SUMMARY REPORT ON THE REGULATORY AUDIT OF TOPICAL REPORT, TP-LIC-RPT-0007, "DESIGN BASIS ACCIDENT METHODOLOGY FOR EVENTS WITH RADIOLOGICAL RELEASE," REVISION 0 (EPID NO. L-2024-TOP-0009)

Applicant: TerraPower, LLC

Applicant Address: 15800 Northup Way, Bellevue, WA 98008

Plant Name: Natrium

Project No.: 99902100

1.0 BACKGROUND

By letter dated March 22, 2024, TerraPower, LLC (TerraPower) submitted topical report (TR) TP-LIC-RPT-0007, "Design Basis Accident Methodology for Events with Radiological Release," Revision 0 (Agencywide Documents Access and Management System (ADAMS) Accession No. (ML24082A262) to the U.S. Nuclear Regulatory Commission (NRC) staff. The TR provides evaluation models (EMs) developed for the Natrium reactor to evaluate design basis accidents (DBAs) with the potential for radiological release. On April 22, 2024, the NRC staff found that the material presented in the TR provides technical information in sufficient detail to enable the NRC staff to conduct a detailed technical review (ML24107B043).

TerraPower requested the NRC's review and approval of the EMs presented in the TR for use by future applications utilizing the Natrium design. The applicant's overall licensing methodology follows the technology-inclusive, risk-informed, and performance-based approach outlined in Regulatory Guide 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).

On July 15, 2024, the NRC staff provided its audit plan for the subject TR to TerraPower (ML24197A156). The audit was conducted virtually from July 23, 2024, to January 29, 2025, using TerraPower's electronic reading room (ERR). The NRC staff held an audit exit meeting with TerraPower on January 29, 2025. By letter dated February 28, 2025, TerraPower submitted a revision to the TR, renumbered as NAT-9394, "Design Basis Accident Methodology for Events with Radiological Release," Revision 0 (ML25063A329) to address the results of the audit, as summarized below.

2.0 AUDIT REGULATORY BASES

The basis for the audit includes:

- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.34(a)(4) and 50.34(b)(4), which apply to applicants for construction permit's (CP) and operating licenses, respectively. These sections require analysis and evaluation of the design and performance of structures, systems, and components (SSCs) of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including 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.

- Paragraph 50.43(e) of 10 CFR states that applications that propose nuclear reactor designs that differ significantly from light-water reactor designs that were licensed before 1997 will be approved only if the performance of each safety feature of the design has been demonstrated through either analysis, appropriate test programs, experience, or a combination thereof; interdependent effects among the safety features of the design are acceptable, as demonstrated by analysis, appropriate test programs, experience, or a combination thereof; and sufficient data exist on the safety features of the design to assess the analytical tools used for safety analyses over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions.

3.0 AUDIT PURPOSE AND OBJECTIVES

The purpose of the audit was for the NRC staff to gain a more detailed understanding of TerraPower's EMs presented in the TR. A secondary purpose of the audit was to identify any information that will require docketing to support the NRC staff's safety evaluation (SE).

4.0 SCOPE OF THE AUDIT AND AUDIT ACTIVITIES

On July 15, 2024, the NRC staff transmitted an audit plan to TerraPower (ML24197A156). The audit was conducted from July 23, 2024, to January 29, 2025, in a virtual format and followed the guidance in the Office of Nuclear Reactor Regulation's Office Instruction LIC-111, "Regulatory Audits," Revision 1 (ML19226A274). TerraPower responded to the audit plan questions over the course of multiple audit meetings. To support addressing the NRC staff questions, TerraPower made the following documents available in its electronic reading room (ERR):

- **[[**
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- NAT-2815, "Phenomena Identification and Ranking Table (PIRT) Report for Natrium Other Quantified Events," Revision 0.
- NAT-5630, "Finite Element Modeling and Analysis Methods for Core Assembly Drop Accidents," Revision 0.
- NAT-5898, "**[[** **]]** User Manual," Revision 0.
- NAT-6148, "Integrated Pool Methodology Technical Report," Revision A.
- NAT-6636, "Transient Fuel Performance Analysis for Natrium Core," Revision 1.
- NAT-6803, "Acquired Software Quality Assurance Plan Under Safety Analysis and Risk," Revision 1.
- NAT-6966, "Fuel Pin Cladding Temperature Criteria for Failure Analysis," Revision 0.
- NAT-7083, "**[[**
  ]]," Revision 0.
- NAT-7287, "**[[**
  ]]," Revision 0.
- NAT-7316, "**[[** **]]**," Revision 0.
- NAT-7320, "**[[**
  ]]," Revision 0.

