NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Wednesday, May 03, 2017 4:00 PM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Jackson, Diane; Haider, Syed
Subject: Request for Additional Information No. 16 (eRAI No. 8783) Section 06.02.01.01.A (SCVB)
Attachments: Request for Additional Information No. 16 (eRAI No. 8783).pdf

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

Please submit your 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.

Gregory Cranston, Senior Project Manager
Licensing Branch 1 (NuScale)
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
301-415-0546

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Created By: Gregory.Cranston@nrc.gov

Recipients:
"NuScaleDCRaisPEm Resource" <NuScaleDCRaisPEm.Resource@nrc.gov>
Tracking Status: None
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"Chowdhury, Prosanta" <Prosanta.Chowdhury@nrc.gov>
Tracking Status: None
"Jackson, Diane" <Diane.Jackson@nrc.gov>
Tracking Status: None
"Haider, Syed" <Syed.Haider@nrc.gov>
Tracking Status: None
"RAI@nuscalepower.com" <RAI@nuscalepower.com>
Tracking Status: None

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Request for Additional Information No. 16 (eRAI No. 8783)

Issue Date: 05/03/2017
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 06.02.01.01.A - PWR Dry Containments, Including Subatmospheric Containments
Application Section: 6.2.1.1 Containment Structure

QUESTIONS

06.02.01.01.A-1

NPM CNV DBA Models and NIST-1 Test Data for Containment Peak Pressure/Temperature Analyses

Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix A, "General Design Criteria [GDC] for Nuclear Power Plants," Criterion 50, "Containment design basis," requires "the reactor containment structure, including access openings, penetrations, and the containment heat removal system shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident. This margin shall reflect (1) the effects of potential energy sources which have not been included in the determination of the peak conditions, such as energy in steam generators and as required by 10 CFR 50.44 energy from metal-water and other chemical reactions that may result from degradation but not total failure of emergency core cooling functioning, 2) the limited experience and experimental data available for defining accident phenomena and containment responses, and (3) the conservatism of the calculational model and input parameters." In addition, 10 CFR, Part 50, Appendix A, Criterion 16, "Containment design," requires "Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require." 10 CFR, Part 50, Appendix A, Criterion 38, "Containment heat removal," requires "A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident (LOCA) and maintain them at acceptably low levels."

Further, 10 CFR Part 52.47, Contents of Applications; Technical Information, (a)(2) also requires "A description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefore, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished," and 52.47(c)(2) "An application for certification of a nuclear power reactor design that differs significantly from the light-water reactor designs described in paragraph (c)(1) of this section or uses simplified, inherent, passive, or other innovative means to accomplish its safety functions must provide an essentially complete nuclear power reactor design except for site-specific elements such as the service water intake structure and the ultimate heat sink, and must meet the requirements of 10 CFR 50.43(e)." Further, from 50.43(e) "Applications for a design certification, combined license, manufacturing license, or operating license that propose nuclear reactor designs which differ significantly from light-water reactor designs that were licensed before 1997, or use simplified, inherent, passive, or other innovative means to accomplish their safety functions, will be approved only if: (1)(i) The performance of each safety feature of the design has been demonstrated through either analysis, appropriate test programs, experience, or a combination thereof; (ii) Interdependent effects among the safety features of the design are acceptable, as demonstrated by analysis, appropriate test programs, experience, or a combination thereof; and (iii) 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"

The staff needs to assess the ability of the applicant's analytical tools used in the safety analyses to meet the aspects of GDCs 16, 38, and 50; Part 52.47 and Part 50.43(e) relevant to the containment design basis. Specifically, the staff needs to assess the ability of the applicant's NRELAP5 model to predict the safety-significant phenomena in order for the staff to conclude that the code results are valid over the applicable range of accident conditions. The thermal-hydraulic phenomena pertinent to NuScale design certification document (DCD) Section 6.2 containment design basis accident (DBA) analyses are the heat transfer from the containment vessel (CNV) to reactor pool (including condensation on the inner surface of the CNV), conduction through CNV wall (represented by the heat transfer plate (HTP) in NIST-1), and the convection to the reactor pool (CPV in NIST-1). The staff needs to review and understand the conservatism of the licensing-basis models, constitutive correlations, and input parameters for the applicant's NPM DBA containment response analyses and the experimental data used to validate the accident phenomenology. Therefore, NuScale is requested to submit the following information:

1. Four NRELAP5 *NuScale Power Module* (NPM) input model decks nodalized and biased for DCD Chapter 6 peak containment pressure/temperature analyses are requested. They include decks for the limiting containment peak pressure case, and the limiting LOCA, main steam line break (MSLB), and main feedwater line break (MFLB) cases for the respective containment design basis accident (DBA). Provide the corresponding base, steady-state, and transient model decks.
2. NRELAP5 NIST-1 input model deck for HP-02 test case. Provide both steady-state and transient model decks.

3. Energy balances on the HP-02 test data as documented in the first three close-out observations made in the June 27-30, 2016, ECCS-Containment Performance Audit Summary Report (ML16168A277), specifically,
    a) Core electrical power-to-primary SG side heat balance,
    b) Primary-to-secondary SG side heat balance, and
    c) Containment-to-cooling-pool heat balance based on the measurements made by the thermocouple grid embedded in the HTP and the condensate drainage.