WHITE PAPER

Proposed PSAR Content and Exceptions

(Non-Proprietary)

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1. INTRODUCTION

1.1 PURPOSE

Terra Innovatum submitted Regulatory Engagement Plan (REP) (Revision 1) to the Staff in June 2025. Among early topics to discuss was the strategy and content for the PSAR in anticipation of the Licensing Application (LA) for TINN SOLO™ Micro Modular Reactor, SMR™.

SOLO fits with the definition of non-power reactor given in NUREG-1537 "Guidelines for Preparing and Reviewing Applications for the Licensing on non-Power Reactors" [2]. TINN intends to apply for the licensing of SOLO the path presented therein.

The purpose of this whitepaper is to propose the approach Terra Innovatum is considering for the development of the PSAR and elicit the Staff comments and opinions so that we can align the most effective process.

1.2 REQUEST TO NRC

For this Whitepaper, Terra Innovatum elicits early feedbacks and comments on the approach taken to generate the information for the PSAR, its outline and possible exceptions.

2. REVIEW OF NUREG-1537

Each section of the NUREG-1537 was reviewed to determine its applicability to the SOLO MMR design and licensing goals. The following subsections describe conclusions derived for each intended Chapter for the PSAR.

2.1 CHAPTER 1: THE FACILITY

NUREG-1537 Expectations: This chapter provides a general overview of the reactor facility and includes:

- 1.1 Summary Description: Core purpose, type, power level, and major systems.
- 1.2 Facility and Site Description: Layout, structures, geography, utilities, shared services.
- 1.3 Identification of Applicant and Contractors.
- 1.4 Interfaces with Other Facilities: Dependencies or interactions with external systems or organizations.
- 1.5 Quality Assurance.
- 1.6-1.8: Regulatory framework, conformance with NUREG-1537, and departures.

SOLO MMR Design Considerations and Goals:

- Modular, transportable (not mobile) design with sealed systems and no shared utilities.
- Small site footprint, EPZ (Emergency Planning Zone) limited to operational boundary, and self-contained support systems (helium coolant, controls, shielding, etc.).
- Licensed as a non-power reactor with a low risk profile (e.g., biological shield, passive decay heat removal system, etc.).

Recommended Exceptions or Deviations:

- **Facility and Site Description**: Streamline environmental and geophysical detail unless required for dose/accident analysis. The EPZ is limited to the operational boundary and environmental risk is minimal.
- **Interfaces with Other Facilities:** There are no shared or interfacing facilities; the reactor is self-contained. Avoids unnecessary qualification of nonexistent external dependencies.
- **QA Program Description:** Provide summary reference to vendor QA program aligned with 10 CFR Part 50, Appendix B, and ANSI/ANS 15.8. Full detail not needed in PSAR; can be referenced or deferred to OLA/FSAR.

2.2 CHAPTER 2: SITE CHARACTERISTICS

NUREG-1537 Expectations: This chapter documents the site's characteristics relevant to reactor safety. It includes:

- 2.1 Geography and Demography: Site location, description, population distribution.
- 2.2 Nearby Industrial, Transportation, and Military Facilities: Locations and routes, air traffic, analysis of potential accidents.
- 2.3 Meteorology: General and local climate, site meteorology.
- 2.4 Hydrology: Surface water, groundwater, site hydrology.
- 2.5 Geology, Seismology, and Geotechnical Engineering: Regional and site geology, seismicity, earthquake potential, vibratory ground motion, surface faulting, liquefaction potential.
- 2.6 Bibliography: List of references.

SOLO MMR Design Considerations and Goals:

- Transportable, modular reactor designed for flexible siting. Ideally deployable at remote, controlled, or urban sites.
- Self-contained: no reliance on external utilities, power grid, water, or infrastructure; passive decay heat removal system with the atmosphere as the ultimate heat sink.
- Designed to tolerate external hazards through the Monolith biological shield and overall external hazard resiliency.
- Small source term, low offsite population risk; EPZ limited to the operational boundary.
- Siting flexibility intended to support research, demonstration, remote deployment, and urban-area applications.

Recommended Exceptions or Deviations:

- **Geography and Demography:**
    - Population distribution analysis can be streamlined due to EPZ constrained to the operational boundary and inherently small source term.
- **Nearby Industrial, Transportation, and Military Facilities:**
    - Qualitative discussion of potential hazards is sufficient. Very small footprint/target and the Monolith provides physical protection against aircraft impact; aircraft risk assessment is not required.
- **Meteorology:**
    - Sections can be streamlined. No significant dependence on meteorological factors for safety functions. The ultimate heat sink is atmospheric convection, independent of local climate variability.
- **Hydrology:**
    - Streamline — no reliance on surface water or groundwater; SOLO MMR is hydrologically independent. No pool leakage. No core melt. The effect of potential floods is limited. Bounding analysis or justifications to cover these aspects can be sufficient.
- **Geology, Seismology, and Geotechnical Engineering:**
    - Provide focused analysis to confirm seismic adequacy of the Monolith and structural supports. Other geotechnical topics can be addressed briefly where they do not affect safety margins.

- **Bibliography:**
  - Standard references list; no exceptions.

2.3 CHAPTER 3: DESIGN OF STRUCTURES, SYSTEMS AND COMPONENTS

NUREG-1537 Expectations: This chapter describes the design bases and design features of structures, systems, and components (SSCs) important to safety. It includes:

- 3.1 Design Criteria: Safety functions, performance criteria, classification of SSCs, codes and standards.
- 3.2 Meteorological Damage: Design considerations for wind, tornado, snow, ice, and lightning hazards.
- 3.3 Water Damage: Design provisions to mitigate damage from internal or external flooding and water intrusion.
- 3.4 Seismic Damage: Seismic design classification of SSCs, seismic analysis, qualification, and anchoring.
- 3.5 Systems and Components: Summary of principal systems and components important to safety.
- 3.6 References: List of references.

SOLO MMR Design Considerations and Goals:

- Reactor uses sealed helium coolant and passive decay heat removal; no water systems required for core heat removal or safety functions.
- Safety-significant SSCs housed within the Monolith, which provides both structural integrity and external hazard protection.
- Reactor core, helium boundary, Integrated Radiological Containment, and Monolith are designed as integrated protective structures.
- External hazard resiliency is a key design feature: the Monolith protects against seismic, tornado, wind, and impact loads.
- No reliance on external cooling sources or active systems for accident mitigation.
- Seismic design uses a performance-based approach; passive systems ensure continued safe configuration under postulated seismic events.
- SSC classification, albeit deterministic, can be aligned with risk-informed, performance-based (RIPB) principles from NEI 18-04 and NEI 21-07.