- NAT-7767, "**[[ ]]** Theory Manual," Revision 1.
- NAT-7926, "[Detailed Safety Analysis Workflow (DSAW)] User Manual," Revision 2.
- NAT-7951, "**[[ ]]**."
- NAT-8094, "Natrium Reactor Fuel Misload Evaluation," Revision 1.
- NAT-9668, "**[[ ]]** User Manual," Revision 0.
- **[[ ]]**."
- **[[ ]]**."
- **[[ ]]**."
- **[[ ]]**."
- **[[ ]]**."
- **[[ ]]**."
- TP-ENG-PLAN-0002, "**[[ ]],**" Revision 01.
- TP-ENG-MAN-0004, "**[[ ]]**," Revision 0.

Members of the NRC audit team included:

- Reed Anzalone, Senior Nuclear Engineer, Natrium Technical Lead
- Stephanie Devlin-Gill, Senior Project Manager, Audit Project Manager
- Zachary Gran, Reactor Scientist
- Michelle Hart, Senior Reactor Engineer
- Steve Jones, Senior Safety and Plant Systems Engineer
- Alec Neller, Nuclear Engineer, Audit Technical Lead

The participants from TerraPower for this audit were Cole Blakely, Anh Bui, Jong Chang, Patrick Donnelly, Chris Forrest, Nick Garstka, Moonkyu Hwang, Brian Johnson, Hugh Luo, Chad Pope, Matthew Presson, Doug Pruitt, Joe Sinodis, and Jarrett Valeri.

On January 29, 2025, the NRC staff held an audit exit meeting with TerraPower and summarized the audit purpose, activities, and high-level results. The NRC staff did not acquire any documents during the audit.

5.0 SUMMARY OF OBSERVATIONS

As indicated in the NRC staff's audit plan, the audit was focused on specific inquiries pertaining to the content of the TR. The NRC staff reviewed information through the TerraPower ERR and held discussions with TerraPower staff to understand and resolve questions. The table below replicates the transmitted audit questions and summarizes the resolution of the questions.

Number	Question	Resolution of Question
1	TR section 2.4, "DBA Event Selection," indicates that DBAs are considered for analysis using the DBA with radiological release methodology based on whether they "have descriptions indicating they involve a potential release of radioactive material." The NRC staff requests that TerraPower, LLC (TerraPower) clarify the process used for determining whether DBAs have the potential for radionuclide releases.	TerraPower stated it would revise the TR to clarify how DBAs are screened for the potential release of radioactive material. TerraPower clarified that in-vessel DBAs are first analyzed with the in-vessel DBA without release EM discussed in TerraPower's TR, "[DBA] Methodology for In-Vessel Events without Radiological Release" (ML24295A202). If a given DBA violates the time-at-temperature no-failure (TATNF) screening criteria, the DBA is further evaluated through the in-vessel methodology contained within the DBA with Release EM discussed in the TR. TerraPower further stated that DBAs that are not in-vessel events are assumed to have the potential for radiological release, and are evaluated using one of the other methodologies contained in the DBA with Release EM, an event-specific method, or with the source term EM discussed in TerraPower's TR, "Radiological Source Term Methodology Report" (ML24261B944).
2	TR table 2-1, "Natrium DBAs with Radioactive Material Release," includes three DBAs that do not appear to be addressed by any of the EMs discussed in the TR: · **[[ ]]**, "Excessive Sodium-Water Reaction in the [Pool Immersion Cell (PIC)] (DBA);" · **[[ ]]**, "Loss of [Ex-Vessel Storage Tank (EVST)] Cooing While Storing Fuel Assembly (DBA);" and · **[[ ]]**, "[Gaseous Radiological Waste Processing System (RWG)] leak from the holdup tank and is released in the [Fuel Handling Building (FHB)] (DBA)." The NRC staff requests additional information from TerraPower on how these DBAs with release were modeled.	TerraPower stated it would revise the TR to clarify how these three DBAs will be modeled and confirmed that these DBAs are not covered by an EM in the TR. TerraPower stated that, for **[[ ]]**, conservative assumptions are made in the source term methodology to determine potential release. TerraPower further stated that, for **[[ ]]**, an event-specific calculation was used in the Kemmerer Power Station Unit 1 Preliminary Safety Analysis Report (PSAR) (ML24088A065). The NRC staff informed TerraPower that it plans to add a Limitation and Condition to the TR SE limiting the use of the DBA with radiological release methodology for these events.
3	The NRC staff requests that TerraPower confirm the list of DBAs provided in TR table 2-1 is comprehensive and	TerraPower stated it would revise the TR to clarify that TR table 2-1 events are illustrative only and do not

