TerraPower

February 4, 2022

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U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Document Control Desk

Subject: Natrium™ Decoupling Strategy

This letter transmits the TerraPower, LLC (TerraPower) white paper titled, "Energy Island Decoupling Strategy." TerraPower requests that the U.S. Nuclear Regulatory Commission (NRC) staff review and evaluate the subject white paper and provide feedback on the decoupling approach to plant design and its impact on operational flexibility, transient separation, and regulatory separation in certain areas.

After the NRC staff has performed a preliminary review of the subject white paper, TerraPower would like to request a follow-up meeting with the NRC staff to establish a schedule and scope for the review. This meeting will be coordinated between TerraPower and the NRC staff.

This letter and enclosure make no new or revised regulatory commitments.

If you have any questions regarding this submittal, please contact Ryan Sprengel at rsprengel@terrapower.com or (425) 324-2888.

Sincerely,

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Enclosure: NATD-LIC-STDY-0001, Rev. 0, “Energy Island Decoupling Strategy”

cc: William (Duke) Kennedy, NRC
Mallecia Sutton, NRC

ENCLOSURE

NATD-LIC-STDY-0001, Rev. 0, “Energy Island Decoupling Strategy”

Controlled Document - Verify Current Revision

WHITE PAPER

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		Page:	1 of 13

Approval

Title	Name	Signature	Date
Originator, Principal Engineer	Seth Krueger	Electronically Signed in Agile	2/3/2022
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Approver, License Application Development Manager	Ryan Sprengel	Electronically Signed in Agile	2/3/2022

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REVISION HISTORY

Revision No.	Effective Date	Affected Section(s)	Description of Change(s)
0	2/4/2022	All	Initial issuance.

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1 INTRODUCTION

The Natrium™ advanced reactor utilizes a novel architecture to reduce the number of safety-related (SR) and non-safety-related with special treatment (NSRST) nuclear systems, thereby facilitating rapid construction and more flexible operations. The Natrium reactor is a TerraPower and GE-Hitachi technology. With a flexible molten salt thermal energy storage system, the Natrium advanced reactor is an excellent complement to the growing mix of renewable energy sources on the grid. It can vary the supply of energy to the grid though the use of its energy storage system to supplement energy security and mitigate the intermittency of solar and wind power. By using flexible energy storage, the Natrium advanced reactor complements these technologies to produce clean, robust energy for today’s needs and the needs of tomorrow’s generation.

One of the Natrium advanced reactor's primary design strategies is its decoupling approach to plant design: the Nuclear Island (NI), which contains the reactor and its supporting systems, is being designed to function as independently as possible from the Energy Island (EI), which contains the thermal energy storage tanks, steam generator, feedwater system, condenser, turbine, and supporting balance of plant (BOP) systems. The EI is physically connected to the NI by a salt system that transports heat between the islands and stores excess thermal energy, providing a buffer that allows the two islands to operate independently over short time scales. The Natrium design team uses the term *decoupling* to describe this level of independence between the two islands.

Heat from the reactor is transported away from the NI via molten salt, which is pumped into a hot salt tank on the EI. The molten salt is pumped through a steam generator to create steam, which is used to drive a steam turbine. The molten salt is then transferred into a cold salt tank and pumped back to the NI to be reheated. Because the salt tank levels can vary over a certain range without affecting operation of the NI or EI, the power output of the steam plant does not need to match the power output of the reactor at any given moment. In this way, the molten salt storage tanks eliminate the direct and real-time coupling of reactor and turbine operation that is inherent in typical nuclear power plants.

This design feature allows operational flexibility of the NI and EI: the NI and EI can be operated essentially as separate power plants as long as the salt tank conditions remain within certain controlled bands. Because of this operational flexibility, most off-normal events that may occur on the EI have no immediate effect on the NI. This transient separation means that events on the EI are reflected by a small set of initiating events associated with changes in plant parameters that directly affect the NI, such as the cold salt tank level. Transient separation allows all defense line (DL) functions to be performed by the NI, except for selected DL2 sensing functions. As a result of DL functions being performed by NI systems, structures, and components (SSCs) and physical separation between the EI and NI, regulatory separation can be achieved in certain areas. As an example, construction of the EI and operation of the turbine generator will be outside the scope of certain regulations that only apply to the NI.

