119, Process safety management of highly hazardous chemicals
2.1.2 CFR, Title 29, Subtitle B, Volume 5, Chapter XVII, Part 1910, Subpart J, Section 147, The control of hazardous energy (lockout/tagout)
2.1.3 CFR, Title 29, Subtitle B, Volume 5, Chapter XVII, Part 1910, Subpart S, Section 331-335, Safety-Related Work Practices

United States Environmental Protection Agency

2.1.4 CFR, Title 40, Volume 21, Chapter I, Subchapter D, Part 112, Oil Pollution Prevention

2.2 American Petroleum Institute (API):

2.2.1 API Standard 650, Welded Steel Tanks for Oil Storage
2.2.2 API Standard 653, Tank Inspection, Repair, Alteration, and Reconstruction
2.2.3 API RP 651, Cathodic Protection of Aboveground Petroleum Storage Tanks
2.2.4 API RP 575, Inspection of Atmospheric and Low-Pressure Storage Tanks
2.2.5 API RP 577, Welding Inspection and Metallurgy
2.2.6 API RP 2000, Venting Atmospheric and Low-Pressure Storage Tanks

2.3 American Society of Mechanical Engineers Codes (ASME):

2.3.1 ASME Boiler and Pressure Vessel Code; Section V, Non-Destructive Examination
2.3.2 ASME Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

2.4 National Association of Corrosion Engineers (NACE):

2.4.1 NACE Recommended Practice, RP0184-91, Repair of Lining Systems
2.4.2 NACE Recommended Practice, RP0193-93, External Cathodic Protection of On-Grade Metallic Storage Tank Bottoms
2.4.3 NACE Recommended Practice, RP0288-94, Inspection of Linings on Steel and Concrete

2.5 National Fire Protection Association (NFPA):

2.5.1 NFPA-30, 2012 Ed., Flammable and Combustible Liquids Code
2.5.2 NFPA-70, 2011 Ed., National Electrical Code
2.5.3 NFPA-780, 2008 Ed., Standard for the Installation of Lightning Protection Systems

2.6 American Society of Nondestructive Testing (ASNT):

2.6.1 ASNT-SNT-TC-1A

2.7 New Jersey Administrative Code (NJAC):

2.7.1 NJAC, Title 7, Chapter 1E, Discharges of Petroleum and other Hazardous Substances

3.0 Description

3.1 Job Description:

Job Number:	17-1103
Contracted by:	Tetra Tech

3.2 Tank Description:

Owner/Operator:	US Air Force - McGuire AFB
Location:	McGuire AFB, NJ
Tank Identification:	2111
Diameter:	45.00 feet
Shell Height:	45.00 feet
Capacity:	535,339 Gallons
Configuration:	Vertical
Foundation:	Concrete Ringwall
Secondary Containment:	Concrete Dike
Year Installed:	1952
Age:	66 years
Construction Code:	API-12C
Manufacturer Name:	Unknown

3.3 Service Description:

Service:	Jet-A	
Specific Gravity:	0.84	
Operating Limits:		
	Minimum Metal Temperature:	12 ˚F
	Maximum Metal Temperature:	Ambient
	Minimum Pressure:	Atmospheric (no vacuum)
	Maximum Pressure:	Product
Seismic Zone:	1	
Current Fill Height:	38.25 feet	
Max Fill Height:	39.25 feet	

3.4 Part Description:

Shell	
Material:	Carbon Steel
Specification:	Unknown Specification
Design:	Cylindrical
Geodesic Dome Roof	
Material:	Aluminum
Specification:	Unknown Specification
Design:	Dome
Internal Floating Roof	
Material:	Carbon Steel
Specification:	Unknown Specification
Design:	Double Decked

3.5 Joint Type Description:

Shell Plate-to-Plate:	Butt-Welded
Roof Plate-to-Plate:	Butt-Riveted
IFR Plate-to-Plate:	Lap-Welded
Shell-to-Roof:	Bolted (Geodesic Dome)

3.6 Inspection Description:

Inspection Type:	API-653 In-Service
Equipment Used:	Ultrasonic Thickness Meter
Last Inspection Date:	June 05, 2009
Inspection Date:	February 22, 2018
Inspector(s):	Richard M. Bailey

3.7 Equipment Description:

Ultrasonic Thickness Meter

Manufacturer:	General Electric
Model:	DMS 2
Calibration Methods Used:	Zeroing Procedure, Copper Coating Calibration Procedure, and Two Point Calibration Procedure

4.0 Inspection

4.1 Results:

4.1.1 **Foundation:** The tank sits on a concrete ringwall foundation. There is cathodic protection and leak detection underneath the tank bottom. The foundation was visually evaluated during the inspection for broken concrete, spalling, cracks, and vegetation against the bottom of the tank. Hairline cracks are present in the foundation. In accordance with API 653 Section 4.5.1.2(e), "Temperature cracks (hairline cracks of uniform width) do not seriously affect the strength of the concrete foundation structure; however, these cracks can be potential access points for moisture or water seepage that could eventually result in corrosion of the reinforcing steel." A settlement survey was performed in accordance with API Standard 653. The results of the survey are available in Appendix A of this report. The foundation appears to be in satisfactory condition.

4.1.2 **Containment:** The tank sits on a concrete containment floor with sloped concrete dike walls. The containment was measured for size. The size is: Length=103' Width=109' Height=7'. The containment is equipped with a drain and sump configuration that is covered with grating. The top of the containment wall is two or more feet in width with proper sloped walls as per NFPA-30 requirements. The containment floor is properly sloped to allow for drainage away from the tank as required by NFPA-30. The containment was visually evaluated during the inspection. Field assessment indicates that the containment is of sufficient size to contain a total tank loss and thus satisfies the requirements of API 653. A formal containment evaluation in accordance with 40 CFR 112 may be required in order to satisfy federal, state, and local requirements.

Minor hairline cracks (temperature cracks) are present in the concrete containment floor. Hairline cracks do not seriously affect the strength of concrete structures; however, these cracks can be potential access points for moisture or water seepage that could corrode the reinforcing steel (rebar). In addition, during cold weather, these moisture pockets are susceptible to freezing and naturally resulting expansion. This could lead to the cracks becoming larger and impacting structural integrity as well as permeability.

Penetrations through the containment floor for the 12" issue and 10" receipt piping are not properly sealed. Except as noted above, the containment appears to be in satisfactory condition.

4.1.3 **Shell:** The shell is constructed from carbon steel material of unknown specification. The shell is a cylindrical design, butt-welded together, consisting of 6 courses. Evaluated the accessible shell welds for corrosion, peaking and banding; they are within the allowable tolerances of API Standard 653. The shell exterior was visually evaluated during the inspection. The exterior coating was inspected for disbonding, adhesion, deterioration, and discoloration. The exterior shell coating is in satisfactory condition. The shell was evaluated for remaining metal thickness utilizing ultrasonic technology. Thickness measurements are listed in the Engineering Data section in Appendix B. A service life evaluation performed shows the shell with greater than 30 years of remaining life under current conditions. The engineering calculations, as per API Standard 653, for the service life evaluation are shown in Appendix A under "Service Life Evaluation."

4.1.4 **Fixed Roof:** The fixed roof is an aluminum geodesic dome with proper screening located at the shell attachment junctures. Fuel personnel reported that the geodesic dome leaks during heavy rainfall.

4.1.5 **Internal Floating Roof:** The floating roof is constructed from carbon steel of unknown specification. The floating roof is a double decked type. Due to safety considerations, the top of the IFR was not accessed during the inspection. A visual evaluation was performed from the top of the rolling ladder. It appears a vacuum breaker was installed since the last inspection. The floating roof was at 13 feet during the inspection which allowed for evaluation of the interior shell plates. There are heavy rubber deposits (streaks) over the entire internal shell. This is evidence that the floating roof periphery "shoe type seal" has failed or is failing. In addition, a slight odor of fuel was present upon opening the access hatch to the IFR. This condition increases the danger of a flammable atmosphere existing on top of the floating roof. Except as noted above, the floating roof is level and appears to be in satisfactory condition.

4.1.6 **Appurtenances:** Inspected and evaluated each tank nozzle in accordance with API Standard 650 and 653. Identified the type and use of each shell nozzle. Measured the nozzle neck thickness on all accessible shell nozzles. Evaluated all nozzle/reinforcement plates for leaks and corrosion, with no discrepancies noted. The tank has a means of grounding via ground straps. Evaluated the mechanical type level gauge and its operation. The tank is equipped with leak detection under the bottom. Inspected the spiral stairway. The bottom stair tread is located approximately 22 inches above grade. OSHA 29 CFR 1910.25 states, "Risers shall be uniform throughout the height of the stairway." Inspected the high-level cut out system. Evaluated the high-level alarm systems, see Painting/Insulation section. Evaluated the handrails; their condition is satisfactory. Inspected the platforms and frames for corrosion and structural soundness; their condition is satisfactory.

4.1.7 **Painting/Insulation:** The tank shell, roof, stairway, piping, and appurtenances are coated. The coating is in good condition on all areas, with the exception of the 1-inch flanges associated with the high-level alarms.

4.2 Maintenance Recommendations:

4.2.1 **Foundation:** Seal the hairline cracks in the foundation with a Sherwin Williams two-part Corobond Flexible Joint Sealant, Corobond Crack Filler, and Corobond 100 Epoxy Primer/Sealer or equivalent.

4.2.2 **Containment:** Seal the containment floor cracks with a Sherwin Williams two-part Corobond Flexible Joint Sealant, Corobond Crack Filler, and Corobond 100 Epoxy Primer/Sealer or equivalent.

4.2.3 **Shell:** None.

4.2.4 **Roof:** Replace the bad sealant material in the geodesic dome.

4.2.5 **Internal Floating Roof:** Close off the center sump for the IFR by welding a 3/16” plate over it.

4.2.6 **Appurtenances:** None.

4.2.7 **Painting/Insulation:** Mechanically clean and recoat areas of coating failure on the high-level alarm flanges. All coating repairs should be accomplished using an epoxy-based coating system or equivalent.

4.3 Compliance Requirements:

4.3.1 **Foundation:** None.

4.3.2 **Containment:** Seal the casing penetrations for the 12" issue and 10" receipt lines. Use a sealant material that is impervious to the product stored in the tank.

4.3.3 **Shell:** None.

4.3.4 **Roof:** None.

4.3.5 **Internal Floating Roof:** Replace the failing/failed periphery shoe type seal in the tank. It is recommended that a double wiper type seal be installed.

API Standard 650 par. H.4.1.4 states, "A vapor-tight rim (or skirt), extending at least 150 mm (6 in.) above the liquid at the design flotation level, shall be provided around both the internal floating roof periphery and around all internal floating roof penetrations..."

4.3.6 **Appurtenances:** Fabricate and install a concrete approach landing for the spiral stairway in order to meet the requirements of OSHA 29 CFR 1910.25.

4.3.7 **Painting/Insulation:** None.

4.4 Serviceability:

4.4.1 API-653 Schedule:

Tank # 2111 is in compliance with the requirements of API Standard 653 for structural integrity; however, the tank does not meet the compliance requirements mandated by federal, state, and/or local regulatory bodies and requires that corrective action(s) be taken. The following schedule may be implemented:

4.4.1.1 Perform routine monthly visual inspections by owner/operator personnel that are knowledgeable of the storage facility operations, the tank, and the characteristics of the product stored; conduct in accordance with API Standard 653.

