NuScaleDCRaisPEm Resource

From:	Chowdhury, Prosanta
Sent:	Tuesday, March 20, 2018 8:09 AM
To:	Request for Additional Information
Cc:	Lee, Samuel; Cranston, Gregory; Murray, Demetrius; Kent, Lauren; Scheetz, Maurin; NuScaleDCRaisPEm Resource
Subject:	Request for Additional Information No. 392 eRAI No. 9318 (18)
Attachments:	Request for Additional Information No. 392 (eRAI No. 9318).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.

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301-415-1647

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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

18-26

Regulations in 10CFR 50.34(f)(2)(v) require automatic indication of the bypassed and inoperable status of safety systems. Chapter 18, “Human Factors Engineering,” of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” lists NUREG-0711, "Human Factors Engineering Program Review Model,” and NUREG-0700, “Human-System Interface Design Review Guidelines,” as the sources of acceptance criteria the staff uses to evaluate whether an applicant meets the regulation. NUREG-0711, Criterion 8.4.4.2(2), describes an acceptable method for complying with the regulation for bypassed and inoperable status indication (BISI).

Provide a description for the following items and revise the submittal as necessary:

1. The staff could not find a description of the provisions for allowing the operations staff to confirm that a bypassed safety function was properly returned to service, which is addressed in the third bullet in NUREG-0711, Criterion 8.4.4.2(2).

2. The staff could not find how the application addresses the following, which is addressed by the sixth bullet of NUREG-0711, Criterion 8.4.4.2(2): “Bypass and inoperable status indicators should be arranged such that personnel can determine whether it is permissible to continue operating the reactor.”

18-27

Regulations in 10 CFR 50.34(f)(2)(xi) require direct indication of relief and safety valve position (open or closed) in the control room. NUREG-0711, Criterion 8.4.4.2(3) states that the applicant should describe how the HSI indicates the position of the relief and safety valves (open or closed) in the control room.

DCD Tier 2, Section 6.3.1, “Emergency Core Cooling- Design Basis,” addresses the 10 CFR 50.34(f)(2)(xi) requirement and states that valve position indication is provided in the main control room for the ECCS valves, trip and reset actuator valves and the reactor safety valves (RSVs). HSI RSR Section 4.6.2(3) “Relief and Safety Valve Position Monitoring,” describes which HSI displays will contain this information and HSI RSR Section 7.0 contains examples of the HSI described in Section 4.6.2(3). However, the staff observed that the examples do not show the information that HSI RSR Section 4.6.2(3) says will be displayed on those HSIs.

1. Please explain whether the examples in the HSI RSR Section 7.0 are representative of the HSI that is designed to comply with 10 CFR 50.34(f)(2)(xi), and please explain whether the HSI will need to be updated to comply with 10 CFR 50.34(f)(2)(xi). Revise the submittal as necessary.

2. It is not clear to the staff if Reactor Pressure Vessel relief valves are the same as the Reactor Safety Valves (RSVs). Please clarify. Revise the submittal as necessary.

18-28

Regulations in 10 CFR 50.34(f)(2)(xvii) require instrumentation to measure, record and readout in the control room: (A) containment pressure; (B) containment water level; (C) containment hydrogen concentration; (D) containment radiation intensity (high level); and (E) noble gas effluents for all potential, accident release points. NUREG-0711, Criterion 8.4.4.2(5) states that the applicant should describe how the control room's HSIs (alarms and displays) inform personnel about: (A) containment pressure; (B) containment water level; (C) containment hydrogen concentration; (D) containment radiation intensity (high level); and (E) noble gas effluents for all potential, accident release points.

(C) containment hydrogen concentration

In HSI RSR Section 4.6.2(5) "Containment Monitoring," NuScale states that they are seeking an exemption from supplying containment hydrogen concentration parameters; however, DCD Part 7, "Exemptions," does not contain an exemption for either 10 CFR 50.44(c)(4) or 10 CFR 50.34(f)(2)(xvii)(C). Furthermore, DCD Tier 2 Chapter 7.2.13 "Displays and Monitoring," states that consistent with 10 CFR 50.34(f)(2)(xvii)(C) and 10 CFR 50.44(c)(4), the containment Process Sampling System (PSS) includes non-safety related oxygen and hydrogen analyzers to continuously monitor the concentrations of these elements in the containment environment during operation and beyond design-basis conditions. The hydrogen analyzer output signal is sent to the MCS, which can provide readout in the main control room.