2 PLANT LAYOUT OVERVIEW

The nuclear heat source is based on a pool-type sodium fast reactor design using metallic Uranium-Zirconium (U-Zr) fuel. The reactor operates at atmospheric pressure, circulating sodium through its core by means of four electromagnetic pumps. Heat is transferred from the hot primary sodium pool to an intermediate sodium piping loop by means of two intermediate heat exchangers. The intermediate piping loop uses sodium to transport reactor heat from each intermediate heat exchanger to two sodium/salt heat exchangers. These sodium/salt heat exchangers in the NI heat salt from the cold salt tank in the EI. That heated salt is then returned to the EI for storage in the hot salt tank, thereby serving as the plant's thermal energy storage system. The hot tank salt is then used on the EI to generate steam to serve commercially available steam turbine generators.

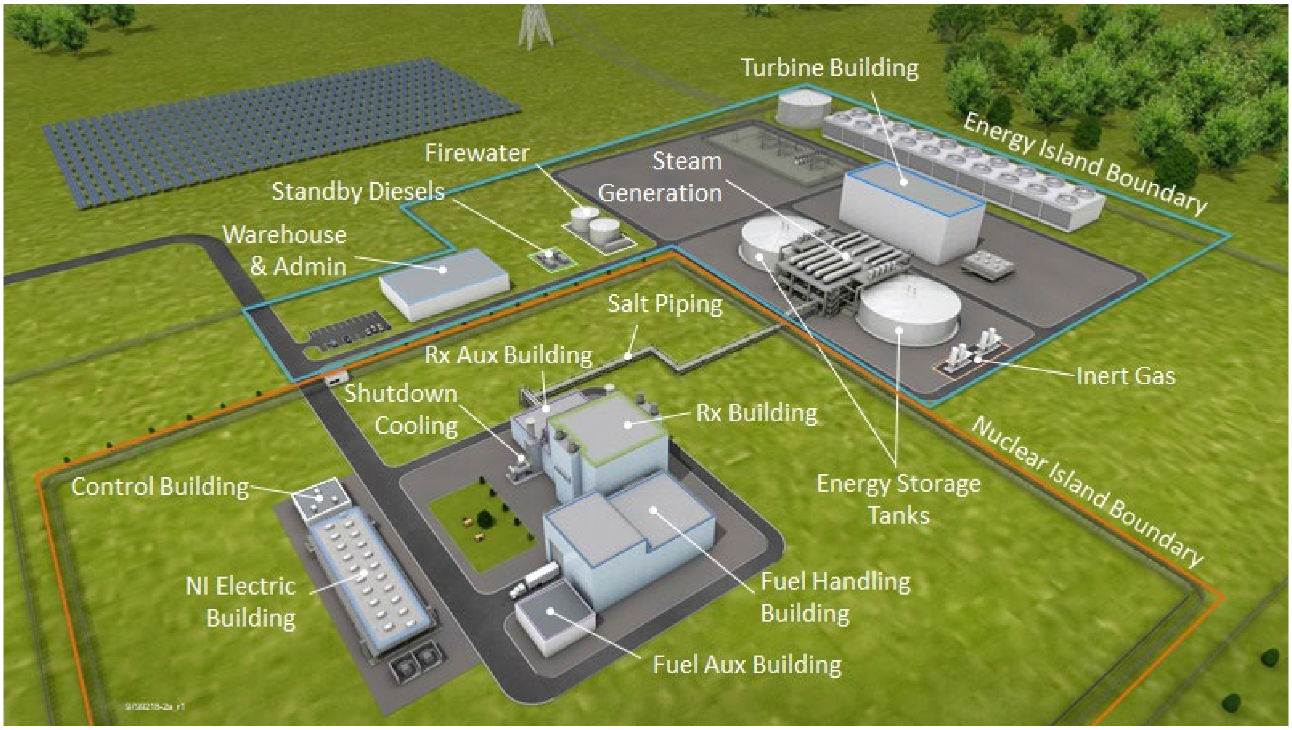

Figure 1. Conceptual Rendering of the Natrium Advanced Reactor

2.1 Interfaces Between NI and EI

Brief descriptions of process systems crossing the NI and EI boundary and the Plant instrumentation and control (I&C) architecture are provided in the following sections to provide the reader with a general understanding of system interactions and demarcations between the NI and EI. Engineering design continues in all of these systems and their configurations are not finalized. However, the conceptual system design descriptions are provided to assist the reader in understanding the plant layout and demonstrating how systems will be separated between the two islands.