Recommended Exceptions or Deviations:

- **Design Criteria:**
    - Adopt deterministic approach with risk insights from RIPB classification consistent with NEI 18-04 to confirm safety-significance of SSCs.
    - Codes and standards applied selectively — ASME Section III for pressure boundaries where applicable, AISC/ACI for structural concrete and steel, other standards per component function and importance to safety.
- **Meteorological Damage:**
    - Streamline section — Monolith provides inherent protection against wind, tornado, snow, ice, and lightning hazards. No credit is taken for emergency power or weather-sensitive active systems.
- **Water Damage:**
    - Section can be minimized — no reliance on water-based cooling; no vulnerable water-bearing SSCs within safety boundary; reactor design is inherently water-independent.
- **Seismic Damage:**

  - Provide focused seismic design basis for the Monolith and for safety-significant SSCs; use of performance-based seismic analysis rather than strictly deterministic approach.
  - Emphasize that safety-significant functions are maintained passively and do not rely on operator action post-seismic event.
- **Systems and Components:**
  - Summarize principal systems and components consistent with SOLO MMR design: reactor core, reactivity control systems, helium boundary, passive decay heat removal system, Monolith, Integrated Radiological Containment, I&C systems.
  - Clarify that no systems rely on **offsite power, water, or HVAC** for postulated accident mitigation.
- **References:**
  - Standard references list; no exceptions.

2.4 CHAPTER 4: REACTOR DESCRIPTION

NUREG-1537 Expectations: This chapter describes the principal features, operating characteristics, and parameters of the reactor. The analysis should demonstrate that the reactor is conservatively designed for safe operation and shutdown under all credible operating conditions. It includes:

- 4.1 Summary Description: Overall reactor description, design basis parameters, principal safety considerations.
- 4.2 Reactor Core: Design and analysis of core components (fuel, moderator, reflector, control rods, startup source, core support structure).
- 4.3 Reactor Tank or Pool: Design features ensuring structural integrity and radiation protection.
- 4.4 Biological Shield: Design of radiation shielding to ensure compliance with exposure limits and ALARA.
- 4.5 Nuclear Design: Nuclear parameters, kinetics, core physics, reactivity coefficients, operating limits.
- 4.6 Thermal-Hydraulic Design: Demonstration of adequate cooling and thermal margins under all operating and transient conditions.

SOLO MMR Design Considerations and Goals:

- Helium-cooled reactor core — no water systems required for core cooling.
- Fuel: Standard LWR-type UO_2 fuel pins helium-cooled.
- Reactor fully housed within the Integrated Radiological Containment; no reactor pool or tank.
- Four diverse and redundant reactivity control systems: control plates, graphite/absorber blocks, absorber cylinders, and He-3 injection system.
- Designed for steady-state operation, no pulsing modes; fuel behavior and performance analyzed for long-term irradiation and thermal cycling.
- Neutron startup source housed within defined locations inside the core region; contributes to monitored safe startup.
- Reactor structure and supports designed to ensure alignment and positioning under seismic and thermal loads.
- Biological shield provided by Monolith structure designed to meet all regulatory dose limits.
- Nuclear design analysis and safety margins based on validated codes and conservative assumptions.
- Thermal-hydraulic performance relies on helium natural convection and passive external heat rejection; no forced flow required.

Recommended Exceptions or Deviations:

- **Summary Description:**
  - Streamline reactor description; emphasize key novel features (sealed helium cooling, Monolith, passive safety of the DHRS).
- **Reactor Core:**
  - **Fuel:** Standard LWR UO_2 fuel, well-characterized; limited need to repeat industry-standard fuel qualification history.
  - **Control Mechanisms:** SOLO MMR uses diverse reactivity control mechanisms; structure section to document differences from conventional rod-based designs.

  - **Moderator and Reflector:** Sealed graphite/beryllium matrix; special attention to temperature-dependent reactivity behavior documented in PDC 12 discussions.
  - **Neutron Startup Source:** Standard startup source — existing qualification experience can be referenced.
  - **Core Support Structure:** Monolith and internal support structures provide core positioning and seismic integrity; no pool or grid plate used.
- **Reactor Tank or Pool:**
  - Section can be **largely omitted** — SOLO MMR has **no reactor tank or pool**; sealed Monolith replaces traditional pool design.
  - Cross-reference to Monolith structure in Chapter 3 and shielding in Section 4.4.
- **Biological Shield:**
  - Shielding function provided entirely by the **Monolith**; detailed shielding calculations referenced to Chapter 11.
  - Shield test program aligned with RG 2.1 where applicable to graphite-based shielding approach.
- **Nuclear Design:**
  - Focus on **steady-state operation only** — no pulsing mode. No load follow or power maneuvering.
  - Include discussion of conservative treatment of reactivity coefficients and feedback effects.
  - Special note: SOLO MMR operates with **limited graphite moderator temperature feedback margin** — consistent with ARDC 12 Basis.
- **Thermal-Hydraulic Design:**
  - Emphasize **helium forced convection**, conduction, and passive decay heat removal from the IRC by the Monolith air baffle (DHRS).
  - No active cooling loops or emergency core cooling system required.
  - Performance and safety margins analyzed using validated codes appropriate for gas-cooled reactor design space.
  - Flow blockage and depressurization scenarios addressed in Chapter 13.

2.5 CHAPTER 5: REACTOR COOLANT SYSTEMS

NUREG-1537 Expectations: this chapter provides the design bases, descriptions, and functional analyses of the reactor coolant systems. It demonstrates how the reactor safely removes fission and decay heat under all operating and accident conditions. It includes:

- 5.1 Summary Description: Overview of the reactor coolant systems and heat removal pathways.
- 5.2 Primary Coolant System: Design and performance of the primary coolant system.
- 5.3 Secondary Coolant System: Design and performance of the secondary heat removal system, if applicable.
- 5.4 Primary Coolant Cleanup System: Methods for maintaining coolant purity and monitoring.
- 5.5 Primary Coolant Makeup Water System: System for replenishing coolant losses.
- 5.6 Nitrogen-16 Control System: Measures to control nitrogen-16 radiation, if applicable.
- 5.7 Auxiliary Systems Using Primary Coolant: Cooling and shielding systems using primary coolant.
- 5.8 References: Supporting references.

SOLO MMR Design Considerations and Goals:

- Helium-cooled reactor core — fully sealed gas-cooled system; no water used in primary or secondary cooling.
- Primary coolant: Helium gas circulating in a fully enclosed system.
- Heat removal: Passive decay heat removal via natural convection in the air gap between the Monolith and the IRC. The external atmosphere/environment is ultimate heat sink.
- No forced circulation required for decay heat removal.
- No water-based systems present; no pool, tank, or makeup water system required. At most helium makeup systems for the IRC atmosphere and the PTCS.
- No nitrogen-16 production, as helium coolant does not activate.
- Reactor designed with fully passive ultimate heat sink — the atmosphere.
- Auxiliary systems are sealed and do not interact with the helium coolant boundary.
- All radiation shielding is provided by the Monolith and Integrated Radiological Containment.