4.4.1.2 The next visual external inspection should be accomplished by a certified API-653 inspector prior to February 2023 in accordance with API-653.

4.4.1.3 The next ultrasonic thickness measurement inspection should be accomplished by a certified API-653 inspector prior to February 2033 in accordance with API-653.

4.4.1.4 The next internal inspection should be accomplished by a certified API-653 inspector prior to June 2029 in accordance with API-653 and based on the previous tank report.

Appendix A
Engineering Calculations

1. Shell Service Life
2. Settlement Evaluation

Shell Life Evaluation

To determine the remaining shell service life and maximum inspection intervals, calculate the corrosion rate and remaining corrosion allowance for each shell course using the following:

$$t_{min} = \left(\frac{2.6(H-1)DG}{SE}\right)$$

API-653 4.3.3.1a

$$t_{min} = \left(\frac{2.6(H)DG}{SE}\right)$$

API-653 4.3.3.1b

$$t_{min} = \left(\frac{2.6(H)DG}{SE}\right) \qquad I_{ut} = \left(\frac{t_{act} - t_{min}}{2\mathrm{C_r}}\right) \qquad I_v = \left(\frac{t_{act} - t_{min}}{4\mathrm{C_r}}\right)$$

Where:

t_{min} = The minimum acceptable shell thickness for each course, in inches; however, t_{min} shall not be less than 0.1 inch for any tank course.

t_{norm} = The nominal shell thickness, in inches.

t_{act} = The current measured shell thickness, excluding pits and corrosion, in inches.

t_{prev} = The previous measured shell thickness, excluding pits and corrosion or t_{norm} in inches.

D = The nominal diameter of the tank, in feet.

H = The height from the bottom of each shell course to the maximum liquid level, in feet.

t_{prev} = The calculated safe fill height, in feet, for the current product.

G = The highest specific gravity of the contents.

Y = Specified minimum yield strength of the plate; use 30,000 pounds per square inch if not known (N/A for riveted tanks).

T = The smaller of the specified minimum tensile strength of the plate or 80,000 pounds per square inch; use 55,000 psi if not known (N/A for riveted tanks).

S = The maximum allowable stress, in pounds per square inch. For welded tanks, use the smaller of 0.80Y or 0.429T for the bottom and the second course or the smaller of 0.88Y or 0.472T for all other courses. For riveted tanks, use S = 21,000 psi. For elevated temperatures above 200°F, the maximum allowable stress shall be the smaller of $2/3$ the minimum yield strength multiplied by the M-factor (M) of API-650 Appendix M or the product design stress value listed in Table 3-2 of API-650.

E = The original joint efficiency for the tank. Use Table 2-1 from API Standard 653 if original E is unknown; E = 1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of one inch or twice the plate thickness. For riveted tanks, use E = 1.0 for shell plates when greater than 6 inches from rivets; use the value of E from API-653 Table 2-1 when within 6 inches of rivets.

C_y = The shell corrosion rate, in inches per year.

I_{ut} = The inspection interval for the next ultrasonic inspection, in years (not to exceed 15 years).

I_v = The inspection interval for the next visual external inspection, in years (not to exceed 5 years).

ΔY = The years between the previous measured shell thickness (t_{prev}) and the current measured shell thickness (t_{act}), in years.

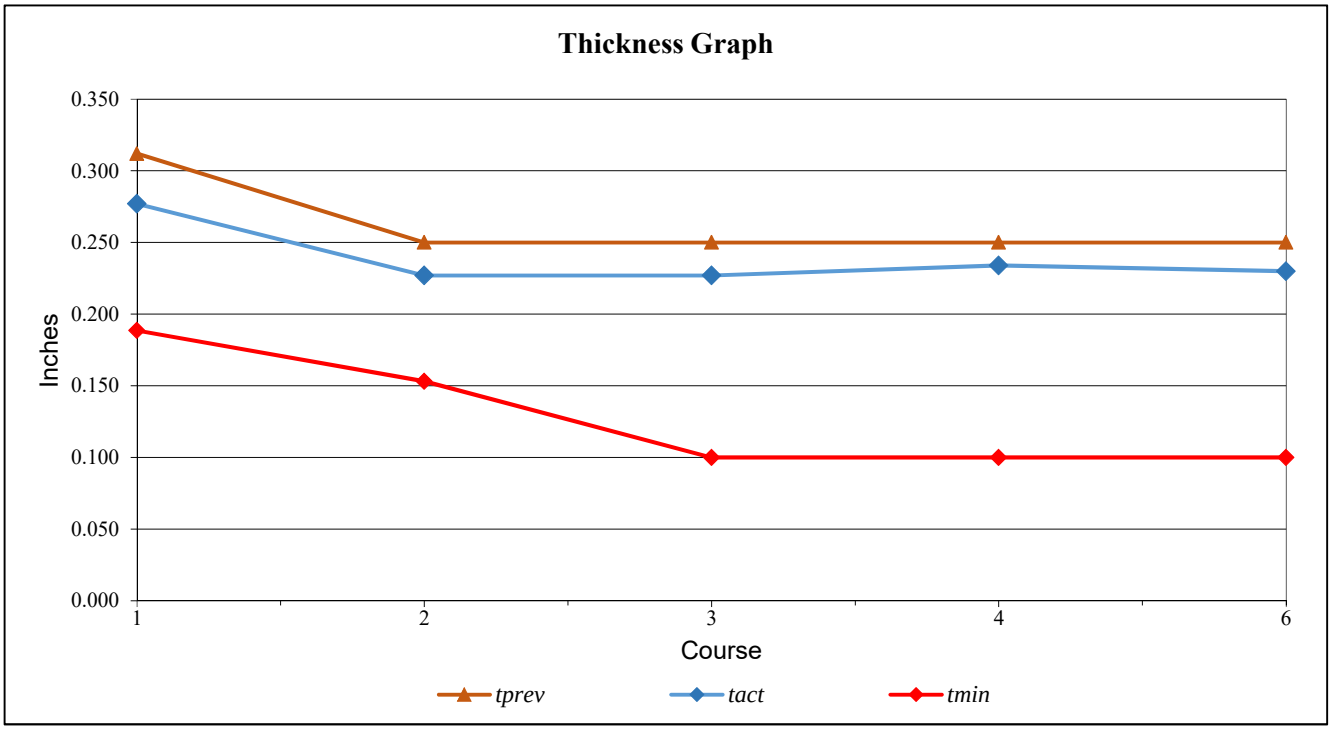
Shell Service Life Evaluation

1) Minimum Required Thickness

D = 45 feet
G = 0.84
Y = 64 years

Course No.	Plate Specification	Course Height (feet)	Product Height (feet) (H)	Maximum Allowable Stress (psi) (S)	Joint Efficiency (E)	Minimum Acceptable Thickness (inches) (t_{min})	Previous Measured Thickness (inches) (t_{prev})*	Current Measured Thickness (inches) (t_{act})
1	Unknown	7.25	39.5	23,600	0.85	0.189	0.312	0.277
2	Unknown	7.5	32.25	23,600	0.85	0.153	0.25	0.227
3	Unknown	7.5	24.75	26,000	0.85	0.100	0.25	0.227
4	Unknown	7.5	17.25	26,000	0.85	0.100	0.25	0.234
5	Unknown	7.5	9.75	26,000	0.85	0.100	0.25	0.234
6	Unknown	7.5	2.25	26,000	0.85	0.100	0.25	0.23

*The t_{prev} values were based on the nominal thickness

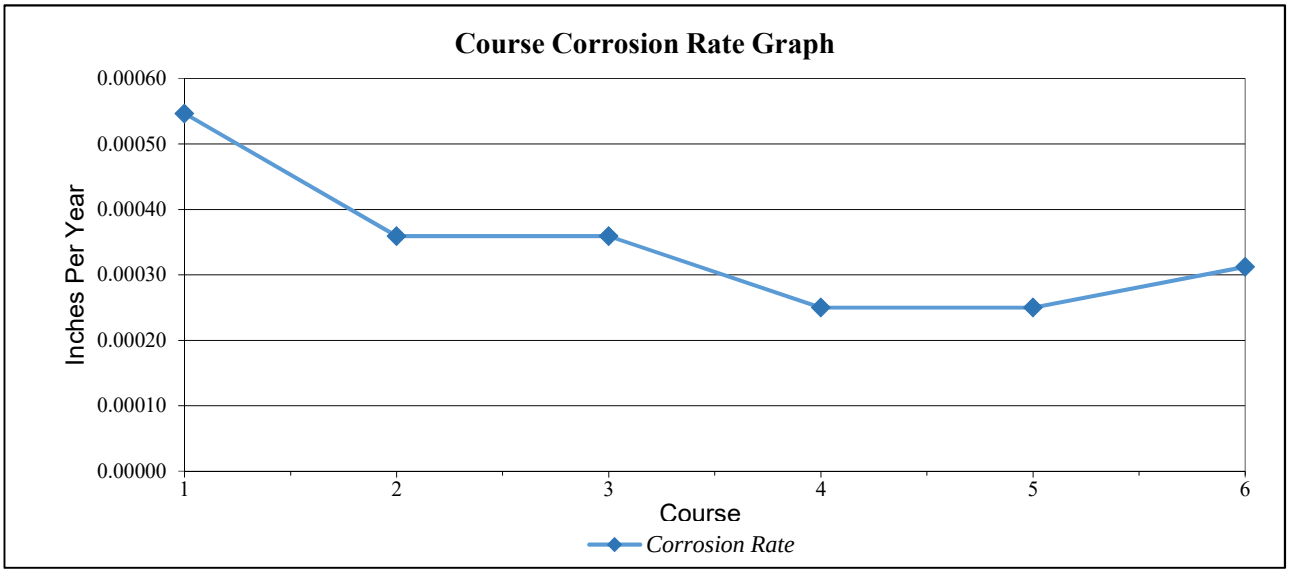


Shell Service Life Evaluation

2) Corrosion Rate, Remaining Life and Inspection Intervals

Course No.	Corrosion Rate (in./yr) (C_r)	Remaining Life (years) (L_r)	Next Visual Inspection (years) (I_v)	Next Ultrasonic Thickness Inspection (years) (I_{ut})
1	0.00055	161	5	15
2	0.00036	205	5	15
3	0.00036	353	5	15
4	0.00025	536	5	15
5	0.00025	536	5	15
6	0.00031	416	5	15

Note: The engineering data used to calculate in-service period of operation (Remaining Life) assumes the tank remains in the same service and all corrosion rates remain constant. The maximum safe fill height for the tank is not limited other than by the established maximum operating liquid level and any other appurtenance such as overflow, vents, or firefighting system.



