UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 19, 2024

Mr. George Wilson
Vice President, Regulatory Affairs
TerraPower, LLC
15800 Northup Way
Bellevue, WA 98008

SUBJECT: TERRAPOWER, LLC – PREAPPLICATION READINESS ASSESSMENT REPORT FOR KEMMERER POWER STATION UNIT 1 PRELIMINARY CONSTRUCTION PERMIT APPLICATION

Dear Mr. Wilson:

By letter dated October 31, 2023, TerraPower, LLC (TerraPower) requested that the U.S. Nuclear Regulatory Commission (NRC) staff conduct a readiness assessment of safety and environmental topics prior to the anticipated construction permit (CP) application for Kemmerer Power Station Unit 1 (Kemmerer Unit 1) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23304A148). The Kemmerer Unit 1 facility, utilizing the Natrium sodium fast reactor technology, would be constructed near Kemmerer, Wyoming, under the U.S. Department of Energy's Advanced Reactor Demonstration Program (ARDP) demonstration pathway.

The NRC staff issued a preapplication readiness assessment plan to TerraPower by letter dated December 20, 2023, outlining the proposed approach for conducting the assessment (ML23352A102). On February 22, 2024, the NRC staff completed the readiness assessment. An overview of the assessment, including general observations, is provided below. The detailed results of the assessment are included as an enclosure to this letter.

Assessment Approach

The readiness assessment entrance meeting was conducted on January 10, 2024. The NRC staff briefed TerraPower on the preliminary results of the readiness assessment during an exit meeting that was held on February 22, 2024. The NRC staff conducted the readiness assessment using TerraPower's electronic reading room in accordance with the Office of Nuclear Reactor Regulation's office instruction LIC-116, "Preapplication Readiness Assessment" (ML20104B698). As indicated in LIC-116, readiness assessments provide the NRC staff with opportunities to (1) identify any required information that is missing from an application, (2) identify technical or regulatory issues that may complicate the acceptance or technical reviews of an application, and (3) become familiar with the content of an application, particularly in areas where applicants plan to propose new concepts or novel design features. While readiness assessments provide valuable insights for the NRC staff and prospective applicants regarding preliminary applications, the readiness assessment is not part of the NRC's official acceptance review process and is not intended to determine whether the associated CP

application will be acceptable for docketing, as would be required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 2, "Agency Rules of Practice and Procedure."

To support the NRC staff's assessment, TerraPower made available its preliminary CP application with some exceptions noted below and in the enclosure. Specifically, the preliminary CP application included a 13-chapter preliminary safety analysis report (PSAR), environmental report (ER), quality assurance program description, proposed exemptions from regulatory requirements, and select general information. TerraPower also provided the NRC staff with an overview of the Natrium design and the preliminary CP application on January 11, 2024.

The NRC staff's observations from the readiness assessment are included in the enclosure to this letter. The enclosed observations were assigned one of the following three categories:

- **Category A – PSAR Gap:** Information that the NRC staff perceives to be necessary to meet the information requirements in 10 CFR 50.34(a) and was not provided in the draft PSAR.

- **Category B – Items Requiring Additional Information:** Item that the NRC staff perceives as needing justification or additional information to support a regulatory finding.

- **Category C – Other:** Observations that should be addressed or considered by TerraPower to support the development of a quality application. If un-addressed, together, they could negatively impact the NRC staff's review of the application, including resources and schedule.

Consistent with the readiness assessment plan, the NRC staff shared observations with TerraPower through daily briefs and during real-time discussions. During these engagements, TerraPower offered initial feedback on how it planned to address the observations (e.g., updating its PSAR or ER, making additional information available during the application review phase as part of a targeted audit). The NRC staff found TerraPower's feedback helpful to contextualize observations and considered this input when categorizing observations. The NRC staff did not identify any Category A items and 30 of the identified items were Category B with the remainder in Category C.

General Observations

In addition to the specific observations included in the enclosures to this letter, the NRC staff made several general observations regarding TerraPower's preliminary CP application including the following:

- TerraPower's preliminary CP application generally contained the information that the NRC staff would expect with a formal submittal, with some exceptions as noted below and in the enclosures. An initial review of the holistic use of the Licensing Modernization Project (LMP) methodology[1] as it was represented in the preliminary CP application provided the NRC staff and TerraPower with valuable learning opportunities.

[1] This methodology is described in Nuclear Energy Institute (NEI) 18-04, Revision 1, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development" (ML19241A472), as endorsed by Regulatory Guide (RG) 1.233, "Guidance for a

- Relative to the use of the LMP methodology, the NRC staff noted that this framework includes novel processes for identifying the safety classification for structures, systems, and components (SSCs) and for developing resulting special treatment requirements for those SSCs. The NRC staff identified that further information may be needed to clarify how special treatments are applied to SSCs, which components support the different safety functions, and how they accomplish that role.

- The NRC staff observed that TerraPower made several references to technical reports and licensing topical reports (TRs) that the NRC staff has not yet reviewed or that are currently under review. For example, several TRs and technical reports referenced in Chapter 3, "Licensing Basis Events," of the PSAR have not been provided to or reviewed by the NRC staff. References to reports for which the reviews have not yet been completed represents a potential CP application review schedule risk. This risk is particularly prevalent for TRs that TerraPower has not yet submitted to the NRC staff, but otherwise intends to submit to support the CP application.

- TerraPower's draft PSAR structure is generally aligned with Nuclear Energy Institute (NEI) 21-07, "Technology Inclusive Guidance for Non-Light-Water Reactors, Safety Analysis Report Content for Applicants Using the NEI 18-04 Methodology" (ML22060A190). However, the NRC staff identified several areas, described in the enclosed observations report, where additional information or clarification would help facilitate an effective forthcoming CP application review.

- The consideration of uncertainties is a relevant factor in the NEI 18-04 methodology and should be addressed for both frequency and consequences of licensing basis events. TerraPower included uncertainties in some of the evaluations in the draft PSAR. Additional information may be needed to describe how some of these uncertainties were determined.

- Different sections of the PSAR, particularly in Chapter 7, "Descriptions for Safety-Significant SSCs," provided varying levels of detail. The CP application will need to consistently contain a level of detail that is sufficient to clearly provide "the relation of the design bases to the principal design criteria" as required by 10 CFR 50.34(a)(3)(ii).

- The draft PSAR included limited "information relative to materials of construction… sufficient to provide reasonable assurance that the final design will conform to the design bases with adequate margin for safety" as required by 10 CFR 50.34(a)(3)(iii). Based on engagements with TerraPower throughout the readiness assessment on this topic, the NRC staff anticipates that additional preliminary information will be available, including in the PSAR, to support the NRC staff's acceptance review and detailed technical review in this area.

Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (ML20091L698)

Next Steps

The NRC staff expects that TerraPower will review the enclosed observations to inform its forthcoming CP application for Kemmerer Unit 1 (ML23214A199).

If you have any questions regarding this matter, please contact Mallecia Sutton, at (301) 415-0673 or via email at Mallecia.Sutton@nrc.gov.

Sincerely,

{{signature:mks1}}

Mohamed Shams, Director
Division of Advanced Reactors and Non-Power Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Project No. 99902100

Enclosure:
Observations Report

cc: TerraPower Natrium
via GovDelivery

SUBJECT: TERRAPOWER, LLC – PREAPPLICATION READINESS ASSESSMENT REPORT FOR KEMMERER POWER STATION UNIT 1 PRELIMINARY CONSTRUCTION PERMIT APPLICATION DATED: MARCH 19, 2024

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ADAMS Accession Nos.: ML24060A227 **NRR-106**

OFFICE	NRR/DANU/UAL1: PM	NRR/DANU/UAL1: LA	NRR/DANU/UTB2: BC
NAME	MSutton	DGreene	CdeMessieres
DATE	03/07/2024	03/11/2024	03/12/2024
OFFICE	NRR/DANU/UAL1: BC	NRR/DANU: D	
NAME	WJessup (SDevlin-Gill for)	MShams	
DATE	03/13/2024	03/19/2024	

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TerraPower Construction Permit Application Readiness Assessment Observations Report – Non-Proprietary

The following definitions are used to categorize each observation:

Category A: PSAR Gap
Information that the U.S. Nuclear Regulatory Commission (NRC) staff perceives to be necessary to meet the information requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.34(a) and was not provided in the draft preliminary safety analysis report (PSAR).

Category B: Items Requiring Additional Information
Item that the NRC staff perceives as needing justification or additional information to support a regulatory finding.

Category C: Other
Observations that should be addressed or considered by TerraPower to support the development of a quality application. If unaddressed, together, they could negatively impact the NRC staff's review of the application, including resources and schedule.

ID	Chapter	Section	Observation	Category
1-1	1	1.4, "Conformance with Regulatory Criteria and Referenced Material"	Table 1.4-2, "Topical Report," provides a list of the topical reports (TRs) referenced in the PSAR. The NRC staff observes that of the 14 TRs listed, only 12 have been submitted to the NRC for review and only one of those has received an NRC safety evaluation (SE). The NRC staff also notes that two of the TRs were submitted recently and in parallel with the readiness review (in March 2024) and have not yet been accepted for review. In addition, the NRC staff notes that some TerraPower TRs are interconnected (i.e., approval of one TR is contingent upon the approval of one or more other TRs). Finally, most of the listed TRs pertain to key topics that have the potential to affect numerous analyses in the PSAR if modified during the review process. The NRC staff observes that the timing and interconnectedness of these TR reviews may impact the construction permit (CP) application review schedule. This risk is particularly acute for the two TRs that have not yet been submitted, the two TRs that were submitted in March 2024 but have not yet been accepted for review, and the TRs that depend on the review and approval of other TRs.	B

ID	Chapter	Section	Observation	Category
1-2	1	1.4, “Conformance with Regulatory Criteria and Referenced Material”	The PSAR should include information adequate to enable the NRC staff to confirm that the limitations and conditions in referenced NRC TR SEs have been addressed.	C
1-3	1	1.4, “Conformance with Regulatory Criteria and Referenced Material”	Section 1.4.2, “Topical Reports and Technical Reports,” states that "technical reports identified in Table 1.4-3 are reviewed as part of the application." The subjects represented in Table 1.4-3, “Technical Reports,” include methodologies that are used to analyze most of the events expected to be described in the PSAR, and the NRC staff have had limited preapplication interaction on some of these subjects. These reports were not made available to the NRC staff as part of the readiness assessment and should be provided as part of the CP application.	B
1-4	1	1.4, “Conformance with Regulatory Criteria and Referenced Material”	Regarding page 1.4-23, Table 1.4-1, “Conformance with Regulatory Guides,” Row 3, for Regulatory Guide (RG) 1.189, “Fire Protection for Nuclear Power Plants” (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23214A287), the last column of the table "section(s)" does not reflect all the PSAR sections that discuss RG 1.189. The last column of Table 1.4-1 should be appropriately updated to include all PSAR sections that discuss this RG.	C
2-6	2	2.3.3.1.3, “ALOHA Dispersion Model”	The basis for information on hazardous materials (e.g., ammonium hydroxide and propane) potentially transported on US-189 should be provided in the PSAR. For example, clarify the basis for the transport quantities in Table 2.3-d, “Transportation Routes – Highway Information Summary.”	C
2-13	2	2.3.3.1.6, “Evaluation of Aircraft Hazards”	TerraPower applied the screening criteria of NUREG−0800, Section 3.5.1.6, “Aircraft Hazards” (ML100331298) to determine whether a detailed analysis was necessary. While it appears that only one of the three screening criteria was met, to preclude a detailed analysis, all three criteria must be met. TerraPower should update the PSAR to include this detailed analysis or justify that the other two criteria are also met.	B