Recommended Exceptions or Deviations:

- **Summary Description:**
    - Emphasize **helium primary coolant**, sealed loop design, and passive decay heat removal from the DHRS.
- **Primary Coolant System:**
    - Helium system design bases provided.
    - No water system components (pumps, valves, drains, etc.) required or present.
    - No conventional primary coolant cleanup system required; helium purity maintained through gas processing skid.
    - No shielding function provided by coolant — shielding provided by Monolith structure.
- **Primary Coolant Cleanup System:**
    - Not applicable in water-based sense. Helium gas treatment skid ensures gas quality — addressed in **I&C and auxiliary system discussions**.

- **Primary Coolant Makeup Water System:**
  - Not applicable — no water-based primary system.
- **Nitrogen-16 Control System:**
  - Not applicable — helium coolant does not produce nitrogen-16.
- **Auxiliary Systems Using Primary Coolant:**
  - No auxiliary systems use helium coolant directly. Heat rejection path is **helium to Monolith to atmosphere**.
  - All other systems (I&C cooling, structural cooling) are independent and isolated from the helium boundary.
  - **No experimental facility cooling** uses primary coolant path.
- **References:**
  - Standard references; no special requirements.

2.6 CHAPTER 6: ENGINEERED SAFETY FEATURES

NUREG-1537 Expectations: this chapter provides the description, design bases, and analyses of Engineered Safety Features (ESFs) used to mitigate the consequences of postulated accidents and ensure that radiological exposures remain within acceptable limits. It includes:

- 6.1 Summary Description: Overview of ESFs and postulated accidents they are intended to mitigate.
- 6.2 Detailed Descriptions: Descriptions of each ESF incorporated into the reactor design.
  - 6.2.1 Confinement
  - 6.2.2 Containment
  - 6.2.3 Emergency Core Cooling System (ECCS)
- 6.3 References: Supporting references.

SOLO MMR Design Considerations and Goals:

- The Monolith provides an integrated confinement, shielding, and passive heat removal function.
- The Integrated Radiological Containment (IRC) is a sealed boundary surrounding the reactor systems — provides containment-like performance for potential radiological releases.
- Reactor core design: helium-cooled, no liquid primary coolant, no water-based ECCS required or applicable.
- Passive decay heat removal is provided through natural convection of air external to the Monolith — eliminating need for ECCS.
- Reactor is designed with low source term and limited potential offsite dose; licensing strategy explicitly targets EPZ limited to operational boundary.
- Reactor building and HVAC system do not need a confinement ESF function. This will be a room above the Monolith hosting the energy conversion system (BoP) and I&C panels/racks and any Human-Machine interface. That room will be protected/shielded by the Monolith/IRC which provides primary radiological barrier.
- No credible scenarios require additional engineered confinement or containment beyond Monolith + IRC structure.

Recommended Exceptions or Deviations:

- **Summary Description:**
  - Emphasize that **Monolith and IRC** together provide the required containment/confinement function for SOLO MMR.
  - No separate ECCS or water-based safety injection system required or present.
- **Confinement:**
  - No separate building confinement system provided or needed.
  - Monolith and IRC provide an integrated radiological containment function; **no HVAC-based negative pressure confinement** is credited or required.
  - Normal HVAC operation is not credited for accident mitigation — addressed separately in **Auxiliary Systems** and **Radiation Protection**.
- **Containment:**
  - Monolith and IRC together constitute the **containment ESF** for SOLO MMR.
  - The sealed Monolith + IRC structure provides a robust boundary capable of maintaining integrity under all postulated events (seismic, depressurization, fire, external impact).

- No conventional power-reactor style "containment isolation valves or airlocks" needed or applicable.
- Detailed structural analysis provided in **Chapters 3 and 13** to demonstrate performance basis.
- IRC acts as primary controlled volume for retention of any fission product release.
- Venting pathways (if any) will be **passively filtered** and demonstrated to meet regulatory dose limits.

- **Emergency Core Cooling System (ECCS):**
  - Not applicable — **no ECCS is required or present**.
  - Passive decay heat removal is ensured via the **natural convection pathway** from the Monolith to the external atmosphere.
  - System is fully passive and does not rely on external power or operator action.
  - No water-based ECCS loops, spray systems, or injection systems required.
  - Thermal-hydraulic analysis in **Chapter 4 and 13** supports this conclusion.
  - Passive features meet or exceed performance requirements established for MMR designs.
- **References:**
  - Standard references; no special requirements.

2.7 CHAPTER 7: INSTRUMENTATION AND CONTROL SYSTEMS

NUREG-1537 Expectations: this chapter describes the Instrumentation and Control (I&C) systems, their design bases, performance analyses, and relationship to reactor safety. It includes:

- 7.1 Summary Description: Overall architecture, philosophy, and objectives of I&C systems.
- 7.2 Design of Instrumentation and Control Systems: Criteria, design bases, system descriptions, performance analyses.
- 7.3 Reactor Control System: Design and operation of the Reactor Control System (RCS).
- 7.4 Reactor Protection System: Design and operation of the Reactor Protection System (RPS).
- 7.5 Engineered Safety Features (ESF) Actuation Systems: Description of systems that initiate ESFs, if applicable.
- 7.6 Control Console and Display Instruments: Description of the human-machine interface (HMI) and operator display/control systems.
- 7.7 Radiation Monitoring Systems: I&C aspects of radiation monitoring; input to RPS or ESF actuation as needed.
- 7.8 Bibliography.

SOLO MMR Design Considerations and Goals:

- Highly digital, software-based I&C architecture, consistent with modern MMR and advanced reactor best practices.
- Core I&C system structured around a fail-safe, diverse, and redundant architecture.
- RCS integrates multiple diverse control mechanisms: control plates, graphite/absorber blocks, absorber cylinders, He-3 injection.
- RPS initiates passive safe shutdown actions; leverages fail-safe logic and minimal operator action.
- ESFs actuated through passive features; active ESF actuation systems not required — Monolith and IRC provide primary protective barrier.
- Control console and HMI designed for remote monitoring and control capability, with secure and cyber-protected architecture.
- Radiation Monitoring System provides continuous monitoring of reactor core, Monolith cavity, external air pathways, and plant areas.
- Full I&C system design supports remote operation, unattended modes, and enhanced cybersecurity provisions (consistent with NEI 08-09 guidance).

Recommended Exceptions or Deviations:

- **Summary Description:**
  - Emphasize use of **integrated digital I&C architecture**, including both RCS and RPS functions.
- **Design Criteria:**
  - Quality assurance per applicable parts of **10 CFR Part 50 Appendix B** and ANSI/ANS 15.8.
  - No traditional seismic or harsh environment qualifications required for many I&C components — justified by passive safety design.
- **Reactor Control System:**
  - Digital RCS controlling diverse reactivity mechanisms, all of which are designed with **fail-safe default positions**.

- No pulsing mode; No load follow controls.
- Control interlocks ensure that reactivity insertions are properly managed.
- Control of He-3 injection system includes cybersecurity provisions and explicit interlocks.