Number	Question	Resolution of Question
	completely captures all DBAs considered for the Natrium design. For example, the US SFR Owner, LLC CP application and corresponding Preliminary Safety Analysis Report (ML24088A065) includes RRS-SPLA-CN, "[Primary Sodium Processing System (SPS-P)] Leak in the [Reactor Auxiliary Building (RAB)]," in table 3.5-4, "Summary of DBAs," which is not included in this TR.	represent all DBAs applicable to the Natrium design. TerraPower clarified that applicants referencing this TR will use the methodologies in the TR for the DBAs defined in the specific licensing application rather than the DBAs listed in TR table 2-1.
4	Assumption 3.2, discussed in TR chapter 3, "Assumptions Requiring Verification," states that "…the range of phenomena involved in the Natrium DBAs with release is assumed to be restricted to the initiating and early transition phases of accident progression." This is also referenced in TR section 5.1.2, "Assumptions," as the reason why "…**[[ ]]**…" is not considered. The NRC staff requests that TerraPower clarify Assumption 3.2 and its basis. Specifically, the NRC staff is requesting to understand how the early transition phase is defined and how the Natrium design features, and the selected events provide a basis for restricting the range of phenomena to only the initiating and early transition phases of accident progression.	TerraPower stated it would revise the TR to remove Assumption 3.2 and include a description of the three event phases associated with severe accidents (i.e., initiating, transition, termination) for the Natrium reactor. TerraPower stated that the phenomena relevant to the in-vessel transients with radiological release methodology come from the initiating and early transition phases because the DBAs resulting in radiological release are due to cladding failure rather than fuel melting. As fuel melt is not expected to occur, TerraPower stated that the DBAs modeled in this methodology do not transition to a severe accident as described in the initiating phase. The NRC staff informed TerraPower that it plans to add a Limitation and Condition to the TR SE limiting the use of the in-vessel transients with radiological release methodology for licensing analyses to events that do not experience severe accident phenomena.
5	Assumption 3.4 refers to "system leakage scenarios." The NRC staff requests that TerraPower clarify what it means by this phrase and discuss why it is appropriate to assume leakage is not a part of, or consequence of, a different event.	TerraPower stated it would revise the TR to clarify that system leakage scenarios consist of DBAs resulting from leakage or breaks in the sodium processing system (SPS), Intermediate Heat Transport System (IHT), RWG, or Sodium Cover Gas System (SCG).TerraPower also stated that it did not assume leakage is part of, or a consequence of, a different event because (1) the **[[**

Number	Question	Resolution of Question
		DBE, these events would not have an associated DBA **]]**.
6	Assumption 3.5 states that "…**[[** **]].**" The NRC staff requests that TerraPower clarify how **[[** **]]**.	TerraPower stated it would revise the TR to clarify that the approach taken for sodium and gas leaks is to determine or assume the maximal release (e.g., complete system release, or all available volume prior to a pump trip). TerraPower stated this approach is described in its source term methodology TR.
7	Assumption 3.6 states that **[[** **]]**. The NRC staff requests that TerraPower clarify whether this assumption also applies **[[** **]].**	TerraPower stated it would revise the TR to clarify that **[[** **]]**.
8	Assumption 3.9 states that the partial flow blockage analysis assumes maximum assembly power, which minimizes local peaking. Considering that flow blockage is a highly localized phenomenon, The NRC staff requests that TerraPower justify why it is appropriate to maximize assembly power instead of local peaking.	TerraPower stated that it would revise the TR to clarify that, for a **[[** **]]**.
9	Assumption 3.10 states that misloads can be analyzed "…**[[** **]].**" The NRC staff requests that TerraPower provide additional clarification on the meaning of this assumption.	TerraPower clarified that the **[[** **]]**.