Align the information in DCD Tier 2 Chapter 7, the HSI RSR and DCD Part 7. Revise the submittal as necessary.

(D) containment radiation intensity (high level)

Information provided in HSI RSR Section 4.6.2(5), "Containment Monitoring," for radiation monitoring contradicts information provided in DCD Tier 2 Chapter 12.3.4, "Area Radiation and Airborne Radioactivity Monitoring Instrumentation," which states that the area and airborne radiological monitoring equipment is designed to provide monitoring of containment radiation levels, conforming to 10 CFR 50.34(f)(2)(xvii).

Align the information in DCD Tier 2 Chapter 12 and the HSI RSR. Revise the submittal as necessary.

(E) noble gas effluents for all potential, accident release points

Information provided in HSI RSR Section 4.6.2(5), "Containment Monitoring," for noble gas effluent monitoring contradicts information in Tier 2 Chapter 11.5 "Process and Effluent Radiation Monitoring Instrumentation and Sampling System" which states that monitoring and sampling equipment has been designed to provide monitoring and sampling instrumentation for measuring and recording noble gas radiological data at release points. The system also

provides continuous monitoring and sampling of radioactive iodine and particulates in gaseous effluents from accident release points in accordance with the requirements of 10 CFR 50.34(f)(2)(xvii) .

Align the information in DCD Tier 2 Chapter 11 and the HSI RSR. Explain how the control room's HSIs (alarms and displays) inform personnel about noble gas effluents for all potential, accident release points. Revise the submittal as necessary.

18-29

Regulations in 10 CFR 50.34(f)(2)(xviii) require unambiguous indication of inadequate core cooling (ICC). NUREG-0711, Criterion 8.4.4.2(6) states than an applicant should describe how the HSI provides unambiguous indication of inadequate core cooling, such as with primary coolant saturation meters in PWRs, and a suitable combination of signals from indicators of coolant level in the reactor vessel and in-core thermocouples in PWRs and BWRs

As described in DCD Tier 2, Section 7.2.13.6, "Three Mile Island Action Items," the following parameters are used to monitor inadequate core cooling (ICC) in the control room and satisfy the requirements of 10 CFR 50.34(f)(2)(xviii): core exit temperature, wide range reactor coolant pressure, degrees of subcooling, wide range reactor coolant hot temperature, Reactor Pressure Vessel (RPV) water level and containment water level. HSI RSR, Section 4.6.2(6), "Core Cooling," contains information about how the HSI addresses 10 CFR 50.34(f)(2)(xviii). HSI RSR Section 7.0, Figure 7-1 contains an example of one HSI described in Section 4.6.2(6). However, the staff observed that the example does not provide indication of the information that DCD Tier 2, Section 7.2.13.6 says will be displayed in the Main Control Room.

Align the information in DCD Tier 2 Section 7.2.13 and the information in HSI RSR Figure 7-1, "Safety Function Monitoring Page." Revise the submittal as necessary.

18-30

Regulations in 10 CFR 50.34(f)(2)(xix) require an applicant to provide instrumentation adequate for monitoring plant conditions following an accident that includes core damage. NUREG-0711, Criterion 8.4.4.2(7) states than an applicant should describe how the HSI assures monitoring of plant and environmental conditions following an accident including core damage.

Regulatory Guide 1.97 is one method that the NRC staff finds acceptable for complying with the agency's regulations with respect to satisfying criteria for accident monitoring instrumentation at nuclear power plants. This RG 1.97, Rev. 4 endorses IEEE-497-2002, "IEEE Standard for Accident Monitoring Instrumentation for Nuclear Power Generating Stations," subject to several regulatory positions.

According to DCD Tier 2 Section 7.2.13.2, "System Status Indication," the Post Accident Monitoring (PAM) variables are displayed in the MCR on the Safety Display Indication System (SDIS), Module Control System (MCS) and Plant Control System (PCS). The SDIS displays continuous real time Type B, C and D PAM variables and meets the display criteria of IEEE-497-2002. PAM variables displayed on the SDIS are also displayed on MCS or PCS. Type E

PAM variables are only displayed on MCS and PCS. There are 15 Type E PAM variables listed in DCD Tier 2 Section 7.2.13. The application does not describe how these are displayed.

