February 25, 2019

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 38 (eRAI No. 8838) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 38 (eRAI No. 8838)," dated May 26, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 38 (eRAI No.8838)," dated July 05, 2018

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

The Enclosures to this letter contain NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8838:

- 03.08.04-1

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 38 (eRAI No. 8838). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

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

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8838, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8838, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0219-64655

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8838, proprietary

Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8838, nonproprietary

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

eRAI No.: 8838
Date of RAI Issue: 05/26/2017

NRC Question No.: 03.08.04-1

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2 requires, in part, that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. DSRS Sections 3.7.2 and 3.8.4 provide review guidance pertaining to the seismic analysis, including interaction of the non-seismic Category I structures with seismic Category I SSCs, and structural design, including consideration of seismic loads, respectively.

FSAR Section 9.1.5.2.3 describes refueling operations including, in part: (1) the placement and restraining of a bioshield on an adjacent bioshield; (2) the use of a containment vessel (CNV) flange tool (CFT) and reactor vessel (RPV) flange tool (RFT) for de- tensioning flange closure bolts and as structural supports during refueling operations; and (3) the placement of the upper CNV with the upper RPV still attached on the module inspection rack in the flooded dry dock.

To assist the staff in evaluating the compliance of the aforementioned components with the above regulatory requirements the staff request the applicant to provide the following information and include these information in the FSAR (Sections 3.7 and 3.8, as applicable).

(1) Describe the method/mechanism for restraining a bioshield mounted on an adjacent bioshield and restraining the upper CNV on the module inspection rack during the refueling operations. Further, provide analysis and design criteria (consistent with DSRS Section 3.7.2.II.8) to ensure no adverse interactions occur between the seismic Category II

bioshields and inspection racks with adjacent seismic Category I SSCs, during refueling operations (and during the transport of new modules, as applicable).

(2) For the seismic Category II CFT, a description of the CFT geometry, weight (with and without the lower CNV), structural materials, separation distance between the CFT and the RFT and surrounding walls, connection to the basemat, and analysis and design criteria (consistent with DSRS Section 3.7.2.II.8) to ensure no adverse interactions occur between the CFT and adjacent seismic Category I SSCs during refueling operations.

(3) For the seismic Category I RFT, design information including geometry, weight (with and without the RPV lower head), separation distance between RFT and surrounding walls, connection to the basemat, applicable design codes, standards, and specifications, design and analysis procedures, structural acceptance criteria, materials, quality control, special construction techniques (as applicable) and quality assurance requirements, testing and in-service surveillance programs, and ITAAC (as applicable). Further, provide the seismic input (ISRS and acceleration time histories) at the base of the RFT, and at lower and upper core plate (if any) elevations while mounted on the RFT. Additionally, provide a description of how the seismic input motion is transferred from the RFT base elevation to the lower and upper core plate (if any) elevations.

NuScale Response:

As discussed in NRC public meetings on August 7, 2018 and January 23, 2019, supplemental responses to eRAI 8838 Question 03.08.04-1 are provided as follows:

1. Staff Feedback - With respect to the containment flange tool (CFT), the response indicates that design specifications have been prepared that establish the design criteria for the SC II CFT that address II/I design requirements. The staff request the applicant to provide a summary in the FSAR addressing the design criteria and II/I requirements for the CFT.

Response - Seismic Category II is defined in FSAR Tier 2, Section 3.2.1.2. The CFT is identified in Table 3.2-1, Classification of SSC, as "CNV support stand."

Due to the proximity of the reactor flange too (RFT) to the pool walls and CFT, these components are designed to preclude adverse interaction with the RFT during the Safe Shutdown Earthquake (SSE). FSAR Section 9.1.5.1 currently states, "General Design Criterion

2 is considered in the design of the OHLHS including the ability of structures, systems, and components in the Reactor Building (RXB) and OHLHS to withstand the effects of earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches. The OHLHS is located in the Seismic Category I RXB. The RBC, the Module Lifting Adapter, and the RFT are designed to retain their load before, during, and after a safe shutdown earthquake (SSE). The CFT and the module inspection rack are designed to ensure that their structural failure or interaction cannot degrade the functioning of Seismic Category I SSC during or after an SSE. Refer to Section 3.2 for information pertaining to safety, seismic, and quality classification of SSC."

2. Staff Feedback - With respect to the RFT, clarify whether the structural acceptance criteria for the RFT stand is also applicable to the embedded plate or if different, provide the structural acceptance criteria for the embedded plate.

Response - Although the RFT support is a not an ASME Code component it is designed to meet the requirements of Subsection NF of ASME Boiler and Pressure Vessel Code, Section III, Division 1.

The embed plate for the RFT is safety-related, Seismic Category I because it connects the RFT to the safety-related, Seismic Category I RXB. The embed plate is designed to meet acceptance criteria in AISC N690 2012 Specification for Safety-Related Steel Structures for Nuclear Facilities for the steel components and ACI 349 2006 Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary for the interactions with the RXB concrete basemat.

3. Staff Feedback - Further, clarify whether the embedded plate is made of 304L stainless steel or if different, indicate the embedded plate material.

Response - The embed plate material is ASTM A240 Type 304L stainless steel.

4. Staff Feedback - Describe how the embedded plate is anchored to the pool basemat.

Response - The RFT embed plate is cast in place with the RXB basemat. The plate is anchored with the use of nine W8 x 28 wide flange beams, in a 3 x 3 pattern with each member spaced 4 feet on center, welded to the bottom of the plate and extending 2 feet into the RXB basemat.

5. Staff Feedback - Describe the specific loads and load combinations used in the analysis and design of the RFT tool.

Response - The reactor flange tool support was analyzed for the SSE. When the design is finalized, it will be analyzed for the load combinations and acceptance criteria as shown in FSAR Tier 2, Table 3.8.4-23.

6. Staff Feedback - Describe the seismic analysis case(s) considered in the analysis and design of the RFT.

Response - The refueling position examined is the situation where the lower reactor pressure vessel (RPV) section, lower riser, lower internals, and fuel are on the RFT stand with all other components of the module removed. This position is examined because it is the only refueling configuration in which the fuel is open to the reactor pool. While in the CFT and while being lifted by the crane, the fuel remains isolated inside the RPV. This configuration is analyzed for six cases in total:

- one seed input motion (Capitola [CAP]),
- one soil type (S7),
- two RXB concrete conditions, cracked and uncracked (CR, UC),
- three stiffness scale adjustments for the RPV, RFT and Lower RVI: soft (77%), nominal, and stiff (130%).

1 seed input x 1 soil type x 2 concrete conditions x 3 stiffness scale adjustments = 6 cases.

7. Staff Feedback - Describe the type of analysis performed (e.g. static, dynamic - response spectrum or time history analysis), analysis software used, and input properties such as damping, cracked/uncrack concrete properties (if any), as applicable.

Response - The RFT support was analyzed using a combination of finite element analysis and hand calculations. For this analysis, the general purpose finite element software ANSYS was used.

The model consists of the lower RPV, lower riser, core barrel, fuel, and RFT support, see Figure 5-5, 5-7, and 5-8 of TR-0916-51502. The RPV model documented in Section 4.1.2 of TR-0916-51502 is modified to incorporate the refueling ledge at the bottom of the RPV. The lower reactor vessel internals (Lower RVI) submodel is consistent with the model documented in Section 4.1.3 of TR-0916-51502. The reactor pool water is not modeled, but the hydrodynamic mass of the structure is accounted for by increasing the density of the RPV, RFT base, RFT upper support ring, and the portion of the LRVI above the lower RPV by the density of water at 200°F and 14.6 psia. The hydrodynamic mass of the RFT upper support I-beams is accounted for using Table N-1311-1 of the Appendices of the ASME BPVC Section III, 2013 edition. The fluid-structure interaction of the water contained by the lower RPV is represented using the Fourier node method.

The RPV alignment feature is laterally constrained to the RFT alignment ring using remote points scoped to the features. The RPV refueling ledge is connected to the RFT support shelf using frictional contact that allows for potential uplift of the RPV. The RFT upper support ring is connected to the outside of the RPV flange using laterally constrained remote points scoped to the features.

Acceleration time histories on top of the base mat at the reactor flange tool location are applied to the bottom of the RFT model, and at the ends of the four RFT upper support I-beams, which are connected to the reactor pool wall by pinned connections. The cracked and uncracked cases are considered for nominal stiffness, reduced stiffness (77%), and increased stiffness (130%), consistent with the analysis of the NPM in the entire pool models outlined in Section 8.0 of TR-0916-51502.

The Y-direction (vertical) time history acceleration files are modified to remove gravity from the input. This is done by subtracting 386.089 in/sec^2 from each time step, such that the only value remaining is the seismic portion of the input. Additionally, the frequency range used to apply damping is adjusted according to the modal results obtained for this configuration. Alpha-beta damping is used for the analysis, and a 4 percent damping value is applied to the frequency range of {{ }}2(a),(c)

8. Staff Feedback - Provide a summary of results for the RFT stand and embedded plate in the FSAR such as demand, capacity/allowable limits, and associated demand over capacity ratios.

Response - The RFT embed plate results are summarized in FSAR Table 3.8.4-21. The RFT structural member results are summarized in FSAR Table 3.8.4-22.

9. Staff Feedback - Provide FSAR figures addressing the RFT stand and embedded plate analysis model and RFT stand and embedded plate design including dimensions (e.g. plates, bolts, welds, concrete anchors, etc…) and materials.

Response - Figures of the RFT stand and embedded plate have been added as FSAR Figures 3.8.4-34 through 3.8.4-36.

10. Staff Feedback - Also, address the RFT analysis case (s) in FSAR Tables 3.7.2-34 and 3.7.2-35.

Response - FSAR Tables 3.7.2-34 and 3.7.2-35 have been revised to address the RFT analysis cases.

11. Staff Feedback - Further, clarify whether the RFTS is covered in the RXB ITAAC or other ITAAC, as applicable.

Response - The RFT Support is covered separately from the RXB ITAAC. The RFT Support ITAAC is discussed in NuScale Tier 1 Section 3.14, along with all equipment shared by NuScale Power Modules 1 through 12.

Also, as stated in FSAR Tier 2, Section 3.8.4.7, “The Seismic Category I RFT Support will be inspected prior to installation via NDE to qualify it in accordance with applicable requirements of ASME Boiler and Pressure Vessel code Section III, Division 1.”

Ongoing inspection of Seismic Category 1 structures is discussed in COL Item 3.8-1.

12. Staff Feedback - Additionally, clarify how the weights associated with both the RFT and CFT have been considered in the analysis/design of the RXB basemat.

Response - The RFT and CFT have been included in the RXB basemat design as uniform distributed loads following Section 3.7.2 of the Design-Specific Review Standard for NuScale SMR Design. These SSC were decoupled from the RXB basemat because they met the NUREG 0800 SRP Section 3.7.2 criteria of, "if $R_m < 0.01$, then decoupling can be done for any R_f." R_m is the ratio of total mass of the supported subsystem to the total mass of the supporting system and R_f is the ratio of the fundamental frequency of the supported subsystem to the dominant frequency of the support motion.

13. Staff Feedback - Describe consideration of temperature effects if any (e.g. at temperature material properties and or temperature demands).

Response - The design temperature of the RFT support is 200°F. Material properties are defined at 200°F in the FEA for the RFT support, Lower RPV, and Lower RVI, with the exception of the fuel beam model properties, which are unchanged from the model in Section 4.1.3.2 of TR-0916-51502 (NuScale Power Module Seismic Analysis). Additionally, because the upper RFT support (4 armed structure) is constructed using pinned connections, thermal growth of the arms at 200°F is accommodated by rotation of the upper support ring.

14. Staff Feedback - Describe consideration of lower RPV uplift and uplift magnitude if any and confirm that the RPV uplift effects have been addressed in the determination of the design demands for the pertinent structural components, as applicable.