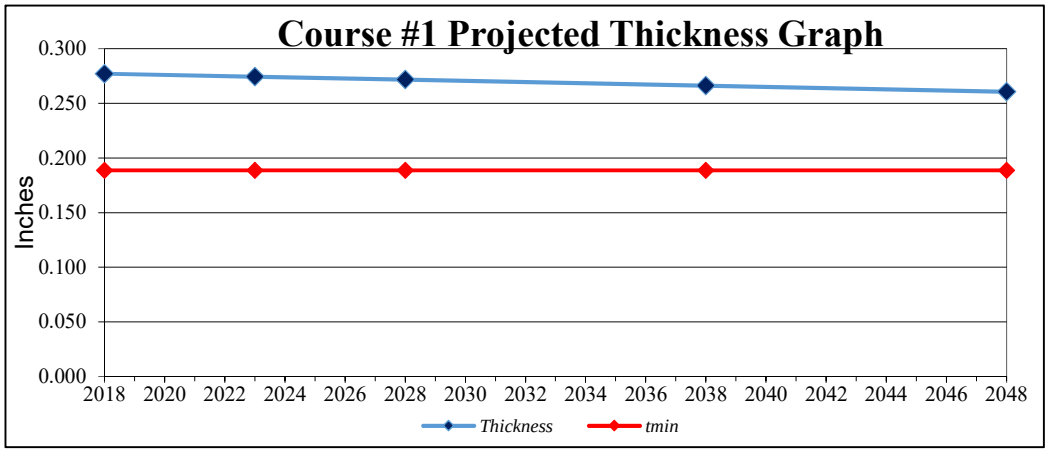
Shell Service Life Evaluation

3) Projected Thickness Chart and Graph

Course #1:

	Year	Thickness	tmin
Current Thickness:	2018	0.277	0.18862313
Anticpated Thickness (5 yrs)*	2023	0.274	0.18862313
Anticpated Thickness (10 yrs)*	2028	0.272	0.18862313
Anticpated Thickness (20 yrs)*	2038	0.266	0.18862313
Anticpated Thickness (30 yrs)*	2048	0.261	0.18862313

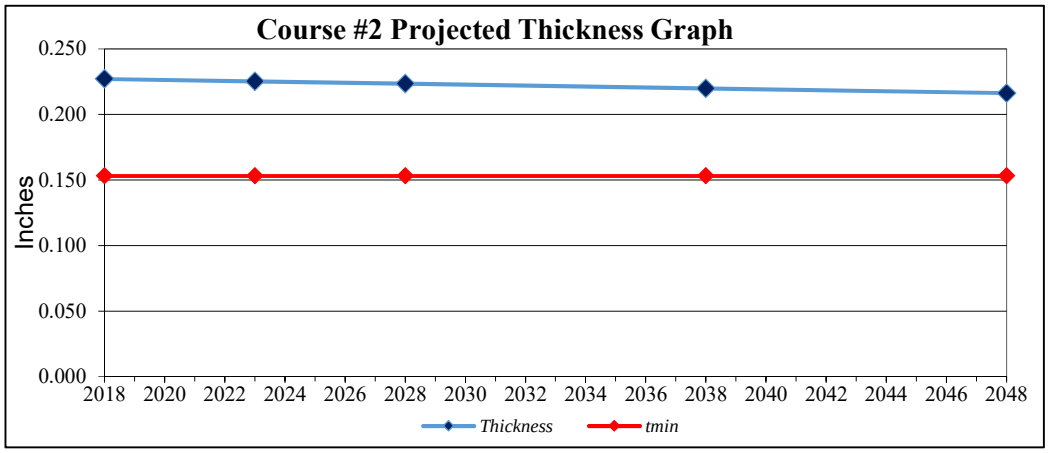
*based on same service and corrosion rates.



Course #2:

	Year	Thickness	tmin
Current Thickness:	2018	0.227	0.15310319
Anticpated Thickness (5 yrs)*	2023	0.225	0.15310319
Anticpated Thickness (10 yrs)*	2028	0.223	0.15310319
Anticpated Thickness (20 yrs)*	2038	0.220	0.15310319
Anticpated Thickness (30 yrs)*	2048	0.216	0.15310319

*based on same service and corrosion rates.

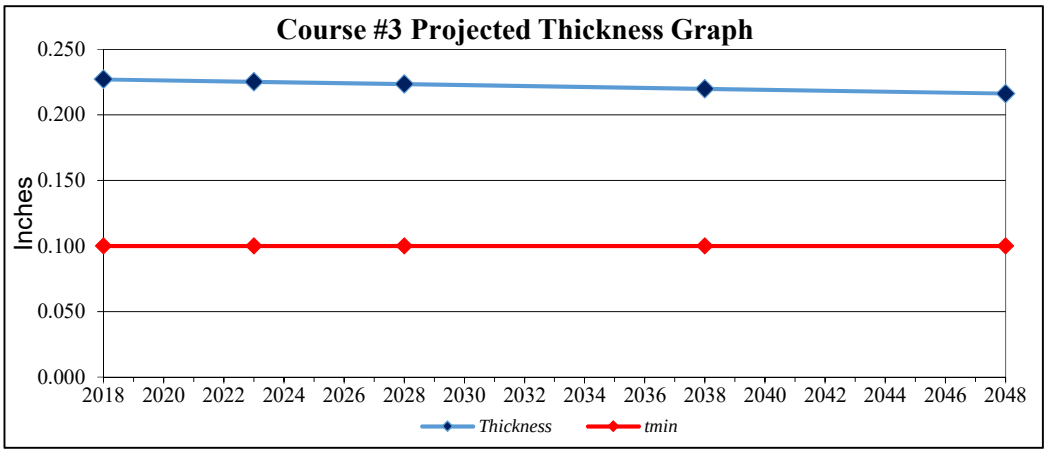


Shell Service Life Evaluation

Course #3:

	Year	Thickness	tmin
Current Thickness:	2018	0.227	0.1
Anticpated Thickness (5 yrs)*	2023	0.225	0.1
Anticpated Thickness (10 yrs)*	2028	0.223	0.1
Anticpated Thickness (20 yrs)*	2038	0.220	0.1
Anticpated Thickness (30 yrs)*	2048	0.216	0.1

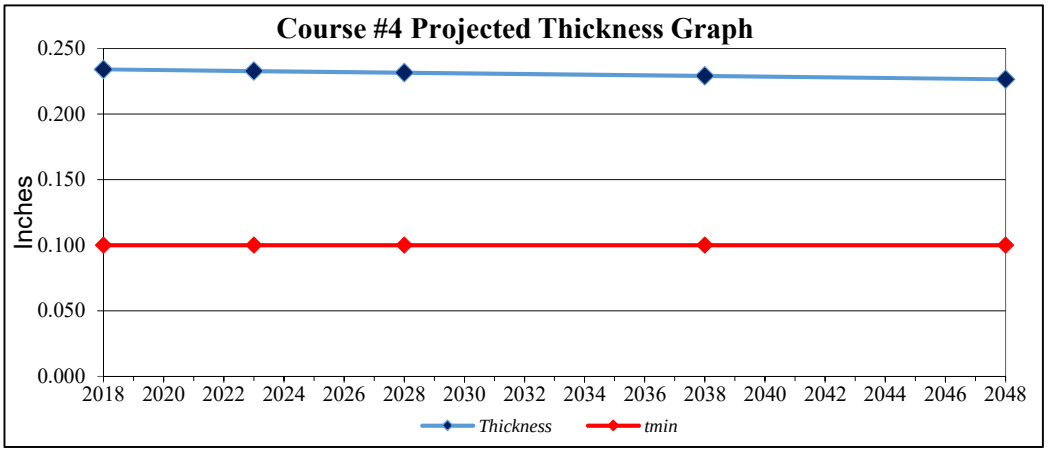
*based on same service and corrosion rates.



Course #4:

	Year	Thickness	tmin
Current Thickness:	2018	0.234	0.1
Anticpated Thickness (5 yrs)*	2023	0.233	0.1
Anticpated Thickness (10 yrs)*	2028	0.232	0.1
Anticpated Thickness (20 yrs)*	2038	0.229	0.1
Anticpated Thickness (30 yrs)*	2048	0.227	0.1

*based on same service and corrosion rates.

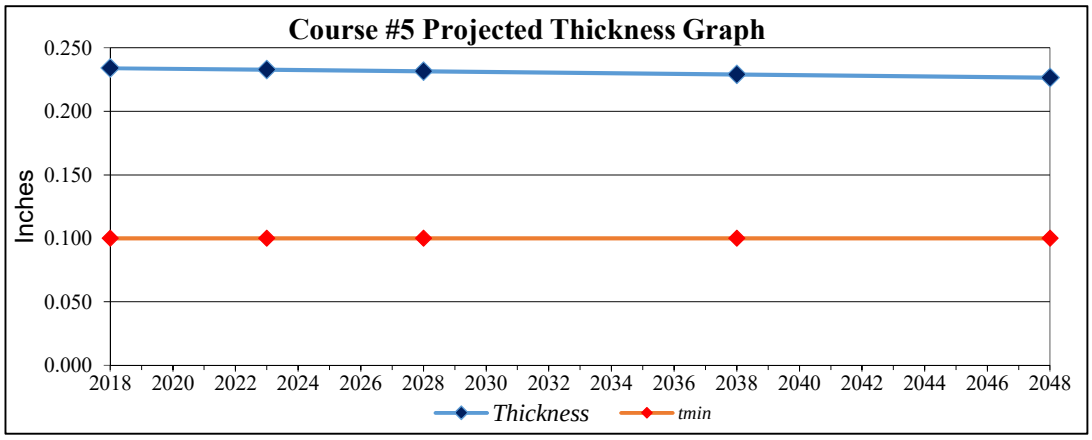


Shell Service Life Evaluation

Course #5:

	Year	Thickness	tmin
Current Thickness:	2018	0.234	0.1
Anticpated Thickness (5 yrs)*	2023	0.233	0.1
Anticpated Thickness (10 yrs)*	2028	0.232	0.1
Anticpated Thickness (20 yrs)*	2038	0.229	0.1
Anticpated Thickness (30 yrs)*	2048	0.227	0.1

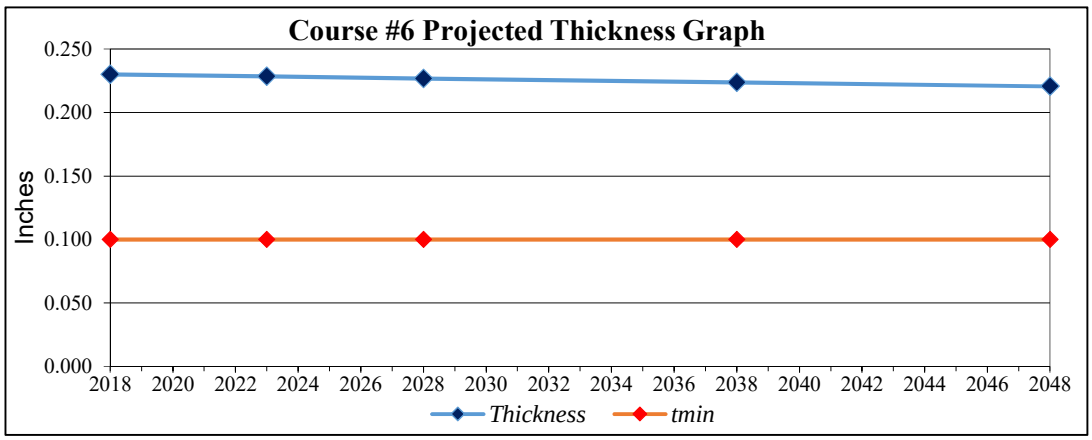
*based on same service and corrosion rates.



