

## NuScaleDCRaisPEm Resource

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**From:** Chowdhury, Prosanta  
**Sent:** Friday, March 23, 2018 10:07 PM  
**To:** Request for Additional Information  
**Cc:** Lee, Samuel; Cranston, Gregory; Murray, Demetrius; Huckabay, Victoria; Kent, Lauren; NuScaleDCRaisPEm Resource  
**Subject:** Request for Additional Information No. 400 eRAI No. 9409 (18)  
**Attachments:** Request for Additional Information No. 400 (eRAI No. 9409).pdf

Attached please find NRC staff's request for additional information (RAI) concerning review of the NuScale Design Certification Application.

Please submit your technically correct and complete response within 60 days of the date of this RAI to the NRC Document Control Desk.

If you have any questions, please contact me.

Thank you.

Prosanta Chowdhury, Project Manager  
Licensing Branch 1 (NuScale)  
Division of New Reactor Licensing  
Office of New Reactors  
U.S. Nuclear Regulatory Commission  
301-415-1647

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## Request for Additional Information No. 400 (eRAI No. 9409)

Issue Date: 03/26/2018

Application Title: NuScale Standard Design Certification - 52-048

Operating Company: NuScale Power, LLC

Docket No. 52-048

Review Section: 18 - Human Factors Engineering

Application Section:

### QUESTIONS

18-36

Title 10 of the *Code of Federal Regulations* (10 CFR), Section 52.47(a)(8) requires an applicant for a design certification to provide a final safety analysis report (FSAR) that includes the information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). Section 10 CFR 50.34(f)(2)(iii) requires an applicant to provide, for Commission review, a control room design that reflects state-of-the-art human factor principles prior to committing to fabrication or revision of fabricated control room panels and layouts. Chapter 18, "Human Factors Engineering," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," and NUREG-0711, "Human Factors Engineering Program Review Model," identify criteria the staff uses to evaluate whether an applicant meets the regulation. The FSAR, Tier 2, Section 18.0, "Human Factors Engineering – Overview," indicates that the HFE program incorporates the applicable guidance provided in NUREG-0711, Revision 3. This regulatory basis applies to all questions in this request for additional information.

NUREG-0711, Review Criterion 5.4(9), states, in part, that the applicant should provide an analysis of the feasibility and reliability of important human actions (HAs) that address the following:

- The analysis establishes the time available using an analysis method and acceptance criteria consistent with the regulatory guidance associated with the actions. The basis for the time available is documented.
- The analysis of the time required is based on a documented sequence of operator actions (based on task analysis, vendor-provided generic technical guidelines for emergency operating procedure (EOP) development, or plant-specific EOPs, depending on the maturity of the design).
- Techniques to minimize bias are used when estimates of time required are derived using methods that are dependent on expert judgment. Uncertainties in the analysis of time required are identified and assessed.
- The sequence of actions uses only alarms, controls, and displays that would be available and operable during the assumed scenario(s).
- The estimated time for operators to complete the credited action is sufficient to allow successful execution of applicable steps in the EOPs.

- Staffing for analysis is justified, and if credited manual actions require additional operators beyond the assumed staffing, the justification for timely availability of the additional staffing is provided and the estimate of time required includes any time needed for calling in additional personnel.
- The analysis of the action sequence is conducted at a level of detail sufficient to identify individual task components, including cognitive elements such as diagnosis and selection of appropriate response.
- The analysis identified a time margin to be added to the time required and the basis for the adequacy of the margin.

The Treatment of Important Human Actions Results Summary Report (TIHA RSR), Section 4.1, "Identification of Risk Important Human Actions from the PRA/HRA [Probabilistic Risk Assessment / Human Reliability Analysis]," states that two important human actions (IHAs) associated with the NuScale Power plant design have been identified. Section 4.3.4, "Staffing and Qualification Analysis," states that the Chemical and Volume Control System (CVCS) and the Containment Flooding and Drain System (CFDS) IHAs were included in the scenarios used during the staffing plan validation.

The FSAR, Chapter 19, "Probabilistic Risk Assessment," documents the results of a Human Reliability Analysis, which was performed to identify potential human failure events and to systematically estimate the probability of those events. Table 19.1-14, "Modeled Human Actions (Post-Initiator)," identified several post-initiator human actions that are performed by the operator to place a mitigating system in service, including manual operation of a component and manual initiation as backup to auto-initiation. For two of the human actions listed in this Table, CFDS-HFE-0001C-FOP-N (operator fails to un-insolate and initiate CFDS injection) and CVCS-HFE-0001C-FOP-N (operator fails to un-isolate and initiate CVCS injection through either the injection line or the pressurizer spray line), the corresponding end note reads: "For diagnosis, the operators have at least 30 minutes (based on thermal hydraulic analysis), and the time available to perform the action is nominal (i.e., greater than the time required to perform the action)."