Response - The potential for uplift of the RPV refueling ledge from the RPV support shelf is accounted for with the use of nonlinear contact at this interface. The maximum relative vertical displacement between the remote point defined at the RFT base and the remote point defined at the bottom of the lower riser transition is {{ }}[2(a),(c)]. This value is reasonably assumed to bound the uplift from the RPV support shelf. This amount of uplift is negligible in the sense that the RPV will not dislodge from the RFT supports. Any impact force on the RPV refueling ledge or RFT support shelf is accounted for in the contact element formulation.

15. Staff Feedback - Describe the interface between the pool liner and embed plates, and list the elevation of the wall anchor plates.

Response - The interface between the pool liner and embed plates is a welded connection. The pool liner does not cover the embed plates nor do the embed plates penetrate the liner. The elevation to the center of the wall anchor plates and wall embed plates is approximately 160 inches above the top of the basemat elevation.

16. As discussed in a public meeting on February 12, 2019, COL Item 3.8-5 has been added to FSAR Section 3.8.4.1.15.

Impact on DCA:

FSAR Tier 2, Sections 3.8.4 and 9.1, and Tables 1.8-2, 3.2-1, 3.7.2-35, and 3.8.4-21 through 3.8.4-23, and Figures 3.8.4-34 through 3.8.4-36 and related Technical Report TR-0916-51502, NuScale Power Module Seismic Analysis, have been revised as described in the response above and as shown in the markup provided with this response.

RAI 01-61, RAI 02.04.13-1, RAI 03.04.01-4, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.03-1, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI 03.05.03-4, RAI 03.06.02-6, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-6S1, RAI 03.07.02-6S2, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.07.02-15S5, RAI 03.07.02-16S1, RAI 03.07.02-23S1, RAI 03.07.02-26, RAI 03.08.04-1S1, RAI 03.08.04-3S2, RAI 03.08.04-23S1, RAI 03.08.04-23S2, RAI 03.08.04-23S3, RAI 03.08.05-14S1, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.02-67, RAI 03.09.02-69, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.11-14S1, RAI 03.11-18, RAI 03.13-3, RAI 04.02-1S2, RAI 05.02.03-19, RAI 05.02.05-8, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 05.04.02.01-19, RAI 06.02.01.01.A-18, RAI 06.02.01.01.A-19, RAI 06.02.06-22, RAI 06.02.06-23, RAI 06.04-1, RAI 09.01.01-20, RAI 09.01.02-4, RAI 09.01.05-3, RAI 09.01.05-6, RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 10.02-1, RAI 10.02-2, RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2, RAI 10.03.06-1, RAI 10.03.06-5, RAI 10.04.06-1, RAI 10.04.06-2, RAI 10.04.06-3, RAI 10.04.10-2, RAI 11.01-2, RAI 12.03-55S1, RAI 13.01.01-1, RAI 13.01.01-1S1, RAI 13.02.02-1, RAI 13.03-4, RAI 13.05.02.01-2, RAI 13.05.02.01-2S1, RAI 13.05.02.01-3, RAI 13.05.02.01-3S1, RAI 13.05.02.01-4, RAI 13.05.02.01-4S1, RAI 14.02-7, RAI 19-31, RAI 19-31S1, RAI 19-38, RAI 20.01-13

Table 1.8-2: Combined License Information Items

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL applicant that references the NuScale Power Plant design certification will identify the site-specific plant location.	1.1
COL Item 1.1-2:	A COL applicant that references the NuScale Power Plant design certification will provide the schedules for completion of construction and commercial operation of each power module.	1.1
COL Item 1.4-1:	A COL applicant that references the NuScale Power Plant design certification will identify the prime agents or contractors for the construction and operation of the nuclear power plant.	1.4
COL Item 1.7-1:	A COL applicant that references the NuScale Power Plant design certification will provide site-specific diagrams and legends, as applicable.	1.7
COL Item 1.7-2:	A COL applicant that references the NuScale Power Plant design certification will list additional site-specific piping and instrumentation diagrams and legends as applicable.	1.7
COL Item 1.8-1:	A COL applicant that references the NuScale Power Plant design certification will provide a list of departures from the certified design.	1.8
COL Item 1.9-1:	A COL applicant that references the NuScale Power Plant design certification will review and address the conformance with regulatory criteria in effect six months before the docket date of the COL application for the site-specific portions and operational aspects of the facility design.	1.9
COL Item 1.10-1:	A COL applicant that references the NuScale Power Plant design certification will evaluate the potential hazards resulting from construction activities of the new NuScale facility to the safety-related and risk significant structures, systems, and components of existing operating unit(s) and newly constructed operating unit(s) at the co-located site per 10 CFR 52.79(a)(31). The evaluation will include identification of management and administrative controls necessary to eliminate or mitigate the consequences of potential hazards and demonstration that the limiting conditions for operation of an operating unit would not be exceeded. This COL item is not applicable for construction activities (build-out of the facility) at an individual NuScale Power Plant with operating NuScale Power Modules.	1.10
COL Item 2.0-1:	A COL applicant that references the NuScale Power Plant design certification will demonstrate that site-specific characteristics are bounded by the design parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the COL applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its combined license application.	2.0
COL Item 2.1-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site geographic and demographic characteristics.	2.1
COL Item 2.2-1:	A COL applicant that references the NuScale Power Plant design certification will describe nearby industrial, transportation, and military facilities. The COL applicant will demonstrate that the design is acceptable for each potential accident, or provide site-specific design alternatives.	2.2
COL Item 2.3-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 2.4-1:	A COL applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, except Section 2.4.8 and Section 2.4.10.	2.4

Table 1.8-2: Combined License Information Items (Continued)

Item No.	Description of COL Information Item	Section
COL Item 3.8-3:	A COL applicant that references the NuScale Power Plant design certification will identify local stiff and soft spots in the foundation soil and address these in the design, as necessary.	3.8
COL Item 3.8-4:	A COL applicant that references the NuScale Power Plant design certification will evaluate and document construction aid elements such as steel beams, Q-decking, formwork, lugs, and other items that are left in place after construction, but that were not part of the certified design, to verify the construction aid elements do not have an appreciable adverse effect on overall mass, stiffness, and seismic demands of the certified building structure. The COL applicant will confirm that these left~~-~~ in ~~-~~ place construction aid elements will not have adverse effects on safety-related structures, systems, and components per Section 3.7.2.	3.8
COL Item 3.8-5:	A COL applicant that references the NuScale Power Plant design certification will verify that the reactor flange tool (RFT) and embed plates are evaluated using site-specific seismic analysis, and generate seismic loads to the reactor pressure vessel and fuel assemblies that are bounded by the certified design. The design of the structural members will be confirmed by assessing demand-to-capacity ratios for the load combinations in Table 3.8.4-23. The design of the embed plates will be confirmed by assessing demand-to-capacity ratios for the load combinations in Table 3.8.4-1 and Table 3.8.4-2, and applicable design codes in Table 3.8.4-12. In addition, the core plate in-structure response spectra for the RFT location shown in Figure B-34 through Figure B-39 of TR-0916-51502 (NuScale Power Module Seismic Analysis) shall be confirmed against the site specific spectra. If either the demands on the structural members or the embed plates exceed their capacity, or core plate motions do not maintain justifiable margin to limits for the fuel assembly, the COL applicant will address and augment the design per the criteria specified in FSAR Section 3.8.4, and the fuel assembly-imposed load limitations.	3.8
COL Item 3.9-1:	A COL applicant that references the NuScale Power Plant design certification will provide the applicable test procedures before the start of testing and will submit the test and inspection results from the comprehensive vibration assessment program for the NuScale Power Module, in accordance with Regulatory Guide 1.20.	3.9
COL Item 3.9-2:	A COL applicant that references the NuScale Power Plant design certification will develop design specifications and design reports in accordance with the requirements outlined under American Society of Mechanical Engineers Boiler and Pressure Vessel Code~~,~~ Section III (Reference 3.9-1). A COL applicant will address any known issues through the reactor vessel internals reliability programs (i.e. Comprehensive Vibration Assessment Program, steam generator programs, etc.) in regards to known aging degradation mechanisms such as those addressed in Section 4.5.2.1.	3.9
COL Item 3.9-3:	A COL applicant that references the NuScale Power Plant design certification will provide a summary of reactor core support structure American Society of Mechanical Engineers (ASME) service level stresses, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Boiler and Pressure Vessel Code Section III Subsection NG.	3.9
COL Item 3.9-4:	A COL applicant that references the NuScale Power Plant design certification will submit a Preservice Testing program for valves as required by 10 CFR 50.55a.	3.9
COL Item 3.9-5:	A COL applicant that references the NuScale Power Plant design certification will establish an Inservice Testing program in accordance with American Society of Mechanical Engineers Operation and Maintenance~~ASME OM~~ Code and 10 CFR 50.55a.	3.9
COL Item 3.9-6:	A COL applicant that references the NuScale Power Plant design certification will identify any site-specific valves, implementation milestones, and the applicable American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM)~~ASME OM~~ Code (and ASME OM Code Cases) for the preservice and inservice testing programs. These programs are to be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a in accordance with the time period specified in 10 CFR 50.55a before the scheduled initial fuel load (or the optional ASME Code Cases listed in Regulatory Guide 1.192 incorporated by reference in 10 CFR 50.55a).	3.9
COL Item 3.9-7:	Not ~~U~~used.	

RAI 03.02.01-2, RAI 03.02.01-3, RAI 03.02.02-2, RAI 03.02.02-6, RAI 03.08.02-14, RAI 03.08.04-1S1, RAI 03.09.02-64, RAI 05.04.02.01-6, RAI 06.02.04-2, RAI 09.01.03-1, RAI 09.02.02-1, RAI 09.02.04-1, RAI 09.02.04-1S1, RAI 09.02.05-1, RAI 09.02.06-1, RAI 09.02.07-4, RAI 09.02.07-5, RAI 09.02.09-2, RAI 09.03.04-5, RAI 09.04.02-1, RAI 09.04.02-1S1, RAI 10.04.07-2, RAI 11.02-1, RAI 12.02-32, RAI 15-17, RAI 15-17S1, RAI 19-14

Table 3.2-1: Classification of Structures, Systems, and Components

SSC (Note 1)	Location	SSC Classification (A1, A2, B1, B2)	RTNSS Category (A,B,C,D,E)	QA Program Applicability (Note 2)	Augmented Design Requirements (Note 3)	Quality Group / Safety Classification (Ref RG 1.26 or RG 1.143) (Note 4)	Seismic Classification (Ref. RG 1.29 or RG 1.143) (Note 5)
CNTS, Containment System							
All components (except as listed below)	RXB	A1	N/A	Q	None	B	I
• CVC Injection Check Valve • CVC Discharge Excess Flow Check Valve • CVC PZR Spray Check Valve	RXB	B2	None	AQ-S	None	C	I
• CVC Injection & Discharge Nozzles • CVC PZR Spray Nozzle • CVC PZR Spray CIV • CVC RPV High Point Degasification Nozzle • CVC RPV High Point Degasification CIV • RVV & RRV Trip/Reset # 1 & 2 Nozzles • RVV Trip 1 & 2/Reset #3 Nozzles • CVC Injection & Discharge CIVs	RXB	A1	N/A	Q	None	A	I
• NPM Lifting Lugs • Top Support Structure • Top Support Structure Diagonal Lifting Braces	RXB	B1	None	AQ-S	• ANSI/ANS 57.1-1992 • ASME NOG-1 • NUREG-0554	N/A	I
• CNV Fasteners • Hydraulic skid • CNV Seismic Shear Lug • CNV CRDM Support Frame • Containment Pressure Transducer (Narrow Range) • Containment Water Level Sensors (Radar Transceiver) • SG 1 & 2 Steam Temperature Sensors (RTD)	RXB	A1	N/A	Q	None	N/A	I
CNTS CFDS Piping in containment	RXB	B2	None	AQ-S	None	B	II
Piping from (CES, CFDS, FWS, MSS, and RCCWS) CIVs to disconnect flange (outside containment)	RXB	B2	None	AQ-S	None	D	I
CVCS Piping from CIVs to disconnect flange (outside containment)	RXB	B2	None	AQ-S	None	C	I
CIV Close and Open Position Sensors: • CES, Inboard and Outboard • CFDS, Inboard and Outboard • CVCS, Inboard and Outboard PZR Spray Line • CVCS, Inboard and Outboard RCS Discharge • CVCS, Inboard and Outboard RCS Injection • CVCS, Inboard and Outboard RPV High-Point Degasification • FWS, Supply to SGs and DHR HXs FWIV • RCCWS, Inboard and Outboard Return and Supply • SGS, Steam Supply CIV/MSIVs and CIV/MSIV Bypasses	RXB	B2	None	AQ-S	IEEE 497-2002 with CORR 1	N/A	I
Containment Pressure Transducer (Wide Range)	RXB	B2	None	AQ-S	IEEE 497-2002 with CORR 1	N/A	I
• Containment Air Temperature (RTDs) • FW Temperature Transducers	RXB	B2	None	AQ-S	None	N/A	II
SGS, Steam Generator System							
• SG tubes • Feedwater plenums • Steam plenums	RXB	A1	N/A	Q	None	A	I
• SG tube supports • Upper and lower SG supports	RXB	A1	N/A	Q	None	N/A	I

