

TERRAPOWER, LLC –TOPICAL REPORT NATD-LIC-RPRT-0001,
“REGULATORY MANAGEMENT OF NATRIUM NUCLEAR ISLAND AND ENERGY ISLAND
DESIGN INTERFACES” AUDIT PLAN
(CAC/EPID NO.00431 L-2022-TOP-0045)

Applicant: TerraPower, LLC (TerraPower)
Applicant Address: 15800 Northup Way, Bellevue, WA 98008
Plant Name(s) and Unit(s): Natrium
Project No(s): 99902100

Background:

By letter dated October 4, 2022, TerraPower submitted topical report (TR) NATD-LIC-RPRT-0001, “Regulatory Management of Natrium Nuclear Island and Energy Island Design Interfaces” (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22277A824) to the U.S. Nuclear Regulatory Commission (NRC) staff. The TR describes TerraPower’s regulatory analyses for the interfaces between Natrium’s Nuclear Island (NI) and Energy Island (EI).

TerraPower indicates in the TR that NI boundary conditions have been designed such that the interrelationship with the EI does not impact the NI safety case. TerraPower also indicates that the thermal energy storage and steam generation operations are independent from reactor power operations due to the Thermal Salt Storage System (TSS) and that, furthermore, this approach allows the power production systems on the EI to be separate entities with respect to design and quality standards while remaining integrated through the TSS. The thermal energy storage capacity of the TSS is noted to be equivalent to several hours of full electrical generation. It is further noted that the EI was designed for energy storage to allow the Natrium plant to vary the energy output based on overall grid conditions (or to supply industrial heat applications) with the EI design enabling the steam turbine and reactor to operate at power levels that are different from one another. TerraPower also indicates in the TR that analyzed transient effects seen in the Intermediate Heat Transport (IHT) system do not directly impact the conditions in the Primary Heat Transport (PHT) system.

TerraPower’s analyses of the effects that EI systems, structures, and components (SSCs) have on the NI play a significant part in the safety classification of the EI SSCs and the regulatory analyses presented in the TR. As such, the NRC staff wishes to better understand these underlying transient analyses, which are not discussed in substantial detail in the TR.

Additionally, TerraPower states in the TR that the Natrium design removes direct interaction between the nuclear reactor and the main turbine generator and that, due to the lack of direct interaction, operation of the main turbine generator is not an apparatus or mechanism whose manipulation directly affects the reactivity or power level of the reactor. TerraPower goes on to

state that on this basis, the Sodium design allows for a non-licensed individual to fully operate and control the main turbine generator.

Purpose:

The purpose of the audit is for the NRC staff to gain a more detailed understanding of transient analyses discussed in Section 7, “Basic Plant Transient Analyses,” of NATD-LIC-RPRT-0001 and how the Sodium design and concept of operations will demonstrate compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54(j) during power operations and identify any information that will require docketing to support the NRC staff’s safety evaluation.

Therefore, the NRC staff is requesting access to internal documents associated with the Basic Plant Transient Analyses and documents that would be used to demonstrate compliance with 10 CFR 50.54(j). In addition, the NRC staff is requesting any documents referenced in the TR data that are not already available to the NRC staff. The NRC staff will summarize its observations in an audit report to be provided to TerraPower, as discussed below.

Regulatory Audit Basis:

The basis for the audit includes:

- Section 50.34, “Contents of applications; technical information,” of 10 CFR. Paragraph 50.34(a)(4) requires that applicants for a construction permit (CP), and subsequently for an operating license (OL) in (b)(4), provide an analysis and evaluation of the design and performance of SSCs of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility. In addition, this analysis must include the determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility and the adequacy of SSCs provided for the prevention of accidents and the mitigation of the consequences of accidents.
- 10 CFR 50.10, “License required; limited work authorization,” which requires, in part, that certain activities constituting construction on a site may not begin without an NRC license or authorization.
- 10 CFR 50.54(j), which requires, in part apparatus and mechanisms other than controls, the operation of which may affect the reactivity or power level of a reactor shall be manipulated only with the knowledge and consent of an operator or senior operator licensed pursuant to 10 CFR Part 55, “Operators’ Licenses,” present at the controls.
- 10 CFR 50.65, “Requirements for monitoring the effectiveness of maintenance at nuclear power plants,” which requires a program to monitor the performance of certain SSCs and the maintenance thereof.
- 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” which provides requirements for quality assurance programs.
- 10 CFR Part 55, which provides requirements for power reactor operator licensing.

The information discussed in the subject TR supports determinations regarding the regulatory treatment of certain SSCs within the Sodium design. The NRC staff anticipates that this information will be primary to the regulatory basis provided in the Sodium CP and OL applications.

Regulatory Audit Scope:

The regulatory audit will follow the guidance in NRR Office Instruction LIC-111 “Regulatory Audits” (ML19226A274) and focus on information provided by TerraPower in the electronic reading room.

Information and Other Material Necessary for the Regulatory Audit:

To understand the separation and interfaces between Natrium’s NI and EI, it is important to understand the Natrium reactor’s response to the failure of any SSCs located on the EI and vice versa. The TR makes claims regarding the independence of the EI and NI such as “the interrelationship with the EI does not impact the NI safety case” (Section 1) and notes that all EI SSCs are non-safety related with no special treatment because “no EI SSCs are required to respond to mitigate any events impacting the NI” (Section 7). Section 7 of the TR further states that “the thermal inertia of the IHT and PHT systems are such that any changes in salt conditions can be adequately responded to using only signals monitored within the NI.” Section 8 of the TR also states that “failures in the thermal storage salt system would lead to a runback, which is not an SR [safety-related] actuation.” The NRC staff would like to better understand what analyses TerraPower used to support conclusions regarding the effect of EI transients on the NI. Please provide access to any such analyses in the electronic reading room.

As stated above, Apparatus and mechanisms other than controls, the operation of which may affect the reactivity or power level of a reactor shall be manipulated only with the knowledge and consent of an operator or senior operator licensed pursuant to 10 CFR Part 55 present at the controls. The NRC staff would like to better understand how the Natrium design and concept of operations will demonstrate compliance with 10 CFR 50.54(j) during power operations.

Please describe how the Natrium design and concept of operations will demonstrate compliance with 10 CFR 50.54(j) during power operations.

Team Assignments

Reed Anzalone	Senior Nuclear Engineer, Audit Lead responsible for audit summary report preparation
Mallecia Sutton	Senior Project Manager, responsible for audit logistics
Jesse Seymour	Senior Reactor Engineer (Examiner)
Ben Adams	General Engineer
Zackery Helgert	General Engineer (Nuclear Regulatory Apprenticeship Network)

Logistics

Entrance Meeting	January 23, 2023, 11:00 a.m.
Exit Meeting	February 23, 2023, 4:30 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 January 17, 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 questions about this audit, please contact me at 301-415-0673 or by email at Mallecia.Sutton@nrc.gov.

Date: January 5, 2023

Sincerely,



Signed by Sutton, Mallecia
on 01/05/23

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