RAIO-1117-57308

November 21, 2017

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 245 (eRAI No. 9148) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 245 (eRAI No. 9148)," dated September 29, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 9148:

- 19-32

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9148

Enclosure 1:

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NuScale Power™

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9148
Date of RAI Issue: 09/29/2017

NRC Question No.: 19-32

10 CFR 52.47(a)(27) states that a DC application must contain an FSAR that includes a description of the design-specific probabilistic risk assessment (PRA) and its results. In accordance with the Statement of Consideration (72 FR 49387) for the revised 10 CFR Part 52, the staff reviews the information contained in the applicant's FSAR Chapter 19, and issues requests for additional information (RAI) and conducts audits of the complete PRA (e.g., models, analyses, data, and codes) to obtain clarifying information as needed. The staff uses guidance contained in SRP Chapter 19.0 Revision 3, "Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors." In accordance with SRP Chapter 19.0 Revision 3, the staff determines whether:

"The assumptions made in the applicant's PRA during design development and certification, in which a specific site may not have been identified or all aspects of the design (e.g., balance of plant) may not have been fully developed, are identified in the DC [design certification] application and either remain valid or are adequately addressed within the COL [combined license] application," and

"FSAR Chapter 19 includes PRA quantitative and qualitative results, including CDF [core damage frequency], LRF [large release frequency], the identification of *key PRA assumptions*, the identification of PRA-based insights, and discussion of the results and insights from importance, sensitivity, and uncertainty analyses." (Emphasis added)

The staff has reviewed the information in the FSAR and examined additional clarifying information from the audit of the complete PRA and determined that certain assumptions used in the internal fire PRA are not adequately described with their bases in the FSAR. Please update FSAR Table 19.1-46, "Key Internal Fire Probabilistic Risk Assessment Assumptions," and the FSAR text as appropriate to describe the assumptions listed below along with their bases.

a) The staff notes that the instrumentation required to perform operator actions has not been established at this point in the design. Therefore, the unstated assumption appears to be that any fire will not affect the availability of instrumentation needed for implementation of any operator actions. If the staff's understanding is correct, please document this assumption and its basis in the FSAR Table 19.1-46 so that it will be validated or updated as appropriate once

the design details become available in the COL phase.

b) The staff understands that the spurious operation probabilities are assumed based on NUREG/CR- 7150. Please document this assumption and its basis in the FSAR Table 19.1-46 so that it will be validated for applicability or be updated as appropriate once the control circuit design is complete in the COL phase.

c) The staff understands that the cables routed in the area under the bioshield have been excluded from fire ignition considerations (e.g., junction boxes). Please document this assumption and its basis in the FSAR Table 19.1-46 so that it may be validated or updated for the as-designed and as- built plant in the COL phase.

d) The staff understands that the transient ignition sources (i.e., Bin 7) are excluded from reactor building fire compartments. Therefore, the unstated assumption appears to be that operations and maintenance activities (excluding welding and cutting) will not cause a fire. Please document this assumption and its basis in the FSAR Table 19.1-46 so that it may be validated or updated for the as- designed, as-built and as-operated plant in the COL phase.

e) The staff understands that the controls for the reactor building crane are expected to utilize fiber optic controls extensively such that spurious operations of the crane are not judged to be credible. Please document this assumption in the FSAR Table 19.1-46 so that it may be validated or updated for the as-designed, as-built and as-operated plant in the COL phase.

NuScale Response:

a) As stated in FSAR Section 19.1.5.2.1, the internal fire PRA (FPRA) is developed from the internal events PRA; Table 19.1-21, which provides key assumptions for the internal events PRA, identifies that control room indication is available to operators unless there is a loss of all four highly reliable DC power system (EDSS) buses. The most important element of determining when instrumentation may be compromised by a fire event is the routing of the cables associated with the instrumentation. FSAR Table 19.1-46, which summarizes FPRA key assumptions, states that cable routing is not defined at the design certification stage.