Table 3.2-1: Classification of Structures, Systems, and Components (Continued)

SSC (Note 1)	Location	SSC Classification (A1, A2, B1, B2)	RTNSS Category (A,B,C,D,E)	QA Program Applicability (Note 2)	Augmented Design Requirements (Note 3)	Quality Group / Safety Classification (Ref RG 1.26 or RG 1.143) (Note 4)	Seismic Classification (Ref. RG 1.29 or RG 1.143) (Note 5)
All other components	RWB, RXB	B2	None	AQ	None	RW-IIc	III
GRWS, Gaseous Radioactive Waste System							
• Charcoal Guard Bed • Charcoal Decay Beds	RWB	B2	None	AQ	None	RW-IIa~~b~~	~~III~~RW-IIa
• Charcoal Drying Heater • Inlet Gas Sampler	RWB	B2	None	None	None	N/A	III
Radiation Indicating Transmitter	RWB	B2	None	AQ	ANSI N13.1-2011	N/A	III
All other components	RWB	B2	None	AQ	None	RW-IIc	III
SRWS, Solid Radioactive Waste System							
Spent Resin Storage Tanks	RWB	B2	None	AQ	None	RW-IIa	RW-IIa
Phase Separator Tanks	RWB	B2	None	AQ	None	RW-IIb	RW-IIb
• Instrumentation • Compactor • In-Line Grab Sampler	RWB	B2	None	None	None	N/A	III
All other components	RWB	B2	None	AQ	None	RW-IIc	III
RWDS, Radioactive Waste Drain System							
All components	RWB, RXB, ANB	B2	None	None	None	D	III
RWBVS, Rad-Waste Building HVAC System							
• Ductwork and Associated Components (Dampers, grilles, etc.) • RXB Exhaust Fan • Instrumentation • RWB Supply Air Handling Unit • RWB Supply Air Fans A/B	RWB	B2	None	AQ	• RG 1.140	N/A	III
All other components	RWB	B2	None	None	None	N/A	III
MAE, Module Assembly Equipment							
• Module Inspection Rack • Module Upender	RXB	B2	None	AQ-S	None	N/A	II
Module Import Trolley	RXB	B2	None	None	None	N/A	III
MAEB, Module Assembly Equipment - Bolting							
~~RPV Support Stand~~RFT Support	RXB	~~A~~B2	N/A	Q	None	C	I
CNV Support Stand	RXB	B2	None	AQ-S	None	N/A	II
All other components	RXB	B2	None	None	None	N/A	III
FHE, Fuel Handling Equipment							
Fuel Handling Machine	RXB	B2	None	AQ-S	• ANSI/ANS 57.1-1992 • NUREG-0554 • ASME NOG-1	N/A	I
• New Fuel Elevator • New Fuel Jib Crane	RXB	B2	None	AQ-S	None	N/A	II
SFSS, Spent Fuel Storage System							
Spent Fuel Storage Rack	RXB	B2	None	AQ-S	• ANSI/ANS 57.1-1992 • ANSI/ANS 57.2-1983 with additions, clarifications, and exceptions of RG 1.13 • ANSI/ANS 57.3	N/A	I
SFPCS, Spent Fuel Pool Cooling System							
• Pumps • Strainers • Valves - (PCUS boundary isolation valves)	RXB	B2	None	AQ	ANSI/ANS 57.2-1983 with additions, clarifications, and exceptions of RG 1.13	D	III
• Flow control orifices • Instrumentation (pressure, temperature, flow, position)	RXB	B2	None	None	None	N/A	III

RAI 03.07.02-10S1, RAI 03.07.02-10S2, RAI 03.07.02-24, RAI 03.08.04-1S1, RAI 03.11-19

Table 3.7.2-34: SSC Seismic Analysis Identification Code Assignments

SSC	Description	Identification Code
CNTS	containment system	5
SGS	steam generator system	5
RXC	reactor core	5
CRDS	control rod drive system	5
CRA	control rod assembly	5
NSA	neutron source assembly	5
RCS	reactor coolant system	5
CVCS	chemical and volume control system	5
ECCS	emergency core cooling system	5
DHRS	decay heat removal system	5
CRHS	control room habitability system	6
CRVS	normal control room HVAC system	6
~~MAEB~~RFT	~~Module Assembly Equipment - Bolting~~Reactor Flange Tool	5 ~~3, 4~~
FHE	fuel handling equipment	3
SFSS	spent fuel storage system	3
RPCS	reactor pool cooling system	3, 4
UHS	ultimate heat sink	3, 4
CES	containment evacuation system	5
MSS	main steam system	5
FWS	feedwater system	5
EDSS	highly reliable DC power system	3[1], 4[1], 6[2]
MPS	module protection system	3[1], 4[1], 6[2]
NMS	neutron monitoring system	3, 4
SDIS	safety display and indication system	6
ICIS	in-core instrumentation system	5
PPS	plant protection system	3[1], 4[1], 6[2]
RMS	radiation monitoring system	3[1], 4[1], 6[2]
RXB	Reactor Building ~~(including Lug Support)~~	1, 2
RXB	Reactor Building - NPM Lug and Skirt Supports	5
RBC	Reactor Building crane	3
RBCM	Reactor Building Components - Pool Liner	1, 2
RBCM	Reactor Building Components - Bioshield	3~~, 4~~
CRB	Control Building	7, 8
SMS	seismic monitoring system	3[1], 4[1], 6[2]

[1]Design for SSC located in the Reactor Building

[2]Design for SSC located in the Control Building

RAI 03.07.02-26, RAI 03.08.04-1S1, RAI 03.08.04-33, RAI 03.08.04-33S1, RAI 03.11-19

Table 3.7.2-35: Analysis Model Summary

No.	Analysis Model	Concrete Condition	Computer Program	SSI and SSSI Soil Types Considered	SSI and SSSI Time History Inputs Used	Purpose	Building Response	FSAR Explanation and Figures	FSAR Results
1	RXB stand-alone bldg	Uncracked & cracked	SAP2000	N/A	N/A	Static analysis	Member forces	Sections: 3.7.2.1.1.1, 3.7.2.1.2.1, 3.8.4.1.1, 3.8.4.3, 3.8.4.4.1, 3.8.5.4.1.2; Figures: 3.7.2-4, 3.8.4-15 through -20	Tables: 3B-2 through -25; Figures 3B-7 through -47
2	RXB stand-alone bldg	Uncracked & cracked	SASSI2010	7, 8 & 11 (with CSDRS Input); 7 & 9 (with CSDRS-HF Input)	CSDRS: Capitola, Chi-Chi, El Centro, Izmit, Yermo. CSDRS-HF: Lucerne	Seismic SSI analysis using 7% material damping	Member forces	Sections: 3.7.2.1.1.3, 3.7.2.1.2.1, 3.7.2.1.2.4, 3.7.2.4, 3.7.2.11, 3.7.5.1.4, 3.8.4.3, 3.8.5.4.1.2; Figures 3.7.2-15 through -21 & -35 (SASSI Input); Table 3.7.2-8 (SASSI Input)	Tables: 3B-2 through -25; Figures 3B-7 through -47
3	RXB stand-alone bldg	Uncracked & cracked	SASSI2010	7, 8 & 11 (with CSDRS Input); 7 & 9 (with CSDRS-HF Input)	CSDRS: Capitola, Chi-Chi, El Centro, Izmit, Yermo. CSDRS-HF: Lucerne	Seismic ISRS generation using 4% material damping	ISRS	Sections: 3.7.2.1.1.3, 3.7.2.1.2.1, 3.7.2.1.2.4, 3.7.2.4, 3.7.2.5, 3.7.2.5.3, 3.7.2.9, 3.7.5.1.4, 3.8.4.3; Figures 3.7.2-15 through -21 & -35 (SASSI Input); Table 3.7.2-8 (SASSI Input)	Figures: 3.7.2-99 through -103
4	RXB stand-alone bldg	Uncracked	ANSYS	Wall accelerations are based on soil types 7, 8, and 11 w CSDRS Input.	CSDRS: Capitola	Slosh heights in reactor pool and determine fluid-structure interaction effects of the RXB Pool	Accelerati-ons, fluid pressures	Sections: 3.7.2.1.1.2, 3.7.2.1.2.4, 3.7.5.1.4, 3.8.4.3; Figures: 3.7.2-32 through -35, 3.8.5-8 through -14	Table 3.7.2-8; Figures 3.7.2-36 through -39

Table 3.7.2-35: Analysis Model Summary (Continued)

No.	Analysis Model	Concrete Condition	Computer Program	SSI and SSSI Soil Types Considered	SSI and SSSI Time History Inputs Used	Purpose	Building Response	FSAR Explanation and Figures	FSAR Results
26	Reactor Building crane (RBC)	N/A	ANSYS	Analysis based on RXB ISRS	Analysis based on RXB ISRS	Structural analysis of RBC	Member forces	Section 9.1.5	Not presented
27	RXB bioshield - partial model	Cracked & uncracked	SAP2000	Analysis based on RXB ISRS	Analysis based on RXB ISRS	Structural analysis of bioshield	Member forces	Sections: 3.7.3, 3.7.3.3.1~~2~~; Figures: 3.7.3-1~~ & -2~~; Tables 3.7.3-8 through -13~~2~~	Table 3.7.3-14
28	Reactor Flange Tool Refueling Configuration	Cracked & uncracked	ANSYS	Soil Type 7 (with CSDRS Input)	CSDRS: Capitola	Determine core plate time histories and ISRS, as well as reactions for structural components	Reaction forces, moments, ISRS	Sections: 3.8.4.1.15, 3.8.4.3.1.12, 3.8.4.4.2, 3.8.4.5 Figures: 3.8.4.34, 3.8.4.35, 3.8.4.36	Tables: 3.8.4-21, 3.8.4-22, 3.8.4-23

3.8.4 Other Seismic Category I Structures

RAI 03.08.04-1, RAI 03.08.04-1S1, RAI 03.08.04-33

The Seismic Category I structures are the RXB and the CRB. These buildings are site independent and designed for the Certified Seismic Design Response Spectra (CSDRS) and the CSDRS-HF (high frequency) described in Section 3.7.1. The static analysis is performed with SAP2000 (Reference 3.8.4-1), the seismic analysis is performed using SASSI2010 (Reference 3.8.4-2), and added fluid loads are determined using ANSYS (Reference 3.8.4-3.) Validation of these computer programs is provided in Section 3.7.5. All of the loads are combined using Excel and Mathcad to determine the overall demand to capacity ratio. A summary of the analysis cases is provided in Table 3.7.2-35. The reactor flange tool (RFT) stand and embed~~ded~~ plate supporting it are also Seismic Category I structures. They both reside inside the RXB, and were also analyzed for seismic response.