Course #6:

	Year	Thickness	tmin
Current Thickness:	2018	0.230	0.1
Anticpated Thickness (5 yrs)*	2023	0.228	0.1
Anticpated Thickness (10 yrs)*	2028	0.227	0.1
Anticpated Thickness (20 yrs)*	2038	0.224	0.1
Anticpated Thickness (30 yrs)*	2048	0.221	0.1

*based on same service and corrosion rates.



Shell Settlement Evaluation

1) Maximum Permissible Out-of-Plane Deflection Calculation

$$S_{max} = \frac{11L^2Y}{2EH}$$

Where:

S_{max} = maximum permissible out-of-plane deflection, in feet.
L = $\Pi D/N$ = arc length between measurement points, in feet.
D = tank diameter, in feet
N = number of survey points.
Y = yield strength, in pounds per square inch (psi).
E = young's modulus, in pounds per square inch (psi)
H = tank height, in feet

D = 45 feet
N = 8
L = 3.14(45)/8 = 17.6715 feet
Y = 30,000 psi
E = 29,000,000 psi
H = 45 feet
L^2 = 312.2805 square feet

$$S_{max} = \frac{11(312.2805)(30{,}000)}{2(29{,}000{,}000)(45)} = 0.0395 \text{ feet}$$

Shell Settlement Measurements

Point No.	Rod Height (inches)
1	31.125
2	31.125
3	31.25
4	31.375
5	31.25
6	31.25
7	31.125
8	31.125

NOTE: The Rod Heights are based on the actual height of the transit at the time of the data collection. This data should only be used for this report. Point #1 is located at Vertical Shell Seam #1.

Shell Settlement Evaluation

1) Out-of-Plane Deflection Calculation

$$|S_i| = U_i - (1/2U_{i-1} + 1/2U_{i+1})$$

Where:

$|S_i|$ = magnitude of the calculated out-of-plane deflection, in feet.

U_i = Out-of-Plane settlement of point "i", in feet

(+) when above cosine curve

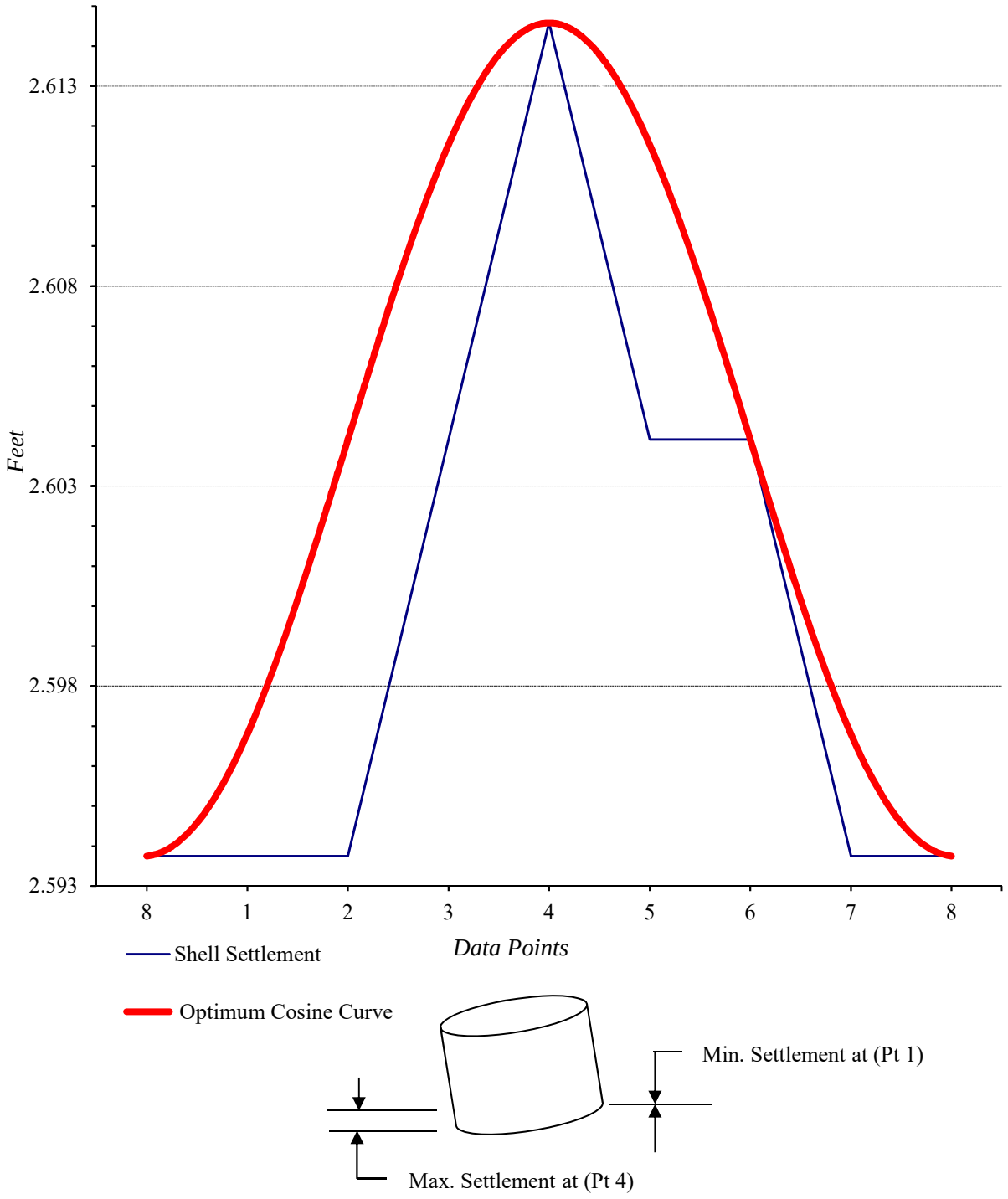
(-) when below cosine curve

Point	Actual	Curve Fit	U_i	U_{i+1}	U_{i-1}	S_i	$\|S_i\|$
1	2.593750	2.596801	-0.003051	-0.010417	0.000000	0.000000	0.002157
2	2.593750	2.593750	0.000000	-0.003051	0.007366	0.007366	0.002157
3	2.604167	2.596801	0.007366	0.000000	0.010417	0.010417	0.002157
4	2.614583	2.604167	0.010417	0.007366	-0.007366	-0.007366	0.010417
5	2.604167	2.611532	-0.007366	0.010417	-0.010417	-0.010417	0.007366
6	2.604167	2.614583	-0.010417	-0.007366	-0.017782	-0.017782	0.002157
7	2.593750	2.611532	-0.017782	-0.010417	-0.010417	-0.010417	0.007366
8	2.593750	2.604167	-0.010417	-0.017782	-0.003051	-0.003051	0.000000

The out-of-plane deflection is acceptable.

Shell Settlement Evaluation

Shell Settlement Graph



Appendix B
Engineering Data

1. Tank Ultrasonic Thickness Data

Shell Plate Thickness Measurements

Shell Plate Number 1-1									
0.293				0.292					0.296
0.305				0.288					0.294
0.299	0.299	0.296	0.290	0.287	0.298	0.294	0.295	0.293	0.294

Shell Plate Number 1-2									
0.292				0.293					0.291
0.292				0.294					0.289
0.288	0.291	0.290	0.291	0.292	0.290	0.288	0.292	0.284	0.291

Shell Plate Number 1-3									
0.287				0.282					0.289
0.286				0.288					0.284
0.284	0.282	0.278	0.285	0.282	0.286	0.297	0.298	0.294	0.298

Shell Plate Number 1-4									
0.305				0.293					0.296
0.301				0.298					0.296
0.294	0.292	0.295	**0.318**	0.292	0.293	0.297	0.297	0.298	0.293

Shell Plate Number 1-5									
0.292				0.282					0.280
0.295				0.280					0.280
0.278	0.282	0.280	0.280	0.281	0.280	0.282	**0.277**	0.278	0.280

Shell Plate Number 1-6									
0.306				0.300					0.293
0.299				0.296					0.292
0.295	0.294	0.298	0.293	0.290	0.290	0.290	0.294	0.292	0.287

NOTE: The bottom two rows are thicknesses across the bottom of the shell plate. The vertical thicknesses are at the vertical seams and in the middle of the plate. The thickness measurements are in inches and were taken randomly. The lowest UT measurements are in **RED**, and the highest UT measurements are in **GREEN** for each shell course.

Shell Drop Thickness Measurements

Point No.	Course #1	Course #2	Course #3	Course #4	Course #5	Course #6
1	0.291	0.238	0.234	0.245	**0.234**	0.234
2	0.288	0.234	0.235	0.242	0.237	0.236
3	0.288	0.237	0.234	0.249	0.239	0.235
4	0.288	**0.227**	**0.238**	0.249	0.238	**0.239**
5	**0.286**	0.236	0.236	0.246	0.236	**0.230**
6	0.288	**0.239**	0.231	**0.250**	**0.240**	0.236
7	0.290	0.238	0.232	0.247	0.238	0.238
8	**0.292**	0.238	0.230	0.243	0.235	**0.239**
9	0.289	0.238	0.231	0.244	0.237	0.238
10	0.287	**0.239**	**0.227**	**0.234**	0.236	0.235

NOTE: Thickness measurements are evenly spaced down each course along the path of each drop. The thickness measurements are in inches. The lowest UT measurements are in **RED**, and the highest UT measurements are in **GREEN** for each shell course.

Shell Nozzle, Nozzle Reinforcement, and Insert Measurements

Nozzle Measurements

Noz Desig.	Nozzle Description	X-Axis (feet)	Y-Axis (feet)	Thickness Measurements (inches)				
				Nom.	0°	90°	180°	270°
A	36" Manway	8.5	3.92	0.375	0.358	0.360	0.360	0.361
B	1" Water Draw-off	17.7	0.34	NA	NA	NA	NA	NA
C	4" Low Suction	19.6	0.79	0.337	0.321	0.334	0.321	0.334
D	12" Issue	21.3	1.5	0.500	0.521	0.489	0.485	0.497
E	1" Low Level Alarm	15.7	4	NA	NA	NA	NA	NA
F	1" Low Level Alarm	15.7	1.5	NA	NA	NA	NA	NA
G	10" Receipt	9.6	1.34	0.500	0.475	0.497	0.501	0.478
H	1" High Level Shut-off	11.9	40.5	NA	NA	NA	NA	NA
I	1" High Level Shut-off	11.9	37.5	NA	NA	NA	NA	NA
J	1" High Level Alarm	13.5	40	NA	NA	NA	NA	NA
K	1" High Level Alarm	13.5	37	NA	NA	NA	NA	NA
L	1" High-High Level Alarm	14.9	41	NA	NA	NA	NA	NA
M	1" High-High Level Alarm	14.9	38	NA	NA	NA	NA	NA
N	36" Manway	4.8	4	0.375	0.362	0.363	0.366	0.363

Nozzle Reinforcement Measurements

Noz Desig.	Reinforcement Description	Width (inches)	Length (inches)	Thickness Measurements (inches)				
				Nom.	0°	90°	180°	270°
A	Tombstone	78	80	0.375	0.368	0.370	0.367	0.368
C	Tombstone	11	15	0.313	0.294	0.296	0.293	0.295
D	Tombstone	27	30	0.313	0.294	0.295	0.301	0.298
G	Tombstone	21	26	0.313	0.293	0.293	0.287	0.292
N	Tombstone	78	80	0.375	0.370	0.369	0.371	0.371