ID	Chapter	Section	Observation	Category
2-15	2	2.3.3.1.6, "Evaluation of Aircraft Hazards"	Provide the basis for assuming only General Aviation aircraft transit through V4 and Q122. Q122 is an area navigation (RNAV) route, meaning only aircraft with global positioning systems (GPS) equipped navigation systems can use this route. Clarify in the PSAR if the General Aviation aircraft that use the Q122 route have RNAV navigational equipment, as given in Table 2.3-q, "Pipeline Toxicity Hazards Results."	C
2-20	2	2.6.4.2.7, "Discontinuity Properties"	Clarify in the PSAR whether the bedding plane discontinuity set is the only one present in the rock mass at the reactor site and whether any other joints, small-scale faults, or folds are within the site.	C
2-23	2	2.6.4.2.7, "Discontinuity Properties"	It is not clear how joint roughness number (Jr), joint alternation number (Ja), and joint roughness coefficient were measured from the cores obtained from borings. In addition, it is not clear how the basic friction angle φ_b and residual friction angle φ_r were measured. Uncertainties introduced in each parameter affect the rock mass strength and rock mass modulus values estimated for use in the design. The PSAR discussion on this topic should be clarified to account for these considerations.	C
2-24	2	2.6.4.2.8, "Rock Mass Properties"	Estimation of Jr and Ja introduces significant uncertainties (see Tables 3, "Jr – values," and 4, "Ja – values," in PSAR reference 2.6.4-i). Using J_r/J_a to estimate the Geological Strength Index to estimate the mechanical strength of the rock mass using Equation (3) of Hoek et al. (PSAR reference 2.6.4-ii) will introduce another layer of uncertainties. Hoek et al. indicate that Equation (3) is not a good fit of the data they used to derive the equation, but the equation may be acceptable for common engineering problems. Provide updates to the PSAR with appropriate justification for these considerations.	C

ID	Chapter	Section	Observation	Category
2-32	2	2.5.1.2, "Probable Maximum Flood [PMF] on Streams and Rivers"	TerraPower should provide updates to the PSAR regarding the following items: A) TerraPower evaluates the site-specific PMF on streams using a combination of Hydrologic Engineering Center (HEC), Hydrologic Modeling System (HMS), and River Analysis System (RAS) models. Explain how the HEC-HMS subbasin outflows are used as input to HEC-RAS channels. Especially, clarify how the HEC-RAS upstream boundary conditions are set up for the HEC-RAS channel sections which are located within each HEC-HMS subbasin. B) The HEC-HMS was set up with four subbasins: However, the East and West subbasins, which cover approximately 67 percent and 27 percent of the entire basin, respectively, are highly channelized so that they could be routed better by more refined subbasins. Discuss a potential bias (underestimation) in PMF estimates due to not fully accounting for detailed channel networks on these subbasins. C) TerraPower states that a unit hydrograph method in HEC-HMS is used to transform rainfall to runoff. However, the models have not been calibrated and verified with observed data. Discuss the applicability of increasing the peak and decreasing time to peak as recommended by NUREG/CR-7046, "Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America" (ML11321A195).	C
2-33	2	2.5.1.2.9, "Sedimentation and Erosion Impact"	Add a discussion in the PSAR regarding the potential for sediment build-up (soil and debris) on the channels near the plant site due to slowing and merging effects of channel flows, especially for the combined events of big flood and dam failure as addressed in PSAR Section 2.5.1.3, "Potential Dam Failures."	C
2-34	2	2.5.3.2.4, "Transport in Groundwater"	Subsection 2.5.3.2.4.2, "Parameter Assignment," states that site-specific distribution coefficient (Kd) values to evaluate the capability of radionuclide transport in groundwater are not yet available but are being determined by Argonne National Laboratory. Please modify the PSAR to address when the site-specific Kd values are available to the NRC staff and what radionuclide species are considered in these Kd values.	C

ID	Chapter	Section	Observation	Category
2-35	2	2.4.1.3.2, “Extreme Winds”	Table 2.1-a, “Kemmerer Unit 1 Site-Specific External DBHLs [Design Basis Hazard Levels],” includes the design wind speed of 110 miles per hour and references PSAR Section 2.4.1.3.2. Include a reference or discussion in PSAR Section 2.4.1.3.2 on how this wind speed was determined.	C
2-36	2	2.4.1.4, “Meteorological Data for Evaluating the Ultimate Heat Sink,” and 2.4.1.5, “Design-Basis Dry and Wet Bulb Temperatures”	Section 2.4.1.4 and 2.4.1.5 discuss the 0.4%, 2%, 15%, 100%, and the 100-year maximum and minimum dry and wet bulb temperatures and refer to them as design-basis temperatures. Table 2.1-a only lists the 0.4% maximum and minimum temperatures as site characteristics. NUREG-0800, Section 2.3.1, “Regional Climatology,” states that site characteristics should include, "Ambient temperature and humidity statistics (e.g., 2% and 1% annual exceedance and 100-year maximum dry bulb temperature and coincident wet bulb temperature; 2% and 1% annual exceedance and 100-year maximum wet bulb temperature (non-coincident); 98% and 99% annual exceedance and 100- year minimum dry bulb temperature) for use in establishing heat loads for the design of normal plant heat sink systems, post-accident containment heat removal systems, and plant heating, ventilating, and air conditioning systems." Update the PSAR to include these additional site characteristics, as appropriate.	C
2-40	2	2.4, “Regional Climatology, Local Meteorology, and Atmospheric Dispersion”	Section 2.4.5.1, “Preoperational Meteorological Measurement Program,” describes the three years or onsite data collected at the Naughton Power Plant meteorological tower. Since this data will provide the basis and primary input for the ARCON96 and XOQDOQ atmospheric dispersion modeling, TerraPower should modify the PSAR to include this data in the format of RG 1.23, “Meteorological Monitoring Programs for Nuclear Power Plants” (ML070350028) Appendix A, “Recommended Format for Hourly Meteorological Data to Be Placed on Electronic Media.”	C
2-41	2	2.4.4.1.1, “ARCON,” and 2.4.4.2, “Long-Term Diffusion Estimates”	To facilitate the NRC staff's review of the ARCON96 and XOQDOQ atmospheric dispersion modeling analysis, the NRC staff will engage with TerraPower to obtain access to the input and output files for each of the model runs in ASCII text format.	C

ID	Chapter	Section	Observation	Category
2-42	2	2.6.3, “Surface Deformation”	PSAR Section 2.6.3 only considers non-seismic sources of surface deformation. The PSAR should be modified to include seismic sources with the potential to deform the surface. If the potential for seismic sources to deform the surface are discussed elsewhere in the PSAR, appropriate references to those sections should be included in Section 2.6.3.	C
2-43	2	7.6.8, “Anticipatory Automatic Seismic Trip System”	Provide an evaluation of the seismic instrumentation requirements in the PSAR (per NUREG-0800 Section 3.7.4, “Seismic Instrumentation,” as referenced in DANU-ISG-2022-01, “Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications—Roadmap” (ML22048B546)). This evaluation should also include justification for any differences between the proposed seismic instrumentation program and the guidelines of RGs 1.12, “Nuclear Power Plant Instrumentation for Earthquakes” (ML17094A831) and 1.166, “Pre-Earthquake Planning, Shutdown, and Restart of a Nuclear Power Plant Following an Earthquake” (ML19266A616). Discussion: PSAR Table 1.4-1 indicates full conformance to RG 1.12. However, the NRC staff reviewed the applicant’s proposed seismic monitoring system in PSAR Section 1.1.4.3.16, “Seismic Monitoring System,” and could not confirm its conformance with RG 1.12; this section did not contain any comparisons with RG 1.12 or RG 1.166 as specified by NUREG-0800 Section 3.7.4, “Seismic Instrumentation.” Furthermore, TerraPower did not include sufficient information on its proposed instrumentation program (i.e., instrumentation type, location, operability, characteristics, installation, activation, remote indication, and maintenance) to assure 1) that the equipment will perform as required, 2) that recorded data are comparable with the data used in the design of the facility, and 3) that exceedance of the operating basis earthquake (OBE) can be determined. Basis: 10 CFR Part 50, Appendix S, “Earthquake Engineering Criteria for Nuclear Power Plants,” requires that suitable instrumentation be provided to promptly evaluate the seismic response of nuclear power plant features important-to-safety after an earthquake. Appendix S also requires shutdown of the nuclear power plant if vibratory ground motion exceeding that of the OBE occurs.	C

ID	Chapter	Section	Observation	Category
3-1	3	3.3.2, “Licensing Methodology for AOO, DBE, BDBE”	The methods used to analyze anticipated operational occurrence (AOOs), design-basis event (DBEs), and beyond-design-basis event (BDBEs) with and without radiological releases, respectively, are in PSAR Sections 3.3.2.1, “In-Vessel AOOs, DBEs, and BDBEs without Radiological Release,” and 3.3.2.2, “Ex-Vessel AOOs, DBEs, and BDBEs, and AOOs, DBEs, and BDBEs with Potential Radiological Release.” Both sections note that the methods used to analyze the events are “similar” to those used for the corresponding design-basis accident (DBAs), including the use of the same codes for the analysis. TerraPower should modify the PSAR to provide sufficient detail for the NRC staff to understand the differences between the AOO, DBE, BDBE methodologies and DBA methodologies. Additionally, no reports (technical or topical) are referenced to provide details on the AOO, DBE, BDBE methodologies and the applicant should provide these references.	B
3-2	3	3.5.1, “Summary Evaluation of AAOs, DBEs, and BDBEs”	Section 3.2.1, “Summary Evaluation of AOOs, DBEs, and BDBEs,” of NEI 21-07, “Safety Analysis Report Content for Applicants Using the NEI 18-04 Methodology,” (ML21250A378) provides a list of information that should be included in the licensing basis event (LBE) summary table. Some of this information is provided in Tables 3.5.1-a “Summary of AOOs,” 3.5.1-b “Summary of BDBEs,” and 3.5.1-c “Summary of BDBEs.” However, the tables do not identify risk-significant LBEs, nor do they identify high-consequence BDBEs, as requested by NEI 21-07. TerraPower should modify the PSAR to include the information needed to make these identifications. This information may be available on the frequency-consequence (F-C) target curves provided in Figures 3.5.1-a “At-Power Hazard Events with Uncertainty Bands,” and 3.5.1-b “Low Power Shutdown Events with Uncertainty Bands,” but these results should be mapped to the events listed in the tables. TerraPower should provide this information to be consistent with NEI 21-07, which indicates that additional information should be provided for risk-significant LBEs and high-consequence BDBEs.	B