3.8.4.1 Description of the Structures

3.8.4.1.1 Reactor Building

A discussion of the RXB and the major features and components is provided in Section 1.2.2.1. Architectural drawings, including plan and section views are provided in Figure 1.2-10 through Figure 1.2-20.

The RXB is a reinforced concrete structure that is deeply embedded in soil, supported on a single basemat foundation, and is designed to withstand the effects of natural phenomena (earthquake, rain, snow, wind, tornado, hurricane) without affecting the operability of the safety-related SSCs within the building.

The RXB has an outside length (excluding pilasters) of 346.0 feet in the east-west direction and a width (excluding pilasters) of 150.5 feet in the north-south direction. There are five pilasters along both the north and south walls and three pilasters on the east and west walls. These pilasters are 5.0 feet wide and extend 5.0 feet out from the wall. In addition, there are four corner pilasters. These pilasters are 12.5 feet wide and extend 2.5 feet out from the wall. The Reactor Building is centered on a below grade basemat with dimensions of 358'-0" by 162'-6." The overall height of the building is approximately 167 feet from the top of roof to the bottom of the basemat. The RXB roof is sloped on north and south sides with a flat segment in the middle; the top of roof elevation is 181'-0".

The ground floor or baseline top of concrete (TOC) is elevation (EL.) 100'-0." The bottom of the foundation concrete is typically 14' -0." There are some portions that extend deeper, which are discussed in Section 1.2.2.1 and in Section 3.8.5. Actual site grade is approximately 6 inches below baseline TOC and sloped away from the structures. However, the terms "grade" and "site grade" refer to EL. 100'-0." The embedment of the RXB is approximately 86 feet.

The predominant feature of the RXB is the ultimate heat sink pool. This pool consists of the spent fuel pool, refueling area pool, and the reactor pool. This large pool occupies the center of the building and runs approximately 80 percent~~%~~ of the length of the building. The normal reactor pool level is maintained at 69 feet, and is discussed in Section 9.1.5. For analysis of the RXB, the RBC is included as a beam and spring model as described in Section 3.7.2.1.2.3.

RAI 03.08.04-8, RAI 03.08.04-9

The RBC is supported at the bridge wheels by a crane rail connected to a steel anchor plate embedded into the reactor building (RXB) at a wall offsets. Normal operating loadings from the RBC are resisted by the crane rails. During a seismic event, all lateral, transverse, and upward loadings are resisted by a seismic restraint system and all vertical downward forces are resisted by the crane rail. The crane rails and seismic restraints transfer the RBC loadings to the RXB structure. Safe shutdown earthquake loading is based on a modal analysis and subsequent response spectrum analysis for low frequency input and high frequency input configurations.

RAI 03.08.04-8, RAI 03.08.04-9

The steel rails and anchor plates meet the design criteria set by AISC N690 Specification for Safety-Related Steel Structures for Nuclear Facilities and ACI 349 Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary, consistent with 10 CFR 50, Appendix A, GDC 1, 2, and 4 and DSRS Section 3.8.4.

RAI 03.08.04-8, RAI 03.08.04-9

3.8.4.1.14 Fuel Handling Machine

RAI 03.08.04-8, RAI 03.08.04-9

Design aspects of the Fuel Handling Machine (FHM) are described in Section 9.1.4.2.2.

RAI 03.08.04-8, RAI 03.08.04-9

The FHM is supported at the bridge wheels by a machined rail connected to a steel anchor plate embedded into the reactor building (RXB) walls. Normal operating loadings from the FHM are resisted by the rails. During a seismic event, all lateral, transverse, and upward loadings are resisted by a seismic restraint system and all vertical downward forces are resisted by the rail. The rails and seismic restraints transfer the FHM loadings to the RXB structure. Safe shutdown earthquake loading is based on a modal analysis and subsequent response spectrum analysis.

RAI 03.08.04-8, RAI 03.08.04-9

The steel rails and anchor plates meet the design criteria set by AISC N690 Specification for Safety-Related Steel Structures for Nuclear Facilities and ACI 349 Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary.

RAI 03.08.04-1

3.8.4.1.15 Reactor Flange Tool

RAI 03.08.04-1, RAI 03.08.04-1S1

The reactor flange tool (RFT) consists of an RFT stand for lower RPV support and four bolting tools. The RFT also includes a four arm upper support structure made with (4)W18 x 130 beams, and a built up C-section support ring that laterally supports the lower RPV at the elevation of the RPV flange (approximately 160 inches from the basemat). See Figure 3.8.4-34. The pool walls contain 44" x 32" x 2" embed plates anchored to the concrete with six 1.5 inch diameter by 12 inch long headed stud anchor bolts. See Figure 3.8.4-35. Wall anchor plates are bolted to the embed plates, and the beams are attached to the wall anchor plates with a pin and clevis. The RFT stand and upper support structure supports the lower RPV when relocated to the refueling pool during refueling operations. The RFT bolting tools position around the outside of the RFT stand on concentric tracks attached to the RFT stand. The bolting tools are used to install and remove the bolts. The RFT stand is attached to a steel plate anchored to the pool basemat, referred to as the RFT base embed plate, which is 20'-8" x 20'-8" x 4.5" and has (9) W8 x 28s attached for anchorage. See Figure 3.8.4-36. Both the wall and base embed plates are stainless steel, and are welded to the pool liner, which does not cover them (i.e. the liner is not penetrated at any point). The lateral (shear) loads imposed between the RFT base embed plate and the RFT stand are carried by four shear pins, located outside the MAEB track. The RFT stand is anchored to the RFT base embed plate by eight capture bolts, located inside the cylindrical support for the lower RPV.

RAI 03.08.04-1S1

The portion of the RFT that supports the lower reactor pressure vessel (RFT stand and upper support structure), and the embed plates in the floor and walls of the refueling pool are Seismic Category I. Other components of the RFT (the bolting tools) are Seismic Category II.~~The reactor flange tool (RFT) is composed of an RFT stand and four bolting tools. The RFT stand is a large square plate with a welded cylindrical section that supports the lower RPV. A hole in the center of the baseplate accommodates the center boss of the lower RPV. The RFT bolting tools move around outside the center cylindrical support on concentric tracks attached to the plate. In this way the bolting tools move around the outside circumference of the lower RPV flange and install and remove the bolts. The RFT stand is attached to a plate anchored to the pool basemat referred to as the RFT embedded plate. The portion of the RFT that supports the lower reactor pressure vessel (RFT stand), and the embedded plate in the floor of the refueling pool, are Seismic Category I. Other components of the RFT (the bolting tools) are Seismic Category II.~~

RAI 03.08.04-1S1

The SSE demand to capacity ratios for the embed plates are summarized in Figure 3.8.4-21. The SSE demand to capacity ratios for the structural members are summarized in Table 3.8.4-22.

RAI 03.08.04-1S1

COL Item 3.8-5: A COL applicant that references the NuScale Power Plant design certification will verify that the reactor flange tool (RFT) and embed plates are evaluated using site-specific seismic analysis, and generate seismic loads to the reactor pressure vessel and fuel assemblies that are bounded by the certified design. The design of the structural members will be confirmed by assessing demand-to-capacity ratios for the load combinations in Table 3.8.4-23. The design of the embed plates will be confirmed by assessing demand-to-capacity ratios for the load combinations in Table 3.8.4-1 and Table 3.8.4-2, and applicable design codes in Table 3.8.4-12. In addition, the core plate in-structure response spectra for the RFT location shown in Figure B-34 through Figure B-39 of TR-0916-51502 (NuScale Power Module Seismic Analysis) shall be confirmed against the site specific spectra. If either the demands on the structural members or the embed plates exceed their capacity, or core plate motions do not maintain justifiable margin to limits for the fuel assembly, the COL applicant will address and augment the design per the criteria specified in FSAR Section 3.8.4, and the fuel assembly-imposed load limitations.

3.8.4.2 Applicable Codes, Standards, and Specifications

The following codes and standards are applicable for the design and construction of Seismic Category I structures and basemats. For the ASTM standards, which are applicable to construction, the code year is not specified. For these standards, the latest endorsed version at the time of construction is used.

3.8.4.2.1 Design Codes and Standards

ACI 207.1R	2005	Guide to Mass Concrete
ACI 211.1	1991	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	2010	Specification for Structural Concrete for Buildings.
ACI 304R	2000	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305.1	2014	Specification for Hot-Weather Concreting.
ACI 306.1	1990	Specification for Cold-Weather Concreting.
ACI 318	2005	Building Code Requirements for Structural Concrete
ACI 347R	2014	Recommended Practice for Concrete Formwork.
ACI 349/349R	2006	Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary
ACI 349.1R	2007	Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures
ACI SP-2	2007	Manual of Concrete Inspection
ACI SP-66	2004	ACI Detailing Manual

3.8.4.3.1.10 Equipment Weights

Table 3.8.4-3 is a summary of the RXB equipment weights per floor. The NPM, bioshields, and RBC are not included in the per floor summary since these loads are applied in the analysis model as described above. The majority of equipment loads are applied as either concentrated nodal loads or uniformly distributed area loads.

Table 3.8.4-4 is a summary of the CRB equipment weights per floor. These loads are applied to the CRB model directly using point loads; or if several pieces of equipment are located in close proximity, an equivalent uniform load is applied over the respective area.

3.8.4.3.1.11 Uniform Equivalent Dead Load

The uniform equivalent dead load for the RXB and CRB is used to account for pieces of equipment less than 1000 lbs in weight not accounted for in the equipment dead loads and for cable trays, piping and ducts. The RXB and CRB floors are designed using a uniform equivalent dead load of 50 psf. The equivalent dead load is 25 psf for the RXB roof and 20 psf for the CRB roof.

RAI 03.08.04-1

3.8.4.3.1.12 RFT Weight

RAI 03.08.04-1, RAI 03.08.04-1S1

The RFT stand, including the upper support structure, weighs approximately 100,000 lb. The RFT bolt tensioning tools weigh approximately 25,000 lb. each. Four bolt tensioning tools operate with the RFT, making the whole RFT assembly weight approximately 200,000 lb. The lower reactor pressure vessel (RPV), lower RVI, and fuel during refueling operations weigh a total of approximately 206,000 lb.~~The RFT stand weighs approximately 80,000 lbs. The RFT bolt tensioning tools weigh approximately 21,000 lbs. each, conservatively this was rounded to 25,000 pounds. Four bolt tensioning tools operate on the RFT, making the whole RFT weight 180,000 pounds. The lower reactor pressure vessel (RPV) weighs approximately 206,000 pounds.~~

3.8.4.3.2 Liquid Loads (F)

The liquid load consists of the water pressure exerted on the walls in the Reactor Pool, Refueling Pool, Spent Fuel Pool and Dry Dock during static and seismic conditions. As noted in Section 3.8.4.3.1.4, the water weight in the RXB is approximately 64,700 kips. This pool water weight is included in the dead load as described above. The CRB does not have liquid loads.

RAI 03.07.02-15S3

The hydrostatic load considers the water pressure exerted on the structural pool walls in contact with the water. The pressure distribution considers zero pressure at the normal water level of the pool and increasing water pressure with water depth.

modeled at their centerlines (neutral planes). All structural steel connections have fixed boundary condition. Penetrations in the walls or slabs are approximated in the SAP2000 model.

RAI 03.08.04-28

The bottom of the foundation basemat of the CRB SAP2000 model has a link element at each node. One end of each link element in the CRB SAP2000 model is connected to the CRB basemat and the other end to a fixed node.

Solid elements are added to the exterior of the CRB embedded walls to model the backfill soil with Soil Type 11 properties (see Section 3.7.1.3). The assumed uniform backfill width is 25 feet.