- **Reactor Protection System:**
    - RPS functions fully digital; no separate analog protection chain required.
    - Monitored parameters include neutron flux, temperature feedback (if applicable), system status, and helium system parameters.
    - **Scram functions** actuate passive safe configurations (e.g., insert control plates, actuate absorber mechanisms, enable He-3 injection).
    - Shutdown is ensured by diverse and redundant means.
    - No water level trips required (helium-cooled design).
- **Engineered Safety Features Actuation Systems:**
    - No active ESF actuation systems required.
    - All ESFs (Monolith, IRC, passive decay heat removal) are **passively actuated** or inherent to the system design.
    - Section can be summarized with appropriate justification — refer to Chapter 6.
- **Control Console and Display Instruments:**
    - Integrated digital HMI with cyber-secure architecture.
    - Supports both **on-site and remote monitoring/operation** under approved conditions.
    - Includes comprehensive control, status display, and system health monitoring.
- **Radiation Monitoring Systems:**
    - Continuous radiation monitoring provided inside Monolith cavity, within IRC, in building above Monolith, and in plant exhaust pathways.
    - Monitors provide input to both RPS and operator displays.
    - No air-based confinement or HVAC-based ESFs; therefore, ESF actuation via radiation monitors not required.
    - Design aligns with Chapter 11 provisions for radiation protection.
- **References:**
    - Standard references; digital I&C guidance to follow applicable NRC and ANSI/ANS standards where relevant, but will reflect unique digital design of MMR architecture.

2.8 CHAPTER 8: ELECTRICAL POWER SYSTEMS

NUREG-1537 Expectations: this chapter describes the electrical power systems supporting reactor operation. It includes both normal and emergency power systems required to maintain safe operation and shutdown. It includes:

- 8.1 Normal Electrical Power Systems: Design bases and description of the normal power supply to the reactor facility.
- 8.2 Emergency Electrical Power Systems: Design bases and description of any backup power required for reactor safety, accident mitigation, and protection of public health and safety.

SOLO MMR Design Considerations and Goals:

- Reactor is designed for passive safe shutdown and passive decay heat removal, independent of electrical power.
- No forced flow cooling or ECCS pumps required.
- All reactivity control mechanisms are fail-safe and do not rely on power to achieve a shutdown state.
- Monolith and IRC provide passive radiological containment — no powered HVAC or ventilation systems required for accident mitigation.
- Primary safety-significant electrical needs during a power loss:
  - Maintenance of I&C system status monitoring.
  - Maintenance of radiation monitoring.
  - Maintenance of minimal lighting and communication.
- Remote operation and monitoring capabilities require a protected power supply for networked systems, but reactor safety is not dependent on it.
- Emergency power is provided via a battery-backed UPS for critical systems — no diesel generator required for safety.

Recommended Exceptions or Deviations:

- **Normal Electrical Power Systems:**
  - Standard commercial power service provides normal facility power.
  - No special electrical separation required for critical systems beyond standard industrial practice and cyber/EMI protections.
  - No special interdependencies between normal electrical power and core cooling or reactor shutdown.
  - Schematic diagrams can be streamlined to reflect simplicity of electrical architecture.
  - Technical specifications not required for normal electrical service — safe shutdown is assured without power.
- **Emergency Electrical Power Systems:**
  - No **Class 1E or nuclear safety-grade** emergency power system required or applicable.
  - No **emergency generator required** — a battery-backed UPS provides backup power to:
    - Reactor I&C system for monitoring shutdown state.
    - Radiation monitoring system.
    - Minimal lighting and communication systems.
  - No emergency power required for:

    - Automatic passive reactor shutdown.
    - Core cooling — passive decay heat removal does not require power.
    - Confinement or containment — Monolith and IRC provide passive protection.
  - No technical specifications required for diesel generator operation or maintenance — not applicable.
  - Surveillance requirements for the battery UPS will be provided as part of routine maintenance and can be referenced but not required in technical specifications.
  - No requirement for **non-interruptible power transfer** — safe shutdown is ensured on loss of power.
- **References:**
  - Standard references; no special requirements.

2.9 CHAPTER 9: AUXILIARY SYSTEMS

NUREG-1537 Expectations: this chapter describes auxiliary systems important to safe operation and shutdown of the reactor, protection of public and worker health and safety, and environmental protection. It includes:

- 9.1 Heating, Ventilation, and Air Conditioning (HVAC) Systems
- 9.2 Handling and Storage of Reactor Fuel
- 9.3 Fire Protection Systems and Programs
- 9.4 Communication Systems
- 9.5 Possession and Use of Byproduct, Source, and Special Nuclear Material
- 9.6 Cover Gas Control in Closed Primary Coolant Systems
- 9.7 Other Auxiliary Systems
- 9.8 References

SOLO MMR Design Considerations and Goals:

- Reactor is helium gas cooled — no liquid or heavy water systems; no cover gas system required.
- No open reactor pool; no wet fuel handling required.
- No pool HVAC required for radiological control — Monolith and IRC provide sealed barriers.
- No dependence on auxiliary systems for safety functions.
- Fuel handling is dry, performed inside a shielded environment with appropriate tooling and only occurs at decommissioning or refueling after at least 15 years of operation.
- Fire protection is conventional industrial-grade, with no safety-significant dependency on active fire suppression for maintaining reactor safety.
- Communications include local and remote secure systems — aligned with modern MMR digital architecture.
- Possession of byproduct, source, and special nuclear material under reactor license is limited to operational needs. SOLO also featured integrated Nuclear Safeguards.
- Reactor does not use cover gas or closed water-based systems that require gas processing.
- Auxiliary systems are not relied upon for safety-significant accident mitigation (Chapter 13).

Recommended Exceptions or Deviations:

- **HVAC Systems:**
  - No HVAC system is credited as an ESF.
  - HVAC provides comfort cooling for equipment spaces; radiation monitoring and filtered exhaust (if used) are secondary and not relied upon for accident mitigation.
  - No HVAC-based confinement function required (Monolith and IRC provide passive radiological containment).
  - Section can be streamlined accordingly.
- **Handling and Storage of Reactor Fuel:**
  - **Dry fuel handling and storage**; no pool or water-based systems used.
  - Fuel subcriticality margin ensured by design and procedural controls ($k<0.90$).

  - Irradiated fuel will be cooled and shielded passively in designated dry storage or shipping casks; no active cooling system required.
- **Fire Protection Systems and Programs:**
  - Conventional fire detection and suppression systems per applicable codes (NFPA 802, local codes).
  - Reactor safe shutdown and decay heat removal are fully passive and **not dependent** on fire suppression system operability.
  - Fire analysis (Chapter 13) will demonstrate no credible scenarios where fire leads to significant radiological release.
- **Communication Systems:**
  - Fully digital architecture supports **local and remote operation/monitoring**.
  - Communications systems designed for cyber-secure operation; details coordinated with physical and cyber security plans.
  - No technical specifications required.
- **Possession and Use of Byproduct, Source, and Special Nuclear Material:**
  - Materials authorized under the reactor license will be clearly defined and limited to operational and research needs.
  - No broad scope possession requested beyond reactor and associated lab areas.
  - Material control, handling, and use subject to facility administrative controls and 10 CFR Parts 20, 30, 40, 70 as applicable.
  - No co-located independent materials license required.
- **Cover Gas Control:**
  - Not applicable — SOLO MMR does not use water-based moderator or reflector; helium coolant is sealed and does not require cover gas control or recombination systems.
- **Other Auxiliary Systems:**
  - No other auxiliary systems are credited for safety in Chapter 13 accident analysis.
  - Auxiliary systems will be designed to ensure they do not interfere with safe shutdown or introduce unanalyzed accident scenarios.
  - No auxiliary system requires technical specifications beyond normal facility controls.
- **References:**
  - Standard references; no special requirements.