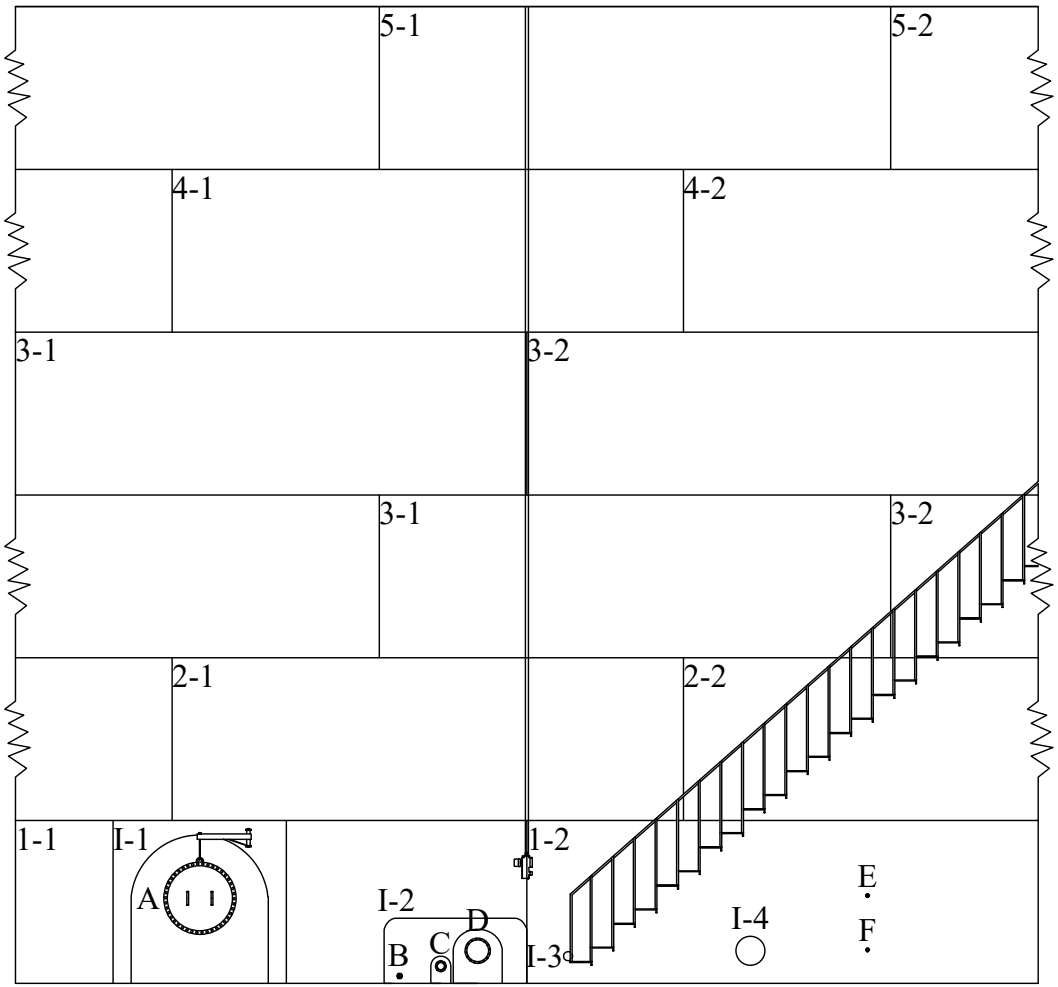
Insert Measurements

Insert Desig.	Insert Description	Width (inches)	Length (inches)	Thickness Measurements (inches)				
				Nom.	0°	90°	180°	270°
INS-1	Rectangular with Square Corners	96.00	88.00	0.313	0.301	0.302	0.301	0.303
INS-2	Rectangular with Round Corners	84.00	36.00	0.313	0.297	0.300	0.301	0.299
INS-3	Circular	5.00	5.00	0.313	0.298	0.301	0.302	0.303
INS-4	Circular	16.00	16.00	0.313	0.301	0.302	0.301	0.301
INS-5	Rectangular with Round Corners	96.00	59.00	0.313	0.302	0.303	0.304	0.304
INS-6	Circular	12.00	12.00	0.313	0.306	0.301	0.300	0.304
INS-7	Rectangular with Square Corners	132.00	88.00	0.313	0.307	0.310	0.307	0.303
INS-8	Circular	12.00	12.00	0.313	0.298	0.302	0.303	0.301
INS-9	Circular	12.00	12.00	0.313	0.301	0.301	0.301	0.302
INS-10	Circular	12.00	12.00	0.313	0.303	0.303	0.304	0.303
INS-11	Circular	12.00	12.00	0.313	0.301	0.300	0.301	0.301

NOTE: The X-Axis is measured from the the first seam to the left of the nozzle on the first course to the center of the nozzle. The Y-Axis is measured from the tank bottom to the center of the nozzle.

Appendix C
Engineering Drawings

1. Shell Layout
2. Floating Roof Layout



Shell Inserts
I-1 - Insert 1 96"x88"
I-2 - Insert 2 84"x36"
I-3 - Insert 3 5" diameter
I-4 - Insert 4 16" diameter
I-5 - Insert 5 96"x59"
I-6 - Insert 6 12" diameter
I-7 - Insert 7 132"x88"
I-8 - Insert 8 12" diameter
I-9 - Insert 9 12" diameter
I-10 - Insert 10 12" diameter
I-11 - Insert 11 12" diameter

Remarks/Legend:
A - 36" Manway
B - 1" Water Draw
C - 4" Low Suction
D - 12" Product Line
E - 1" Low Level Indicator
F - 1" Low Level Indicator
G - 10" Product
H - 1" High Level Shut-off
I - 1" High Level Shut-off
J - 1" High Level Indicator
K - 1" High Level Indicator
L - 1" High High Level Indicator
M - 1" High High Level Indicator
N - 36" Manway

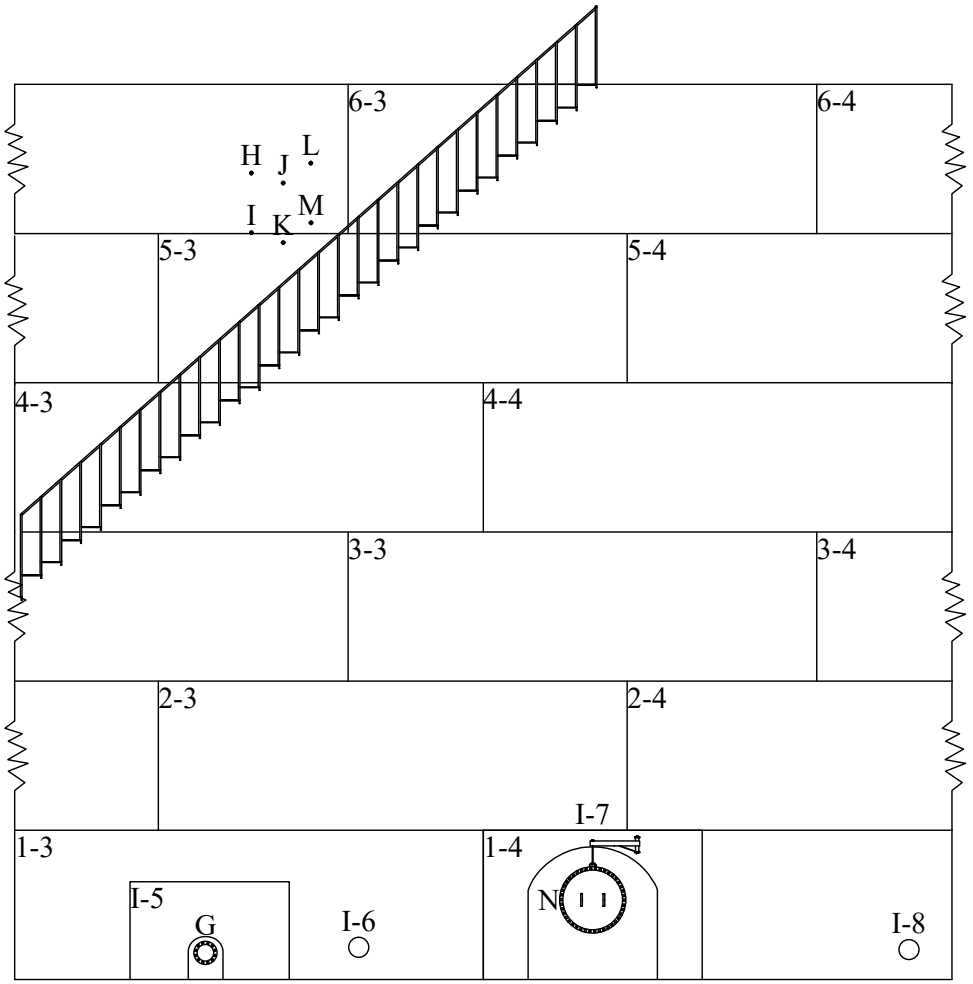
*Notes
Tank Diameter is 45'
Tank Height is 45'

Owner:
US Air Force, Mcguire Air Force Base; Burlington County, NJ

Drawn By:	InterSpec, LLC.	Modified By:	InterSpec, LLC.
Date:	2/22/2018	Rev. No.:	N/A
Scale:	N/A		

Drawing Title:
Shell Layout (1 of 3)

Description:
Tank # 2111



Shell Inserts
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I-7 - Insert 7 132"x88"
I-8 - Insert 8 12" diameter
I-9 - Insert 9 12" diameter
I-10 - Insert 10 12" diameter
I-11 - Insert 11 12" diameter

Remarks/Legend:
A - 36" Manway
B - 1" Water Draw
C - 4" Low Suction
D - 12" Product Line
E - 1" Low Level Indicator
F - 1" Low Level Indicator
G - 10" Product
H - 1" High Level Shut-off
I - 1" High Level Shut-off
J - 1" High Level Indicator
K - 1" High Level Indicator
L - 1" High High Level Indicator
M - 1" High High Level Indicator
N - 36" Manway