ID	Chapter	Section	Observation	Category
3-3	3	3.6, “Anticipated Operational Occurrences,” through 3.8, “Beyond Design Basis Events”	The LBE narratives generally consist of high-level descriptions of the initiating event and the end-state in terms of key attributes (e.g., reactivity, decay heat removal). The NRC staff’s overall observation is that the LBE descriptions do not contain enough detail to clearly identify the entire event sequence and the evolution of the system state throughout the transient. More specifically, NEI 21-07 Sections 3.3.1, “AOO-1,” 3.4.1, “DBE-1,” and 3.5.1, “BDBE-1,” indicate that the event narratives (regardless of category) should describe: • initial plant conditions and plant operating state; • radionuclide source and whether it involves multiple reactors and sources; • initiating events covered in the family; • characterization of the responses of SSCs that provide probabilistic risk assessment (PRA) safety functions (PSFs); • operator actions that perform PSFs; • identification of whether there is a release; and • definition of the safe, stable end-state The examples provided in the PSAR generally seem to identify the radionuclide source, the initiating event, and whether there is a release. However, the PSAR should be modified to include: a. Initial conditions for each transient. b. Characterization of the responses of the SSCs that provide PSFs involved in the prevention or mitigation of each event. c. In addition to the generic definition of the safe and stable end-state in Section 3.4.3, “Safe, Stable, End States,” a quantitative demonstration that the safe and stable end-state is met (for example, by providing the final temperature at the termination of the transient).	B
3-5	3	3.7, “Design Basis Events”	Section 3.4.1, “DBE-1,” of NEI 21-07 indicates that additional information should be provided for the most limiting DBEs that are used to map to DBAs, including "plots of responses of key plant parameters needed to characterize the plant response" and "the mean, 5th, and 95th percentile values of the estimated frequency." This information is needed to "enable a comparison of the realistic behavior of the plant (DBE) to the conservatively analyzed behavior." TerraPower should modify the PSAR to include the information requested by NEI 21-07.	C

ID	Chapter	Section	Observation	Category
3-6	3	3.2, “Licensing Methodology for Mechanistic Source Term”	The PSAR should identify where the list of bullets on page 3.2-1 comes from, since these effectively represent requirements imposed on the mechanistic source term (MST) analysis. The bullets appear to generally map to the high-level requirements provided in Table 4.3.16.1-1 of American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) RA-S-1.4-2021, “Probabilistic Risk Assessment for Advanced Non-Light Water Reactor Nuclear Power Plants,” but do not exactly match. For example, ASME/ANS RA-S-1.4-2021 notes that any uncertainties that are not quantified must be addressed by sensitivity analysis, but this is not reflected in the PSAR.	C
3-7	3	3.2, “Licensing Methodology for Mechanistic Source Term”	Section 2.2, “Source Term,” of NEI 21-07 notes that for a CP application, "the PSAR should describe the technical areas that require research and development to confirm the assumptions and methodologies used to present the mechanistic source term." The issue of research and development (R&D) needed to support the MST methodology is not apparently addressed in PSAR Chapter 2, “Site Information,” nor is it addressed in PSAR Chapter 13, “Research and Development.” Please clarify this in the PSAR.	C
3-9	3	3.3.3, “Licensing Methodology for Major Accident”	Ensure that the Major Accident assumptions on event scenario, source term, consequence analysis, and dose results are clearly identified in the PSAR. Include information in the PSAR regarding if the Major Accident is analyzed similarly to the DBA (i.e., only credit safety-related (SR) SSCs).	C
3-10	3	3.3.3, “Licensing Methodology for Major Accident”	It is not clear from PSAR Section 3.3.3 whether only internal event BDBEs were included in consideration for the Major Accident. Update the PSAR to clearly identify which BDBE was chosen as the basis for the Major Accident deterministic analysis.	C
3-13	3	3, “Licensing Basis Events”	TerraPower should modify the PSAR to provide a clear description of the method for performing uncertainty analyses and in particular for determining consequence uncertainties, which are significant to the determinations made under NEI 18-04. It is clear that some kind of consequence uncertainty was evaluated based on the F-C figures provided in Section 3.5, but it is not clear how these values were determined.	B

ID	Chapter	Section	Observation	Category
3-14	3	3, “Licensing Basis Events”	Modify the PSAR to clarify the descriptions of the plant initial condition for transients. The existing descriptions in the PSAR are not clear either at a generic level in Sections 3.1, “Probabilistic Risk Assessment,” through Section 3.3, “Licensing Methods for Evaluation of LBEs,” or in the specific analysis results presented in Section 3.6, “Anticipated Operational Occurrences,” through Section 3.9, “Desing Basis Accidents.” This information is necessary for the NRC staff to determine the acceptability and adequacy of the LBE analyses in general. In particular, TerraPower should clearly discuss how the DBA assumptions (e.g., initial conditions, system availability) are appropriately informed by the limiting DBE, including consequence uncertainty analysis (see Observation 3-13, above), as discussed in NEI 21-07 Section 3.6, “Design Basis Accidents.”	B
3-15	3	3.4.1, “Application for NEI 18-04 Methodology”	This section indicates that the PRA model includes "all known event initiators," including both internal and external hazards. Clarify the PSAR description of the scope, as it is the NRC staff's understanding that the PRA for the CP application does not include external hazards.	C
3-16	3	3.4.3, “Safe, Stable End States”	TerraPower should modify the PSAR to include the basis for the end-state criteria discussed in this section. a. Clarify and provide additional justification in the PSAR why a critical condition (k_{eff}=1.0) is an acceptable end-state criterion for BDBEs. b. Clarify and provide additional justification in the PSAR for the 625°C peak cladding temperature value and the relationship with criteria in referenced TRs. The NRC staff notes that 625°C may be acceptable for an extended period of time but not indefinitely; at some point the fuel elements may no longer be capable of meeting their design bases. c. Temperature and reactivity are related, so for transients with temperature decreasing and k_{eff} close to or at 1.0, there may be an issue with recriticality, depending on which SSCs are available to mitigate the transient. In these cases, the PSAR should indicate what would be used as the basis for determining when to stop the analysis.	C

ID	Chapter	Section	Observation	Category
3-18	3	3.3.1.1, “In-Vessel DBAs without Radiological Release”	Update the PSAR to address the following: Section 3.3.1.1 notes that Sections 1 through 7 of TP-LIC-RPT-0004, “Design Basis Accident Methodology for In-Vessel Events without Radiological Release” (ML23272A260), are incorporated by reference. This TR was submitted to the NRC staff with eight sections, and it is not clear why Section 8, “Conclusions and Limitations,” is not incorporated by reference. References to different sections in this TR do not appear to correspond to the information in the TR submitted for NRC review. For example, the PSAR indicates that requirements for model adequacy as demonstrated through assessments are discussed in TP-LIC-RPT-0004 Section 6, “Natrium Sample Analysis Results”; in the version submitted to the NRC staff, Section 6 is titled “Natrium Sample Analysis Results.”	C
3-19	3	3.3.2, “Licensing Methodology for AAO, DBE, and BDBE”	Update the description of the LBE licensing methodology in PSAR 3.3.2 such that it has a subsection on the LBE radiological consequences methodology such as was provided for the DBAs in PSAR 3.3.1.4, “Radiological Consequences.”	C
3-21	3	3.12, “Nuclear Design”	The NRC staff typically sees reactor vessel fluence calculational methodology with other nuclear design methods (see, for example, Section 4.3, “Nuclear Design,” of NUREG-0800 (ML070740003)). However, this is not provided. PSAR Section 7.1.2, “Reactor Enclosure System,” relies on fluence calculations as the basis for demonstrating that "materials remain within degradation limits with margin.” Please modify the PSAR to provide the reactor vessel fluence calculational methodology or explain how this demonstration will be justified.	B
3-22	3	3.13.3, “Codes Used in System Evaluation”	Section 3.13.3 mentions the use of STAR-CCM+, a computational fluid dynamics (CFD) tool, to “characterize the pressure drop, heat transfer, and thermal mixing used to assess the thermal hydraulic performance of core assemblies." Due to the complexity of CFD analyses; challenges with verification, validation, and uncertainty quantification of CFD tools; and limited applicable precedent, the NRC staff's review of TerraPower CFD analysis may have an effect on the Natrium review schedule.	C

ID	Chapter	Section	Observation	Category
3-23	3	3.14, “Criticality Safety of Fresh and Spent Fuel”	The PSAR indicates that either the approach provided in NUREG/CR-6698, “Guide for Validation of Nuclear Criticality Safety Calculational Methodology,” (ML050250061) or the Whisper software may be used to calculate the upper subcritical limit (USL). However, there is no clear methodology that indicates how TerraPower would choose whether to use NUREG/CR-6698 or Whisper. Additionally, Whisper represents a new review and approval by staff if utilized by TerraPower. The document referenced for Whisper USL calculations, while useful as a user manual, does not appear to provide sufficient detail on how Whisper performs USL calculations. Please update the PSAR with a discussion about which methodology will be used to calculate the USL and the appropriate justification for TerraPower’s choice.	C
3-24	3	3.11, “Fuel System Design”	Fuel performance methodologies are not discussed in sufficient detail in NAT-2806, “TerraPower, LLC (TerraPower) Natrium Topical Report: Fuel and Control Assembly Qualification” (ML23025A409). From PSAR Table 1.4-3, “Technical Report,” it would appear there are other technical reports that may cover or closely interface with this technical area, including technical reports related to fuel assembly design analysis, steady state core modeling, and core seismic analysis. However, because these documents have not yet been provided, the NRC staff cannot judge at the present time whether there will be sufficient information to support the PSAR in this area. Please update the PSAR with a discussion, as necessary, of fuel assembly design analysis, steady state core modeling, and core seismic analysis.	B
3-25	3	3.11, “Fuel System Design”	From a review of NAT-2806, it is not clear how uncertainties in fuel thermal-mechanical performance are characterized and incorporated into TerraPower safety analyses, including the PRA and associated consequence analyses. Please update the PSAR with a discussion of uncertainties or an appropriate reference.	B
3-26	3	3.11, “Fuel System Design”	Section 5.5.3, “Other Core Materials,” of NAT-2806 lists materials other than HT9 and U-10Zr that may be used in the reactor core, including SS304, SS316, and Inconel 718. Clarify in the PSAR where and how these materials will be used and the plans to consider their performance in a sodium environment.	B