Number	Question	Resolution of Question
10	Assumption 3.14 states that "[t]he In-Vessel Transients with Radiological Release methodology assumes that only Type 1 fuel is used." The NRC staff requests that TerraPower clarify if this methodology will be updated prior to the use of Type 1B in lead test assemblies as discussed in the "Natrium Topical Report: Fuel and Control Assembly Qualification" (ML23025A409)?	TerraPower stated that this methodology will be revised to support Type 1B fuel prior to its use in lead test assemblies.
11	TR table 4-1, "Figures of Merit for In-Vessel DBAs," lists figures of merit for in-vessel DBAs without release, referenced from TerraPower's TR titled "Design Basis Accident Methodology for In-Vessel Events without Radiological Release," Revision 0 (ML23272A260). The NRC staff requests that TerraPower clarify if the figures of merit in the cited TR are revised, will this TR be revised.	TerraPower stated it would revise the TR to clarify that the table represents the figures of merit as a snapshot in time, and that the TR will be updated accordingly as the figures of merit evolve. The NRC staff notes that revisions of TerraPower's TR "[DBA] Methodology for In-Vessel Events without Radiological Release," were submitted to the NRC since the time the NRC staff asked audit question 11. Revision 2 of the "[DBA] Methodology for In-Vessel Events without Radiological Release," TR can be found at ML24295A202.
12	TR table 4-1 provides a brief overview of the TATNF criterion, which is an integral part of TerraPower's safety analysis. The NRC staff requests that TerraPower provide documentation that details how the TATNF criterion is determined.	TerraPower provided NAT-6966 on the ERR for the NRC staff to audit. NAT-6966 provided the NRC staff with a better understanding of how the TATNF criteria were developed.
13	The NRC staff requests that TerraPower provide clarification on Figure 4.1-1, "EM Calculational Devices and Analysis Workflow." Specifically, the NRC staff requests that TerraPower clarify how the various EMs and codes are **[[** **]]**.	TerraPower stated it would revise the figure in the TR to clarify how the various EMs and codes are linked.
14	Multiple sections of the TR discuss the use of TerraPower's Acquired Software Quality Assurance (QA) Plan under Safety Analysis and Risk. TR section 4.2,	TerraPower provided NAT-6803 and TP-ENG-PLAN-0002 on the ERR for the NRC staff to audit. These documents provided the NRC staff with a

Number	Question	Resolution of Question
	"Evaluation Model Development," states that this plan provides a process framework supporting the QA requirements for software that are used for analyses in the Natrium plant. The NRC staff requests that TerraPower provide this document for the NRC staff audit review.	better understanding of how TerraPower plans to meet QA requirements for the software used for analyses in the Natrium plant.
15	TR section 4.4, "Evaluation Model Assessment," states that "…an assessment matrix is created for each methodology based on the PIRT results" The NRC staff requests that TerraPower clarify what it means by "each methodology" and if assessment matrices were created for fuel misloads, fuel handling accidents (FHAs), and sodium leaks.	TerraPower stated it would revise the TR to clarify that an assessment matrix is created for each methodology that has an associated PIRT. TerraPower clarified that the code qualification, verification, and validation performed for steady-state core design, fuel performance, and thermal-hydraulics codes serve the function of an assessment matrix for the fuel misload methodology as no new phenomena are introduced beyond those modeled for the steady-state analysis. TerraPower stated that the FHA and sodium liquid and gas leak methodology assessment matrices have not been developed for the dynamics and structural analysis nor the calculation of leak rate and timing applicable for the two methodologies, respectively. TerraPower stated these may be developed in the future.
16	The NRC staff does not fully understand how **[[ ]]** will be employed for the in-vessel transient with radiological release EM as described in TR section 5.1 "In-vessel Transients with Radiological Release Methodology." TR section 5.1.1, "Purpose and Scope," describes how **[[ ]].** As shown in Figure 5.1-1, "DSAW Data Flow," **[[ ]].** This section also notes that, if necessary **[[**	TerraPower stated that it would revise the TR to clarify: • how **[[ ]]** is used for in-vessel transient analyses; • that, for in-vessel transient analyses, DSAW would first be used to determine peak-pin margin to failure. If DSAW results demonstrate assembly-wide failures are expected, the **[[ ]]**; • which **[[ ]]**; and