2.10 CHAPTER 10: EXPERIMENTAL FACILITIES AND UTILIZATION

NUREG-1537 Expectations: this chapter describes the reactor's experimental facilities, their intended use, and associated safety analyses and administrative controls. It includes:

- 10.1 Summary Description
- 10.2 Experimental Facilities
- 10.3 Experiment Review

SOLO MMR Design Considerations and Goals:

- SOLO MMR is designed for modular, transportable use; the initial license application focuses on demonstration of power production, isotope production applications and material testing not open academic user program or broad experimental access.
- Experimental capabilities are limited to:
  - In-Monolith irradiation facilities, integrated in the core/reflector structure, used for isotope production and materials testing.
  - No wet irradiation facilities (no pool or water penetrations).
  - No cold neutron source planned.
- Experiments are designed and installed as fixed configurations within the core or Monolith — transient, removable, or fuel experiments are not planned.
- Safety philosophy: all experimental configurations must be passive, mechanically robust, and not interfere with:
  - Reactivity control
  - Core heat removal (helium flow)
  - Structural integrity of the Monolith or IRC
- Safety analysis must ensure that:
  - No experiment introduces a credible mechanism for prompt reactivity insertion or positive reactivity feedback.
  - All experimental failure modes are bounded by Chapter 13 accident analysis.
  - Experiments cannot compromise the performance of Monolith, IRC, or passive heat removal.

Recommended Exceptions or Deviations:

- **Summary Description:**
  - Experimental program limited to **isotope production** and **materials testing** in designated irradiation facilities.
  - No **pulsing mode**, **fuel experiments**, or **large transient reactivity experiments** permitted.
  - No open user program — experiments are approved and installed by the facility licensee/operator.
  - Experiment program explicitly bounded by design envelope and **Technical Specifications**.
- **Experimental Facilities:**
  - Fixed irradiation positions within **graphite/beryllium moderator** matrix.
  - No penetrations below core or Monolith helium boundary.
  - No liquid experiments, no pressurized loops, no pool-penetrating facilities.

  - All experiments designed with inherent safety and passive response to off-normal conditions.
  - Radiological analysis of potential **argon-41** or other gaseous release will be provided in Chapter 11 and Chapter 13.
  - Radiation shielding and streaming evaluated — no streaming pathways from Monolith to occupied areas allowed.
- **Experiment Review:**
  - A formal **Experiment Safety Review Process** will be established and documented in the facility's **Conduct of Operations** (Chapter 12).
  - All experiments subject to licensee-controlled review; **no experiments allowed without licensee approval** and confirmation that they are bounded by SAR and Technical Specifications.
  - Experiment categories and review process will follow **Regulatory Guides 2.2 and 2.4**, tailored to SOLO MMR application.
  - For isotope production, fixed targets and encapsulated target holders used — no open materials inserted into core.
  - MHA due to experiment failure evaluated and addressed in Chapter 13 (if applicable).
  - Experiment review process ensures compliance with:
    - 10 CFR 50.59
    - Applicable Technical Specifications
    - ALARA principles
    - Public and worker dose limits per 10 CFR Part 20
  - Administrative controls include:
    - Experiment approval committee
    - Written safety analysis for each experiment
    - Configuration control and access control for experimental facilities
    - Emergency procedures for potential experiment malfunctions.

2.11 CHAPTER 11: RADIATION PROTECTION PROGRAM AND WASTE MANAGEMENT

NUREG-1537 Expectations: this chapter describes the reactor facility's Radiation Protection Program (RPP) and Radioactive Waste Management processes to ensure compliance with 10 CFR Part 20 and ALARA principles. It includes:

- 11.1 Radiation Protection
- 11.2 Radioactive Waste Management
- 11.3 Bibliography

SOLO MMR Design Considerations and Goals:

- SOLO MMR is a helium-cooled, sealed reactor system with no liquid coolant loops exposed to atmosphere and no reactor pool.
- The reactor is enclosed within a Monolith and Integrated Radiological Containment (IRC) — provides a very high degree of inherent radiation containment.
- Helium coolant loop is closed — no routine release path for airborne or liquid radioactive material from primary system.
- Solid radioactive waste is expected to be very low in volume and well controlled.
- Reactor has no liquid effluents, and no liquid radioactive waste is planned to be released or generated.
- Gaseous radioactive source is limited to traces.
- Radiation Protection Program is established consistent with:
    - 10 CFR 20.1101
    - ALARA principles
    - 10 CFR 20 Subparts C, D, and G
- Environmental monitoring is established primarily for verification — no credible routine releases expected.

Recommended Exceptions or Deviations:

- **Radiation Sources:**
    - Principal sources: sealed core components and in-core irradiation targets.
    - No pool, no water activation, no N-16 production.
    - Helium primary system does not serve as a source of public radiation dose.
    - Expected gaseous releases are limited to low levels of **argon-41**, primarily from beam port operations or graphite outgassing.
- **Airborne Radioactive Sources:**
    - No open coolant pathways — airborne sources are limited.
    - Argon-41 analysis will be included in this chapter and Chapter 13; dispersion modeling will use conservative assumptions but recognize the **low production rate** of Ar-41 in a small MMR.
- **Liquid Radioactive Sources:**
    - No liquid radioactive sources are expected.
    - No reactor pool, no primary water system, no liquid radioactive waste pathways.

- Minor laboratory liquids associated with target processing will be handled under separate **materials license** procedures and fully controlled.