SAP2000 Analysis

All applicable loads are converted to lumped joint masses for use in 1-g and dynamic analyses. This is accomplished in SAP2000 by using the Mass Source function. In the CRB models, mass comes from concrete and steel self-weight, equipment joint nodal and uniform loads, uniform floor live loads, roof snow loads, and applied nodal masses. The specified load cases used in computing dynamic mass are defined by specifying the multiplier for each load case considered. In this model, all long term loads were assigned a multiplier of 1.0, live loads a multiplier of 0.25, and snow loads a multiplier of 0.75. Live load mass participation requirements for dynamic analyses are given in Section 3.8.4.3.4. Table 3.8.4-9 lists the additional masses to be included from various load cases and its corresponding multipliers, which are considered as one of the mass sources for the CRB SAP2000 models for 1-g and dynamic analyses performed.

Load cases are developed in (or converted to) SAP2000 to address the different design loads discussed in Section 3.8.4.3. These cases are individually evaluated or combined to address the load combinations identified in Table 3.8.4-1 and Table 3.8.4-2 for the CRB.

RAI 03.08.04-1

RFT Design Analysis Procedures

RAI 03.08.04-1, RAI 03.08.04-1S1

~~A half symmetry finite element model of the RFT stand and lower reactor vessel was constructed, meshed, and analyzed, with the loadings in vertical or single radial directions. To account for the mass of the bolt tensioning equipment, mass elements were added to the rails.~~

RAI 03.08.04-1, RAI 03.08.04-1S1

A finite element model of the RFT stand and upper support structure, as well as the lower reactor pressure vessel and lower reactor vessel internals, was constructed, meshed, and analyzed for SSE loading with a time history analysis. ~~The lateral (shear) loads imposed between the basemat embedded plate and the RFT stand will be carried by 4 shear pins, located outside the MAEB track. The RFT stand is~~

~~anchored to the baseplate by means of 8 bolts, located inside the cylindrical support for the lower RPV.~~

RAI 03.08.04-1, RAI 03.08.04-1S1

This analysis is used to generate in-structure response spectra to support analysis of the fuel when supported by the lower RPV in the RFT, with the upper core plate in position. The results of this analysis are used to analyze the fuel to demonstrate acceptable margins to limits for the fuel itself. This analysis is described in more detail in Section 5.2 of TR-0916-51502 (NuScale Power Module Seismic Analysis).~~The results of the RFT stand finite element analysis demonstrate that it will provide adequate restraint for the lower RPV section during the safe shutdown earthquake (SSE).~~

RAI 03.08.04-1, RAI 03.08.04-1S1

Results of the RFT analysis~~stand finite element model were~~ are also used as input to the embed~~ded~~ plate design. The RFT embed~~ded~~ plate analysis and design demonstrate that the embedment safely supports the vertical and lateral forces from the RFT stand in addition to loads imposed by water.

3.8.4.5 Structural Acceptance Criteria

The load cases for the RXB and CRB are provided in Table 3.8.4-1 and Table 3.8.4-2. These tables identify the design code applied for each load combination.

RAI 03.08.04-25

Code requirements are outlined in Table 3.8.4-12 which indicates the design codes for each Seismic Category based on the type of structure or loading.

RAI 03.08.04-10

Limits for allowable stresses, strains, deformations and other design criteria for the reinforced concrete structures are in accordance with ACI 349/349R and its appendices as modified by the exceptions specified in RG 1.142. Structural acceptance criteria for the steel components are in accordance with AISC N690 (Reference 3.8.4-6). Load combination 10 from Table 3.8.4-1 has been determined to be the controlling load combination. As such, this load combination was used to assess the adequacy of the structures. The use of AISC N690 (Reference 3.8.4-6) was to obtain loads from allowable strength design load combinations for use in the analysis of safety related, seismic category I steel structures. Load combination comparisons are performed on a case by case basis between AISC N690-1994 including Supplement 2 (2004) and AISC N690-2012 for verification that AISC N690-2012 provides the governing case.

Appendix 3B, Reactor Building and Control Building Design Approach and Critical Section Details, provides results for selected sections of both the RXB and CRB.

Section 3.8.5.5 identifies acceptance criteria applicable to additional basemat load combinations.

RAI 03.08.04-1, RAI 03.08.04-1S1

The RFT stand and upper support structure are Seismic Category I (SC- I) structures, and are designed and demonstrated via analysis to meet the requirements of an SC-I structure. They are therefore designed and analyzed to meet the requirements of supporting the lower reactor pressure vessel during an SSE, and to meet the requirements of Subsection NF of ASME Boiler and Pressure Vessel Code, Section III, Division 1 (Reference 3.8.4-9) rules and criteria. The load combinations used for the design of the structural members are shown in Table 3.8.4-23.~~The RFT stand support structure is a non-ASME Code component but was analyzed and shown to meet the requirements of Subsection NF of ASME Boiler and Pressure Vessel Code, Section III, Division 1 (Reference 3.8.4-9) using Class 2 plate and shell support rules. Paragraph NF-3255 states that Class 2 bolts shall be analyzed to Class 1 limits provided in NF-3225. Therefore the bolts were analyzed using Class 1 limits while the components and welds were analyzed using Class 2 limits.~~

RAI 03.08.04-1

Per Subsubparagraph NF-3256.2(a)(1) of ASME Boiler and Pressure Vessel Code, Section III, Division 1, "Rules for Construction of Nuclear Facility Components", 2013 Edition (Reference 3.8.4-9), the allowable stress limits for full penetration welds shall not exceed the allowable stress value for the base metal.

3.8.4.6 Materials, Quality Control and Special Construction Techniques

3.8.4.6.1 Materials

The principal construction materials for structures are concrete, reinforcing steel, structural steel, stainless steel, bolts, anchor bolts and weld electrodes. Table 3.8.4-10 provides the specifics of the materials considered for the structural design.

3.8.4.6.1.1 Concrete

Structural concrete used in the Seismic Category I RXB and CRB conforms to ACI 349, as supplemented by RG 1.142, and ACI 301. The majority of the structural concrete has a minimum compressive strength (f'c) of 5000 psi. The exception is the external walls of the RXB which require a higher compressive strength of 7000 psi.

Specific concrete mix will be developed based upon site conditions. Concrete mixes are designed in accordance with ACI 211.1, using materials qualified and accepted for this work. The mix will be based on field testing of trial mixtures with actual materials used. However, the concrete constituents conform to the following codes:

Cement

Cement conforms to the requirements of ASTM C150.

Aggregates

The RFT stand will be assembled from forgings or plate material which will be cut, machined, and welded and/or bolted together. The entire structure except for the bolts is made of 304L stainless steel. The socket head cap screws are made of Type 316L stainless steel and the capture bolts are made of SA-193, B8S.

3.8.4.6.2 Quality Control

Chapter 17 details the quality assurance program.

3.8.4.6.3 Special Construction Techniques

RAI 03.08.04-1, RAI 03.08.04-1S1

Modular construction, where wall or slab elements (or the rebar reinforcement) is pre-fabricated and then incorporated into the building, is~~will be~~ used when possible. This process is expected to leave sacrificial (non-structural) steel within the buildings. Typically this will be reinforcing beams underneath slabs. The uniform distributed dead load applied in the structural and seismic analyses encompasses the weight of this steel. The RFT stand and embed~~ded~~ plate will be fabricated using conventional fabrication processes.

3.8.4.7 Testing and Inservice Inspection Requirements

RAI 03.08.04-1, RAI 03.08.04-1S1

There is no testing or in~~-~~service surveillance beyond the quality control tests performed during construction, which is in accordance with ACI 349, and AISC N690 (Reference 3.8.4-6). The Seismic Category I RFT stand will be inspected prior to installation via NDE, to qualify it in accordance with applicable requirements of ASME Boiler and Pressure Vessel ~~c~~Code Section III, Division 1 (Reference 3.8.4-9).

COL Item 3.8-1: A COL applicant that references the NuScale Power Plant design certification will describe the site-specific program for monitoring and maintenance of the Seismic Category I structures in accordance with the requirements of 10 CFR 50.65 as discussed in Regulatory Guide 1.160. Monitoring is to include below grade walls, groundwater chemistry if needed, base settlements and differential displacements.

3.8.4.8 Evaluation of Design for Site Specific Acceptability

RAI 02.03.01-2, RAI 03.08.04-23S3

The RXB and CRB are designed to remain operable and to transmit forces, moments, and accelerations so that contained, safety-related SSC remain operable during and following an earthquake, with a spectra equal to the CSDRS or the CSDRS-HF. This is accomplished by confirming the buildings meet code-~~-~~acceptance criteria if situated on a soft soil site, a hard soil/soft rock site, a rock site, and a hard rock site. However, each actual site will have unique soil conditions and a site-specific SSE. The entire analysis described in Section 3.8.4 does not need to be re-performed if it can be shown that non-seismic loads are less than those produced by the site parameters provided in

RAI 03.08.04-1S1

Table 3.8.4-21: RFT Embed Plates Demand to Capacity Ratios for SSE

Floor Embed Plate and Concrete		
Category	**Acceptance Criteria (Reference 3.8.4-5 and Reference 3.8.4-6)**	**Design to Capacity Ratio**
Bearing of plate on concrete	AISC Sections J7, J8	0.01
Overturning	N/A	0.34
Bending of plate	AISC N690 Section F11	0.35
W8x28 embedded in concrete in shear	AISC N690 Section G2	0.36
Weld of W8x28 embedded in concrete	AISC N690 Section J2	0.23
Wall Embed Plate and Anchor Baseplate		
Category	**Acceptance Criteria (Reference 3.8.4-5 and Reference 3.8.4-6)**	**Design to Capacity Ratio**
Moment capacity of embed plate	ACI 349 Appendix D.5, D.3	0.34
Tension on anchor bolts	ACI 349 Appendix D.5	0.67
Shear on anchor bolt	ACI 349 Appendix D.6	0.46
Anchor bolt in tension and shear interaction	ACI 349 Appendix D.7	1.13 (interaction limit is 1.2)
Embed plate in bending	AISC N690 Section F11	0.48

RAI 03.08.04-1S1

Table 3.8.4-22: RFT Structural Member Demand to Capacity Ratios for SSE

Component and Stress Analyzed	Acceptance Criteria (Reference 3.8.4-9)	Demand to Capacity Ratio
RFT upper support arms (I-beams)		
Combined bending and compression	NF-3322.1.e.1 Equation 20/21	0.48
Shear tear out of pin from I-beam collars	NF-3322.1.b.1 Equation 3a	0.28
RFT upper support ring (C-Section)		
Shear	NF-3322.1.b.1 Equation 3a	0.57
Upper support arm pin		
Shear	NF-3322.1.b.1 Equation 3a	0.32
Bending	NF-3322.1.d.1-a Equation 9	0.81
RXB baseplate connection (RFT upper support structure)		
Shear in clevis	NF-3322.1.b.1 Equation 3a	0.14
Tension and compression in clevis	NF-3322.1.a.1 Equation 1	0.15
Bending	NF-3322.1.d.1-a Equation 9	0.45
Shear tear out of pin from clevis	NF-3322.1.b.1 Equation 3a	0.69
Wall anchor plate bolts		
Combined shear and tension	NF-3324.6.3-a	0.59
RPV alignment ring (RFT lower structure)		
Bearing	NF-3322.1.f.1 Equation 23	0.09
Shear pins (RFT lower structure)		
Shear	NF-3324.6.a.2.-a-1	0.21
Capture bolts (RFT lower structure)		
Tension	NF-3324.6.a.1	0.72
RPV support shelf (RFT lower structure)		
Bearing	NF-3322.1.f.1 Equation 23	0.55
Shear on socket head cap screws	NF-3324.6.a.2-a-1	0.18