ID	Chapter	Section	Observation	Category
3-27	3	3.11, “Fuel System Design”	NAT-2806 contains very little coverage on fuel welds. In particular, the NRC staff is interested in how TerraPower plans to ensure weld quality and how corrosion characteristics of the cladding in the heat affected zone will be considered.	B
3-28	3	3, “Licensing Basis Events”	Section 3, "Methodologies, Analyses, and Site Evaluations," of RG 1.253, “Guidance for a Technology-Inclusive Content of Application Methodology to Inform the Licensing Basis and Content-of-Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors” (ML23194A194), endorses NEI 21 07, Revision 1. Section 2.4, "Other Methodologies and Analyses," of NEI 21-07, states that “The applicant should describe the analytical methodology and the key inputs and assumptions used. The applicant should address the applicability of the analytical methodology to the specific analysis, including a discussion of supporting data. Details of the analyses should be in plant records and available for regulatory audits.” Regarding the "Two-Step Licensing (CP Content)," NEI 21-07 states that an applicant should describe the technical areas that require R&D to confirm the assumptions and methodologies used to present the adequacy of the design. Update the PSAR to clearly identify the methodologies, key inputs, and associated assumptions, such as civil and structural analysis, piping analysis, electrical load analysis, stress analysis, etc., where applicable. Additionally, clarify whether the R&D was utilized to ensure design adequacy, and if so, specify the technical areas involved.	C
3-29	3	3, “Licensing Basis Events”	Insert the term CP-stage, Operating License (OL)-stage, or post-fuel load in front of the term "PRA" to indicate which PRA is preferred.	C

ID	Chapter	Section	Observation	Category
3-30	3	3.1, “Probabilistic Risk Assessments”	Draft RG DG-1413. DG-1413 "Technology-Inclusive Identification of Licensing Events for Commercial Nuclear Plants" states that an acceptable technology-inclusive approach for identifying commercial nuclear plant licensing events should involve conducting a systematic and comprehensive search for initiating events (IEs). In addition, Section A "Introduction" of DG-1413 states that "The identification of a comprehensive set of licensing events is fundamental to the safe design of commercial nuclear plants… Accordingly, it is essential to identify a comprehensive set of licensing events that considers all radiological sources at the plant, all internal and external hazards, and all plant operating states." The PSAR does not discuss the search for IEs. It does not provide a list of postulated IEs and the associated basis for bounding, screening, or grouping IEs. It is uncertain whether the external hazards outlined in Sections 2.1 and 6.1.1, particularly in Table 2.1-1 and Table 6.1.1-a, are comprehensive and thorough. Please update the PSAR to include a more detailed discussion on the identification and completeness of IEs.	C
3-31	3	3.1, “Probabilistic Risk Assessments”	RG 1.253. Appendix A, Section A.2 "General," states that consistent with NEI 21-07, Revision 1, Section 2.1.1, the CP applicant should clearly document in the PSAR the essential assumptions made in developing the LMP-based safety analysis, which should include those assumptions relevant to the probability and consequence models, and the selection of elements to be incorporated in the CP PRA models. The essential assumptions mentioned above should be provided in the PSAR.	C
3-32	3	3.1, “Probabilistic Risk Assessments”	NEI 18-04 notes that risk importance measures such as risk reduction worth can be used to gain additional insights into the significance of particular events and SSCs. In accordance with RG 1.233, which endorses NEI 18-04, the PSAR should include the importance measures generated from the PRA.	C

ID	Chapter	Section	Observation	Category
3-33	3	3.1, “Probabilistic Risk Assessments”	RG 1.253, appendix A, Section A.7 "PRA Documentation," states that the PSAR should address how a PRA configuration control program has been used to ensure the CP PRA represents the as-designed, as-to-be-built, as-to-be-operated facility described in the CP application and how the PRA configuration control program will ensure that the PRA supporting the OL application will represent the as-built, as-to-be-operated facility; account for all radiological sources, all hazards, and all plant operating states. Provide additional information on the PRA configuration control program, consistent with the appendix A positions summarized above, in PSAR Section 3.1.	C
3-34	3	3.1.1, “Overview of PRA”	RG 1.253. Appendix A of RG 1.253 states that "The CP applicant should consider the near-term and long-term uses of the PRA as the PRA is developed to help ensure that it will be acceptable to support these uses." The PSAR should include a list of programs and risk-informed applications that use CP-stage PRA and PRA insights.	C
3-35	3	3.3, “Licensing Methodology for AOO, DBE, and BDBE”	RG 1.233 states that "when the uncertainty bands defined by the 5th percentile and 95th percentile of the frequency estimates straddles a frequency boundary, the LBE is evaluated in both LBE categories." However, Section 3.3.2 of the PSAR, "Licensing Methodology for AOO, DBE, and BDBE," states that "AOOs, DBEs, and BDBEs are selected and categorized based on the mean event sequence frequency of occurrence per plant year for a given event." Update the PSAR to ensure conformance with RG 1.233 and NEI 18-04 as it pertains to uncertainty.	B
3-38	3	3.4.1, “Application of NE 18-04 Methodology”	NEI 18-04 states that "An LBE is considered within the F-C Target when a point defined by the upper 95th percentile uncertainty on both the LBE frequency and dose is within the F-C Target." Section 3.4.1 of the PSAR "Application of NE 18-04 Methodology" provides the mean event sequence frequencies of occurrence per plant-year for AOOs, DBEs, and BDBEs; however, it lacks consideration of uncertainty bands. Therefore, the PSAR should be updated to address the treatment of uncertainties. Note that the uncertainty bands were included in Figures 3.5.1-a and 3.5.1-b without accompanying discussion.	B

ID	Chapter	Section	Observation	Category
3-39	3	3.5.1, “Summary Evaluation of AOOs, DBEs, and BDBEs”	Figure 3.5.1-a "At-Power Hazard Events with Uncertainty Bands," in Section 3.5.1, "Summary Evaluation of AOOs, DBEs, and BDBEs," shows the plotting of seismic sequences, straight winds sequences, tornado sequences, internal flood sequences, and sodium fire sequences. However, Table 3.1.1-b, "Hazards that Proceed to Analysis," indicates that the aforementioned hazards are addressed by DBHLs. Therefore, additional information about Table 3.1.1-b and Figure 3.5.1-a is necessary for the NRC staff review. Details about seismic sequence (family) that exceed the F-C Target, and associated treatment are also needed.	B

3-40	3	3.5.1, “Summary Evaluation of AOOs, DBEs, and BDBEs”	Figure 3.5.1-b "Low Power Shutdown Events with Uncertainty Bands," in Section 3.5.1, "Summary Evaluation of AOOs, DBEs, and BDBEs," shows the plotting of low power shut down (LPSD) sequences (families). However, Section 3 on PRA and other sections in the PSAR do not address LPSD, except the screening of "Other Plant Operating States" in Table 3.1.1-a. Furthermore, in Sections 3.6, 3.7, and 3.8, the discussion of LBEs identifies only 8 LPSD events, whereas Figure 3.5.1-b displays several dots. Clarify the discrepancies between Figure 3.5.1-b and the information provided in the aforementioned sections. Address any inconsistencies to ensure coherence in the LPSD analysis.	B
3-41	3	3.5.2, “Summary of DBAs”	Table 3.5.2-a "Summary of DBAs," in Section 3.5.1, "Summary Evaluation of DBAs," identifies the DBAs but does not indicate whether these DBAs are associated with at-power or LPSD operating states. This information is needed to support the NRC staff review and its conclusion regarding the DBAs evaluation.	B
3-43	3	3.14.2.1, “Spent Fuel Pool Storage”	The PSAR states, "Because each FFC [failed fuel canister] is certified as leak-tight, the criticality analysis of the SFP [spent fuel pool] will credit moderator exclusion within each FFC." It is not immediately clear how an FFC certified as leaktight per ANSI N14.5-2014 (referenced in PSAR Section 7.3.1) applies to ingress of water into the package, as the standard defines "leaktight" as "the degree of package containment that, in a practical sense, precludes any significant release of radioactive materials." Provide clarification in the PSAR regarding this issue.	B
3-44	3	3.14.2.1, “Spent Fuel Pool Storage”	The PSAR states that 90 percent of the boron is credited borated stainless steel neutron absorber plates. However, it does not appear that the PSAR addresses the fabrication, qualification, or monitoring of the neutron absorber material. This information is important to ensure the fuel storage facilities maintain the level of criticality control assumed in the analysis of record, and the PSAR should provide at least some preliminary, high-level information to give assurance that it will be appropriately addressed at the final safety analysis report (FSAR).	B
3-45	3	3.14.2.3, “In-Vessel Storage”	The PSAR states that the criticality analysis of the in-vessel storage (IVS) demonstrates there is insufficient neutronic communication between the core and IVS to affect k-effective. It further states that the core is not explicitly included in the IVS criticality models. Update the PSAR to reflect the boundary condition applied to the criticality analysis that demonstrates the insufficient neutronic communication or something else.	C

4-3	4	4.1, “Overall Plant Risk Performance Summary”	Section 4.1 of the PSAR states that "For the integrated risk evaluation, all LBEs include AOOs, DBEs, and BDBEs; as DBAs are addressed deterministically, they are not included in the integrated risk evaluation." The statement does not indicate how the integrated risk evaluation was performed; more details on the methodology should be provided in the PSAR.	B
4.4	4	4.2, “Defense-in-Depth”	RG 1.253, Regulatory Positions C.5.d specifies that the applicant should discuss how changes to the design are assessed for possible effects on the defense-in-depth (DID) analysis. Preliminary information on this, to the extent it is available, should be provided in the PSAR.	C
5-1	5	Table 5.2-1, “SR Functions Supporting Control of Heat Generation”	Classification for the instrumentation and controls (I&C) systems is not located in Chapter 5 (e.g., reactor protection system (RPS), nuclear instrumentation system (XIS), reactor instrumentation system (RIS)); their classification is not known until Table 7.6.1.1-a, “I&C System Classification and DL [defense line] Functions.” The creation of pointers between the tables or some type of discussion may be warranted.	C
5-3	5	5.3, “Principal Design Criteria”	In the PSAR the control room radiological habitability analysis and results should be discussed for comparison to the principal design criterion (PDC) 19 control room radiological habitability dose criterion.	C
5-4	5	5.2, “Safety-Significant PRA Safety Functions”	Section 5.2 “Safety-Significant PRA Safety Functions,” of the PSAR uses the phrase "10 CFR 50.34 release limits" several times. It should be noted that 10 CFR 50.34 does not include release limits but only dose criteria. Section 5.2 should be revised or should include a description of the phrase "release limits" as mentioned.	C
5-5	5	5.3.2.1, “PDC 10-Reactor Design”	The NRC staff met with TerraPower in July 2023 to discuss specified acceptable system radionuclide release design limits (SARRDLs) and functional containment performance (ML24059A159). During this meeting, TerraPower discussed a process for determining which systems are subject to SARRDLs and a preliminary list of these systems. The systems listed in Section 5.3.2.1, “PDC 10-Reactor Design,” are not fully consistent with the systems discussed at the meeting, and the process used to determine which SSCs are subject to SARRDLs was not clearly provided or referenced in the PSAR. Update the PSAR, as appropriate, to address this item.	C

