

NUCLEAR REGULATORY COMMISSION (NRC) and OTHER FEDERAL REGULATIONS and STANDARDS
Input for Micro-Reactor RFP

NRC's Principles of Good Regulation for Efficiency states "where several effective alternatives are available, the option which minimizes the use of resources should be adopted."

Micro-reactors differ significantly from large light-water reactors (LWRs) for which the NRC has developed most of its regulations and guidance. It is the responsibility of the contractor to work with the NRC to both determine the path for licensing the micro-reactor as well as executing that path and receiving the license approval. Contractors should refer to the document titled "A Regulatory Review Roadmap for Non-Light Water Reactors" which can be found at the following website address:
<https://www.nrc.gov/docs/ML1731/ML17312B567.pdf>

LICENSING

- 10 CFR 50 – Domestic licensing of production and utilization facilities
 - Applies also to research test reactors (non-power reactors)
 - 50.21(C) – Class 104 licenses for medical therapy/research/development facilities
 - (c) A production or utilization facility, which is useful in the conduct of research and development activities of the types specified in section 31 of the Act, and which is not a facility of the type specified in paragraph (b) of this section or in § 50.22.
 - 50.22 – Class 103 licenses for commercial and industrial facilities
 - A class 103 license will be issued, to an applicant who qualifies, for any one or more of the following: To transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, or use a production or utilization facility for industrial or commercial purposes; **Provided, however,** That in the case of a production or utilization facility which is useful in the conduct of research and development activities of the types specified in section 31 of the Act, such facility is deemed to be for industrial or commercial purposes if the facility is to be used so that more than 50 percent of the annual cost of owning and operating the facility is devoted to the production of materials, products, or energy for sale or commercial distribution, or to the sale of services, other than research and development or education or training.

Title	Requirements addressed
General applicant information	10 CFR 50.33(a) 10 CFR 50.33(b) 10 CFR 50.33(c) 10 CFR 50.33(d)
Class of license	10 CFR 50.33(e)
Financial qualification	10 CFR 50.33(f)
Radiological emergency response plans	10 CFR 50.33(g)
Decommissioning	10 CFR 50.33(k)

Table adapted from Aurora reactor application: <https://www.nrc.gov/docs/ML2007/ML20075A000.html>

- 10 CFR 52 – COL/COLA (Combined Licensing Application)
 - Doesn't need a design certification, can use design that hasn't been approved by NRC yet.
 - Constructing and Operating license at the same time
 - 52.15 – Filing of applications
 - 52.16 – Contents of applications; general information
 - 52.17 – Contents of applications; technical information
 - 52.24 – Issuance of early site permit
 - 52.25 – Extent of activities permitted

Contents of Application

- 52.77 – General Information
- 52.79 – Technical Information in final safety analysis report
- 52.80 – Additional technical information related to emergency planning and conformity of constructed facility to rules/regulations

Primary Parts to COLA

- **Part I: Company information and financial requirements (10 CFR 50.33 requirement within 52.77)**
 - **Financial Requirements**
 - Each application for a construction permit, operating license, or combined license submitted by a newly-formed entity organized for the primary purpose of constructing and/or operating a facility must also include information showing:
 - (i) The legal and financial relationships it has or proposes to have with its stockholders or owners;
 - (ii) The stockholders' or owners' financial ability to meet any contractual obligation to the entity which they have incurred or proposed to incur; and
 - (iii) Any other information considered necessary by the Commission to enable it to determine the applicant's financial qualification.
- **Part II: Final Safety Analysis Report (10 CFR 52.79)**
- **Part III: Aurora Environmental Report – Combined License Stage (10 CFR 52.80)**
- **Part VI: Proposed license conditions**
 - Proposed inspection, tests, analysis, and acceptance criteria (ITAAC) (10 CFR 52.80)

Requirements from Final Safety Analysis Report (FSAR)

- **Part IV: Technical Specifications (10 CFR 52.79(a)(30))**
 - (10 CFR 52.79(a)(30)) - Proposed technical specifications prepared in accordance with the requirements of §§ 50.36 and 50.36a of this chapter
 - Boundaries of site, proposed location, population profile, description/safety
 - **Part V: Non-applicabilities and requested exemptions**
 - **Part VII: Enclosures**
- 10 CFR 53 – Regulatory framework for advanced reactors

- **In development.** Governs advanced nuclear reactors/non-LWRs
- NRC is expected to finalize rule by Oct 2024
- 10 CFR 81 – Granting patent licenses and establish standard specifications for the issuance of licenses to rights in inventions covered by patents/patent applications
 - Do our expectations fit the standards for patents for the vendor?