2.1.1 NI Salt System (NSS)

The NI Salt System (NSS) transfers heat from the Intermediate Heat Transport (IHT) Sodium-Salt Heat Exchangers (SHXs) to the EI Salt System (ESS) piping. Molten salt from the Thermal Storage System (TSS) cold salt tank passes across the NI/EI boundary, into the Reactor Auxiliary Building (RAB) and into the SHXs. After the SHXs heat the salt, it continues out of the RAB, across the NI/EI boundary and into the TSS hot salt tank. The NSS Drain Isolation Valves inside the RAB form the boundary between the NSS and the ESS systems.

A second major function of the NSS is to isolate and drain the salt side of the SHXs and attached piping inboard of the NSS Isolation Valves. This is done to allow for complete process separation between the NI and EI, an enabling feature of the decoupling strategy.

The final major function of the NSS is to monitor the molten salt flow rate, hot salt, and cold salt leg temperatures, and ensure radioactivity leaving the NI is within discharge limits during all modes of plant operation. The NSS temperature sensors provide indication of abnormal salt conditions entering the SHX. This supports the decoupling concept of the plant by the NSS system providing parameters to the NI control room which indicate that the EI is providing cold salt within the expected temperature band. Temperature and flow monitoring will be part of calorimetrics, a series of measurements and calculations which calibrate the reactor power level prior to full power operations.

2.1.2 Thermal Salt Heat Transport (ESS)

The ESS transports reactor generated heat from the NI to the EI by circulating salt from the TSS cold salt tank to the NSS, and back from the NSS to the TSS hot salt tank. The ESS is primarily composed of:

- Cold salt transfer pumps (x3)
- Hot and cold salt piping
- Salt piping gravity drain lines and tanks
- Salt pipe heat trace
- ESS Instrumentation and Controls (I&C)

The ESS originates at the exit of the cold salt tank where it transports cold molten salt to the NSS via three vertical turbine cold salt pumps, with the pump suction drawing salt from the bottom of the cold salt tank. Three cold salt pumps are in operation during normal power operations, powered by Variable Frequency Drives (VFDs). The flow in ESS piping will be controlled by both VFDs and control valves. There are three cold salt pumps, each rated for up to 50% of the total rated flow, to ensure availability of salt flow to the NI The ESS pipelines that exit the three respective salt pumps combine into one header that then travels to the NSS. Downstream of the EI and NI boundary, the ESS branches into two heat transfer trains, each leading to SHXs in the IHT system. The ESS cold salt piping ends at the SHX inlet isolation valves and becomes the NSS system.

Each heat transfer train will consist of two SHXs that exchange heat from the IHT loop to the molten salt coming from the NSS. The heated salt re-enters the ESS from the NSS. The ESS crosses the NI/EI boundary and discharges to the TSS hot salt tank in the EI. The hot salt piping, prior to discharging to the TSS hot salt tank, will temporarily branch into two pipelines with control valves to support startup and normal operations.

2.1.3 Instrumentation and Control

The Natrium I&C architecture is in development. The ongoing conceptual design phase includes defining the I&C systems which compose the architecture, allocation of functions to those I&C systems, and definition of interfaces between the I&C systems resulting from the manner in which functions were decomposed and allocated.

The overall plant I&C design includes a NI I&C architecture and a separate EI I&C architecture. Each of these architectures comprises:

- Control systems which implement functions to control and monitor the process systems operating within their respective island,
- Human-machine interface systems which facilitate operator interface to the process systems, and
- The network/data communication infrastructure which implements interfaces between control systems, between control systems and HMI systems, and between control systems and plant process systems.

Each I&C system is classified based on its importance to safety in accordance with the process outlined in NEI 18-04, Rev. 1, “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development,” and endorsed in Regulatory Guide 1.233, Rev. 0, “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.” While the safety classifications are preliminary, the NI I&C architecture is likely to include SR, NSRST and NST (non-safety-related with no special treatment) classified systems, while the EI I&C architecture is likely to include only NST classified systems. The NI I&C architecture implements the fundamental I&C design principles defined by the NRC: independence, redundancy, defense-in-depth, and deterministic behavior. It is designed with simplicity as a high priority.