Number	Question	Resolution of Question
	]] that integrates severe accident modules is planned to be employed. This seems to contrast with TR section 5.1.4, "EM Description," which states that **[[** **]]** The NRC staff requests that TerraPower clarify: • how **[[** **]]** will be used in transient analyses. • the DSAW process for transient analyses and how it interfaces with **[[** **]].** • The TR also discusses **[[** **]]** Has the determination been made to use **[[** **]]** • how **[[** **]]** Additionally, the NRC staff notes that **[[** **]].** • TR section 5.1.4 states that **[[** **]].** • TR section 5.1.4 discusses the use of **[[**	• what acceptance criteria are used for DSAW, which consist of **[[** **]]**. TerraPower additionally clarified that **[[** **]]**. The NRC staff informed TerraPower that it plans to add a Limitation and Condition to the TR SE regarding the completion of code qualification, verification, and validation for future applicants referencing the TR.

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17	The NRC staff requests that TerraPower provide documentation, such as user and technical manuals, on **[[ ]]**, DSAW, **[[ ]]**.	TerraPower provided various manuals detailing the codes used in the EMs discussed in the TR on the ERR for the NRC staff to audit. These documents are listed in section 4, "Scope of the Audit and Audit Activities," of this audit summary report. These documents provided the NRC staff with a better understanding of **[[ ]]**, DSAW, **[[ ]]**.
18	TR section 5.1.6, "EM Assessment," notes that " **[[ ]]** analyze several unprotected events (ULOF, ULOHS [Unprotected Loss of Heat Sink], UTOP [Unprotected Transient Over Power], etc.) that potentially involve fuel failure." The NRC staff requests that TerraPower provide these analyses for staff audit.	TerraPower provided NAT-2815 and NAT-7951 on the ERR for the NRC staff to audit. These documents provided the NRC staff with a better understanding of how **[[ ]]** is used for in-vessel transients that potentially involve fuel failure.
19	Section 5.1.6 of the TR notes that some "…DBAs that lead to potential fuel failures are associated with… asymmetric boundary conditions at the inlet of the core" but then states that these multidimensional effects cannot be assessed with **[[ ]]** TerraPower proposes to "identify and address non-conservatisms" associated with this issue using a **[[ ]].** The NRC staff requests that TerraPower clarify why that does not appear to be developed and why TerraPower has not included it in the TR.	TerraPower provided NAT-6148 and NAT-6636 on the ERR for the NRC staff to audit. NAT-6636 contained evaluations of asymmetric events, which demonstrated significant margin to clad failure. NAT-6148 provided the NRC staff with a better understanding of the status of TerraPower's integrated pool methodology **[[ ]]**, which is being developed to support a potential final safety analysis report submittal. TerraPower stated that it would revise the TR to clarify that DBA evaluations performed for the Natrium reactor show that symmetric events (e.g., loss of two

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	• The NRC staff requests that TerraPower provide additional information regarding the development of the **[[ ]].** • If asymmetric transients have the potential of being analyzed non-conservatively using **[[ ]]** the NRC staff requests that TerraPower clarify how TerraPower will maintain reasonable assurance that analyses performed in support of the licensing applications refencing this TR methodology are adequate.	intermediate heat exchangers (IHXs)) bound asymmetric events (e.g., loss of one IHX) and that asymmetric flow or temperature distributions are unlikely to result in cladding failures.
20	TR section 5.2.5, "EM Description," states that **[[ ]]** Given that **[[ ]]**, the NRC staff requests that TerraPower clarify the nature of **[[ ]].**	TerraPower stated it would revise the TR to clarify how the partial flow blockage DBA is modeled. TerraPower stated that **[[ ]]**. TerraPower further stated that **[[ ]]**. TerraPower clarified that a **[[ ]]**.
21	**[[ ]].** The NRC staff requests that TerraPower clarify **[[ ]].**	TerraPower clarified that it performed analyses of ten fuel misload scenarios and that these analyses demonstrated that the**[[ ]]**. Accordingly, TerraPower stated it would revise the TR to update the **[[ ]]**.
22	TR section 5.3.1, "Purpose and Scope," states that the purpose of the fuel misload methodology includes analyzing the consequences of fuel loaded in the right	TerraPower stated that it would revise the TR to clarify that the potential for fuel failures from fuel assemblies in the correct location but with the wrong orientation are