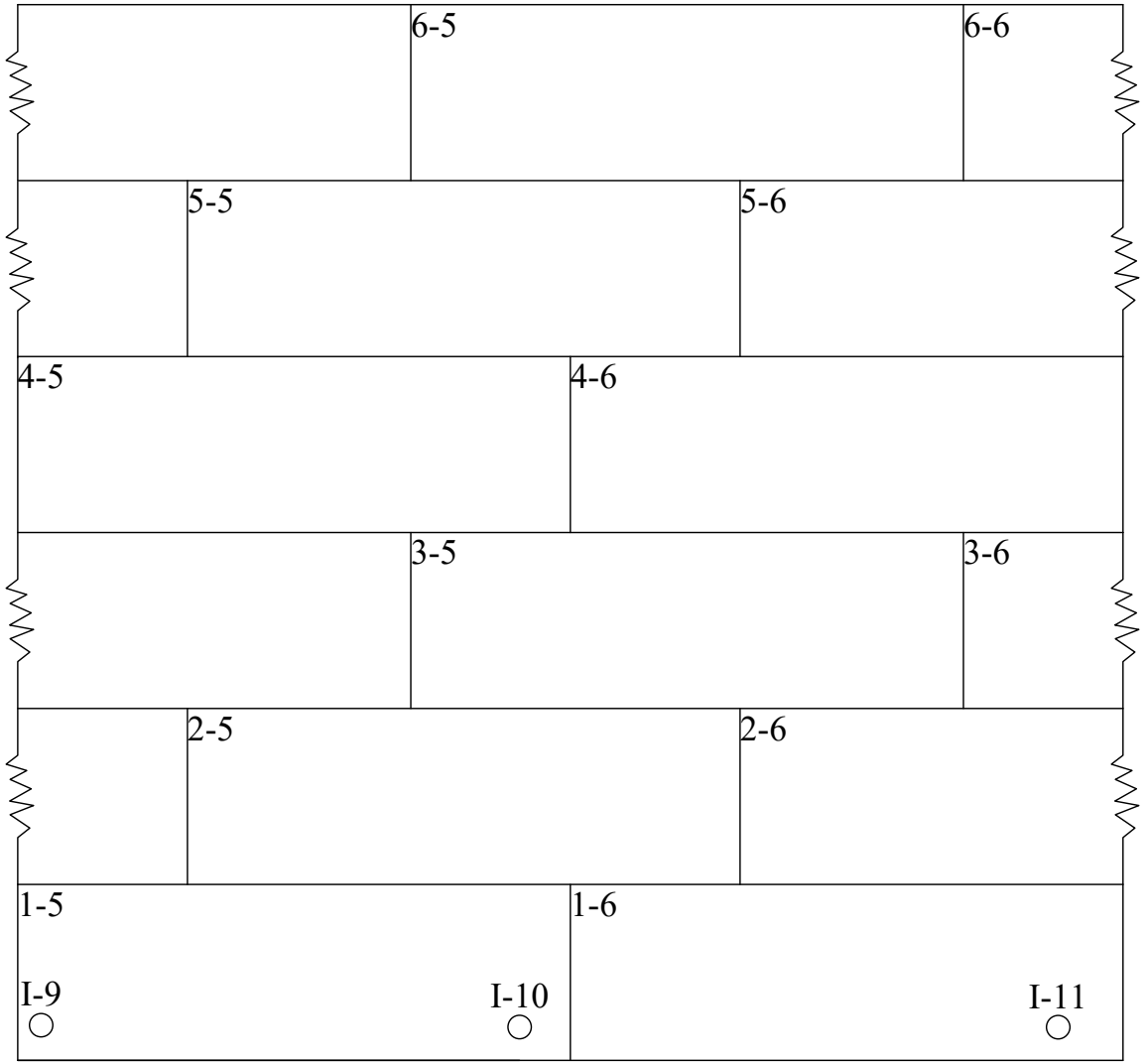
*Notes
Tank Diameter is 45'
Tank Height is 45'

Owner:
US Air Force, Mcguire Air Force Base; Burlington County, NJ

Drawn By:	InterSpec, LLC.	Modified By:	InterSpec, LLC.
Date:	2/22/2018	Rev. No.: N/A	Scale: N/A

Drawing Title:
Shell Layout (2 of 3)

Description:
Tank # 2111



Shell Inserts
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I-6 - Insert 6 12" diameter
I-7 - Insert 7 132"x88"
I-8 - Insert 8 12" diameter
I-9 - Insert 9 12" diameter
I-10 - Insert 10 12" diameter
I-11 - Insert 11 12" diameter

Remarks/Legend:
A - 36" Manway
B - 1" Water Draw
C - 4" Low Suction
D - 12" Product Line
E - 1" Low Level Indicator
F - 1" Low Level Indicator
G - 10" Product
H - 1" High Level Shut-off
I - 1" High Level Shut-off
J - 1" High Level Indicator
K - 1" High Level Indicator
L - 1" High High Level Indicator
M - 1" High High Level Indicator
N - 36" Manway

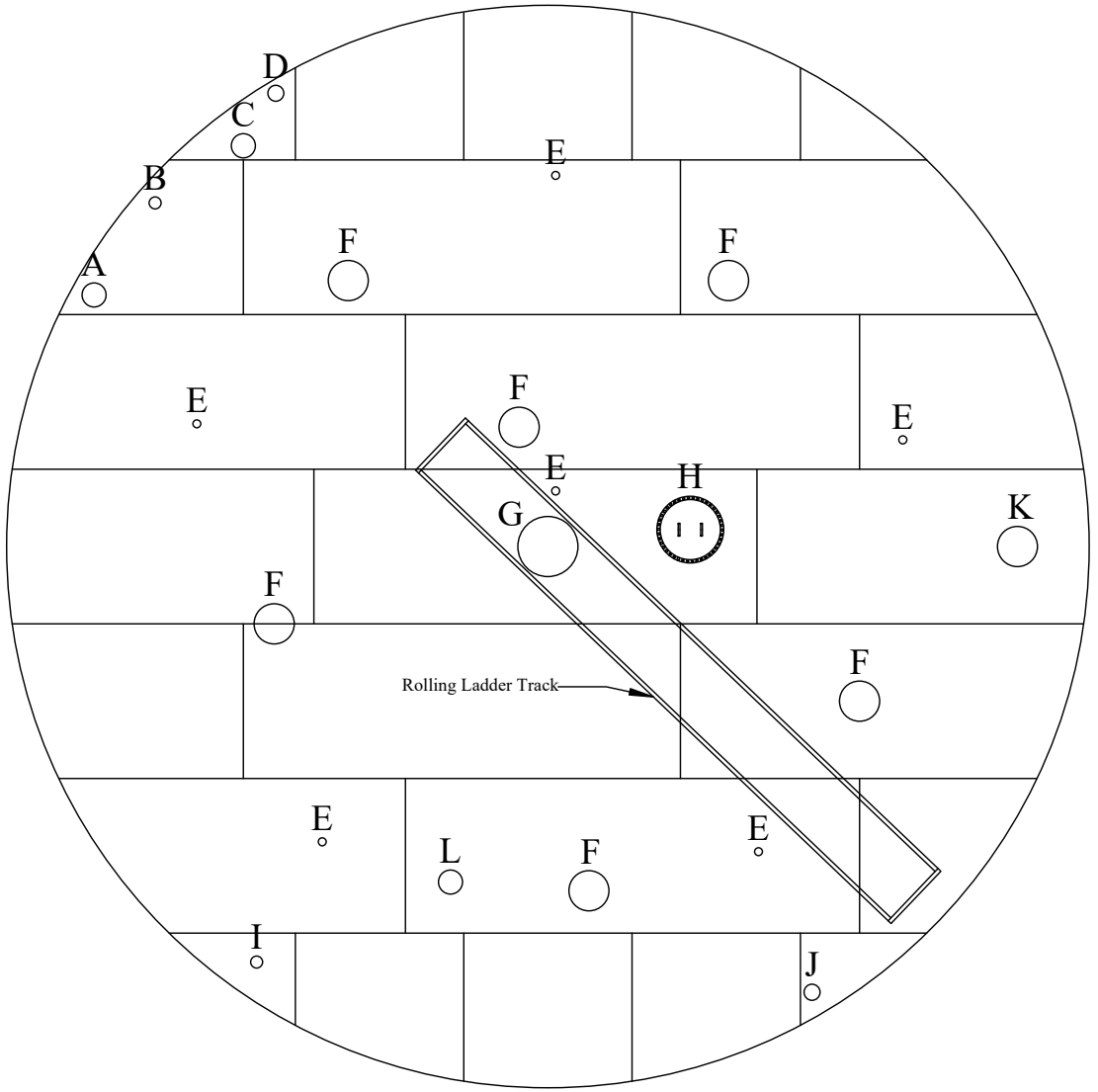
*Notes
Tank Diameter is 45'
Tank Height is 45'

Owner:
US Air Force, Mcguire Air Force Base;
Burlington County, NJ

Drawn By:	InterSpec, LLC.	Modified By:	InterSpec, LLC.
Date:	2/22/2018	Rev. No.:	N/A
Scale:	N/A		

Drawing Title:
Shell Layout (3 of 3)

Description:
Tank # 2111



Remarks/Legend:
A - 12" Gauge Well
B - 6" Over Flow
C - 12" Gauge Well
D - 8" Sample Hatch
E - Five (5) 4" Floating Roof Legs
F - Six (6) 20" Pontoons
G - 30" Sump
H - 30" Manway
I - 6" Seal Vent
J - 8" Hatch
K - 20" ATG Well
L - 12" Vacuum Breaker (NEW)

*Notes
Tank Diameter is 45'

Owner:
US Air Force, Mcguire Air Force Base;
Burlington County, NJ

Drawn By:	InterSpec, LLC.	Modified By:	InterSpec, LLC.
Date:	2/22/2018	Rev. No.: N/A	Scale: N/A

Drawing Title:
Floating Roof

Description:
Tank # 2111

Appendix D
API Checklist

1. In-Service Checklist

Table C-1 Tank In-Service Inspection Checklist

C.1.1 Foundation

a [X] Measure foundation levelness and bottom elevations (see Appendix B for extent of measurements).

C.1.1.1 Concrete Ring

a [X] Inspect for broken concrete, spalling and cracks, particularly under backup bars used in butt welded annular rings under the shell.
b [NA] Inspect drain openings in ring, back of waterdraw basins and top surface of ring for indications of bottom leakage.
c [X] Inspect for cavities under foundation and vegetation against bottom of tank.
d [X] Check that runoff rainwater from the shell drains away from the tank.
e [X] Check for settlement around perimeter of tank.

C.1.1.2 Asphalt

a [NA] Check for settling of tank into asphalt base which would direct runoff rain water under the tank instead of away from it.
b [NA] Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.

C.1.1.3 Oiled Dirt or Sand

a [NA] Check for settlement into the base which would direct runoff rain water under the tank rather than away from it.

C.1.1.4 Rock

a [NA] Presence of crushed rock under the steel bottom usually results in severe underside corrosion. Make a note to do additional bottom plate examination (ultrasonic, hammer testing or turning of coupons) when the tank is out of service.

C.1.1.5 Site Drainage

a [X] Check site for drainage away from the tank and associated piping and manifolds.
b [X] Check operating condition of dike drains.

C.1.1.6 Housekeeping

a [X] Inspect the area for buildup of trash, vegetation, and other inflammables buildup.

C.1.1.7 Cathodic Protection

a [X] Review cathodic protection potential readings.

C.1.2 Shells

C.1.2.1 External Visual Inspection

a [X] Visually inspect for paint failures, pitting, and corrosion.
b [X] Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.
c [X] Inspect the bottom-to-foundation seal, if any.

C.1.2.2 Internal (Floating Roof Tank)

a [X] Visually inspect for grooving, corrosion, pitting, and coating failures.

C.1.2.3 Riveted Shell Inspection

a [NA] Inspect external surface for rivet and seam leaks.
b [NA] Locate leaks by sketch or photo (location will be lost when shell is abrasively cleaned for painting).
c [NA] Inspect rivets for corrosion loss and wear.
d [NA] Inspect vertical seams to see if they have been full fillet lap welded to increase joint efficiency.
e [NA] If no record exists of vertical riveted seams, dimension and sketch (or photograph) the rivet pattern: number of rows, rivet size, pitch length, and note whether the joint is butt riveted or lap riveted.