Consistent with the decoupling philosophy, interfaces between the NI and EI I&C architectures are limited. Data communication between islands is implemented in a uni-directional fashion. Both the NI and EI I&C architectures will provide for appropriate cyber security under a cyber security program.

Within the NI I&C system, few EI sensors will provide input to the Coolant Temperature Control (CTC) System; the DL2 sensing signals include Cold Salt Tank Level. The CTC system interfaces with the Rod Control System (RCS) to provide the DL 2 power run back function while operating in Mode 1: Power Operations.

3 DECOUPLING STRATEGY

Decoupling of the NI from the EI is central to the Natrium design philosophy. The NI has been designed such that the EI transients and events do not impact its safety case, a design principal known as transient separation. Thermal energy supply to the steam generators and turbine operations are independent from reactor power operations due to the presence of molten salt energy storage tanks, a design principal known as operational flexibility. With separation of the plant areas into two islands, the power production systems are effectively designed, constructed, operated, and managed as separate entities, potentially allowing for regulatory separation in certain areas. Through this division in plant areas, both nuclear reactor and power production facilities are optimized, ultimately translating to reduced construction risk and improved operations and maintenance performance.

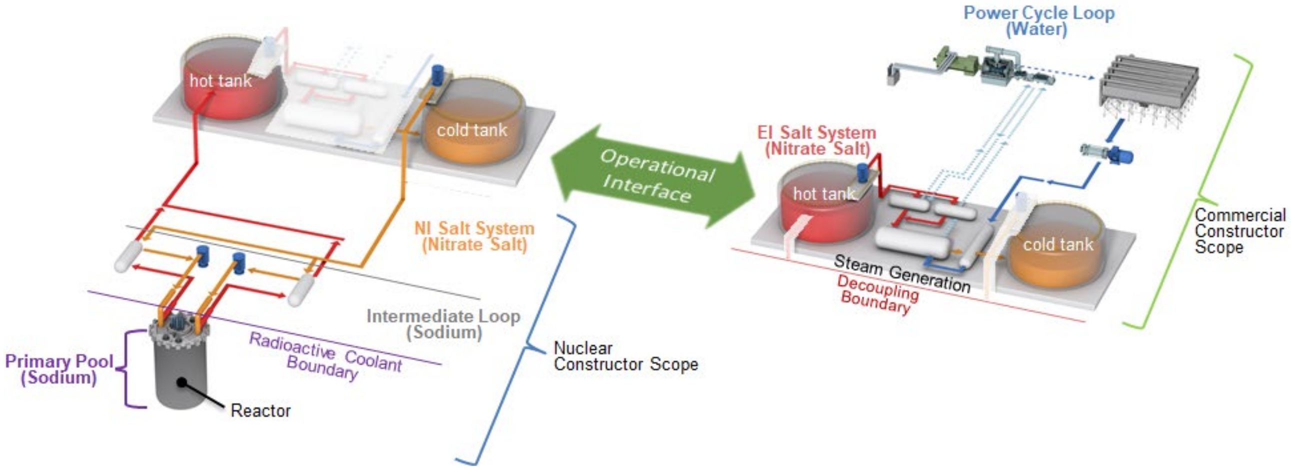

Figure 2. Heat Transport Systems Overview Highlighting Operational Interface.

A key to achieving the decoupling principle is the molten salt thermal energy storage system, a technology used in the concentrated solar power industry. The thermal energy storage system, located outside the NI, is comprised of two molten salt tanks: a hot tank and a cold tank. The salt tanks are used for energy storage and the reactor is the charging system. Its architecture is essentially the same as molten salt systems for concentrated solar power except the solar receiver tower is replaced with the Natrium advanced reactor. The charging salt loop transports salt from the cold tank to the reactor for heating and routes it to the hot tank. The steam salt loop transports salt from the hot tank to the steam generators to generate superheated steam and returns salt to the cold tank. The energy storage capacity for the tank pair is equivalent to 4.3 hours at 500-MWe net load. The thermal energy storage system is charged by a sodium intermediate loop between the primary loop and the salt heat transfer loop.

Regulatory separation in certain areas, enables portions of the EI to be designed, constructed, and operated without certain regulations typically applied to nuclear BOP systems. The NI is considered independent from the EI from a safety case perspective because no EI salt systems will perform safety related DL3 functions, nor are EI systems necessary to meet the Frequency-Consequence (F-C) target. Bounding conditions of interface parameters such as salt pressure, temperature, and flow are included in the safety analysis such that nuclear safety can be evaluated with minimal EI detail during licensing. Further detail of operational flexibility, transient separation, and regulatory separation are provided in following sections.