5-6	5	5.3.2.2, “PDC 11-Reactor Inherent Protection” /3.12“Nuclear Design”	The list of prompt reactivity feedback mechanisms in Section 5.3.2.2 “PDC 11-Reactor Inherent Protection,” does not appear to be complete, nor is it consistent with the corresponding list in Section 3.12 “Nuclear Design.” Neither section appears to provide or reference a definition of the reactivity coefficients that would enable the NRC staff to determine whether these are adequately characterized in the PSAR. Update the PSAR to address these issues and include preliminary results such that the NRC staff can understand the signs and relative magnitudes of significant reactivity feedback mechanisms.	B
5-8	5	5.3.4.4, “PDC 33-Primary Coolant Inventory Maintenance”	Section 5.3.4.4 states that Primary Heat Transport System (PHT) sodium inventory is protected by the RPS. Update the PSAR to clarify how this is accomplished.	C
5-9	5	5.3.6.11, “PDC 80-Reactor Vessel and Reactor System Structural Design Basis”	The implementation summary for PDC 80 covers passive heat removal. Update this summary to also address control rod insertability, which is included in PDC 80.	C
6-1	6	6.1, “Design Requirements for Safety-Related SSCs”	Table 3.1.1-b "Hazards that Proceed to Analysis," indicates that the internal fire DBHL is credited for the CP application. However, Section 6.1, Table 6.1.1-a "Design Basis Hazard Levels," does not include any information on internal fire. Clarify the PSAR in this area.	C
6-2	6	6.1.2, “Summary of SRDC”	Section 6.1.2 states that the required functional design criteria (RFDC) are described in Section 5.2, “Safety-significant PRA Safety Functions.” However, Section 5.2 mentions safety-related design criteria (SRDC) but not RFDC. Update the PSAR to address this issue.	C

7-1	7	7.6.1, “I&C Systems Introductions”	TerraPower should clarify in the PSAR where they are planning to provide a description of the conformance of the I&C design to IEEE 603-1991. For example, PSAR Section 7.6.3.2.2, “Principal Design Criteria,” briefly discusses how the RPS is designed in accordance with IEEE 603-2018; but there is no mention of IEEE 603-1991, which is incorporated by reference in 10 CFR 50.55a(h). In Table 1.4-5 "Consensus Codes and Standards," 603-1991 is referenced and elsewhere, the 2018 version is cited, but 1991 requirements will be met. Lastly, TerraPower should identify whether there are any planned exceptions for the requirements in 50.55a(h) or similar related to the I&C design.	C
7-4	7	7.6.1.2.1, “I&C Systems”	This section indicates that one-way communication from SR I&C systems to the non-safety-related with special treatment (NSRST) or non-safety-related with no special treatment (NST) systems will be performed via isolated hardwire or through data-diode and gateways. In support of the OL application, TerraPower should clarify whether the one-way, outbound communications will be performed via a diode function built into a gateway; specifically, TerraPower should clarify whether the diode functionality will be built in the gateway via software. If that is the case then, the NRC staff recommends additional discussion on this approach in the PSAR. The NRC staff notes that the NRC staff has not previously accepted licensee use of software-based solutions to perform this function.	C
7-5	7	7.6.1, “I&C Systems Introduction”	Clarify whether plant specific action items discussed in Section 7.0, “Plant Specific Action Items” of the “RadICS Topical Report” SE (ML19233A177) will be addressed in the PSAR or in TR NAT-4950, “Instrumentation & Control Architecture and Design Basis Topical Report” that was provided in draft form in the TerraPower electronic reading room to support the readiness assessment.	C
7-9	7	7.6.3.1, “Reactor Protection System Descriptions, Architecture, and Equipment Locations”	This section states that there are some variables required for the post-accident monitoring system which are not already provided to the RPS safety function chassis. TerraPower should clarify in the PSAR which are these variables and the basis for not including them as part of the RPS safety function chassis.	C

7-18	7	7.3.1.2.2, “Safety-Significant Functions”	Update the PSAR descriptions of the bottom-loading transfer cask (BLTC) and pool immersion cell (PIC) radionuclide retention SSC safety function descriptions to ensure consistency. The BLTC safety-related function (for fuel assembly drop) is described as supported by PIC components designed to ASME Boiler and Pressure Vessel (B&PV) Code Section VIII. Section VIII is appropriate for NSRST functions per appendix A to RG 1.87, “Acceptability of ASME Code Section III, Division 5, 'High Temperature Reactors'”, Revision 2 (ML22101A263), and no basis for a lower design standard is provided.	C
7-19	7	7.1.2.2, “Safety Design Basis” and 7.1.2.3, “System Design and Performance Evaluation”	Both of these sections refer to a 60-year design lifetime for non-replaceable components (e.g., vessel). Based on information provided during the overview presentation on January 11, 2024, the hot pool of sodium and the vessel wall will be at temperatures of ~510 degrees Celsius (°C). This qualifies it as “high temperature” as per ASME code Section III Division 5 (III-5). TerraPower also indicated that the vessel would be constructed of 316H stainless steel (SS). In III-5 none of the base and filler metals are qualified for a design life that exceeds 300,000 hours. Additionally, at “high temperatures,” material properties are in the time-dependent regime (i.e., creep regime). Based on the information in the PSAR, it appears the design lifetime exceeds the qualified time at temperature endorsed in RG 1.87, Revision 2. Please provide additional information on the methodology to extend the qualification for both the base and filler metals to the design lifetime, and update the PSAR, as appropriate.	B
7-20	7	7.3.1.3.1, “Spent Fuel Pool,” and 7.3.1.2.3, “Regulatory Guides”	The basis for the design heat load for the SFP is unclear. Please explain in the PSAR the assumptions and key administrative controls that support the specified heat load and the deviation from RG 1.13, “Spent Fuel Storage Facility Design Basis” (ML070310035), regarding design heat removal capability.	C
7-21	7	7.3.2.3, “System Design and Performance Evaluation”	Clarify in the PSAR whether the passive heat removal capability for the ex-vessel fuel handling machine is bounding or reflects operational inputs. TerraPower should provide the basis for heat removal capability for the ex-vessel storage tank and the BLTC and identify any initial conditions intended to be considered in the calculation of the necessary heat removal capability for these SSCs.	C

7-22	7	Table 7.1.2-a, “RES Safety and ASME Code Classifications”	The cited table states that the guard vessel is SR and classified as ASME Code Section VIII, Division 1. The table also clarifies that the guard vessel has a SR heat transfer function but is NSRST for radionuclide retention as a DID function. RG 1.87, Revision 2 endorses use of Section III for SR components and Section VIII for NSRST components. TerraPower should provide additional information to justify how the design basis of the guard vessel supports its performance of a SR function. The PSAR should be updated, as appropriate.	B
7-23	7	Section 7.1.2.3, “System Design and Performance Evaluation,” Subsection “Guard Vessel”	This section does not appear to provide the temperature that the guard vessel will experience during normal operations or during off-normal scenarios. During the presentation on January 11, 2024, TerraPower stated that it intends to construct the guard vessel of 2.25Cr-1Mo steel. For this specific steel, "high temperature," is defined by ASME code as at or above 370°C. TerraPower should modify the PSAR to clarify the temperatures the guard vessel will experience, the times it will experience these temperatures, which ASME code sections are applicable, and how the material is justified for its intended use.	B
7-24	7	Section 7.4.1.2.2, “Safety-Significant Function”	The radionuclide retention safety function of the gaseous radwaste processing system is classified as NSRST. However, it is not clear how the safety significance of potential events such as potential leakage from the waste gas holdup tank was assessed with respect to source term and offsite consequences. PSAR Section 5.2, “Safety-Significant PRA Safety Function,” indicates that the safety significance of the radionuclide retention function for the gaseous radwaste system barriers is to be determined. Please modify the PSAR to describe the criteria for establishing whether confinement barriers would be necessary and how the radionuclide inventory would be managed to justify the specified safety classification.	B
7-25	7	Section 7.2.1, “Reactor Air Cooling System,” and 7.2.2, “Intermediate Air Cooling System”	Section 6.4.1, “Description for SR SSC-1,” of NEI 21-07 states that SR system descriptions should include "brief summaries of first-of-a-kind special treatment tests to be performed (if any)." TerraPower should modify the PSAR to include either a description of planned tests or a justification of why the reactor air cooling (RAC) & intermediate air cooling systems do not require first-of-kind special treatment tests.	C

7-26	7	Section 7.1.3, “Primary Heat Transport System,” and 7.1.3.1, “Primary Sodium Pump”	The SR function DL3-HR2, "[Primary sodium pump (PSP)] Trip on High-High Primary Sodium Temperature” appears to be described inconsistently. Table 5.2-2, “SR Functions Supporting Control of Heat Removal,” states that a PSP trip signal is generated upon exceeding a high temperature limit with a low flux signal. This is similar to Section 7.1.3, which states that the PSPs trip upon indication of elevated primary temperatures after successful shutdown. However, in Section 7.1.3.1.2, this trip only mentions the PSP tripping on high-high primary sodium temperature to prevent overheating. Section 6.4.1 of NEI 21-07 states that descriptions of SR SSCs should include "electric power, support systems, and interface requirements needed to support the RSFs [required safety functions]." Further discussion of the interface between XIS, RIS, and the PSP would be beneficial to address this guidance for this RSF. TerraPower should clarify in the PSAR whether for this RSF, when the reactor is shutdown, the PSPs will trip to prevent overheating the primary sodium. Additionally, TerraPower should clarify in the PSAR if this trip is based on cold pool or hot pool temperature. The title of DL3-HR2 is alternatively written as "PSP Pump Trip on High Cold Pool Temperature" in Section 7.6.4, “Neutron Instrumentation System.”	C
7-27	7	Section 7.1.3, “Primary Heat Transport System,” and 7.1.3.1, “Primary Sodium Pump”	The safety-significant function, DL4-HR2 “PSP Pump Trip Automatic Backup,” is discussed as a NSRST function for both the PHT system in Section 7.1.3 and for the PSP in Section 7.1.3.1. TerraPower should clarify what causes this trip; based on Table 5.2-4, “NSRST Functions” and Section 7.6.2, “NI Control System,” it is associated with the nuclear island coolant temperature control system. Section 7.3.1, “Description for NSRST SSC-1,” of NEI 21-07 requires that SSC descriptions include "electric power, support systems, and interface requirements needed to support the safety-significant functions." TerraPower should clarify in the PSAR how the PSP interfaces with the coolant temperature control system for this safety-significant function.	C