The staff compared the PAM variables listed in DCD Tier 2 Section 7.2.13 with the SDIS sample display page in HSI RSR Figure 7-3. For Type D PAM variables, only 18 out of 27 identified Type D variables are located on the SDI sample page in HSI RSR Figure 7-3. Contrary to DCD Tier 2 Section 7.2.13.2, “System Status Indication,” nine Type D variables are not displayed on the SDIS.

Explain why some Type D variables listed in DCD Tier 2 Section 7 have been omitted from the SDIS display. Align the information in DCD Tier 2 Section 7.2.13 and the information in HSI RSR, Section 4.6.2(7), “Post-accident Monitoring.” Clarify how Type E PAM variables are displayed in the MCR. Revise the submittal as necessary.

18-31

Regulations in 10 CFR 50.34(f)(2)(xxvi) require an applicant to provide for leakage control and detection in the design of systems outside containment that contain or might contain radioactive materials. NUREG-0711, Criterion 8.4.4.2(10) states that an applicant should describe how the HSI provides for leakage control and detection in the design of systems outside containment that contain (or might contain) accident-source-term radioactive materials after an accident.

The staff reviewed HSI RSR Figure 7-3, “SDI Page,” and observed that it does not include leakage control and detection parameters for systems outside containment as stated in HSI RSR Section 4.6.2(8), “Leakage Control.”

Explain why the information in HSI RSR Figure 7-3 is not consistent with information provided in HSI RSR Section 4.6.2(8). Explain how the HSI provides for leakage control and detection in the design of systems outside containment that contain (or might contain) accident-source-term radioactive materials after an accident.

18-32

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 must include 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.

NUREG-0711, Rev. 3, "Human Factors Engineering Program Review Model," Criterion 8.4.4.2(12), “Manual Initiation of Protective Actions,” states that the applicant should describe how the HSI supports the manual initiation of protective actions at the system level for safety systems otherwise initiated automatically.

The staff reviewed DCD Tier 2 Section 7.2.12.2, “Manual Control,” and Human Systems Interface Design Results Summary Report, RP-0316-17619-P, Revision 0 Section 4.6.2(10), “Manual Initiation of Protective Actions,” and found that the list for manual actuation of protective actions in Section 7 does not match the HSI for manual action of protection actions provided in HSR RSR Section 4.6.2(10) and Figure 4-51. The staff does not have information about how the HSI supports manual initiation of all the protective actions described in Section 7.

Align the information in the HSI RSR with the information in DCD Tier 2 Section 7.2.12.2. Revise the submittal as necessary. Explain how the HSI supports manual initiation of all protective actions for safety systems otherwise initiated automatically.

18-33

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 must include 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.

NUREG-0711, Rev. 3, "Human Factors Engineering Program Review Model," Criterion 8.4.4.2(15), “Computer-Based Procedure Platform,” states that the applicant’s computer-based procedures should be consistent with the design review guidance in NUREG-0700, Section 8, “Computer-Based Procedure System.”

The staff reviewed Human Systems Interface Design Results Summary Report, RP-0316-17619-P, Revision 0 and Human Factors Engineering Interface Style Guide, ES-034-1381-P, Revision 1 and found that the design of computer-based procedures is consistent with the guidance in NUREG-0700, Section 8 except for the following review criteria: 8.2.2-10 and 8.3.1-1.

Please describe how the computer-based procedures are consistent with these review criteria or describe why these were not addressed. Revise the submittal as necessary.

NUREG-0711, Criterion 8.4.4.2(15), “Computer-Based Procedure Platform,” states that the applicant’s computer-based procedures should be consistent with the design review guidance in DI&C-ISG-5, "Highly-Integrated Control Rooms - Human Factors issues (HICR - HF)," Section 1 (NRC, 2008).

Human Systems Interface Design Results Summary Report, RP-0316-17619-P, Revision 0 states that NuScale computer-based procedures are designed in accordance with the guidance in Section 1 of DI&C ISG-05, 2008 however the staff cannot find this information in the application.

Include a description of how the design of the computer-based procedures is consistent with the guidance in DI&C ISG-05, Section 1 or provide where this information can be found. Revise the submittal as necessary.