3.1 Transient Separation

The NI boundary conditions have been intentionally designed so its interface with the EI does not impact its safety case, a design principal known as transient separation. This design principle complements the Natrium advanced reactor defense-in-depth (DID) strategy and offers a separation of DLs and functions between the two islands.

3.1.1 Decoupling, Defense in Depth and Evaluation of Safety

The Natrium advanced reactor is using the NEI 18-04 process to demonstrate DID adequacy. Per NEI 18-04, Section 5.3:

"DID is to be considered and incorporated into all phases of defining the design requirements, developing the design, evaluating the design from both deterministic and probabilistic perspectives, and defining the programs to ensure adequate public protection. The reactor designer is responsible for ensuring that DID is achieved through the incorporation of DID features and programs in the design phases and in turn, conducting the evaluation that arrives at the decision of whether adequate DID has been achieved."

There are three key elements of the process for evaluating DID adequacy, as follows:

- Plant Capability DID, which involves the specification of plant functional and physical capabilities that create layers of defense, or defense lines, to assure safety adequacy in the plant design.
- Programmatic DID, which involves incorporating special treatment during plant design, construction, and operation to ensure safety adequacy throughout the life of the plant.
- Risk-Informed Evaluation of DID, which provides a "systematic and comprehensive process for examining the DID adequacy achieved by the combination of plant capability and programmatic elements" (NEI 18-04, Section 5.2).

3.1.1.1 Defense Line Definition

DL1 includes programmatic elements and design features that minimize potential for Postulated Initiating Events (PIE) to occur and also minimize potential for failures to occur in subsequent defense lines. DL1 does not include performance of control or mitigations functions; such functions reside in subsequent defense lines. DL1 design features include those used to establish reliability and robustness of equipment performing DL functions. Reliability targets for SR and NSRST SSCs will be established to ensure the effectiveness of the DL strategy. Design features also include independence and diversity applied to the design to minimize common cause failure (CCF) and failure propagation.

DL2 is the first set of functions relied upon in response to Anticipated Operational Occurrences (AOOs) but is also available to respond to Design Basis Events (DBEs). DL2 contains design functions that act to mitigate AOO PIEs and most DBE PIEs to prevent parameters from reaching a DL3 actuation setpoint. These DL2 functions will use sensor measurements of NI parameters, with the exception of only a few EI parameters (e.g., cold salt tank level). Equipment performing DL2 functions will generally be classified as NST, although it is possible for a DL2 function to be classified as NSRST if it keeps an AOO within the F-C target or is deemed a necessary DID measure. Due to decoupling, no EI systems are expected to take action during DBEs in order to meet the F-C target.

DL3 contains design functions that act to mitigate AOO and DBE PIEs by quickly terminating the fission process (reactivity control) and passively removing reactor decay heat, thereby placing the plant in a safe and stable shutdown state. DL3 also contains any design functions necessary to establish a physical barrier to radioactive release (e.g., close an isolation valve) if that barrier is required to meet acceptance criteria for the scenario being analyzed. There are no DL3 functions performed by SSCs on the EI.

DL4 contains design functions that can place and maintain the plant in a safe state for AOO and DBE PIEs that cannot be mitigated by DL2 alone; DL4 provides the second DL for these PIEs (DL3 is the first DL). DL4 functions may also be credited as the second DL in the DID adequacy evaluation for selected PIEs that can be mitigated by DL2 functions; this approach may be used if an effective DL4 function already exists or if the addition of a new DL4 function is determined to be advantageous. In addition, DL4 functions are used to mitigate Beyond Design Basis Event (BDBE) PIEs and to mitigate severe accidents. Within the LMP process, BDBEs are a frequency category and do not necessarily result in off-site consequences. Any BDBEs that have a dose over 25 rem are considered *high consequence BDBEs*. Any function needed to keep the frequency of high consequence BDBEs in the BDBE frequency range is a Required Safety Function, along with those functions credited in the conservative assessment of DBAs. Equipment performing a DL4 function necessary for responding to a high consequence BDBE would be categorized as SR. Currently there are no such high consequence events in the initial probabilistic risk assessment (PRA) and based on previous experience there should be no such events for the Natrium advanced reactor. However, it is possible that such an event could be uncovered as the design detail and scope of the PRA increase. For the purposes of decoupling, it is required that no EI-based initiators lead to high consequence BDBEs. Also related to decoupling, there are no EI SSCs which perform DL4 functions.