- **Solid Radioactive Sources:**
  - Limited to fuel elements (during decommissioning), target materials, and minimal activated structural components.
  - Waste volumes expected to be **very small** and will be disposed of through licensed radioactive waste disposal vendors.
  - Onsite waste storage will be **temporary and limited**; no long-term accumulation.
- **Radiation Protection Program:**
  - Fully compliant with 10 CFR 20 and ALARA.
  - Program covers operation, maintenance, target handling, and decommissioning.
  - Radiation Protection staff will be organizationally independent of reactor operations.
  - Routine area surveys and airborne sampling to verify **expected negligible dose contributions**.
- **ALARA Program:**
  - Formal ALARA policy and program will be established.
  - Program integrated into reactor operation, maintenance, and experiment approval.
  - Routine trending of dose results, process review, and improvement.
  - Goals: keep public and occupational doses well below regulatory limits.
- **Radiation Monitoring and Surveying:**
  - Fixed area monitors and portable instrumentation will be provided.
  - Airborne monitoring focused on beam ports and target handling areas.
  - Effluent monitoring: stack monitor will be provided (even though expected effluent is minimal).
  - No liquid effluent monitoring required.
- **Radiation Exposure Control and Dosimetry:**
  - Personnel dosimetry program compliant with 10 CFR 20.
  - Program includes personnel TLDs or equivalent, extremity dosimetry as needed, and bioassay only if required by target handling activities.
  - Access controls for high radiation areas in beam port regions.
- **Contamination Control:**
  - Program is focused on:
    - Target handling areas.
    - Maintenance activities.
    - Any experimental facilities.
  - No contamination expected from normal reactor operation (helium system is closed and sealed).
- **Environmental Monitoring:**

  - Program will include airborne sampling near facility exhaust points.
  - Groundwater monitoring not required (reactor is dry system with no liquid pathways).
  - Environmental program designed primarily for **verification and public reassurance**.
- **Waste Management:**
  - Gaseous waste limited to Ar-41; stack releases monitored and documented.
  - Liquid waste: none from reactor operation.
  - Solid waste: small volume; stored, documented, and shipped to disposal vendors per 10 CFR 20 and 10 CFR 61.
- **Release of Radioactive Waste:**
  - No planned liquid releases.
  - Gaseous release path limited to stack exhaust, monitored.
  - Solid waste released offsite via licensed disposal vendors.
  - Program includes verification of compliance with 10 CFR 20 Subpart D and ALARA.

2.12 CHAPTER 12: CONDUCT OF OPERATIONS

NUREG-1537 Expectations: this chapter describes the organizational, procedural, and administrative framework governing reactor operation and facility safety programs.
It covers the following elements:

- Facility organization and management
- Review and audit activities
- Procedures
- Required actions for events
- Reporting
- Recordkeeping
- Emergency planning
- Security planning
- Quality assurance
- Operator training and requalification
- Startup plan
- Environmental reports

SOLO MMR Design Considerations and Goals:

- SOLO MMR is a sealed, factory-fueled, air-cooled microreactor with a very limited and inherently passive operational profile.
- Facility operations model is based on remote monitoring, periodic maintenance, and well-defined operational cycles.
- Radiation source term and operational hazards are minimized compared to conventional research reactors.
- Operational programs will meet or exceed applicable NRC guidance while reflecting the unique minimal operational intervention philosophy of the MMR.

Recommended Exceptions or Deviations:

Section 12.1 Organization

- SOLO MMR facility organization will be based on:
    - **Facility Licensee Organization** — overall license responsibility.
    - **SOLO MMR Operations and Maintenance Team** — trained and certified personnel responsible for operation and maintenance cycles.
    - **Radiation Protection Organization** — independent of reactor operations (see Chapter 11).
    - **Review and Audit Function** — provided by an independent **Safety Review Committee** with authority to review facility operations, procedures, and safety performance.
- Minimal on-site staffing is required during **normal shutdown state**; certified operator presence required during certain operational phases (e.g., startup, irradiation cycle initiation, maintenance).
- Organizational structure and responsibilities fully compliant with 10 CFR 50.54 requirements.

Section 12.2 Review and Audit Activities

- Review and audit functions provided by an independent **Safety Review Committee**.

- Committee members will include expertise in:
    - Reactor operations
    - Radiation protection
    - Nuclear engineering or physics
    - Quality assurance
    - External member(s) to ensure independence
- Committee will review:
    - Operating procedures
    - Technical specification changes
    - Event reports
    - Emergency plan updates
    - Security program effectiveness
    - Operator training and qualification program

Section 12.3 Procedures

- SOLO MMR will be operated in accordance with a controlled set of **Operating Procedures**, which will cover:
    - Reactor startup, operation, and shutdown
    - Maintenance and inspection activities
    - Radiation protection and contamination control
    - Emergency response
    - Security procedures
    - Quality assurance
- Procedure change process will comply with 10 CFR 50.59 as applicable.

Section 12.4 Required Actions

- Clear procedures will define required actions in case of:
    - **Violation of safety limits**
    - **Reportable events**
    - **Abnormal conditions**
- Immediate notification of facility management and NRC will be provided as required.
- Events will be reviewed by the Safety Review Committee.

Section 12.5 Reports

- Annual Operating Report to NRC will include:
    - Operating history
    - Event summary
    - Changes made under 10 CFR 50.59
    - Radiation protection summary

  - Waste management summary
- Special reports submitted to NRC for:
  - Safety limit violations
  - Reportable events
  - Security plan changes
  - Changes affecting accident analyses

Section 12.6 Records

- Comprehensive records will be maintained, including:
  - Operations and maintenance logs
  - Radiation surveys
  - Effluent monitoring
  - Waste shipments
  - Training and qualification records
  - Review and audit reports
  - Emergency plan drills and tests
- Record retention will comply with NRC requirements.

Section 12.7 Emergency Planning

- SOLO MMR Emergency Plan will follow ANSI/ANS 15.16-1978 and Regulatory Guide 2.6 guidance.
- Emergency classes and action levels will be defined consistent with:
  - Reactor type
  - Source term (minimal)
  - Site boundary characteristics (small EPZ expected)
- Coordination with local emergency responders will be established.
- Emergency plan will be reviewed periodically and after drills.

Section 12.8 Security Planning

- Security Plan will meet requirements of 10 CFR 73 and RG 5.59 as applicable.
- Security measures consistent with:
  - Category of special nuclear material
  - Limited source term and fuel form
  - Modular transportable reactor configuration
- Safeguards information will be protected per NRC requirements.

Section 12.9 Quality Assurance

- Quality Assurance Program will be based on:
  - RG 2.5 and ANSI/ANS 15.8 guidance.
- Program will cover:

- Design and construction
- Installation and commissioning
- Operations and maintenance
- Procurement and supplier qualification
- Document control
- Audits and corrective action

Section 12.10 Operator Training and Requalification

- Operator training and requalification program will comply with:
  - 10 CFR Part 55
  - ANSI/ANS 15.4-1988 guidance
- Program will cover:
  - Initial training and licensing
  - Biennial requalification
  - Emergency procedures training
  - Simulator or equivalent training for unique MMR features
- Requalification records and program audits will be maintained.

Section 12.11 Startup Plan

- Startup Plan will be implemented for:
  - Initial core loading
  - Core changes
  - Major maintenance affecting core performance
- Plan will include:
  - Subcritical multiplication measurements
  - Criticality approach
  - Reactivity measurements
  - Radiation and effluent measurements
  - Performance verification vs. SAR analyses
- Results will be reported to NRC.