EXEMPTIONS

- 10 CFR 2.390 - Public inspections, exemptions, requests for withholding
 - Lists out matters that can be exempt from disclosure such as national security interests, classified material

SITING

- 10 CFR 100 – Covers reactor site criteria and establishing requirements for proposed sites for stationary power/testing reactors subject. The Contractor shall ensure requirements around radiological safety boundaries covered in Part 100 are strictly adhered to.
 - 100.3 – Definitions on terms related to siting requirements
 - Combined license, Early Site Permit, Exclusion area, Low population zone, Population center distance, Power reactor, Response spectrum, Safe Shutdown Earthquake Ground Motion, Surface deformation, Testing reactor

Proposed Site Characterization Information fulfilling NRC Requirements

Section	Requirement
Seismic evaluation	10 CFR 52.79(a)(1)(iii) 10 CFR 100.23(d)
Meteorological evaluation	10 CFR 52.79(a)(1)(iii) 10 CFR 100.21(d)
Hydrologic evaluation	10 CFR 52.79(a)(1)(iii) 10 CFR 100.21(d)
Geologic evaluation	10 CFR 52.79(a)(1)(iii) 10 CFR 100.21(d) 10 CFR 100.23(c) 10 CFR 100.23(d)
Man-made hazards evaluation	10 CFR 52.79(a)(1)(iv) 10 CFR 100.21(e)
Population demographics evaluation	10 CFR 52.79(a)(1)(v) 10 CFR 100.21(h)
Security plan impact evaluation	10 CFR 100.21(f)
Emergency plan impact evaluation	10 CFR 100.21(g)

Table adapted from the Aurora reactor application:

<https://www.nrc.gov/docs/ML2007/ML20075A000.html>

Geological factors

- 10 CFR 100.21 – non-seismic siting criteria

- Every site must have an exclusion area and a low population zone, as defined in § 100.3
- The population center distance must be at least one and one-third (1.33) times the distance from the reactor to the outer boundary of the low population zone
- 10 CFR 100.23 – Geologic and seismic siting criteria
 - Describes the criteria and nature of investigations required to obtain the geologic and seismic data necessary to determine the suitability of the proposed site and the plant design bases.
 - Data on vibratory ground motion, tectonic and nontectonic surface deformation, Earthquake recurrence rates, Fault geometry and slip rates, Seismically-induced flooding, Site foundation material, Safe Shutdown Earthquake Ground Motion
 - Liquefaction potential, soil and rock stability, natural and artificial slope stability, cooling water supply, remote safety-related structure siting

TRANSPORTATION

- 10 CFR 71 – Packaging and Transportation of Radioactive Material
 - Establishes the requirements for packaging, prep for shipment and transportation of licensed material
 - Procedures and standards for NRC approval of packaging and shipping procedures for fissile material and for a quantity of other licensed material in excess of Type A quantity
- 49 CFR Subpart I – Class 7 (Radioactive) Materials
 - Sets forth requirements for packaging and transportation of Class 7 radioactive materials by offers and carriers subject to the chapter. The requirements are in addition to other requirements or NRC 10 CFR Part 71
- U.S. NRC RG 7.11
 - Recommendations for towards the criteria of shipping containment vessels
- 49 CFR 173.420 - Uranium hexafluoride (fissile, fissile excepted and non-fissile)
 - Packaging and Transportation requirements of quantities greater than 0.1 kg of fissile, fissile excepted or non-fissile uranium hexafluoride.
 - All cleaning, testing, design, fabrication, and inspection of packaging must be in accordance with American National Standard N14.1

SAFETY

- 10 CFR 20 – Standard for protection against radiation
 - Establishes standards for protection against ionizing radiation resulting from activities conducted under licenses issued by NRC.
- 10 CFR 50.47 – Emergency Plans
 - The Contractor shall prepare an Emergency Action Plan to outline potential scenarios involving accidental release of radiological material (or purposeful release in the event of terrorism) and methods for countering and neutralizing negative impacts from such release.

The size of Emergency Planning Zones (EPZs) may be determined on a case-by-case basis for gas-cooled nuclear reactors and for reactors with an authorized power level less than 250 MW thermal; it does not obviate the need for EPZs.

- 10 CFR 50.160 (C)(1)(iii) – Proposed draft for onsite emergency plan
 - Provides alternative performance-based EP requirements for an SMR, non-LWR, or NPUF applicant’s or licensee’s EP program.
- National Fire Protection Association (NFPA) 1144 – Standard for Reducing Structure Ignition Hazards from Wildland Fire

POTENTIAL EXTERNAL HAZARDS TO CONSIDER

- Avalanche
- Hurricane
- Seismic event
- Biological events
- Ice cover (causing blockage of river)
- Sinkholes
- Coastal erosion
- Landslide
- Snow
- Drought
- Lightning
- Soil shrink-swell
- External flooding
- Low lake or river water level
- Storm surge
- Forest fire
- Low winter temperature
- Tornadoes (extreme winds)
- Frost
- Non-safety building fire
- Toxic gas
- Grass fire
- Precipitation, intense
- Transportation accident [1] [2]
- Hail
- Release of chemicals from onsite storage
- Tsunami
- High summer temperature
- River diversion
- Turbine-generated missiles
- High tide
- Sandstorm
- Volcanic activity
- High winds
- Seiche
- Waves

ENVIRONMENTAL

- 10 CFR 51 – Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions
 - The National Environmental Policy Act (NEPA) requires Federal agencies to evaluate the impacts of proposed federal actions on the human environment.

