

**TERRAPOWER, LLC – AUDIT PLAN FOR TOPICAL REPORT NATD-LIC-RPRT-002
“PRINCIPAL DESIGN CRITERIA FOR THE NATRIUM ADVANCED REACTOR,” REVISION 0
(CAC / EPID NO. 00431 / L-2021-TOP-0020)**

August 22, 2023

Applicant: TerraPower, LLC

Applicant Address: 15800 Northup Way, Bellevue, WA 98008

Plant Name(s) and Unit(s): Natrium

Project No(s): 99902100

Background:

By letter dated January 24, 2023, TerraPower, LLC (TerraPower) submitted topical report (TR) NATD-LIC-RPRT-002, “Principal Design Criteria for the Natrium Advanced Reactor,” (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23024A281) to the U.S. Nuclear Regulatory Commission (NRC) staff. On March 17, 2023, the NRC staff found that the TR contained technical information in sufficient detail such that the NRC staff could begin its detailed technical review of the TR (ML23074A347).

TerraPower requested the NRC staff’s review and approval of its proposed principal design criteria (PDC), as presented in the subject TR. These PDC would be used by applicants using TerraPower’s Natrium reactor design as part of future licensing submittals. TerraPower’s overall licensing methodology for the Natrium reactor design follows the technology-inclusive, risk-informed, and performance-based approach outlined in Regulatory Guide (RG) 1.233, “Guidance for a 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,” Revision 0 (ML20091L698). Additionally, the PDC development has been informed by RG 1.232, “Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors,” Revision 0 (ML17325A611).

The establishment of PDC is integral to the review of the nuclear facility design, and the development of its structures, systems, and components (SSC) design bases. These criteria aid in the NRC staff’s evaluation of other regulations and allow the NRC staff to have reasonable assurance that the proposed nuclear reactor facility design will conform to the design bases with adequate margins for safety.

Purpose:

The purpose of the audit is for the NRC staff to gain a more detailed understanding of the PDC proposed for the Natrium SFR. A secondary purpose of the audit is to identify any information that will require docketing to support the NRC staff’s safety evaluation for the TR.

Regulatory Audit Basis:

The basis for the audit includes:

- 10 CFR 50.34(a)(3)(i) requires that facilities are required to describe the PDC in their preliminary safety analysis report supporting a construction permit application.
- The minimum requirements for light-water reactor (LWR) PDC are described in Appendix A to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities.” Appendix A contains the general design criteria (GDC). The GDC are generally applicable to non-light-water reactors (non-LWRs) and are intended to provide guidance in establishing the PDC for non-LWRs.
- RG 1.232 provides a set of advanced reactor design criteria which serve the same purpose for non-LWRs as the GDCs serve for LWRs. RG 1.232 also provides two sets of technology-specific, non-LWR design criteria for SFRs (SFR-DC) and modular high temperature gas cooled reactors.
- RG 1.233 provides guidance on using a technology-inclusive, risk-informed, and performance-based methodology to inform the licensing basis and content of applications for non-LWRs. RG 1.233 endorsed Nuclear Energy Institute (NEI) 18-04, “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development,” Revision 1 (ML19241A472).

Regulatory Audit Methodology:

This regulatory audit will follow the guidance in NRR Office Instruction LIC-111, “Regulatory Audits,” (ML19226A274) and focus on information provided by TerraPower in an online reference portal.

Information and Other Material Necessary for the Regulatory Audit:

The NRC staff is requesting access to information on the plant design and documents that support the NRC’s understanding of the technical basis and justifications for the PDC’s proposed in the TR. The NRC staff is also requesting any documents referenced in the TR data that are not already available.