DL5 is the final layer of defense and constitutes special measures taken to reduce offsite impact in the unlikely event of a significant release. It is expected that the highest frequency releases exceeding 25 rem will be assessed when formulating the Emergency Planning Zone even if they are below the BDBE frequency cutoff. For the purposes of decoupling, EI events should not result in an offsite hazard (less than 1 rem total effective dose equivalent over 4 days from an unmitigated release). EI workers may be required to evacuate in some postulated release events originating from the NI. The continued operation or lack of operation of the EI must not significantly impact the progression of the most likely severe accidents.

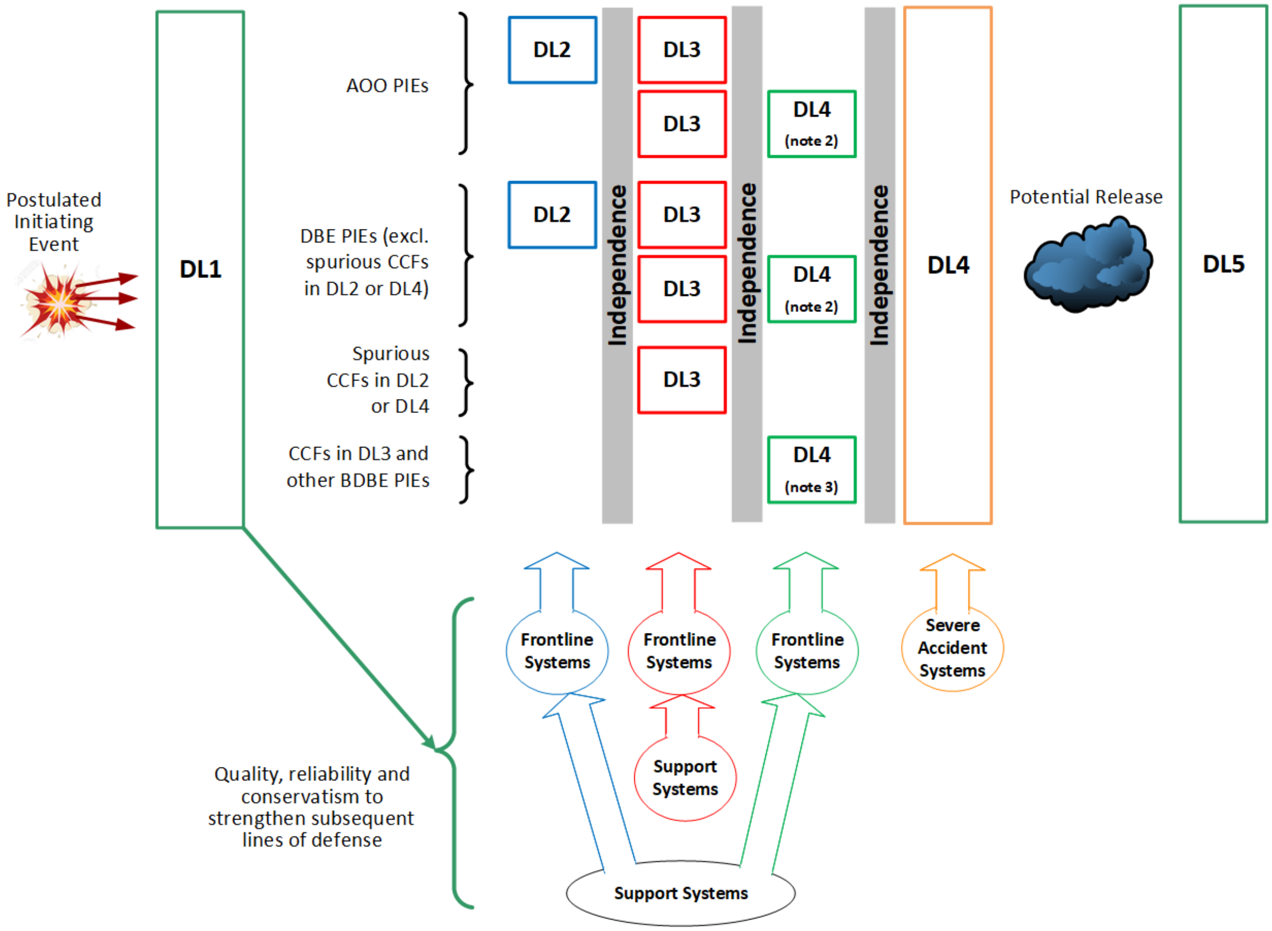

Figure 3. Natrium Advanced Reactor Defense Lines*

(*) Figure 3 Notes:

1. Certain actuated equipment in front line systems supports functions in more than one defense line.
2. DL2 functions can also be credited as long as they are not affected by the assumed failure. For DBE PIEs, DL4 is not needed if the PRA shows that the frequency of the PIE and additional failure is less than 5E-07 per year.
3. DL2 and DL3 functions can also be credited as long as they are not affected by the CCF.

3.1.1.2 Defense in Depth Approach

A Fault Evaluation activity, layered deterministic design basis safety analyses (DSA), and a PRA are used to support the overall DID approach, including the DL concept. The Fault Evaluation activity identifies the PIEs and event sequences (which may include additional failures) to be analyzed and the plant functions credited to mitigate them and organizes them in a Faulted Events List. The Faulted Events List is a primary, formal interface between the various analyses and the plant design. The Faulted Events List identifies the DL functions using the following approach:

- The baseline case evaluates the plant response to AOO and DBE PIEs to achieve a safe plant state, assuming all plant functions perform as designed. The baseline case uses only DL2 functions unless a safe state cannot be achieved with DL2 functions only. In those cases, DL3 functions may be used in place of, or in addition to, DL2 functions.
- The conservative case evaluates the plant response to AOO, and DBE PIEs and PIEs initiated by CCFs in DL2 and DL4 to achieve a safe plant state using only DL3 functions.
- The extended case evaluates the plant response to BDBE PIEs and PIEs initiated by CCFs in DL3 using any available (i.e., unaffected by the CCF) function in any DL. In addition, an extended case is also used:
    - To identify DL4 functions for AOO PIEs that were not fully mitigated by DL2 functions alone in the baseline case
    - To identify DL4 functions for DBE PIEs that were not fully mitigated by DL2 functions alone in the baseline case and were not mitigated to a frequency of less than 5E-07 in the conservative case
    - To identify DL4 functions for other AOO and DBE PIEs, even if not required by this DL strategy, to assist in the determination of DID adequacy and the classification of SSCs.
    - To identify DL4 functions that could be credited in the DID adequacy evaluation instead of DL2 functions.

The DSAs quantitatively verify that the credited DL functions adequately mitigate the PIEs to specific acceptance criteria. The PRA assesses the final plant design for acceptability with respect to DID, including whether the PIEs and event sequences are properly classified based on their frequency. The plant functions credited in these analyses, and the SSCs responsible for performing the functions, are part of the DL concept and are subject to requirements derived from the analyses and from the concept itself. These analyses are also an important source for determining which DL1 provisions are important relative to the plant's safety case. Assumptions and initial conditions used in these analyses will be justified based on one or more DL1 provisions. It is important that the analyses explicitly acknowledge and document these DL1 provisions as they are used.

3.1.1.3 Impact of Transient Separation and the Defense in Depth Approach

Most events on the EI that would affect the NI in a typical nuclear power plant have no immediate impact on the NI for the Natrium advanced reactor. For example, the NI is capable of continued operation at full power even if the turbine trips. As a result, most EI events are not considered PIEs in the safety analyses. EI events can lead to PIEs if they result in a change to an interface parameter between the EI and NI, such as low level in the cold salt tank during normal operation. As a result, numerous possible events on the EI that would be considered PIEs for a typical nuclear power plant can be reflected in a small set of PIEs associated with a set of interface parameters, such as cold salt tank level; only these PIEs need to be evaluated in the safety analyses.

An example of a DL2 function that utilizes NI SSCs to minimize severity of thermal transients and provide decay heat removal is the power run back function. A power run back is a response to an event that would lead to a reactor SCRAM were the run back not performed. It is a rapid decrease in power, more rapid than the normal plant shutdown, to the point where the reactor is at 5% power and the Primary Heat Transport (PHT) and IHT system flows are at 20% with the plant being cooled by the Intermediate Air Cooling (IAC) system via its Air Heat Exchangers (AHX). Thus, following a power run back, the plant is no longer relying on the EI for cooling. The reactor is still at power should the problem creating the need to perform the run back be readily correctable, thus presenting the opportunity to return to power relatively quickly. The plant could be held at this reduced power and flow state while the problem that necessitated the power run back is corrected.