7-28	7	7.1.3, “Primary Heat Transport System,” and 7.1.3.1, “Primary Sodium Pump”	Section 7.3.1 of NEI 21-07 states "controls and displays needed to support safety-significant functions - where human actions are required to accomplish safety-significant functions, a description of required controls and displays should be provided." The PHT and PSP systems support the NSRST function DL2-HR3, “Manual PSP Pump Trip.” Per Table 5.2-4, “NSRST Functions,” this PSF is associated with an AOO and two BDBEs. TerraPower should clarify in the PSAR what, if any, displays would be required to prompt human action to accomplish this safety-significant function.	C
7-29	7	7.2.1, “Reactor Air Cooling System”	Provide updates to the PSAR to discuss potential activation of air from the reactor air cooling system, given the proximity of this system to the reactor and the potential for Argon-41 generation. As necessary, also provide a discussion of whether it is necessary to include radiation monitoring on the exhaust of this system to monitor gaseous Argon-41 in support of PDC 60, "Control of Release of Radioactive Materials to the Environment," and PDC 64, "Monitoring Radioactivity Release."	C
7-31 / 7-32	7	Chapter 7, “Descriptions for Safety-Significant SSCs”	The PSAR included limited “information relative to materials of construction… sufficient to provide reasonable assurance that the final design will conform to the design bases with adequate margin for safety” as required by 10 CFR 50.34(a)(3)(iii). Please provide additional information on preliminary materials of construction (e.g., base metal and material composition or references to ASME code provisions for selecting filler metals) as appropriate, for safety-significant SSCs that require mechanical and structural integrity to fulfill their PSF. Additionally, please provide preliminary or bounding temperature and fluence information for these SSCs, as this information forms a portion of the design-basis for these SSCs.	B

7-33	7	Chapter 7, “Descriptions for Safety-Significant SSCs”	TerraPower’s plans for material surveillance are unclear. In the implementation portion of Section 5.3.4.3, “PDC 32 - Inspection of Primary Coolant Boundary,” the PSAR states that reactor enclosure system (RES) does not include or rely on material surveillance coupons. In Section 7.1.1, “Reactor Core System,” the PSAR states "[t]he purpose of material surveillance assemblies is to provide enclosure and support for the material specimens identified by the Reliability and Integrity Management Program… Placement of the material surveillance assemblies within the core is based on input from the surveillance program plan and the requirements for temperature and fluence. Material test specimens can also be installed in reflector or shield assemblies as needed to satisfy program requirements." On page 7.1.2-13 of the PSAR it states that "an in-vessel material surveillance program is not required…" Clarify if TerraPower intends to collect data from surveillance coupons and if so, what kind of data will be collected.	B
7-34	7	Chapter 7, “Descriptions for Safety-Significant SSCs”	TerraPower’s plans for inspection are unclear. PDC 32, “Inspection of primary coolant boundary,” and 77, “Inspection of the intermediate coolant boundary,” require safety-significant SSCs to be designed to allow inspection of the various coolant boundaries. However, during the in-person design meeting on January 11, 2024, the NRC staff were told that their design goal was to not rely on inspection. TerraPower should clarify in the PSAR whether all safety-significant SSCs requiring mechanical or structural integrity to fulfill their PSFs will be designed to allow for inspection.	C
7-35	7	Chapter 7, “Descriptions for Safety-Significant SSCs”	TerraPower should clarify the significance of guard piping in the PSAR.	C
7-37	7	7.5.3.2, “Design Basis”	This section states that the Nuclear Island Fire Protection System Design Scope is in full conformance with RG 1.189. TerraPower should clarify elsewhere in the PSAR that "full conformance" with RG 1.189 includes the entire RG including Chapter 1, “Fire Protection Program,” Chapter 2, “Fire Prevention,” Chapter 5 “Safe Shutdown Capability,” and Chapter 8 “Fire Protection for New Reactors,” as applicable. The current wording may only mean that the Nuclear Island Fire Protection is in full conformance with the RG and that would only include certain sections of the RG related to Fire Protection Systems.	C

7-38	7	7.1.4, "Intermediate Heat Transport System"	TerraPower's draft TR NAT-4950 discusses an intermediate sodium pump (ISP) trip on low primary sodium level, stating that it is an engineered safety feature (ESF) to support the RSFs. TerraPower should clarify if this trip is an SR or NSRST PSF. If so, TerraPower should discuss it in the PSAR. The PSAR does discuss an ISP trip for High Primary Sodium Level, which is not mentioned in NAT-4950.	C
7-39	7	Section 7.6.3.2, "Reactor Protection System Design Bases and Associated Safety Functions"	There is no setpoint methodology called out in the PSAR or NAT-4950, however this is a requirement of IEEE 603, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Clause 6.8. TerraPower should clarify the RG and standards used to develop the setpoint methodology. The RG and standards listed in the referenced TR 2016-RPC003-TR-001, "RadICS Topical Report" are out of date. This TR does not provide a methodology for addressing platform uncertainties. Some acceptable approaches are discussed in RG 1.105, "Setpoints for Safety-Related Instrumentation," Revision 4 (ML20330A329) and ANSI/ISA 67.04.01-2018, "Setpoints for Nuclear Safety-Related Instrumentation." TerraPower should provide a table listing sensor, range, setpoint, analytical limit (AL) that protect safety limits (SL). SLs and ALs should be provided in the plant safety analysis.	C
7-40	7	Section 7.6.5, "Reactor Instrumentation System"	TerraPower should clarify if there will be any digital sensors. If digital sensors will be used, TerraPower should discuss common-cause failure regarding the digital sensors and specify whether that discussion is in the CP application or in NAT-4950.	C
7-41	7	Section 7.6.7.1.1, "Plant Control"	PSAR Section 7.6.7.1.1 states that the Main Control Room contains equipment that allows operators to initiate or take manual control of functions associated with the RPS and Nuclear Island and Control System. Provide additional clarification on what that means.	C
7-42	7	Section 7.6.8.1, "Systems Descriptions, Architecture, and Equipment Locations"	The first sentence of the first paragraph states that the Anticipatory Seismic Trip System (AST) provides actuation signals to Reactor Trip Breaker (RTBs) through an interface device. However, the AST inputs to the RTBs are not shown in Figure 5.1 of NAT-4950. In the PSAR, clarify.	C

7-43	7	Figure. 7.6.8-a, “AST Signals and Interface”	Clarify how the AST signals are isolated from the RPS and clarify if the 125 VDC relay shown at top of RPS boxes is the isolating device.	C
7-44	7	Section 7.1.3, “Primary Heat Transport System”	TerraPower should include RG 1.246, “Acceptability of ASME Code, Section XI, Division 2, Requirements for Reliability and Integrity Management Programs for [Nuclear Power Plants], for Non-LWRs,” Revision 0 (ML22061A244) in PSAR Section 1.4. This RG endorses ASME Section XI, Division 2 with conditions. ASME Section XI, Division 2 is mentioned in several places in the PSAR as a standard for inspection and monitoring of primary coolant boundary SSCs.	C
7-45	7	Section 7.5.1.2, “Design Basis”	The discussion with respect to PDC 4, “Environmental and dynamic effects design bases,” expresses protection for the crane from environmental effects; the safety concern is protection of safety-related equipment from the effects of crane malfunctions. Address in the PSAR how safety-related equipment is protected. Also, discuss the means of minimizing the potential for fires and explosions per PDC 3, “Fire protection.”.	C
7-46	7	Section 7.5.1.1, “Summary Description”	Section 7.5.1.1 and Table 7.5-1a, “Code Classifications for the Nuclear Island Cranes and Hoists,” describe monorail hoists in the reactor auxiliary and fuel handling buildings, but the text in does not describe how safety-related SSCs are protected from damage due to malfunctions or seismic events. The PSAR text should describe safety basis (e.g., separation, barrier, or crane/hoist design).	C
7-47	7	Section 7.5.2.2, “Design Basis”	TerraPower should clarify conformance with PDC Criterion 2, "Design bases for protection against natural phenomena.” Heating, ventilation, and air conditioning (HVAC) systems may use penetrations in structures that otherwise provide protection from missiles and damaging winds. Also, the NST portions of the HVAC itself may be located such that its collapse or damage from natural phenomena could affect the functional capability of safety-related SSCs. Please clarify how the HVAC system meets PDC 2 including clarifying provisions taken such that collapse of NST potions of the HVAC don’t impair SR SSCs’ ability to perform their PSF.	C

7-48	7	Chapter 7, Multiple Sections	Throughout the PSAR, TerraPower credits material selection for mitigating specific degradation mechanisms such as “swelling, irradiation creep, fatigue, loss of ductility (stress rupture) and dimensional changes.” TerraPower should clarify which degradation mechanisms are applicable to the safety-significant components and how they are being mitigated. TerraPower should describe the applicable degradation mechanisms for safety-significant components, as well as how they are accounted for/mitigated in the design. Additionally, the NRC staff notes degradation mechanisms that are not mentioned in the PSAR, (e. g., stress relaxation cracking) are likely applicable to the materials relevant to Natrium and should be accounted for.	B
7-50	7	7.2.4.3.1, “Plugging Temperature Indicator”	TerraPower should provide additional information on the plugging temperature indicator. This includes available information related to correlations to verify that impurities can accurately be measured in the time needed to take corrective actions, as well as any R&D needed to ensure this is available for the OL application. In the PSAR, include a discussion for how sensors and instrumentation work together to ensure sodium purity is maintained at required levels, and whether these combine to allow for detection in an adequate timeframe to correct sodium chemistry if needed since many of these methods seem to be off-line techniques.	C
7-51	7	Chapter 7, Multiple Sections	TerraPower should clarify which NSRST functions each of the SSCs serve.	B