Specific audit information needs and questions include:

1. Provide a discussion on the chemical stability and potential for corrosion of liquid sodium as a coolant. To the extent possible, this discussion should reference operating experience from SFRs with operating experience (e.g., Experimental Breeder Reactor (EBR)-II, Fast Flux Test Facility (FFTF)).
2. The Natrium design and proposed PDCs use a functional containment approach (see Section 5.3.1 of the TR and Natrium PDC 16) which includes various barriers to radionuclide release, including the fuel cladding and the primary coolant boundary. Please discuss how TerraPower’s implementation of the functional containment concept is consistent with the concept expressed in Natrium PDCs 14, 30, 31, and 32 that only portions of the primary coolant boundary should be subject to the quality and design standards provided for in the Natrium PDCs. Please also discuss the extent to which the Natrium PDC ensures the integrity of the primary coolant boundary during transients and accidents.

3. With respect to Natrium PDC 73, provide a discussion on the extent to which guard piping is used on intermediate sodium loop pipes in the Natrium design and whether any guard piping is inerted.
4. With respect to Natrium PDC 73 and 74, provide a discussion on the potential for leak-induced sodium fires in the Natrium design.
5. Consistent with the use of a functional containment approach, Natrium PDC 10 utilizes the concept of specified acceptable system radionuclide release design limits (SARRDLs) instead of the SFR-DC 10 concept of specified acceptable fuel design limits (SAFDLs). Please provide a discussion on the relationship between fuel design limits and limits on the release of radionuclides.
6. Provide an explanation of the proposed reactivity control system by discussing in more detail “independent” aspects (e.g., electrical and mechanical systems associated with the reactivity control system), as well as the means to exclude potential common mode and common cause related failure mechanisms (e.g., seismic, fire, etc.). Also, discuss conditions under which the movement of control rods inside the reactor core can be restricted due to thermo-mechanical misalignments caused by external or internal forces.
7. Provide a discussion on the transient and accident categories provided in the proposed PDCs (e.g., “anticipated operational occurrences”) and how these relate to the licensing basis event categories provided in NEI 18-04.

Team Assignments:

Reed Anzalone	Senior Nuclear Engineer, Audit Lead
Mallecia Sutton	Senior Project Manager, Lead Natrium PM
Roel Brusselmans	Project Manager, Audit PM
Mohsen Khatib-Rahbar	Consultant (Energy Research, Inc.)
Imtiaz Madni	Consultant (Energy Research, Inc.)

Logistics:

Entrance Meeting	September 7, 2023, 4:00 p.m.
Exit Meeting	October 5, 2023, 4:00 p.m.

Audit meetings will take place in a virtual format, using Microsoft Teams or another similar platform. Audit meetings will be scheduled on an as-needed basis after the entrance meeting and once the NRC staff has had the opportunity to review any documents placed in the online reference portal. The audit will begin on September 7, 2023, and continue as necessary, with activities occurring intermittently during the audit period. The audit period may be reduced or extended, depending on the progress made by the NRC staff and TerraPower in addressing audit questions.

Special Requests:

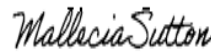
The NRC staff requests that TerraPower ensure that their technical staff are available to answer questions during the audit. The NRC staff also requests that TerraPower provide access to supporting documents via the TerraPower online reference portal.

Deliverables:

At the completion of the audit, the audit team will issue an audit summary within 90 days after the exit meeting but will strive for a shorter duration. The audit summary will be declared and entered as an official agency record in ADAMS and be made available for public viewing through the publicly available records component of ADAMS.

If you have any questions, please contact me at 301-415-0673 or via email at Mallecia.Sutton@nrc.gov.

Sincerely,



Signed by Sutton, Mallecia
on 08/22/23

Mallecia Sutton, Senior Project Manager
Advanced Reactors Licensing Branch 1
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Project No.: 99902100

Enclosure:
As stated

cc: TerraPower Natrium via GovDelivery

SUBJECT: TERRAPOWDER, LLC – AUDIT PLAN FOR TOPICAL REPORT NATD-LIC-RPRT-002 “PRINCIPAL DESIGN CRITERIA FOR THE NATRIUM ADVANCED REACTOR,” REVISION 0 (CAC / EPID NO. 00431 / L-2021-TOP-0020”) DATED: AUGUST 22, 2023

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NRR-106

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