RAI 03.08.04-1S1

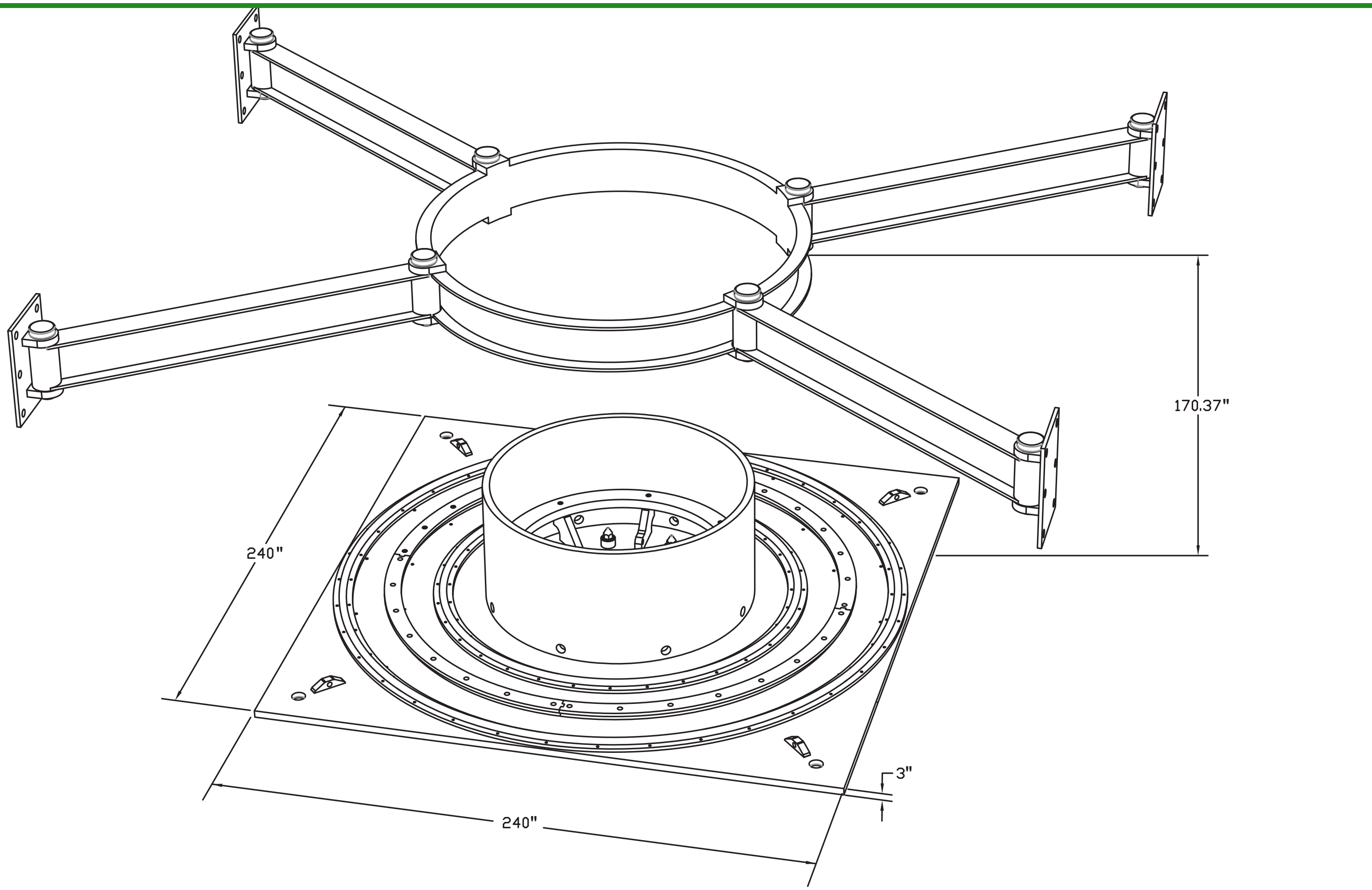
Table 3.8.4-23: Reactor Flange Tool Structural Member Load Combinations

Plant Event	Condition	Service Level	Load Combination[(1)]	Stress Limit / Acceptance Criteria[(2)]
Design	Design	Design	1.2*DW_RPV + DYN	Design
Normal Operation	Normal	A	DW_RPV + DYN	A
Loss of RBC load carrying capability	Normal	B	DW_NPM	B
SSE	Faulted	D	DW_RPV + SSE	D

1. Abbreviations: DW_NPM=deadweight of the NPM; DW_RPV = deadweight of the lower RPV lower RVI, and fuel; DYN = Dynamic load factor; SSE=Safe Shutdown Earthquake.
2. Stress limits are as specified in Subsection NF of the ASME BPVC.

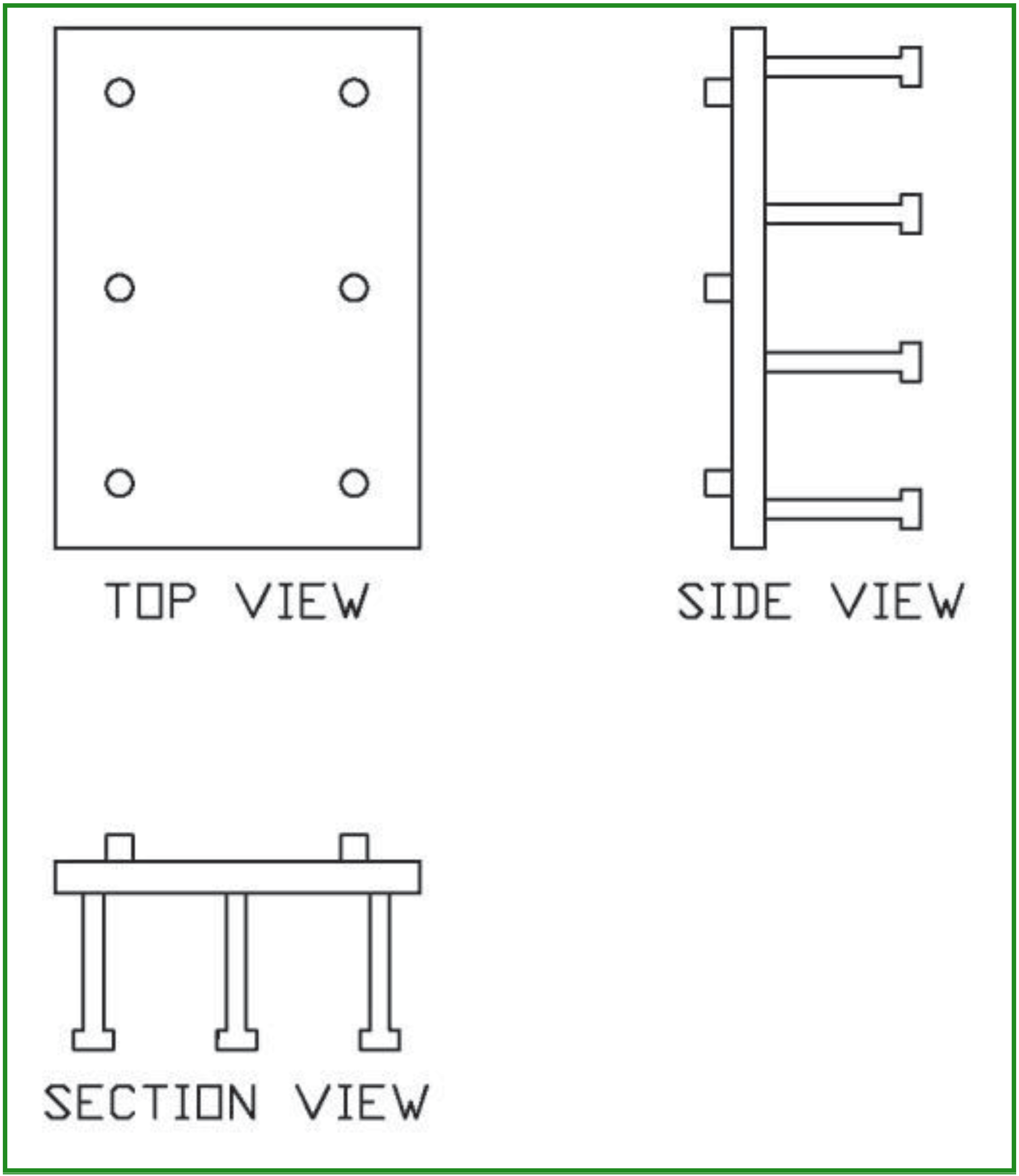
RAI 03.08.04-1S1

Figure 3.8.4-34: Reactor Flange Tool Support and Stand



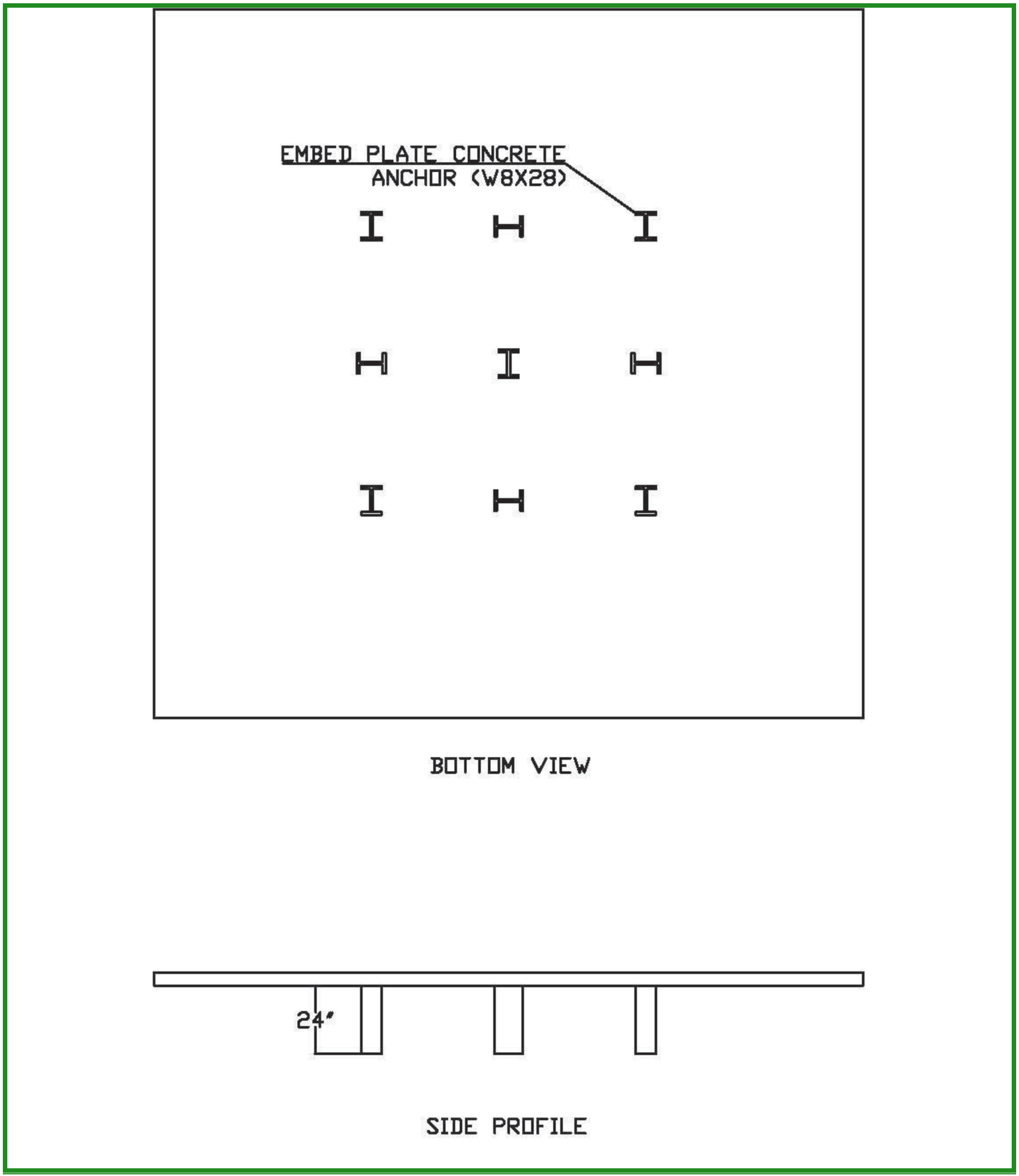
RAI 03.08.04-1S1

Figure 3.8.4-35: Reactor Flange Tool Upper Support Wall Embed Plate



RAI 03.08.04-1S1

Figure 3.8.4-36: Reactor Flange Tool Base Embed Plate



with two drums, two ropes, two motors, and two gear boxes. A geared limit switch, used to define the RBC low hook position keeps the wet hoist main frame and machinery above the reactor pool water level. Only the bottom block and ropes of the wet hoist enter the water. Holes in the bottom block sheave guard allow water to fill the space when lowered into the water and drain water when removed.