7-52	7	Chapter 7, Multiple Sections	For CP applications, Section 6.4.1, “Description for SR SSC-1,” of NEI 21-07 specifies that “[t]he descriptions for SR SSCs should be provided at a functional level and should identify the performance-based requirements needed for individual major components” and notes that “[t]he guidance for other SSC description content in Chapter 6 should be tailored to the information available at the CP stage.” The referenced guidance, also provided in Section 6.4.1 of NEI 21-07, specifies, in part, that the PSAR should provide the following for SR SSCs: - The SSC purpose in the context of supporting the RSFs - The specific SSC function in the context of supporting the RSFs - Key design features relevant to the performance of RSFs. Section 7.3.1, “Description for NSRST SSC-1,” of NEI 21-07 specifies that essentially the same information should be provided for NSRST SSCs, except the term “safety-significant functions” is used instead of “RSFs.” For CP applications, Section 7.3.1 specifies that “content addressing NSRST SSCs should follow the approach used in Chapter 6 for SR SSCs” and that the descriptions for NSRST SSCs should “be developed to identify safety-significant functions to be provided by those SSCs.” TerraPower should clearly identify in the PSAR the information identified by NEI 21-07 for either SR or NSRST SSCs, particularly the through-line between the required or safety-significant functions, SSC design, and design requirements. TerraPower should clearly tie the safety functions to the SSC purpose. The safety functions supported by the SSCs described in the section are provided, but it is not clear which components support the different safety functions and how they accomplish that role. Performance-based requirements do not appear to be particularly highlighted, and there are no evaluations of SSC performance against any performance-based requirements. Additionally, the staff observed a variance in how clearly the information is presented from section to section in Chapter 7. For example, Section 7.1.2.2 provides a table that lays out reasonably clearly which PSFs are supported by the RES and how this functional support is provided (though the staff notes that this does not clearly translate to design requirements for the components). By contrast, Section 7.1.1.2 provides a list of PSFs supported by the reactor core components (RCC) system but does not describe how the	B

			RCC provides these functions. TerraPower should modify its PSAR to clarify this information.	
8-1	8	Table 1.4-1, "Conformance with Regulatory Guides," and 8.1.1, "Disposition of Limitations on NRC Approval of TerraPower QATR"	Regarding RG 1.54 "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants" (ML17031A288), both Table 1.4-1 and Section 8.1.1 state that Kemmerer Unit 1 partially conforms to RG 1.54 and that for the regulatory positions it does not conform to, more current American Society for Testing and Materials (ASTM) standards are used. TerraPower should clarify in the PSAR the positions from RG 1.54 that Kemmerer Unit 1 does not conform to and provide justification or the current ASTM standards that will be used.	C
8-2	8	8.1.2, "Responsibilities During Design and Construction," 8.1.3, "Organization and Controls"	Section 8.1.2 states that TerraPower, along with a wholly owned subsidiary of TerraPower, is responsible for the establishment and execution of quality assurance program requirements during design, construction, and preoperational testing phases for Kemmerer Unit 1. Section 8.1.3 states that the wholly owned subsidiary project organization and responsibilities, including those related to quality assurance (QA) during preoperational testing through operation, are described in Section 11.1, "Organization." TerraPower should update the PSAR to describe the relationship between TerraPower and its wholly owned subsidiary. Specifically, TerraPower should clarify if its wholly owned subsidiary will implement TerraPower's approved Quality Assurance Program Description for the design, construction, and preoperational testing phases for Kemmerer Unit 1.	C
8-3	8	Table 8.0-2, "Additional Special Treatment Programs for Operations"	Regarding the information on page 8.0-7, Table 8.0-2, first row for "Fire Protection Program," TerraPower should consider designating a PSAR section for "Fire Protection Program" which for the CP application could include mentioning the PSAR sections that discuss fire protection and the statement that the fire protection program will be provided at the OL-stage. Typically fire protection is discussed in chapter 9, and a dedicated PSAR section facilitates the NRC staff's review.	C

9-1	9	9.1, “Liquid and Gaseous Effluents”	TerraPower should explain in the PSAR compliance with 10 CFR 50.34a, “Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors.” While the PSAR includes pertinent system descriptions and assumed releases from the Gaseous Radioactive Waste System, Liquid Radioactive Waste System and Solid Radioactive Waste System, a statement regarding how this information supports regulatory compliance is not included. This is a regulation that should be explicitly cited and addressed in Chapter 9 discussions consistent with the regulations specified in ARCAP Section 9.1, “Liquid and Gaseous Effluents.”	C
9-2	9	9.1.2.2, “Gaseous Effluents”	PSAR Section 9.1.2.2 provides information on the use of 10 CFR Part 50 appendix I “Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion, “As Low as is Reasonably Achievable" for Radioactive Material in Light Water-Cooled Nuclear Power Reactor Effluents,” as low as reasonably achievable (ALARA) dose criteria and compares their dose analysis to these limits in PSAR Table 9.1-d, “Compliance of [Maximally Exposed Individual (MEI)] External Doses with 10 CFR 50 Appendix I Criteria.” TerraPower should include a discussion in its PSAR on why the selection of the Appendix I dose criteria is appropriate for their design given that these criteria are stated to be for Light Water-Cooled Nuclear Power Reactors.	C
9-3	9	9.1, “Liquid and Gaseous Effluents”	Regarding PSAR Table 9.1-c, “Gaseous Effluent Doses to MEI” and Table 9.1-d, “Compliance of MEI External Doses with 10 CFR 50 Appendix I Criteria,” TerraPower should provide details in the PSAR on the XOQ data used and state the assumed distances for the MEI for each calculation. The NRC staff would likely request the additional details of these MEI calculations at the time of the official submittal to confirm the input and output files associated with these calculations along with any other supporting calculation file details or explanations.	C
9-4	9	9.1, “Liquid and Gaseous Effluents”	ARCAP Section 9.1, specifies two options to achieve compliance with 10 CFR 20.1302(b), “Compliance with dose limits for individual members of the public.” The NRC staff did not observe any discussions related to achieving either option. In PSAR Section 9, TerraPower should clarify how it plans to comply with 10 CFR 20.1302(b).	C

9-5	9	9.1, “Liquid and Gaseous Effluents”	In PSAR Section 9.1, TerraPower should provide additional information about the various sources generated at their facility. Examples of this would be describing how H-3 and Ar-41 are generated at the facility. This would be a breakdown of the sources of radioactivity by what the facility produces as fission products, activation products and corrosion products.	C
9-6	9	9.1, “Liquid and Gaseous Effluents”	For the source term provided in Table 9.1-a, “Annual Gaseous Effluent Release Activities,” and Table 9.1-b, “Liquid Source Term,” TerraPower should clarify how the releases and source terms were determined and whether the source terms are different from accident analysis source terms.	C
9-7	9	9.2, “Contamination Control”	The NRC staff recommends that TerraPower clarify in the PSAR how the current Natrium design addresses 10 CFR 20.1406, “Minimization of contamination.” Understanding that this is a topic that will largely be addressed at the OL stage, TerraPower should clarify the Natrium design features that can be shared now, whether there are any design features that the applicant is considering now for leakage collection and detection, and anything that can provide insight into the applicant's design considerations given some of the design differences encountered with this type of reactor. As an example, the NRC staff reviewed information provided in PSAR Section 9.3, “Solid Radwaste Processing,” for the PDCs found there were discussions that included the use of sumps to direct liquid spills during processing and storage.	C
9-9	9	9.3, “Solid Radwaste Processing”	TerraPower should clarify in PSAR Section 9.3 the amount of waste storage space available. This required information on the amount of solid waste the applicant estimates it will generate at this time and how long it will take for the applicant to fill their designated storage space before offsite waste shipments are needed.	C
10-2	10	10.3, “Design Considerations”	Terrapower should provide more detailed source terms for the major radiation sources described in PSAR Section 10.3, Table 10.3-1, “Major Radiation Sources.” This information would be used to support staff understanding of the radiation environment at the facility and inform the basis of the radiation zone maps. This information would provide the NRC staff with sufficient information to understand the basis for the mapping, including any supporting calculations.	C

10-3	10	10.5, “Preliminary Dose Assessment for Expected Occupancy”	TerraPower should clarify in PSAR sections 10.3, 10.4, “Design Provisions” and 10.5, where the applicant plans to provide information related to the radiation zone mapping expected at the facility. The radiation zone mapping would be used to inform the NRC staff on the radiation environments expected at the facility and to provide insight into the basis of the occupational radiation exposure estimates provided in PSAR Section 10.5. Further clarification needed includes the methodology the applicant will plan on using to establish their radiation zoning requirements and establishing that their definitions for areas such as radiation areas, high radiation areas, and very high radiation areas are all consistent with those definitions contained in 10 CFR 20.1003 “Definitions.”	C
10-4	10	10.5, “Preliminary Dose Assessment for Expected Occupancy”	TerraPower should clarify if the list of work activities provided in PSAR Table 10.5-1, “Routine Online Operations Dose Assessment for Expected Occupancy,” is a complete list of activities expected to be performed at the facility. PSAR Table 10.5-1 appears to be a summary table but lacks other details that feed into the total occupation radiation exposure table. The information contained in Table 10.5-1 does not include some of the details in the reference tables in RG 8.19, “Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants -- Design Stage Man-Rem” (ML003739550), such as average dose rates, exposure time per event, number of workers and number of events per year.	C
11-1	11	Table 11.5-1, “Proposed Variables and Condition for Technical Specification,” Section 3.7, “Refueling Operations”	Clarify in the PSAR if the ex-vessel fuel handling systems and the SFP rely on a specific decay time in the ex-vessel storage tank as an initial condition supporting the heat removal safety function. Clarify in the PSAR if this parameter is the initial condition of evaluated LBEs and identified as a potential TS.	C
11-3	11	11.6.2	Cybersecurity plan templates currently approved by the NRC prohibit the use of wireless technology in safety-related and important-to-safety systems. If TerraPower plans to implement wireless technology for applications such as the reactor building crane, it should engage the NRC staff further on how it plans to do so securely and in a manner that meets NRC requirements.	C