C.1.2.4 Wind Girder (Floating Roof Tanks)

a [NA] Inspect wind girder and handrail for corrosion damage (paint failure, pitting, corrosion product buildup), especially where it occurs at tack welded junctions, and for broken welds.
b [NA] Check support welds to shell for pitting, especially on shell plates.
c [NA] Note whether supports have reinforcing pads welded to shell.

Table C-1 Tank In-Service Inspection Checklist

C.1.3 Shell Appurtenances

C.1.3.1 Manways and Nozzles

a	X	Inspect for cracks or signs of leakage on weld joints at nozzles, manways, and reinforcing plates.
b	X	Inspect for shell plate dimpling around nozzles, caused by excessive pipe deflection.
c	X	Inspect for flange leaks and leaks around bolting.
d	NA	Inspect sealing of insulation around manways and nozzles.
e	NA	Check for inadequate manway flange and cover thickness on mixer manways.

C.1.3.2 Tank Piping Manifolds

a	NA	Inspect manifold piping, flanges, and valves for leaks.
b	NA	Inspect fire fighting system components.
c	X	Check for anchored piping which would be hazardous to the tank shell or bottom connections during earth movement.
d	X	Check for adequate thermal pressure relief of piping to the tank.
e	NA	Check operation of regulators for tanks with purge gas systems.
f	X	Check sample connections for leaks and for proper valve operation.
g	NA	Check for damage and test the accuracy of temperature indicators.
h	X	Check welds on shell-mounted davit clips above valves 6 inches and larger.

C.1.3.3 Autogauge System

a	NA	Inspect autogauge tape guide and lower sheave housing (floating swings) for leaks.
b	X	Inspect autogauge head for damage.
c	X	Bump the checker on autogauge head for proper movement of tape.
d	NA	Identify size and construction material of autogauge tape guide (floating roof tanks).
e	X	Ask operator if tape tends to hang up during tank roof movement (floating roof tanks).
f	X	Compare actual product level to the reading on the autogauge (maximum variation is 2 inches).
g	NA	On floating roof tanks, when the roof is in the lowest position, check that no more than two feet of tape are exposed at the end of the tape guide.
h	NA	Inspect condition of board and legibility of board-type autogauges.
i	NA	Test freedom of movement of marker and float.

C.1.3.4 Shell-Mounted Sample Station

a	NA	Inspect sample lines for function of valves and plugging of lines, including drain or return-to-tank line.
b	NA	Check circulation pump for leaks and operating problems.
c	NA	Test bracing and supports of sample system lines and equipment.

C.1.3.5 Heater (Shell Manway Mounted)

a	NA	Inspect condensate drain for presence of oil indicating leakage.

C.1.3.6 Mixer

a	NA	Inspect for proper mounting flange and support.
b	NA	Inspect for leakage.
c	NA	Inspect condition of power lines and connections to mixer.

C.1.3.7 Swing Lines: Winch Operation

a	NA	Nonfloating. Raise, then lower the swing line with the winch, and check for cable tightness to confirm that swing line lowered properly.
b	NA	Floating. With tank half full or more, lower the swing line, then let out cable and check if swing has pulled cable tight, indicating that the winch is operating properly.
c	NA	Indicator. Check that the indicator moves in the proper direction: Floating swing line indicators show a lower level as cable is wound up on the winch. Non-floating swing line indicators show the opposite.

C.1.3.8 Swing Lines: External Guide System

a	NA	Check for leaks at threaded and flanged joints.

Table C-1 Tank In-Service Inspection Checklist

C.1.3.9 Swing Lines: Identify Ballast Varying Need

a [NA] Check for significant difference in stock specific gravity.

C.1.3.10 Swing Lines: Cable Material and Condition

a [NA] For non-stainless steel cable, check for corrosion over entire length.

b [NA] All cable: check for wear or fraying.

C.1.3.11 Swing Lines: Product Sample Comparison

a [NA] Check for water or gravity differences that would indicate a leaking swing joint.

C.1.3.12 Swing Lines: Target

a [NA] Target should indicate direction of swing opening (up or down) and height above bottom where suction will be lost with swing on bottom support.

C.1.4 Roofs

C.1.4.1 Deck Plate Internal Corrosion

a [NA] For safety, before accessing the roof, check with ultrasonic instrument or lightly use a ball peen hammer to test the deck plate near the edge of the roof for thinning. (Corrosion normally attacks the deck plate at the edge of a fixed roof and at the rafters in the center of the roof first.)

C.1.4.2 Deck Plate External Corrosion

a [X] Visually inspect for paint failure, holes, pitting, and corrosion product on the roof deck.

C.1.4.3 Roof Deck Drainage

a [X] Look for indication of standing water. (Significant sagging of fixed roof deck indicates potential rafter failure. Large standing water areas on a floating roof indicate inadequate drainage design or, if to one side, an unlevel roof with possible leaking pontoons).

C.1.4.4 Level of Floating Roof

a [X] At several locations, measure distance from roof rim to a horizontal weld seam above the roof. A variance in the readings indicates a nonlevel roof with possible shell out-of-round, out-of-plumb, leaking pontoons or hangup. On small diameter tanks, an unlevel condition can indicate unequal loading at that level.

C.1.4.5 Gas Test Internal Floating Roof

a [X] Test for explosive gas on top of the internal floating roof. Readings could indicate a leaking roof, leaking seal system or inadequate ventilation of the area above the internal floating roof.

C.1.4.6 Roof Insulation

a [NA] Visually inspect for cracks or leaks in the insulation weather coat where runoff rain water could penetrate the insulation.

b [NA] Inspect for wet insulation under the weather coat.

c [NA] Remove small test sections of insulation and check roof deck for corrosion and holes near the edge of the insulated area.

C.1.4.7 Floating Roof Seal Systems

a [NA] Inspect the condition of the seal, measure and record maximum rim spaces and seal-to-shell gaps around the full roof circumference at the level of inspection (Note: Inspection of the seal and measurement of the rim spaces and seal-to-shell gaps at more than one level may be necessary to more fully determine if any problems exist at other levels of tank operation)

b [NA] Measure and record annular space at 30 foot spacing (minimum of 4 quadrants) around roof and record. Measurements should be taken in directly opposite pairs.

1 [ ] _____ _____ Opposite pair 1.

2 [ ] _____ _____ Opposite pair 2.

c [X] Check if seal fabric on primary shoe seals is pulling shoes away from shell (fabric not wide enough).

d [X] Inspect fabric for deterioration, holes, tears, and cracks.

e [X] Inspect visible metallic parts for corrosion and wear.

f [X] Inspect for openings in seals that would permit vapor emissions.

g [X] Inspect for protruding bolt or rivet heads against the shell.

h [NA] Pull both primary and secondary seal systems back all around the shell to check their operation.

i [NA] Inspect secondary seals for signs of buckling or indications that their angle with the shell is too shallow.

j [NA] Inspect wedge-type wiper seals for flexibility, resilience, cracks and tears.

Table C-1 Tank In-Service Inspection Checklist

C.1.5 Roof Appurtenances

C.1.5.1 Sample Hatch

a	NA	Inspect condition and functioning of sample hatch cover.
b	NA	On tanks governed by Air Quality Monitoring District rules, check for the condition of seal inside hatch cover.
c	NA	Check for corrosion and plugging on thief and gauge hatch cover.
d	X	Where sample hatch is used to reel gauge stock level, check for marker and tab stating hold off distance.
e	X	Check for reinforcing pad where sample hatch pipe penetrates the roof deck.
f	X	On floating roof sample hatch and recoil systems, inspect operation of recoil reel and condition of rope.
g	X	Test operation of system.
h	NA	On ultra clean stocks such as JP4, check for presence and condition of protective coating or liner inside sample hatch (preventing rust from pipe getting into sample).

C.1.5.2 Gauge Well

a	X	Inspect visible portion of the gauge well for thinning, size of slots, and cover condition.
b	X	Check for a hold off distance marker and tab with hold off distance (legible).
c	NA	On floating roofs, inspect condition of roof guide for gauge well, particularly the condition of the rollers for grooving.
d	NA	If accessible, check the distance from the gauge well pipe to the tank shell at different levels.
e	NA	If tank has a gauge well washer, check valve for leakage and for presence of a bull plug or blind flange.

C.1.5.3 Fixed Roof Scaffold Support

a	NA	Inspect scaffold support for corrosion, wear, and structural soundness.

C.1.5.4 Autogauge: Inspection Hatch and Guides (Fixed Roof)

a	NA	Check the hatch for corrosion and missing bolts.
b	NA	Look for corrosion on the tape guide's and float guide's wire anchors.

C.1.5.5 Autogauge: Float Well Cover

a	NA	Inspect for corrosion.
b	NA	Check tape cable for wear or fraying caused by rubbing on the cover.

C.1.5.6 Sample Hatch (Internal Floating Roof)

a	NA	Check overall conditions.
b	NA	When equipped with a fabric seal, check for automatic sealing after sampling.
c	X	When equipped with a recoil reel opening device, check for proper operation.

C.1.5.7 Roof-Mounted Vents (Internal Floating Roof)

a	NA	Check condition of screens, locking and pivot pins.

C.1.5.8 Gauging Platform Drip Ring

a	NA	On fixed roof tanks with drip rings under the gauging platform or sampling area, inspect for plugged drain return to the tank.

C.1.5.9 Emergency Roof Drains

a	NA	Inspect vapor plugs for emergency drain: that seal fabric discs are slightly smaller than the pipe ID and that fabric seal is above the liquid level.

C.1.5.10 Removable Roof Leg Racks

a	NA	Check for leg racks on roof.

C.1.5.11 Vacuum Breakers

a	X	Report size, number and type of vacuum breakers. Inspect vacuum breakers. If high legs are set, check for setting of mechanical vacuum breaker in high leg position.

C.1.5.12 Rim Vents

a	NA	Check condition of the screen on the rim vent cover.
b	NA	Check for plating off or removal of rim vents where jurisdictional rules do not permit removal.

Table C-1 Tank In-Service Inspection Checklist

C.1.5.13 Pontoon Inspection Hatches

a	NA	Open pontoon inspection hatch covers and visually check inside for pontoon leakage.
b	NA	Test for explosive gas (an indicator of vapor space leaks).
c	NA	If pontoon hatches are equipped with locked down covers, check for vent tubes. Check that vent tubes are not plugged up. Inspect lock down devices for condition and operation.

C.1.6 Access Structures

C.1.6.1 Handrails

a	X	Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails.
b	X	Inspect for pitting and holes, paint failure.
c	X	Inspect attachment welds.
d	X	Identify cold joints and sharp edges. Inspect the handrails and midrails.
e	NA	Inspect safety drop bar (or safety chain) for corrosion, functioning and length.
f	X	Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level.

C.1.6.2 Platform Frame

a	X	Inspect frame for corrosion and paint failure.
b	X	Inspect the attachment of frame to supports and supports to tank for corrosion and weld failure.
c	NA	Check reinforcing pads where supports are attached to shell or roof.
d	X	Inspect the surface that deck plate or grating rests on for thinning and holes.
e	X	Check that flat-surface to flat-surface junctures are seal welded.