Section 12.12 Environmental Reports

- Environmental Reports will be provided as required under:
  - 10 CFR 51
  - Categorical exclusion or Environmental Assessment process
- SOLO MMR is expected to qualify for streamlined environmental review due to:
  - Low source term
  - No liquid effluents
  - No routine significant gaseous effluents

- Small site impact

2.13 CHAPTER 13: ACCIDENT ANALYSES

NUREG-1537 Expectations: this chapter demonstrates that the reactor design, safety features, and operational limits ensure no credible accident results in unacceptable radiological consequences to the public, the reactor staff, or the environment.

NUREG expects:

- Identification and grouping of initiating events.
- Conservative bounding analysis of the Maximum Hypothetical Accident (MHA).
- Event-specific analyses of limiting events per group.
- Clear demonstration that facility design and operating limits ensure regulatory compliance.

SOLO MMR Design Considerations and Goals:

- Reactor design provides inherent protection against credible accidents.
- Heat removal under accident conditions is fully passive via the Monolith and Integrated Radiological Containment (IRC).
- No TRISO fuel; fuel is PWR-type UO_2 with Zircaloy cladding.
- No on-site spent fuel storage; no complex in-core experimental program.
- No powered emergency cooling or ventilation needed.
- Source term is low and confined within a sealed reactor and IRC.
- Emergency Planning Zone (EPZ) goal is operational boundary.

Recommended Exceptions or Deviations:

Accident Initiating Events

- SOLO MMR will analyze initiating events per NUREG-1537 categories.
- Where categories are not applicable, this will be justified in the PSAR.

Maximum Hypothetical Accident (MHA)

- The MHA will be defined as:
  - Beyond-design-basis mechanical damage to multiple fuel pins resulting in release of fission products within the IRC.
  - Loss of active ventilation and confinement systems.
  - Conservative bounding release assumptions per NUREG and Reg. Guides.
- MHA will bound all credible accident scenarios.

Insertion of Excess Reactivity

- SOLO MMR has inherent negative reactivity feedback.
- Four diverse and redundant shutdown mechanisms are provided (not all of them credited in the licensing space).
- Credible events analyzed will include:
  - Spurious reactivity insertion from control system malfunction.
  - Reactivity insertion from experimental error (limited by Technical Specifications).
- Analysis will demonstrate:
  - No prompt criticality.

    - No core damage.
    - No significant release of fission products.

Loss of Coolant

- Helium coolant
- Passive air convection removes decay heat from the IRC under all conditions (the DHRS).
- Loss of helium is not an accident of consequence:
    - Minimal over pressurization of the IRC.
    - Fuel temperature remains within safe limits.

Loss of Coolant Flow

- Similar effects as the Loss of Coolant.

Mishandling or Malfunction of Fuel

- Not applicable. Fuel is preloaded in the reactor when assembled.

Experiment Malfunction

- SOLO MMR will not support fueled experiments.
- Experiments will be limited by Technical Specifications to prevent adverse reactivity effects.
- Activation of non-fuel materials will be analyzed.
- Release of activated products will be bounded by MHA analysis.

Loss of Normal Electrical Power

- All safety-significant functions rely on **passive systems**.
- Loss of power does not impair decay heat removal or confinement.
- No accident progression from loss of electrical power.

External Events

- The reactor structure (Monolith + IRC) is designed to withstand:
    - Seismic events per NRC and site-specific criteria.
    - Aircraft impact (robustness evaluated as part of licensing).
    - External fires, floods, hurricanes, tornados (analysis included in PSAR).
- Structural integrity and confinement maintained.

Mishandling or Malfunction of Equipment

- No single failure or equipment malfunction can cause fuel damage or release of radioactive material.
- Safety-significant I&C is designed for fail-safe operation.
- Control system and shutdown systems include redundancy and diversity.

Summary Conclusions:

- SOLO MMR is designed to ensure that no credible accident results in unacceptable offsite radiological consequences.
- MHA analysis will demonstrate that even under conservative bounding assumptions:
    - Public doses remain well below 10 CFR 20.1301 limits.

  - The EPZ can be confined to the operational boundary.
- Reactor core and confinement structure provide robust barriers to fission product release.
- Passive decay heat removal ensures core integrity without reliance on active systems.
- The overall accident analysis will fully support NRC expectations.

2.14 CHAPTER 14: TECHNICAL SPECIFICATIONS

NUREG-1537 Expectations: this chapter confirms that the applicant has developed facility Technical Specifications (TS) that will:

- Set operating limits, conditions, and surveillance requirements.
- Ensure public and worker protection under 10 CFR Part 20.
- Control operation of safety-significant systems and functions.
- Address design-specific features and risks.
- Be incorporated into the reactor's operating license per 10 CFR 50.36.

SOLO MMR Design Considerations and Goals:

- SOLO MMR safety is based on:
  - Fully passive accident response.
  - Inherently safe fuel design and core physics.
  - Robust Integrated Radiological Containment (IRC).
  - No reliance on active cooling or confinement during accidents.
  - Very limited experimentation scope; no fueled experiments.
  - Fixed fuel loading and no in-pool fuel handling during operation.
- The Technical Specifications will be designed to support:
  - Clear demonstration of compliance with 10 CFR Part 20 limits.
  - A limited EPZ confined to the operational boundary.
- **Recommended Exceptions or Deviations:**
- **Applicability of ANS/ANS-15.1**
- SOLO MMR TS will be structured consistent with **ANS/ANS-15.1-1990**, but with the following clarifications:
  - Not all ANS/ANS-15.1 sections apply (e.g. sections dealing with complex experiment programs, powered ECCS, forced circulation systems, or in-pool fuel movements).
  - Where sections are not applicable, this will be clearly stated and justified in the TS and PSAR.
- **Content of SOLO MMR TS**

SOLO MMR Technical Specifications will include:

Safety Limits (SL) — to ensure that:

- Peak fuel temperature remains within design limits under all operating conditions.
- Helium temperature and pressure within design limits.
- Reactivity insertion limits ensure no prompt criticality.

Limiting Safety System Settings (LSSS) — for:

- Reactor Protection System (RPS) setpoints that actuate shutdown systems.
- Radiation monitoring and associated alarms.
- No active ECCS required (passive heat removal provided).

Limiting Conditions for Operation (LCO) — addressing:

- Operability of shutdown mechanisms (per diverse, redundant design).
- Operability of radiation monitoring.
- IRC integrity (as verified by surveillance and inspections).
- Limits on experiments (reactivity worth, source term, physical configuration).
- Administrative controls to limit activation product release.

Surveillance Requirements — for:

- Periodic verification of shutdown system performance.
- IRC leak-tightness testing as applicable.
- Calibration of radiation monitors.
- Verification of experimental configuration limits.

Design Features — description of:

- Passive decay heat removal system (DHRS).
- Structural barriers (IRC, Monolith).
- Key features that support inherent safety (negative feedback, core geometry).

Administrative Controls — including:

- Procedures for operator qualification and training.
- Experiment review and approval process.
- Radiation protection program alignment with ALARA.
- Reporting requirements consistent with NUREG guidance.
- Provisions for periodic review and audit.

Emergency Plan Action Levels — tied to TS where needed to support the site boundary EPZ strategy.