PIEs are only established for events that must be addressed by a DL2 function on the NI to avoid initiation of a DL3 function (e.g., power runback to avoid a scram). DL functions to mitigate PIEs will use sensor measurements of NI parameters (e.g., NSS cold salt system temperature, pressure, or flow rate), except for selected DL2 functions, which may use sensor measurements of EI parameters (e.g., cold salt tank level). As discussed under operational flexibility, NI control room operators will be alerted when interface parameters are outside the controlled band, allowing some amount of time for preemptive action on the NI to prevent the PIE, which reduces its frequency (a DL1 feature).

PIEs represent the safety case interface between the NI and EI. The impacts of EI events on the NI are reflected in a set of PIEs (expected to be a small number) that are evaluated in the safety analyses. In summary, for the purposes of decoupling no EI systems will be necessary to meet the F-C target, no EI salt systems will perform DL3 functions, and no EI-based initiators will lead to high consequence BDBEs.

3.2 Operational Flexibility

Operational flexibility enables the steam turbine and reactor to operate at different power levels and enables improvement in MWe/min ramp rates. This flexibility makes the Natrium advanced reactor competitive with fossil fuel combined cycle plants. The molten salt tanks are where the two islands interface. They serve as energy storage and provide a buffer from the initiating events of the steam turbine and BOP systems. The duty cycle of the reactor is very low because it does not need to participate in grid demand changes. The NI operates at 100%, 24/7 at a capacity factor >90%. Meanwhile, the EI is free to ramp more quickly and schedule power output.

Because of the thermal energy storage capacity of the salt tanks, normal operation of the NI and EI can be managed separately. The NI control room separately manages reactor power and salt flow to the NI using the ESS cold tank pumps. The EI control room manages the plant power output by controlling TSS flow from the hot tank to the Steam Generating System (SGS) using the TSS hot salt pumps. The EI varies plant output power based on grid demand, a concept known as dispatchable power, while maintaining the salt tank levels and temperatures within controlled bands that do not affect NI operation or require NI operator actions. The reactor will typically remain at full power during these fluctuations in plant power output.

If a salt tank parameter, such as level or temperature, goes outside of the controlled band and into the alert band, an alert is received by EI and NI control rooms. An alert does not indicate that NI or EI operators will be required by procedures to take immediate action. However, procedures will provide for the possibility that actions may need to be taken, depending on the cause of the alert, the expected progression of the problem, and the projected time to restore the tank levels/temperatures to the controlled band. For example, NI control room may decrease reactor output to allow additional time for salt tank levels or temperatures to be restored to the controlled band, or NI control room may preemptively shut down the reactor (or EI control room may take the turbine unit offline) if it is clear that salt tank levels or temperatures cannot be restored in time to avoid a plant shutdown. NI control room may take these actions even before an alert level is reached; the NI and EI control rooms are able to communicate with one another and will make informed decisions with inputs from one another. Significant plant parameters being outside the alert bands are considered AOOs which will be analyzed by safety analysis and shall have procedural responses in place.

3.3 Regulatory Separation

Transient separation results in all DL functions being performed by NI SSCs, except for selected DL2 sensing functions, which are likely to be classified as NST. Utilizing guidance in NEI 18-04 and Regulatory Guide 1.233, the SSCs within the EI are anticipated to be classified as NST. As a result of DL functions being performed by NI SSCs and physical separation between the EI and NI, regulatory separation can be achieved in certain areas. As mentioned above, construction of the EI and operation of the turbine generator will be outside the scope of certain regulations that only apply to the NI which will allow the NI and EI to be constructed separately utilizing applicable construction practices, codes, and standards, with the EI constructed under a non-nuclear quality assurance program.

The overall plant layout provides physical separation between the NI and EI which is accomplished by long runs of piping systems that pass between the NI and EI (e.g., the hot and cold salt lines). This physical separation minimizes the potential for external events initiated by EI component failures to impact NI components.

Because there are several systems that pass fluids between the EI and NI, system design will ensure that any effluent from the NI meets applicable regulations and that isolation capabilities are provided, where required.

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