Components of the wet hoist that are be submerged in water are fabricated of stainless steel or a comparable corrosion resistant alloy for contamination control. A radiation alarm mounted on the wet hoist alerts the operator of unsafe radiation levels.

The wet hoist contains a load-sensing device that is interlocked with the RBC main hoist drive system. The load weighing assembly monitors for slack rope, high loads, contact with an obstruction, and broken wires.

The wet hoist contains redundant systems to prevent raising equipment above a safe carrying height. These systems include an upper stop limit switch, an overload sensor, and an upper mechanical stop.

Other Refueling Devices

The CFT is mounted at the bottom of the refueling pool adjacent to the SFP in the RXB. The CFT is used to assemble and disassemble the lower parting flange on the containment vessel (CNV). The CFT is composed of a CNV support stand, guides, and associated tooling for assembly, disassembly, and inspection of the CNV lower parting flange connection and fasteners. The RBC is used to place the NPM in the CNV support stand and remains connected to the NPM. The lower containment remains in the CFT once unbolted. The upper NPM is then moved to the RFT. The CFT is designed for service in a borated water environment.

RAI 03.08.04-1S1

The RFT is located~~mounted~~ at the bottom of the refueling pool adjacent to the CFT. The RBC ~~is used to~~ moves the NPM from the CFT to the RFT and remains connected to the NPM. The RFT supports the lower portion of the reactor vessel, containing~~which contains~~ the core, during refueling operations. The RFT consists~~is composed~~ of a reactor pressure vessel (RPV) support stand, guides, and remotely-operated equipment that perform~~s~~ closure bolt installation and tensioning for assembly and disassembly of the RPV lower parting flange connection and fasteners. The RFT is designed for service in a borated water environment.

RAI 03.08.04-1S1

The module inspection rack is a permanently-mounted work platform located in the dry dock of the RXB used to support the NPM for inspection and maintenance. It supports the NPM in the vertical orientation~~ by shear lugs~~. The RBC moves the upper CNV with the upper reactor vessel from the RFT to the module inspection rack. The design of the module inspection rack and its seismic analysis ensure that the SSC of the module inspection rack are be able to withstand the SSE and retain the load.

{{

}}2(a),(c)

Figure 5-4 Cutaway view showing NPM cavities and rigid floor representation

5.2 Three-Dimensional ANSYS model of Lower NPM and Reactor Flange Tool

The refueling position examined is the lower RPV, lower riser, core support structure, and fuel (Figure 5-5) on the reactor flange tool support with other components of the module removed. This position is the only refueling configuration in which the fuel is open to the reactor pool. While in the containment flange tool (CFT) and while being lifted by the crane, the fuel remains isolated inside the RPV. See Figure 5-6 for the location of the RFT.

The model consists of the lower RPV, lower riser, core barrel, fuel, and RFT support, see Figure 5-7 for a rendering of the lower RPV inside the RFT support. Material properties are defined at the RFT design temperature, 200°F, with the exception of the fuel beam model, which is consistent with the model in Section 4.1.3.2. The RPV model documented in Section 4.1.2 has been modified to incorporate the refueling ledge at the bottom of the RPV, see Figure 5-8 for the RPV/RFT submodel before combination with the LRVI submodel. Note that the RFT support shell shown in Figure 5-7 is not modeled in ANSYS down to the elevation of the RPV support shelf for added conservatism. The LRVI submodel is consistent with the model documented in Section 4.1.3, except that modulus of elasticity of the lower riser and core barrel are taken at 200°F. The ~~mass of the displaced pool water~~reactor pool water is not modeled, and the hydrodynamic mass of the structure is accounted for by increasing the density of the RPV, RFT base, RFT upper support ring, and the portion of the LRVI above the lower RPV by the density of water at ~~7~~200°F and 14.6 psia. The hydrodynamic mass of the RFT upper support

I-beams is accounted for using Table N-1311-1 of the Appendices of Reference 10.1.5. The fluid-structure interaction of the water contained by the lower RPV is represented using the Fourier node method described in Section 4.1.8.5.

The RPV alignment feature is laterally constrained to the RFT alignment ring using remote points scoped to the features. The RPV refueling ledge is connected to the RFT support shelf using frictional contact that allows for potential uplift of the RPV. The RFT upper support ring is connected to the outside of the RPV flange using laterally constrained remote points scoped to the features.

{{

}}2(a),(c)

Figure 5-5 Lower RPV, Lower Riser, and Core Support for analysis inside the RFT (fuel not shown)

{{

}}2(a),(c)

Figure 5-7 Refueling Configuration for Seismic Analysis~~.~~ (LRVI not shown)

{{

}}2(a),(c)

Figure 5-8 RPV to RFT Support Interface (LRVI not shown).

Acceleration time histories on top of the base mat at the reactor flange tool location are applied to the bottom of the RFT model, and at the ends of the four RFT upper support I-beams, which are connected to the reactor pool wall by pinned connections. The cracked and uncracked cases are considered for nominal stiffness, ~~as well as the cracked case with~~ reduced stiffness (77%), and increased stiffness (130%), consistent with the analysis of the NPM in the entire pool models outlined in Section 8.0.

The Y-direction (vertical) time history acceleration files are modified to remove gravity from the input. This is done by subtracting 386.089 in/sec^2 from each time step, such that the only value remaining is the seismic portion of the input. Additionally, the frequency range used to apply damping is adjusted according to the modal results obtained for this configuration. Alpha-beta damping is used for the analysis, and a 4 percent damping value is applied to the frequency range of {{ }}2(a),(c)

Table 8-7 Maximum seismic reactions at RPV Upper Supports (cylindrical coordinates)

ID	Description	Maximum force (lbf)		
		FR Radial	FY Vertical	Fθ Circumferential
4	RPV upper support - segment -X+Z	{{		}}2(a),(c)
5	RPV upper support - segment +X+Z	{{		}}2(a),(c)
6	RPV upper support - segment +X-Z	{{		}}2(a),(c)
7	RPV upper support - segment -X-Z	{{		}}2(a),(c)

Table 8-8 Maximum Seismic Reactions on Bottom of Reflector and at Fuel Assembly Supports

ID	Description	Maximum force (lbf)			Maximum Moment (in-lbf)			Coor-dinate System
		FX East-West	FY Vertical	FZ North-South	MX	MY	MZ	
17	Reflector, Lower Core Plate	{{						}}2(a),(c)
18	Fuel Assemblies, Lower Core Plate	{{						}}2(a),(c)
19	Fuel Assemblies, Upper Core Plate	{{						}}2(a),(c)

Note: Maximum reaction loads from either NPM in entire pool or lower NPM in RFT analysis.

Maximum uplift displacements were calculated for each of the ~~six~~ twelve runs. The maximum uplift for the CNV skirt occurred in the run representing the Capitola time history, soil type 7, with cracked concrete, on the NPM in operating bay ~~1~~ 6 with an increased ~~reduced~~ stiffness.

Reflector block uplift is calculated with respect to the top of the lower core plate, for either the NPM in the entire pool analysis or the lower NPM in the RFT analysis. The maximum uplift for the reflector blocks occurred in the run representing the Capitola time history, soil type 7, with cracked concrete, on the NPM in operating bay 1 with a nominal stiffness.

The displacements and time are provided in Table 8-9.

Table 8-9 Maximum uplift displacements

Component	Max. Uplift Displacement (in)	Occurring Time (s)
CNV Skirt	{{	}}2(a),(c)
1st Reflector Block	{{	}}2(a),(c)

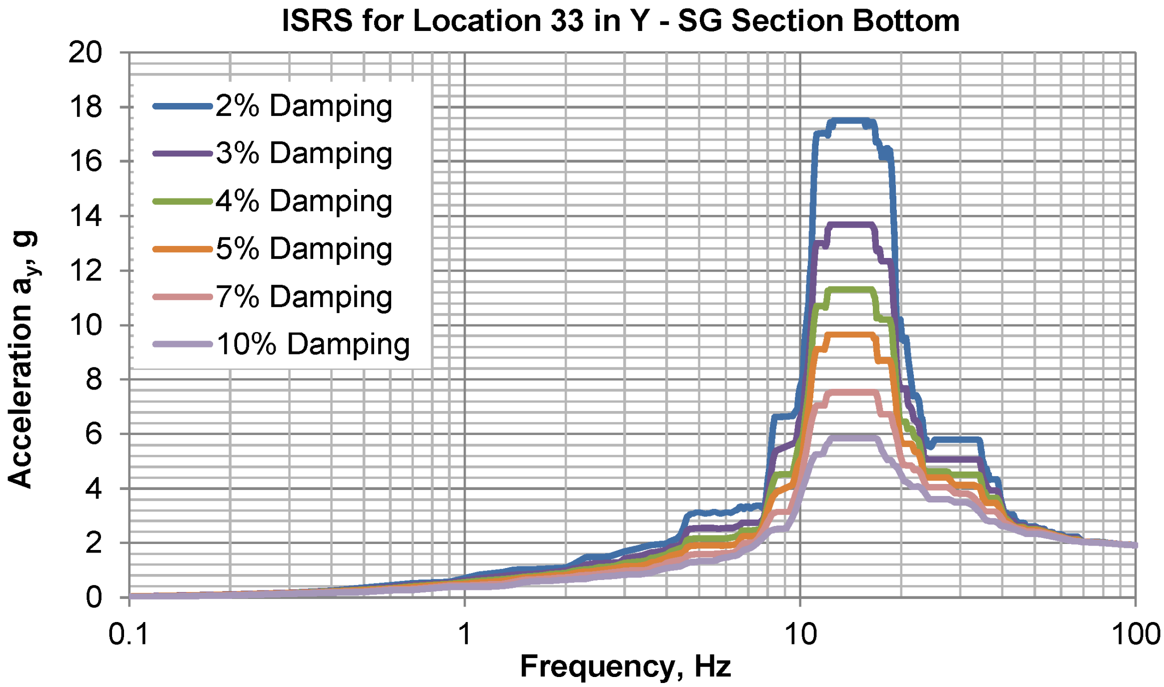


Figure B-33 Design ISRS, steam generator section bottom, location 33, Y-direction (vertical)