Number	Question	Resolution of Question
	location but with the wrong orientation; however, this was not discussed further in section 5.3, "Fuel Misload Methodology." The NRC staff requests that TerraPower clarify what analyses have been done for fuel misloads where fuel assemblies were in the right location but had the wrong orientation.	**[[** **]]**.
23	Core misload analyses are typically performed to identify the impacts of the worst fuel misload that is not detectable by instrumentation or startup testing. The NRC staff requests that TerraPower clarify if the misloads discussed in this TR are considered to be detectable. If so, the NRC staff requests that TerraPower provide a brief overview of the methods that would be used to identify misloads during fuel loading, startup, or operation. If not, the NRC staff requests that TerraPower provide further discussion on the conditions the misloaded fuel is assumed to experience in the analysis.	TerraPower clarified that the **[[** **]]**. TerraPower further stated that analysis of Natrium's **[[** **]]**. For the Kemmerer Unit 1 PSAR, TerraPower stated it **[[** **]]**.
24	The NRC staff requests that TerraPower clarify if the fuel misload analysis methodology considers the potential for fuel assemblies to not be fully seated.	TerraPower stated that the fuel misload analysis does not consider the potential for fuel assemblies not to be fully seated because the **[[** **]]**.
25	TR section 5.3.4, "EM Description," describes the fuel misload methodology used for the Natrium reactor. It states that ten fuel misload cases were analyzed, **[[** **]]**. The NRC staff requests that TerraPower provide documentation on the referenced fuel misload analyses to assist the NRC staff in better understanding the application of the fuel misload EM. Ensure that the referenced documentation is clear on the acceptance criteria that were used for the analyses.	TerraPower provided NAT-8094 and NAT-6636 on the ERR for the NRC staff to audit. These documents provided NRC staff with a better understanding of how the fuel misload methodology described in the TR is applied, including the applicable acceptance criteria.

Number	Question	Resolution of Question
26	TR section 5.4.3, "Acceptance criteria," lists two acceptance criteria for FHAs: dropped fuel assemblies must not result in fuel cladding mechanical failure and must not create unacceptable core conditions that impact safe reactor operations, such as local criticality or reduced flow. TR section 5.4, "Fuel Handling Accident Methodology," focuses on analyzing mechanical failure for fuel assemblies without any further discussion on the potential for unacceptable core conditions. The NRC staff requests that TerraPower clarify what analyses have been performed for FHAs related to the creation of unacceptable core conditions.	TerraPower stated that it would revise the TR to clarify that the acceptance criteria discussed for FHAs in TR section 5.4.3 do not apply to this methodology but rather are used to provide fuel failure information for later source term analysis.
27	TR section 5.4.4, "EM Scope and Requirements," states that **[[ ]]**.	TerraPower stated that it is **[[ ]]**. The NRC staff informed TerraPower that it plans to add a Limitation and Condition to the TR SE regarding this topic.
28	TR section 5.4.4 provides a list of phenomena that the FHA EM should be able to model. The NRC staff requests that TerraPower clarify if TerraPower has verified that **[[ ]]** is able to model these.	TerraPower stated that **[[ ]]** is capable of modeling the phenomena discussed in TR section 5.4.4 except for non-linear fracture mechanics resulting from dynamic loads or impacts, which can be modeled with **[[ ]]**. TerraPower clarified that **[[ ]]** are used for FHAs for the Natrium reactor. The NRC staff reviewed the applicable manuals for **[[ ]]**.
29	Section 5.4.5, "EM Description," states that "some experimentally determined factors, such as the impact	TerraPower clarified that the impact damping coefficient and impact stiffness are the model factors that will need