Summary Conclusions

- SOLO MMR Technical Specifications will:
    - Be **fully derived from the PSAR safety analyses**.
    - Be structured using ANS/ANS-15.1 as a guide, with justified exceptions.
    - Clearly document the inherent and passive safety features of the design.
    - Provide a transparent, framework consistent with NUREG-1537, and NRC expectations.
    - Support the conclusion that **no credible accident results in public dose exceeding 10 CFR Part 20 limits**.

2.15 CHAPTER 15: FINANCIAL QUALIFICATIONS

NUREG-1537 Expectations: Applicant must demonstrate financial ability to:

- Construct the facility.
- Operate the facility.
- Decommission the facility.

Regulatory Basis:

- 10 CFR 50.33(f), (k) — financial qualifications.
- 10 CFR 50.75 — decommissioning funding assurance.

SOLO MMR Context and Approach:

- Privately funded project by **Terra Innovatum and associated investors**.
- Reactor design is **simple, low-power (5 MWth), no liquid metal or complex systems →** decommissioning and operational costs are significantly lower than large research reactors.
- No DOE fuel program participation.

Financial Ability to Construct

- Construction is fully funded through private investment, as documented in application correspondence and provided to NRC under proprietary request.
- Cost estimates based on:
  - Contracted vendor quotes
  - Site preparation and installation costs.
- No reliance on uncommitted public funds or grants.

Financial Ability to Operate

- Initial 5-year operating costs forecast prepared based on:
  - Fixed-fuel core with 5-year operating life.
  - Minimal operational staffing due to remote monitoring design.
  - No in-core fuel movements or complex experimental program.
- Operations fully funded via established investment funding and projected revenue streams.
- NRC-required statement of financial solvency provided in application package.

Financial Ability to Decommission

- Decommissioning funding assurance provided per 10 CFR 50.75.
- Method: **pre-paid external sinking fund** established by Terra Innovatum prior to fuel load.
- Decommissioning cost estimate based on:
  - NUREG/CR-1756 adjusted for SOLO MMR modular graphite/steel/helium system with no large contaminated primary coolant system.
  - Fuel removal/disposal arrangements contracted with qualified supplier.
- Decommissioning fund size and update provisions provided to NRC under proprietary cover.

Summary

- Terra Innovatum's financial qualifications meet or exceed the requirements of:

  - 10 CFR 50.33(f), (k).
  - 10 CFR 50.75.
- SOLO MMR design and project structure minimize financial risk exposure in construction, operation, and decommissioning phases.
- All required supporting financial documents provided to NRC as part of application and under proprietary control where necessary.

2.16 CHAPTER 16: OTHER LICENSE CONSIDERATIONS

NUREG-1537 Expectations:
Applicant addresses additional license considerations not covered elsewhere in the SAR. Topics include:

- Prior use of reactor components.
- Medical use of the reactor (i.e. BNCT or other human therapy).
- Other license-specific issues.

16.1 Prior Use of Reactor Components

Applicability: Primarily for license renewal or reuse of components from other facilities (fuel, control drives, structural components).

SOLO MMR Context:

- SOLO MMR uses new components manufactured specifically for this project.
- No prior-use reactor components are being employed.
- No reused DOE fuel or equipment.
- No technical specifications required for component prior-use tracking.

16.2 Medical Use of Reactor

Applicability: Only if reactor is used for direct human therapy (BNCT or other).

SOLO MMR Context:

- SOLO MMR is designed as a research/test reactor (RTR) for materials testing and isotope production.
- It is not authorized for direct human therapy under this license.
- No BNCT or human therapy systems or programs are planned.
- If future therapy is proposed, it will require a license amendment (Class 104a) with full SAR update per NUREG-1537 Ch.16 guidance.

16.3 Other License Considerations

- No additional license considerations identified at this time.
- No prior adverse licensing history.
- No reliance on exempt or legacy regulatory treatment.

Summary

- **Prior use of components:** Not applicable to SOLO MMR.
- **Medical use:** Not applicable under current license scope.
- **No additional special license considerations at this time.**

2.17 CHAPTER 17: DECOMMISIONING AND POSSESSION-ONLY LICENSE AMENDEMENTS

NUREG-1537 Expectations: Applicant describes:

- Decommissioning planning and regulatory commitments.
- Preliminary and Final Decommissioning Plans (DP).
- Possession-only license pathway if pursued.

SOLO MMR Design Considerations and Goals:

Section 17.1 Decommissioning

A Decommissioning Report for the SOLO RTR facility will be provided with the Operating License application, consistent with 10 CFR 50.33(k), and will address the content requirements in 10 CFR 50.75(d)(2).

Section 15.3 of this PSAR describes the financial assurances for the availability of funding to support decommissioning.

Section 17.2 Possession-Only License Amendment

This section relates to a possession-only license amendment and is not applicable to the construction and initial operation phases of the SOLO MMR facility.

2.18 CHAPTER 18: HIGHLY ENERICHED TO LOW ENERICHED URANIUM CONVERSIONS

NUREG-1537 Expectations: If applicable, applicant provides the safety analyses and licensing basis to support conversion from highly enriched uranium (HEU) to low-enriched uranium (LEU) fuel, per 10 CFR 50.64.

Section 18.1 Applicability of 10 CFR 50.64 to SOLO MMR

The requirements of **10 CFR 50.64** apply to conversion of existing **HEU-fueled non-power reactors** to **LEU fuel**. SOLO MMR is designed from inception to use **LEU fuel** and will be licensed and operated as an **LEU-fueled Micro-Modular Reactor (MMR)**. Therefore, **no HEU-to-LEU conversion** is required.

The provisions of 10 CFR 50.64 and Chapter 18 of NUREG-1537 are **not applicable** to the initial licensing of SOLO MMR.

Section 18.2 Conversion Planning (Future Considerations)

If, in the future, any change is proposed that would involve fuel enrichment, core design substantially altering the current LEU basis, Licensing actions involving conversion from an HEU core (if applicable in future), then SOLO MMR would submit a conversion proposal and safety analysis consistent with 10 CFR 50.64, NUREG-1537 Chapter 18 and Appendix 18.1 guidance, and applicable NRC regulatory guides.

SOLO MMR will maintain a current SAR and licensing basis documenting continued compliance with the LEU fuel design and no use of HEU fuel.

Summary

- SOLO MMR is designed and will be operated with **LEU fuel** only.
- No conversion from HEU to LEU is applicable.
- No content from NUREG-1537 Chapter 18 applies at this time.
- SOLO MMR will follow applicable NRC requirements if a future conversion were ever proposed.

3. REFERENCES

[1] "Nuclear Energy Institute (NEI) 18-06, Guidelines for Development of a Regulatory Engagement Plan (REP), Revision 0," 2018.

[2] "NUREG-1537, Guidelines for Preparing and Reviewing Applications for the Licensing of a Non- Power Reactor," 1996.

[3] "USNRC, DANU-ISG-2022-01, Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications—Roadmap, Interim Staff Guidance," March 2024.