The assumption in the FPRA is that instrumentation is assumed to be available to perform operator actions when the equipment (e.g., pumps, valves) required to perform the actions is available. That is, instrumentation required for the performance of an operator action is assumed to be affected by the same fire event that affects the equipment required to perform the action (e.g., by fire in area in which control circuitry is located). This assumption has been added to FSAR Table 19.1-46.

b) The spurious operation probabilities postulated in the FPRA are based on the circuit failure mode probabilities provided in NUREG/CR-7150, Volume 2 (FSAR Reference 19.1-46). These probabilities are derived from a simplified control circuit analysis, based on the material of construction and separation requirements, as stated in the key assumptions provided in FSAR

Table 19.1-46. The control circuit failure mode assumption in FSAR Table 19.1-46 has been clarified to include control circuit configuration.

c) The assumption in the FPRA is that a fire under the bioshield will not compromise cables or equipment in the area. This is consistent with FSAR Section 9A.6.4.3 which states that a fire in the area at the top of a module (under the bioshield) is virtually impossible as all of the cabling under the bioshield is routed in conduit or is three-hour rated cable which results in no intervening combustible loading for an exposure fire impacting other cable or components in the area. As noted in FSAR Section 9A.6.4.3, the top of a module area is inaccessible during reactor operation which precludes the introduction of transient combustibles. FSAR Table 19.1-46 has been modified to include the assumption regarding fire under the bioshield.

d) The fire ignition frequencies used in the development of the FPRA are developed based on the ignition frequencies provided in NUREG-2169 (FSAR Reference 19.1-45). Table 4-4 of NUREG-2169 identifies Bin 7 transient frequencies as applicable to a diesel generator room. Accordingly, the entirety of this frequency was allocated to generator-related fire compartments and there is no unstated assumption.

A study has been performed in which the Bin 7 fire frequency was allocated to the reactor and control buildings in a manner consistent with Bins 5 and 6. The total fire frequency (i.e., sum of all postulated fire initiating events) increases insignificantly and results in a negligible increase to the core damage frequency and large release frequency. No additional candidates for risk significance were identified as a result of this analysis.

e) Design of the crane controls is not complete at the design certification stage; however, the FPRA assumption is not dependent on the control circuit material. An assumption has been added to FSAR Table 19.1-46 stating that fire-induced spurious operation of the crane is judged not to be credible. FSAR Table 19.1-72 has also been updated for consistency with this assumption.

Impact on DCA:

FSAR Tables 19.1-46 and 19.1-72 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 19-18, RAI 19-32

Table 19.1-46: Key Internal Fire Probabilistic Risk Assessment Assumptions

Assumption	Basis
Fire compartments are screened if a fire in the compartment does not result in an automatic or manual plant trip and does not contain mitigating equipment.	Common engineering practice
For buildings that are not within the scope of the FHA, the fire compartment is the entire building. Other elements, not located inside a building, are grouped into a single fire compartment unless substantial fire barriers exist to justify separation (e.g., the plant yard area, transformers).	Common engineering practice
Cable routing and raceways are not defined at the design certification stage; fire affects are assumed from component and control equipment locations.	Engineering judgment
Fire-induced initiating events are grouped into four categories: a spurious ECCS valve opening, LOOP, RCS LOCA inside containment, and transient.	Engineering judgment
Fire frequencies are based on mapping plant ignition sources to generic fire bins and associated frequencies, and generally include equally weighted transient ignition sources. The highest error factor associated with any bin in a compartment was used for the compartment.	Common engineering practice
Detailed control circuits are not designed at the design certification stage; simplified circuit analysis is based on the material of construction and separation requirements. Spurious operation probabilities are influenced by assumed control circuit configurations.	Engineering judgment
Separation of redundant safe shutdown equipment and cabling is achieved ~~(i.e., one division of safe shutdown equipment remains free of fire damage for a fire in any fire compartment)~~.	Although not defined at design certification, the Fire Safe Shutdown Plan requires fire separation.
Electrical protective devices, including circuit breakers and fuses, are appropriately coordinated to preclude the possibility of fault current exceeding cable ampacity and also preclude the possibility of circuits credited in the FPRA from becoming associated with other circuits by sharing a common power supply.	Common engineering practice
A fiber optic control cable is not capable of causing a spurious component operation because it is not capable of producing a "hot short" per NEI 00-01. Therefore, when a fire is capable of damaging a fiber optic cable, it is only modeled as a loss of control.	Common engineering practice
No credit is taken for hot shorts to clear when they affect the inventory in the DHRS heat exchangers.	Bounding assumption
Simplified fire scenarios were developed for general compartment fires, MCR fires and multi-compartment fires.	Bounding simplification
A fire spreading from one compartment to another requires the failure of at least one passive fire barrier and the fire suppression system. Fires spreading into multiple additional compartments are judged to not be credible.	Engineering judgment
Screening probabilities are used for failure of fire suppression and passive barrier features.	Common engineering practice
Consistent with the internal events analysis, high stress was considered for operator actions.	Engineering judgment
Risk associated with seismic-fire interactions is small; no unique seismic fire hazards were identified and seismic events are not expected to challenge the fire suppression system.	Engineering judgment
Fires igniting under the bioshield and challenging plant equipment are not credible because cable is routed in conduit or three hour rated. (FSAR 9A.6.4.3)	Engineering judgment