C.1.6.3 Deck Plate and Grating

a	X	Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure.
b	X	Inspect plate-to-frame weld for rust scale buildup.
c	X	Inspect grating for corrosion-caused thinning of bars and failure of welds.
d	NA	Check grating tie down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway.

C.1.6.4 Stairway Stringers

a	X	Inspect spiral stairway stringers for corrosion, paint failure and weld failure. Inspect attachment of stairway treads to stringer.
b	X	Inspect stairway supports to shell welds and reinforcing pads.
c	NA	Inspect steel support attachment to concrete base for corrosion.

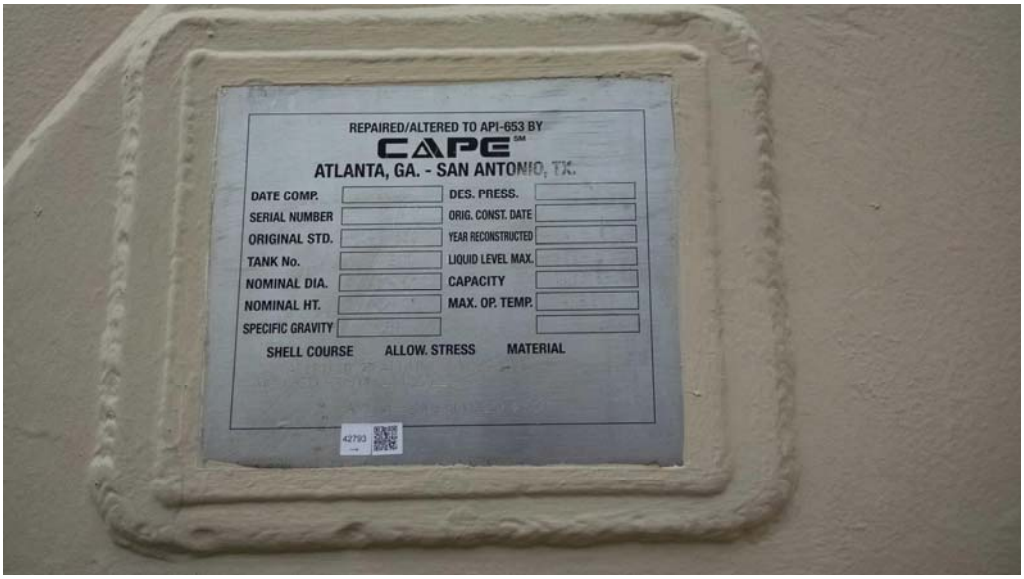
C.1.6.5 Rolling Ladder

a	X	Inspect rolling ladder stringers for corrosion.
b	X	Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers.
c	X	Check for wear and corrosion where rolling ladder attaches to gauging platform.
d	X	Inspect pivot bar for wear and secureness.
e	X	Inspect operation of self-leveling stairway treads.
f	NA	Inspect for corrosion and wear on moving parts.
g	NA	Inspect rolling ladder wheels for freedom of movement, flat spots and wear on axle.
h	NA	Inspect alignment of rolling ladder with roof rack.
i	NA	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough).
j	NA	Inspect rolling ladder track welds for corrosion.
k	NA	Inspect track supports on roof for reinforcing pads seal welded to deck plate.
l	NA	Check by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs. Maximum angle. _____
m	NA	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side.

Appendix E
Photographs

E.1 Overview of Tank 2111

E.2 Shell Nozzle A, 36" Manhole



E.3 Tank Data Plate

E.4 Tank Data Plate

E.5 Description of Internal Liner

E.6 Stainless Steel PRT

E.7 Stainless Steel PRT

E.8 Shell Nozzle B, 1" Water Draw

E.9 Shell Nozzle C, 4" Low Point Suction

E.10 Shell Nozzle D, 12" Tank Receipt

E.11 Piping Associated with Shell Nozzle D

E.12 Expansion Joint Nozzle D

E.13 Piping Penetration into Containment Floor

E.14 Thermal Relief Piping (Nozzle D)

E.15 Mechanical Tank Level Gauge

E.16 Level of Fuel in Tank

E.17 Crack in Concrete Foundation

E.18 Crack in Concrete Foundation

E.19 TRV Calibration Stickers Current

E.20 Containment View

E.21 Crack in Containment Floor (Typical)

E.22 Low Level Alarm

E.23 Rear View of LLA

E.24 Shell Nozzle G, 10" Tank Receipt

E.25 Piping Associated with Nozzle G

E.26 Expansion Joint (Nozzle G)

E.27 Fuel Sample Port

E.28 Tubing and Conduit Servicing High Level System

E.29 Tank Grounding and Leak Detection Port

E.30 Shell Nozzle N, 36" Manhole

E.31 View of Alarms and Platform

E.32 Containment View

E.33 Containment View

E.34 Containment View

E.35 Containment View

E.36 Shell Nozzles G-M

E.37 Bottom Step Measurement

E.38 Level Alarms

E.39 Level Alarms

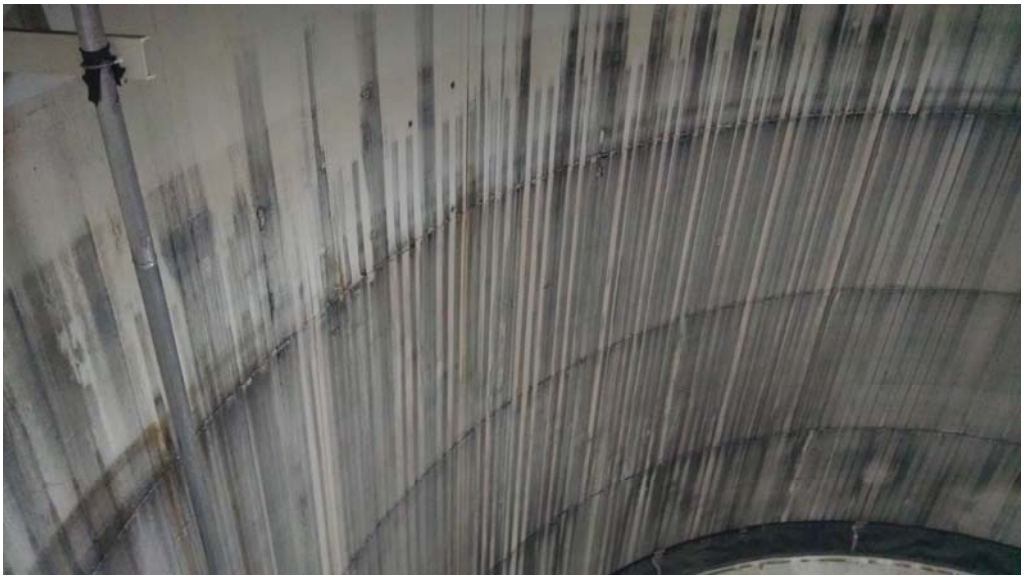
E.40 Tank Gauge Hold Off Distance

E.41 Fixed Roof (Geodesic Dome)

E.42 ENRAF System

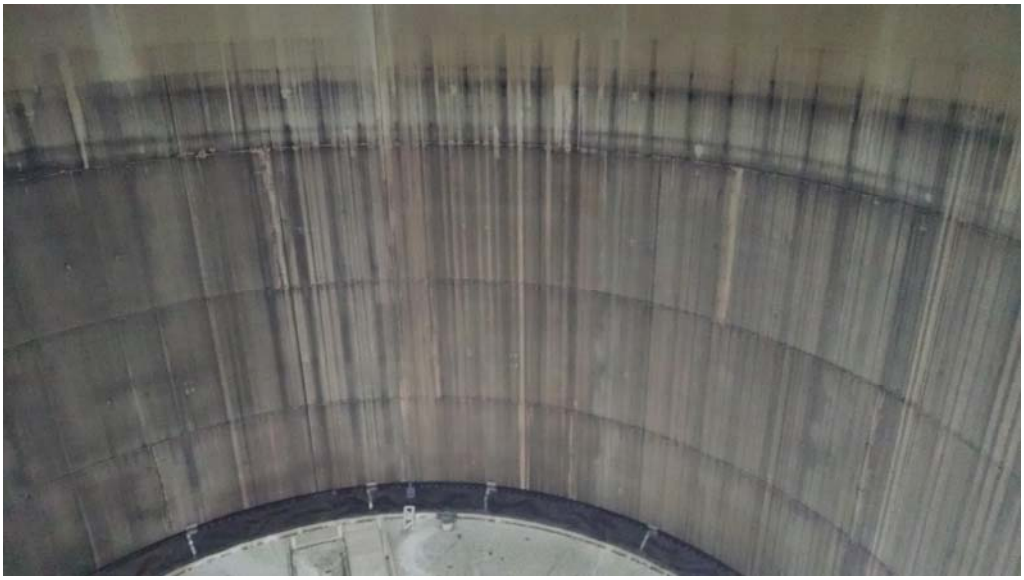
E.43 Gauge Pole

E.44 View from Top of Rolling Ladder

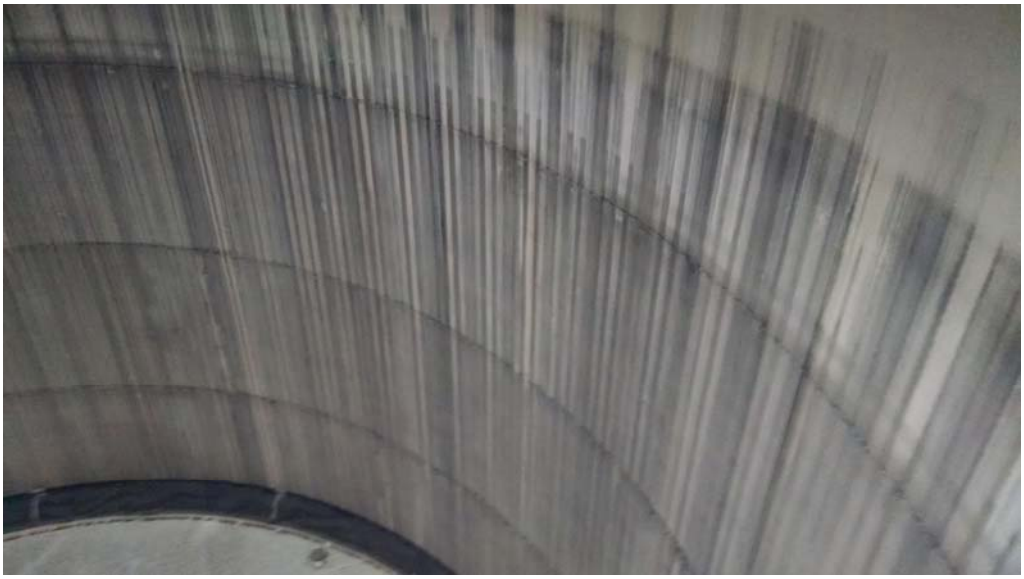


E.45 Heavy Rubber Streaking on Shell

E.46 Heavy Rubber Streaking on Shell



E.47 Heavy Rubber Streaking on Shell



E.48 Heavy Rubber Streaking on Shell

E.49 Top View of IFR

E.50 Top View of IFR