Number	Question	Resolution of Question
	damping coefficient" are inputs to the finite element model of Natrium's fuel assembly. The NRC staff requests that TerraPower clarify what experimental factors are inputs to this model and what experiments have been done to determine these factors.	to be quantified through Natrium core assembly impact tests.
30	Section 5.4.5 discusses a finite element model of the Natrium fuel assembly which has been used for preliminary analysis of FHAs. The NRC staff requests that TerraPower provide any existing documentation available on this model for NRC staff audit review.	TerraPower provided NAT-5630 on the ERR providing the NRC staff with a better understanding of how Natrium fuel assemblies are modeled for FHA analyses.
31	The NRC staff requests that TerraPower clarify what role, if any, **[[ ]]** will play in the FHA EM. The NRC staff notes that it is included as a suitable software in table 4-2, "Representative Events with Potential Fuel Failure and Radiological Release," and in TR section 6.1, "Summary of Codes Selected." This appears to contrast with footnote 5, which states that **[[ ]]**.	TerraPower stated it would revise the TR to clarify that **[[ ]]** have been used for FHA analysis.
32	TR section 5.5, "Sodium Liquid and Gas Leak Methodology," states that the analysis of sodium and gas leaks "includes the extent of leaks and releases based on the event initiation – the location, timing, system conditions, and propagation." The NRC staff notes that this characterization of a potential leak is not discussed in the TR. The NRC staff requests that TerraPower clarify what work has been done on this topic.	TerraPower stated it would revise the TR to clarify that a detailed mechanistic methodology for determining specific leak conditions has not yet been developed. TerraPower further stated that the current results from sodium and gas leak DBA analyses, which assume maximized release, should be bounding for results from a mechanistic methodology because TerraPower expects a mechanistic system release model would result in a lower quantity of activated sodium or gas release by crediting some retention of fluid within intact portions of the affected system. The NRC staff informed TerraPower that it plans to add a Limitation and Condition to the TR SE regarding the justification of adequate conservativism for initial and boundary conditions.

Number	Question	Resolution of Question
33	TR section 5.5.3, "EM Scope and Requirements," states that the EM established for analyzing sodium and gas leaks should have the capability of modeling important processes and phenomena identified during the PIRT for SPS leaks, shown in table 2-5 in TerraPower's TR, "Radiological Source Term Methodology Report," Revision 1 (ML24017A116). The NRC staff requests that TerraPower clarify other processes or phenomena that were considered in the modeling of leaks from the SCG or IHT. The NRC staff notes that the **[[** **]]**. TR section 6.2, "EM Conservatism Study," documents several conservatisms associated with the in-vessel transients. It then states: "An effort is underway to demonstrate that the conservative approach described above is sufficiently conservative for the Natrium design. Ongoing work is planned to be complete prior to TerraPower's submittal of an operating license application, and that information will be included in a future licensing submittal." The NRC staff requests that TerraPower make the results of this effort to date available for the NRC staff audit and discuss in further detail why the conservatisms listed are sufficient for the analyses performed using this TR.	TerraPower clarified how the PIRT for SPS leaks was developed, addressing how the phenomena identified are also applicable for leaks from the SCG or IHT. TerraPower provided NAT-6636 and NAT-6966 on the ERR for NRC staff to audit. These provided NRC staff with a better understanding of the conservatisms taken for the in-vessel transients with release EM.
34	Appendix A, "TATNF and Related Analyses," brings together several different concepts, and it is not clear how these concepts are related to the TATNF criterion, each other, or the main body of the TR. The NRC staff requests that TerraPower provide clarification on the purpose of appendix A and its relationship to the DBA with radiological release EM.	TerraPower stated it would revise the TR to clarify how the concepts in appendix A relate to in-vessel transients with radiological release methodology.
35	The NRC staff requests that TerraPower provide additional information on how the legacy data in	TerraPower stated it would revise the TR to clarify that experimental data in appendix B can be used to assess

Number	Question	Resolution of Question
	appendix B, “Initial Experimental Database for Fuel Performance and Radiological Release/Transport Methodology,” is planned for use in assessing DBAs with release and to which EMs this assessment matrix relates.	performance of the EMs developed to analyze fuel performance and in-vessel DBAs potentially involving radiological release. TerraPower further stated that the lists in appendix B are preliminary and provided because these experiments were used to inform the initial PIRT development and subsequent experimental database development.

6.0 REQUESTS FOR ADDITIONAL INFORMATION RESULTING FROM AUDIT

As a result of the audit, the NRC staff did not identify any requests for additional information related to this TR. However, TerraPower revised the subject TR to address questions discussed during the audit.

7.0 OPEN ITEMS AND PROPOSED CLOSURE PATHS

There are no open items resulting from this audit.