Table 19.1-46: Key Internal Fire Probabilistic Risk Assessment Assumptions

Assumption	Basis
Instrumentation required for the performance of an operator action is affected by the same fire events that affect equipment required to perform the action (e.g., pumps, valves)	Engineering judgment
The reactor building crane cannot be spuriously operated as a result of a fire.	Engineering judgment

RAI 19-32

Table 19.1-72: Internal Fire Susceptibility During Low Power and Shutdown Plant Operating States

Plant Operating State	Internal Fire Susceptibility
POS1, Shutdown and initial cooling	Systems credited for mitigation of events that occur in this POS are susceptible to fire-induced failures. The probability of a randomly induced internal fire occurring during the short duration of the POS is judged to be sufficiently small to warrant not modeling it explicitly. A challenge associated with this POS is the potential for fire-induced spurious operation of the CVCS makeup pumps that may result in RPV overpressurization at low pressure. Fires are not expected to be capable of causing the spurious operations of the CVCS makeup pump and the valves providing LTOP in the same fire compartments.
POS2, Cooling through containment and module disconnection	Once the ECCS is actuated, reclosing them to terminate passive cooling requires the spurious operation of two solenoid valves for each of the ECCS valves and also requires the spurious operation of a CVCS makeup pump. The components are not expected to be affected by a fire in the same compartment. Similarly, draining the inventory in the CNV would require spurious operation of the CFDS. This would require the spurious operation of multiple solenoid valves, the CFDS pumps, and the nitrogen distribution system. The components are not expected to be affected by a fire in the same compartment.
POS3, Transport and disassembly	An internal fire event may result in a loss of power the crane; however the crane is designed to fail-safe on a loss of power. Mechanical failures dominate the crane failure probability and are not expected to be induced by internal fires. ~~Controls for the crane are expected to utilize fiber optic controls extensively such that spurious operations of the crane are not judged to be credible.~~Spurious operation of the crane does not pose a credible threat to an NPM.
POS4, Refueling and maintenance	In this POS all decay heat is being removed by the UHS and accordingly there is no effect from an internal fire during this POS.
POS5, Reassembly, transport, and reconnection	An internal fire event may result in a loss of power the crane; however the crane is designed to fail-safe on a loss of power. Mechanical failures dominate the crane failure probability and are not expected to be induced by internal fires. ~~Controls for the crane are expected to utilize fiber optic controls extensively such that spurious operations of the crane are not believed to be credible.~~Spurious operation of the crane does not pose a credible threat to an NPM.
POS6, Heatup	Systems credited for mitigation of events that occur in this POS are susceptible to fire-induced failures. The probability of a randomly induced internal fire occurring during the short duration of the POS is judged to be sufficiently small to warrant not modeling it explicitly. A challenge associated with this POS is the potential for fire-induced spurious operation of the CVCS makeup pumps that may result in RPV overpressurization at low pressure. Fires are not expected to be capable of causing the spurious operations of the CVCS makeup pump and the valves providing LTOP in the same fire compartments.
POS7, Low power operation	Systems credited for mitigation of events that occur in this POS are susceptible to fire-induced failures. The probability of a randomly induced internal fire occurring during the short duration of the POS is judged to be sufficiently small to warrant not modeling it explicitly.