Potential Environmental Report Sections

Section	Requirement
Description of Site Area	
Site Description	10 CFR 51.45(b) 10 CFR 51.45(c)

Site Preparation	10 CFR 51.45(b) 10 CFR 51.45(c)
Operational activities	10 CFR 51.45(b) 10 CFR 51.45(c)
Status of compliance	10 CFR 51.45(d)
Projected Impacts	10 CFR 51.45(b)(2) 10 CFR 51.45(b)(4) 10 CFR 51.45(c)
Environmental impacts of alternatives	10 CFR 51.45(b)(3) 10 CFR 51.45(c)
Summary of impacts	
Irreversible and irretrievable commitments of resources	10 CFR 51.45(b)(5)
Benefits and cost	10 CFR 51.45(c)

The EPF shall be constructed on the grounds of Eielson AFB, avoiding areas designated as unfeasible in the map provided in Attachment PR2, Site Map Micro Reactor Locations. The Contractor shall propose a preferred site or sites, or area of the base, accounting for acreage, proximity to housing or community facilities, access to electrical and thermal energy distribution systems, and any applicable safety and environmental considerations that will need to be approved by the Government. Attachment PR3 Site Environmental Summary provides the results of an environmental baselining analysis conducted June – November 2021 on potential conditions at Eielson AFB. Depending on the Contractor’s chosen technology and construction methodology, relevant information from the report includes data such as floodplain status, soil makeup and characteristics, known environmental contamination, existing biological and cultural resources, traffic and infrastructure considerations, and follow up studies or surveys that may be required.

In addition to the siting requirements specifically provided in 10 CFR 100, the Contractor shall include an area of cleared vegetation around the powerhouse with a width of approximately 30 feet to minimize fire risk. This mirrors the requirements of the Aurora reactor and meets the requirements of NFPA 1144.

The NRC will complete an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) before construction can begin. The environmental conditions outlined in Attachment PR3 Site Environmental Summary will inform the EIS. The NRC Interim Staff Guidance on Environmental Considerations Associated with Micro-Reactors, available at <https://www.nrc.gov/docs/ML2025/ML20252A076.pdf>, provides an overview of NRC’s approach to NEPA reviews for micro-reactors. In siting the proposed EPF, the Contractor shall follow all applicable provisions of 10 CFR 100, “reactor siting criteria”, incorporating proper distance between the reactor and the outer boundary of the low population zone as defined in 10 CFR 100.3.

OPERATING

- CFR 50.54 – Condition of Licenses
 - Outlines conditions in every nuclear power reactor operating license issued. Some details may not be relevant as SMRs/MRs have different technologies that do not require control rooms, large staff, etc. Vendors should be aware of this regulation but ...

- 10 CFR 54 – Requirements for Renewal of Operating Licenses for Nuclear Power Plants
 - Governs the issuance of renewed operating licenses and renewed combined licenses for licensed nuclear power plants
- 10 CFR 55 – Operators’ Licenses
 - Establishes procedures and criteria for the issuance of licenses to operators and senior operators of utilization facilities licensed under the Atomic Energy Act of 1954, as amended, or Section 202 of the Energy Reorganization Act of 1974, as amended, and part 50, part 52, or part 54 of this chapter, and provides terms and conditions to modify, maintain and renew these licenses
 - Establishes minimum staffing requirements for control rooms

FUEL – *How does HALEU fuel fall into this?*

- 10 CFR 70 – Domestic licensing for handling enriched uranium or Special Nuclear Material (SNM)
 - Licensing to receive title to, own, acquire, deliver, receive, possess, use, and transfer SNM; and establish and provide for the terms and conditions upon which the Commission will issue such licenses
 - How do the designs of MRs change the way Spent fuel is handled, therefore changing the procedures/criteria of the licenses?
- 10 CFR 30
 - Domestic Licensing of byproduct material, radioactive material, or discrete sources of radium-226
- 10 CFR 40 – Domestic licensing of Source Material
 - Establishes procedures and criteria for the issuance of licenses to receive title to, receive, possess, use, transfer, or deliver source and byproduct materials, as defined in this part, and establish and provide for the terms and conditions upon which the Commission will issue such licenses
- 40 CFR 191 - Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes
 - This regulation sets environmental standards for public protection from the management and disposal of spent nuclear fuel, high-level radioactive wastes and certain wastes that contain elements with atomic numbers higher than uranium (transuranic wastes)