The Human Factors Engineering Staffing and Qualifications Results Summary Report (S&Q RSR), Section 3.3.2, "Staffing Plan Validation Scenario Development" provides information regarding the time available to perform the important HAs, based on the most limiting probabilistic risk assessment (PRA) sequence. The same information is also provided in the Control Room Staffing Plan Validation Results (SPV Results) document, Appendix D, "Scenario 1 Description and Basis." The information regarding the time available to perform the IHAs provided in the S&Q RSR and the SPV Results document does not appear to be consistent with the information provided in the FSAR Chapter 19.

It is not clear how the time available as shown in the S&Q RSR and the SPV Results document was determined, based on the PRA/HRA information provided in the FSAR, Chapter 19. Provide additional information regarding the time available to perform the IHAs, as follows:

- a. Explain the apparent inconsistency between the time available as shown in the S&Q RSR and the SPV Results document, and the time available (30 minutes) determined by the PRA/HRA information provided in the FSAR, Chapter 19.

- b. If the time available was determined by means other than the PRA/HRA analysis, describe the analysis method and acceptance criteria used to determine the time available to perform the IHAs identified in the TIHA RSR. In your response, identify the applicable regulatory guidance that was used for the chosen analysis method and acceptance criteria, if any.
- c. Provide the time available that was determined for each IHA, using the analysis method and acceptance criteria discussed above.

18-37

The TIHA RSR, Section 4.1, "Identification of Risk Important Human Actions from the PRA/HRA," stated that two IHAs associated with the NuScale Power plant design have been identified. The same IHAs are also discussed in the Task Analysis Results Summary Report (TA RSR), Section 4.5, "Important Human Action Results."

The S&Q RSR, Section 3.1.4, "Treatment of Important Human Actions," states that the important HAs are identified as described in the TIHA RSR. It further states: "Detailed [Task Analysis] (TA) determined the feasibility and reliability of IHAs." TA also performs a workload assessment, time margin assessment, and determines the number of people required to accomplish a task as well as the knowledge and abilities that determine qualifications." Section 3.3.2, "Staffing Plan Validation Scenario Development," provides additional information, indicating that the number of important HAs was revised and no longer corresponds to the information provided in the TIHA RSR and TA RSR. Furthermore, the SPV Results document, Appendix D, "Scenario 1 Description and Basis," describes the inclusion of important HAs in the scenario, which is consistent with the information provided in the S&Q RSR, but inconsistent with the TA RSR and TIHA RSR.

Provide additional information explaining the apparent inconsistency in the identification and evaluation of the important HAs as described in the above referenced documents.

18-38

The TA RSR, Section 3.7, "Analysis of Feasibility and Reliability for Important Human Actions," stated, in part, that the time-required calculation was based on an understanding of the sequence of operator actions and took into account secondary tasks. It further stated that the time-required estimates for important human actions were simulated and measured when feasible, or obtained through operator and expert interviews, software modeling of human behavior during tasks, and OERs.

- a. Provide the results of the analysis that was performed to determine the time required to complete each important HA, based on a documented sequence of operator actions. If estimates of time required were derived using methods that are dependent on expert judgement, clarify what techniques to minimize bias were used and how uncertainties in the analysis of time required were identified and assessed.
- b. Provide additional information clarifying whether the sequence of actions that were analyzed for the purpose of determining the feasibility and reliability for important HAs

used only alarms, controls, and displays that would be available and operable during the assumed scenarios.

18-39

The SPV Results document, Section 6.2.1, "Scenario Completion Acceptability," discussed the criteria that were used to determine the staffing plan scenario testing success, including the ratio of the time required to the time available to perform actions. Appendix A, "Scenario Results Report," Section A.1, "Results Summary," documented evaluation of the simulation results against the criteria defined in Section 6.2.1 of the document.

Section 6.1.1, "Time Analysis," discussed the time measurement analysis, including a time margin to be added to be added to the time required. The time ratio discussed in Section 6.1.1 is more conservative than the criteria described in Section 6.2.1.

Provide additional information regarding the basis for the adequacy of the margin to be added to the time required, as discussed in Section 6.1.1 of the SPV Results document. In your response, clarify why the less conservative time ratio described in Section 6.2.1 was used, as opposed to the more conservative value identified in Section 6.1.1.

18-40

The S&Q RSR, Section 4.7, "Staffing Plan Validation Results Analysis," indicates a time the PRA assumes is the most limiting completion time for these actions, and that time is greater than 30 minutes. The same section in the S&Q RSR also identifies the times it took crews to complete these two actions in the simulator during the staffing plan validation and the time margin determined by comparing the crews' times to the time assumed in the PRA.

Please explain whether the responses to Questions 1 and 4 above impact the conclusion discussed in the last paragraph of the S&Q RSR, Section 4.7 and the conclusions discussed in the SPV Results document, Section 6.1.1, "Time Analysis," and if so, please revise the S&Q RSR, Section 4.7 as necessary.