11-5	11	11.1, “Organization”	TerraPower should clarify in the PSAR Chapter 11.1 whether TerraPower is committing to using ANSI/ANS-3.2-2012, “Managerial, Administrative, and Quality Assurance Controls for Operational Phase of Nuclear Power Plants,” as endorsed under RG 1.33, “Quality Assurance Program Requirements (Operation),” (ML13109A458)) or provide justification for an alternative approach.	C
11-6	11	11.1, “Organization”	TerraPower should discuss in the PSAR its measures for the periodic assessment of the adequacy of the operating organization in a manner equivalent to that of ANS-3.2-2012 Section 3.1.3.1.	C
11-7	11	11.1, “Organization”	Pursuant to the provisions of 10 CFR 50.120, “Training and qualification of nuclear power plant personnel,” TerraPower should discuss in Chapter 11.1 of the PSAR, the expectations for the future training of non-licensed plant staff and whether it will be done in a manner akin to that of licensed operators.	C
11-8	11	11.1, “Organization”	In the conduct of operations discussion in the PSAR, TerraPower should clarify how on-shift engineering expertise will be accounted for within the operating organization (reference 50 FR 43621 and NUREG-0737, “Clarification of [Three Mile Island] Action Plan Requirements” (ML051400209)) and provide future justification in conjunction with an OL application.	C
11-9	11	11.2, “Human Factors Engineering”	TerraPower should update the descriptions provided in the human-system interface related portions of Chapter 7, “Descriptions of Safety-Significant SSCs,” and the HFE-related material in Chapter 11.2 to clarify whether TerraPower intends for the design to address all of the technologically relevant post-Three Mile Island indications of 10 CFR 50.34(f). While Safety Parameter Display System was noted to be specifically addressed, TerraPower should clarify if other items will be incorporated into the human-system interface inventory as well.	C

11-11	11	11.6.1, “Fitness-for-Duty”	Section 11.6.1, “Fitness-for-Duty” includes the following statement: “The Fitness-for-Duty [FFD] program will have provisions that ensure the requirements of 10 CFR Part 26, except subparts I and K, are met for the individuals identified in 10 CFR 26.4(e).” Title 10 CFR 26.401(b) requires that “Entities who intend to implement an FFD program under this subpart shall submit a description of the FFD program and its implementation as part of the license, permit, or limited work authorization application.” TerraPower should update Section 11.6 with additional detail to clarify the applicant’s FFD program and how it will be implemented for the 10 CFR 26.4(e) workforce. Table 1, “FFD program applicability and milestones” in NUREG-0800, Standard Review Plan, 13.7.2, “Fitness for Duty – Construction,” includes information on the worker populations (e.g., construction management and oversight personnel; FFD program personnel; security) covered by 10 CFR 26.4(e) and the milestone when each population is subject to the and FFD program under 10 CFR Part 26.	C

11-12	11	11.6.2, “Security”	Section 11.6.2, “Security” includes the following statements: “A physical security plan, training and qualification plan, and cyber security plan will be provided with the application for an OL as required by 10 CFR 50.34I(1), (2), (3).” “A safeguards contingency plan will be provided with the application for an OL as required by 10 CFR 50.34(d).” NUREG-0800, Standard Review Plan, 13.6.3, “Physical Security – Early Site Permit and Reactor Siting Criteria,” states that: “…Similar to the requirement for an [Early Site Permit] application, each [CP] application under 10 CFR 50.34(a), “Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents—Nuclear Power Reactors,” requires that the PSAR considers the site evaluation factors identified in 10 CFR Part 100, “Reactor Site Criteria,” and the site characteristics must comply with this regulation. The requirement of 10 CFR 100.21(f) requires that the site characteristics must permit adequate security plans and measures to be developed. The intent of the review is to determine if adequate security plans and measures meeting the performance and prescriptive regulatory requirements of 10 CFR Part 73, “Physical Protection of Plants and Materials,” for a nuclear power reactor can be developed.” Information provided in Chapter 2, “Site Information,” described and analyzed various items to include site location, nearby industrial, transportation, and military facilities, meteorology (regional climatology and local meteorology), hydrology (floods, ice effects), and seismology. These criteria may or may not affect the design and implementation of engineering controls, operational requirements, and, if applicable, any management systems for meeting security requirements. TerraPower should clarify in its PSAR how the applicant considered whether the site characteristics will permit adequate security plans and measures to be developed.	C

11-13	11	11.3.4.2, "Authorities and Responsibilities of Facility Emergency Personnel"	Title 10 CFR 50.160(b)(1)(iii)(E), "Staffing and Operations," states that the emergency plan should describe the on-shift emergency response to the NRC staff augmentation process, including maintenance of staffing and succession of leadership for the duration of the emergency response or expansion of the response as needed. Section 11.3.4.2, "Authorities and Responsibilities of Facility Emergency Personnel," of the PSAR states, in part, that the shift manager will function as the Emergency Director (ED) and will fulfill this role until duties are transitioned to an emergency response facility (ERF) ED. The health physics person on-shift will support the ED with the radiological health physics aspects of the emergency until duties are transitioned to an ERF. The functional role of engineering support is to monitor and evaluate changing core/thermal hydraulic issues. This function is important to emergency response because monitoring and evaluating core conditions, or thermal hydraulic conditions for the reactor coolant systems, can support timely corrective actions(s), emergency classification levels declarations, and subsequent protective action recommendations. TerraPower should describe in the PSAR how the engineering support function is performed on-shift, if this function is to be performed as a collateral duty, and how this function can be performed when needed without any additional competing priorities.	C
11-14	11	11.3.9, "Emergency Response Facilities and Equipment"	Title 10 CFR 50.160(b)(1)(iv)(A)(4) states that the emergency plan should describe each ERF, including, as applicable, descriptions of location, capabilities, size, equipment, and backup locations to transfer the functions if the facility is not habitable or accessible. Section 11.3.9, "Emergency Facilities and Equipment," of the PSAR states, in part, that a primary ERF Emergency Response Facility Primary (ERFP), located onsite, and a backup Emergency Response Facility Backup (ERFB), located offsite, will be available. Either of these facilities support functions similar to that for a technical support center (TSC) as described in NUREG-0696, "Functional Criteria for Emergency Response Facilities," (ML051390358). Section 11.3.9 further states that under normal conditions, the ERFP and ERFB will be designed to be comfortable and habitable. Consistent with 50.160(b)(1)(iv)(A)(4), TerraPower should describe in the PSAR the functional criteria for the proposed ERFP and ERFB as it pertains to facility space, structure, and radiological habitability as that comparable to a TSC described in sections 2.4, 2.5, and 2.6 of NUREG-0696. TerraPower should describe what, if any, differences exist between the ERFP and ERFB as it relates to those functional criteria.	C

11-15	11	11.3.10, “Performance Monitoring”	10 CFR 50.160(b)(1)(iv)(B)(9), “Drills and Exercises,” states that the emergency plan should describe the drill and exercise program, with references to the process for testing and implementing major portions of the planning, preparations, capabilities, and coordination with offsite organizations to maintain the key skills of emergency responders. Section 11.3.10, “Performance Monitoring,” states, in part, that drills and exercises will be used to demonstrate the capabilities to perform and maintain emergency response functions as listed in 10 CFR 50.160(b)(1)(iii)(A) through (H) and performance metrics and objectives for each of these functions will be developed and used for evaluation. TerraPower should clarify in the PSAR whether supporting organizations identified in the Kemmerer Emergency Plan as having an emergency response role, responsibility, or authority, will be requested to participate in scheduled drills and exercises. TerraPower should describe in the PSAR the periodicity of those drills and exercises to include support organizations so that to maintain those key skills necessary for emergency responders.	C
12-2 / 12-3	12	12.6 “FOAK Testing”	Regarding FOAK testing, the NRC staff recognizes the information that has been provided in PSAR Chapter 13, “Research and Development,” to meet the requirements of 10 CFR 50.34(a)(8) that the CP application include "An identification of those structures, systems, or components of the facility, if any, which require research and development to confirm the adequacy of their design; and identification and description of the research and development program which will be conducted to resolve any safety questions associated with such structures, systems or components; and a schedule of the research and development program showing that such safety questions will be resolved at or before the latest date stated in the application for completion of construction of the facility." TerraPower should clarify in the PSAR what might be captured as part of the first-of-a-kind (FOAK) testing and whether there any supporting information that might be available that would provide insights on what type of FOAK testing is being contemplated. TerraPower should also clarify in the PSAR if any FOAK testing items might be subject to testing on every plant under the initial test program to confirm the SSCs will perform their intended function prior to the plant being placed into commercial operation.	C

ER 2-1	ER 2	2.6, “Historic and Cultural Resources”	TerraPower should clarify the definitions of “historic and cultural resources” and "historically significant.”	C
ER 2-5	ER 2	2.9, “Radiological Environment and Radiological Monitoring”	TerraPower should provide additional information on the background radiological characteristics of the site per Section 2.9, “Radiological Environment and Radiological Monitoring,” of RG 4.2 “Preparation of Environmental Reports for Nuclear Power Stations,” Revision 3 (ML18071A400). Specifically, RG 4.2 states that "For a partially developed or undeveloped site that does not have operating or permanently shut down reactors, the applicant should summarize any information available from the appropriate literature about background radiological characteristics of the site. This characterization should address the sources of natural background and the background radiation levels from those sources in the area surrounding the site. The naturally occurring background radiation dose rates at the site should be estimated and provided in the ER."	C
ER 4-1	ER 4	4.9, “Radiological Health,” and 4.9.4, “Total Dose to Construction Workers”	During construction, various sealed source radioactive materials will be brought onsite for temporary use (e.g., radiograph sources, moisture density gauges). Thus, these radiological materials could expose construction workers to radiation. To incorporate this hazard, TerraPower should consider the text used to describe the environmental impact in Section 4.8.2, “Radiological Impacts,” of the ”Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes),” Revision 1 (ML23089A388).	C
ER 4-5	ER 4	4.6, “Historic and Cultural Resources”	Section 4.6, page 4.6-1 "...analysis assumes the recommendations of the Class III cultural resource inventory report..." Instead, if the information is available, TerraPower should modify the ER to include the U.S. Department of Energy determinations of eligibility and effect.	C

ER 5-2	ER 5	5.11, “Postulated Accidents”	10 CFR 51.41: “…to submit such information to the Commission as may be useful in aiding the Commission in complying with Section 102(2) of NEPA.” 10 CFR 51.45(c): “The environmental report must include an analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects.” Also: the analysis in the ER should also include consideration of the economic, technical, and other benefits and costs of the proposed action and its alternatives. The current discussions on Severe Accident Mitigation Alternatives (SAMA) in ER Section 5.11.3, “Severe Accident Mitigation Alternatives,” only presents analysis for population dose risks costs and states a full analysis would be provided at the OL-stage. TerraPower should provide a bounding CP SAMA evaluation by applying other information and assumptions without the use of an emergency plan. TerraPower should consider the MACCS guidance for input parameters as provided in NUREG/CR-7270, “Technical Bases for Consequence Analyses Using MACCS (MELCOR Accident Consequence Code System),” (ML22294A091). TerraPower should apply the other cost formulas of NUREG/BR-0184, “Regulatory Analysis Technical Evaluation Handbook,” (ML050190193) as outlined in NEI 05-1, “Severe Accident Mitigation Alternative (SAMA) Revision A,” (occupational exposure and onsite risk costs) (ML053500423). Please explain in greater detail why the other cost risks values cannot be calculated now but will only become available at the OL-stage.	C