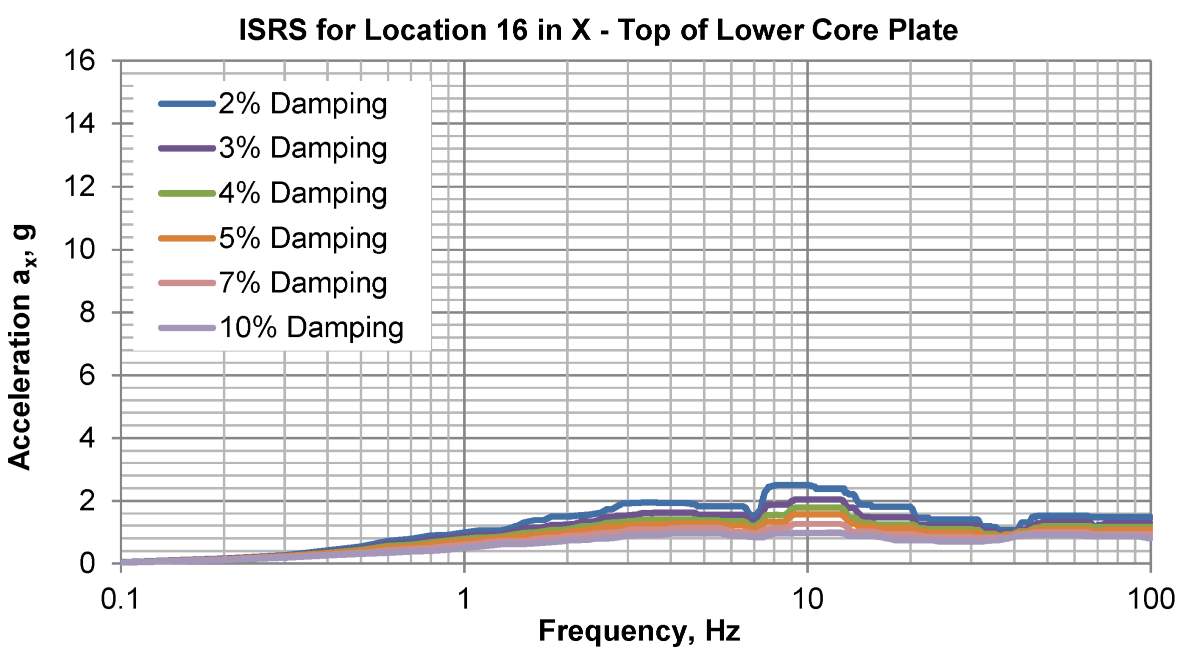


Figure B-34 RFT Model ISRS, top of lower core plate, location 16, X-Direction (east-west)

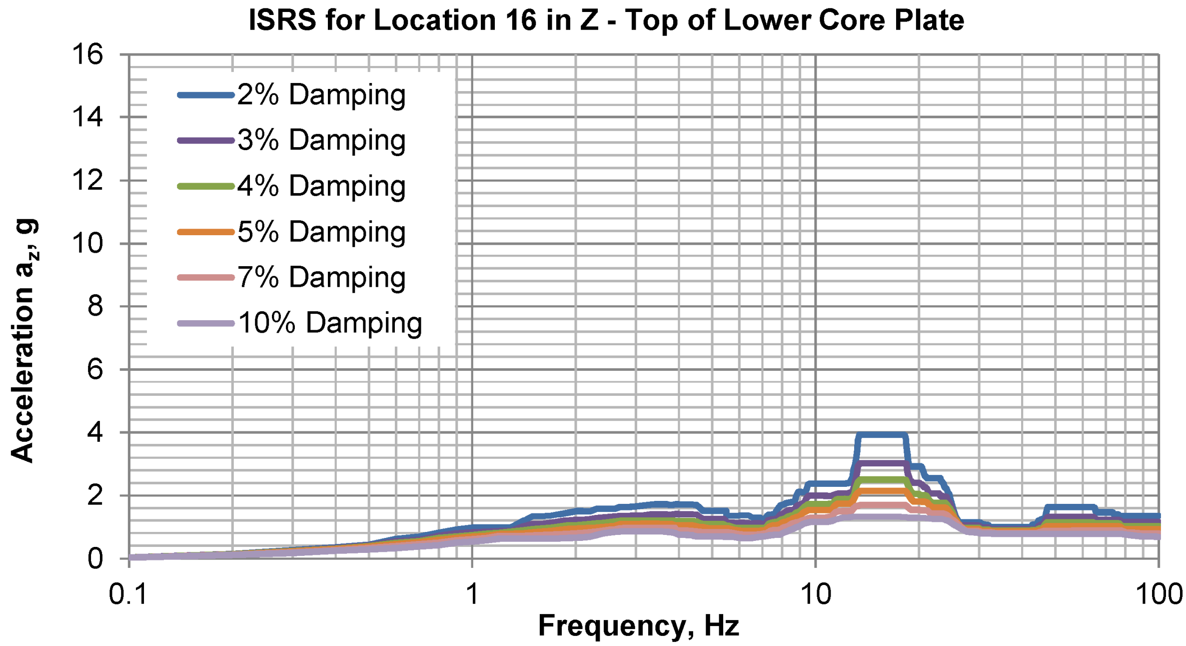


Figure B-35 RFT Model ISRS, top of lower core plate, location 16, Z-Direction (north-south)

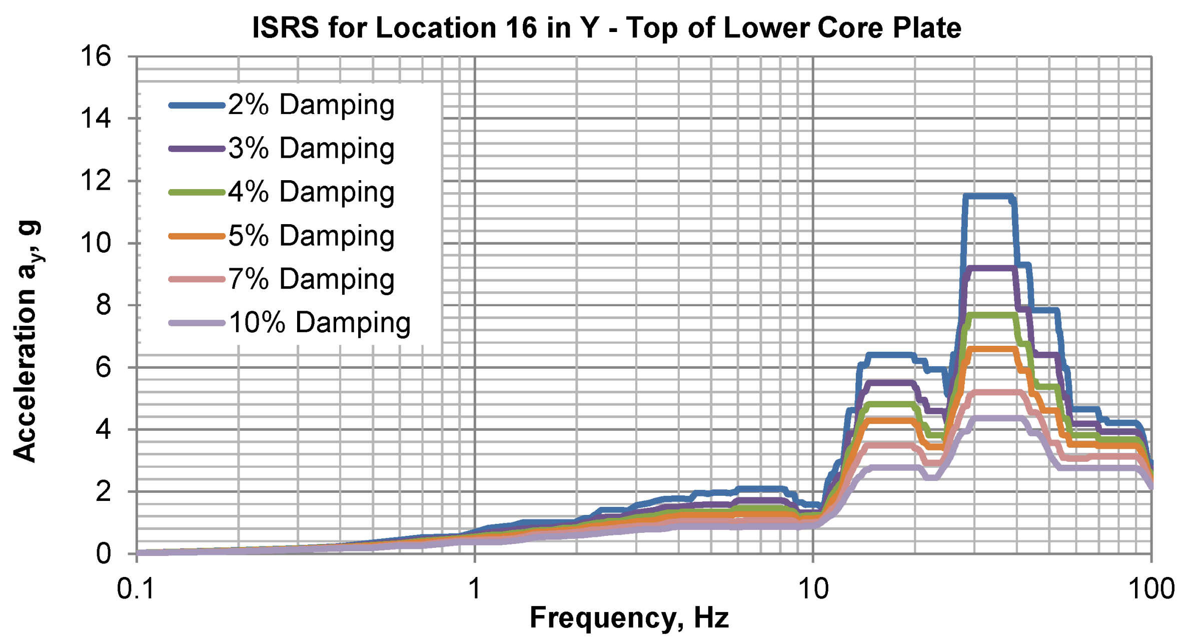


Figure B-36 RFT Model ISRS, top of lower core plate, location 16, Y-Direction (vertical)

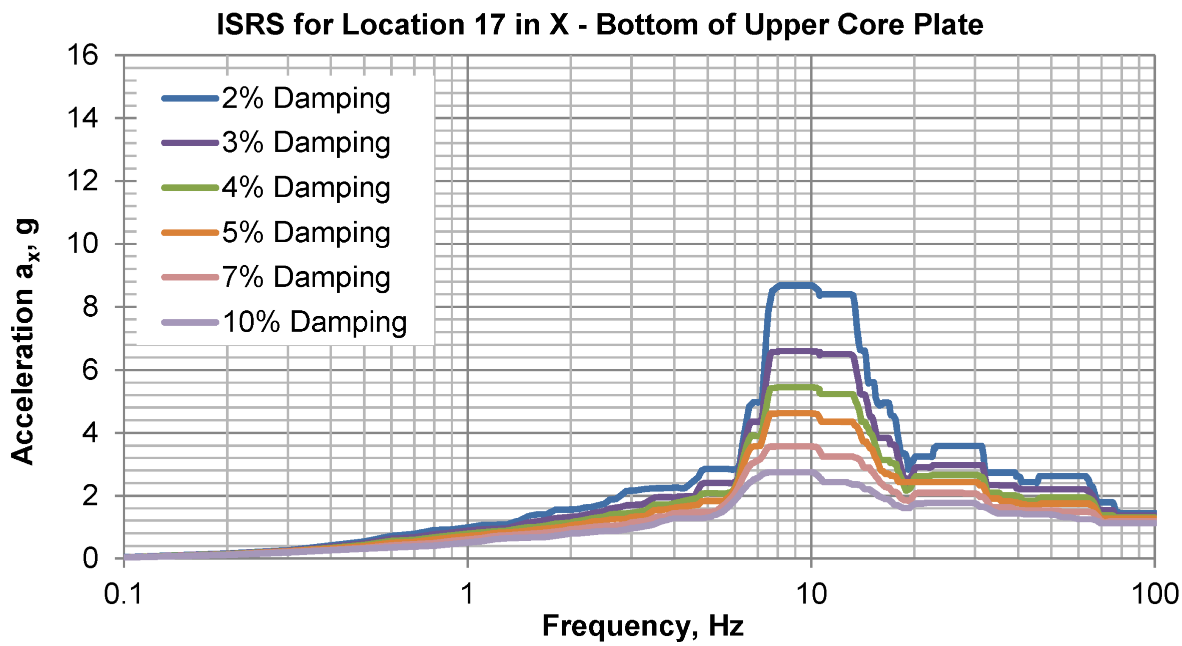


Figure B-37 RFT Model ISRS, bottom of upper core plate, location 17, X-Direction (east-west)

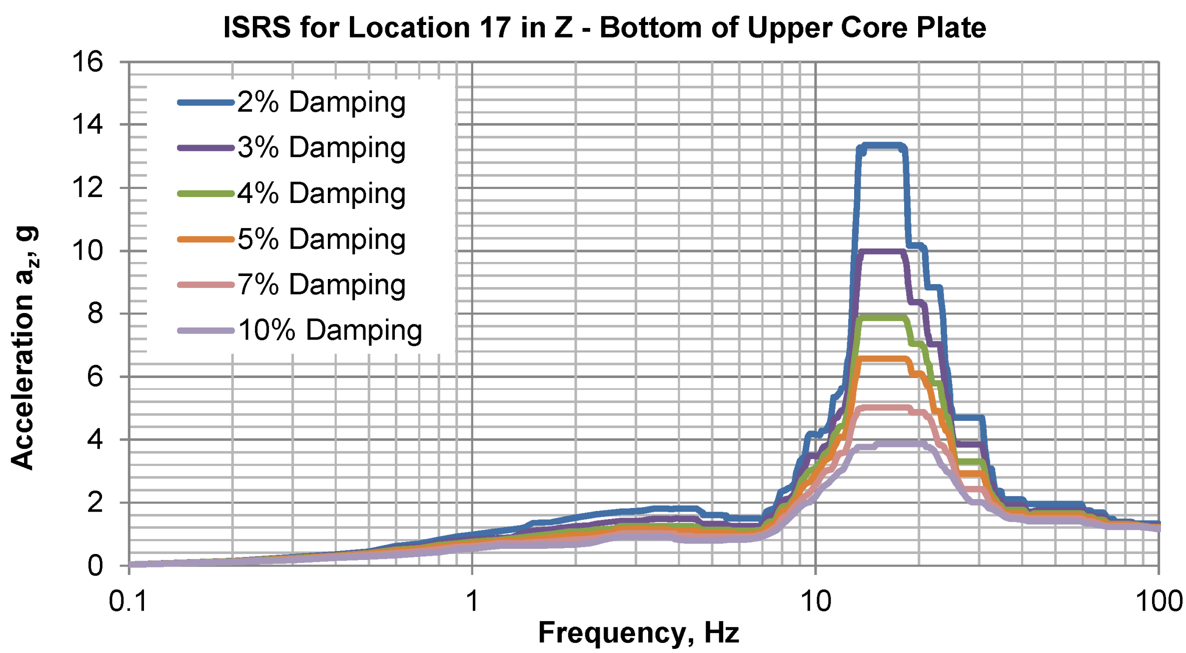


Figure B-38 RFT Model ISRS, bottom of upper core plate, location 17, Z-Direction (north-south)

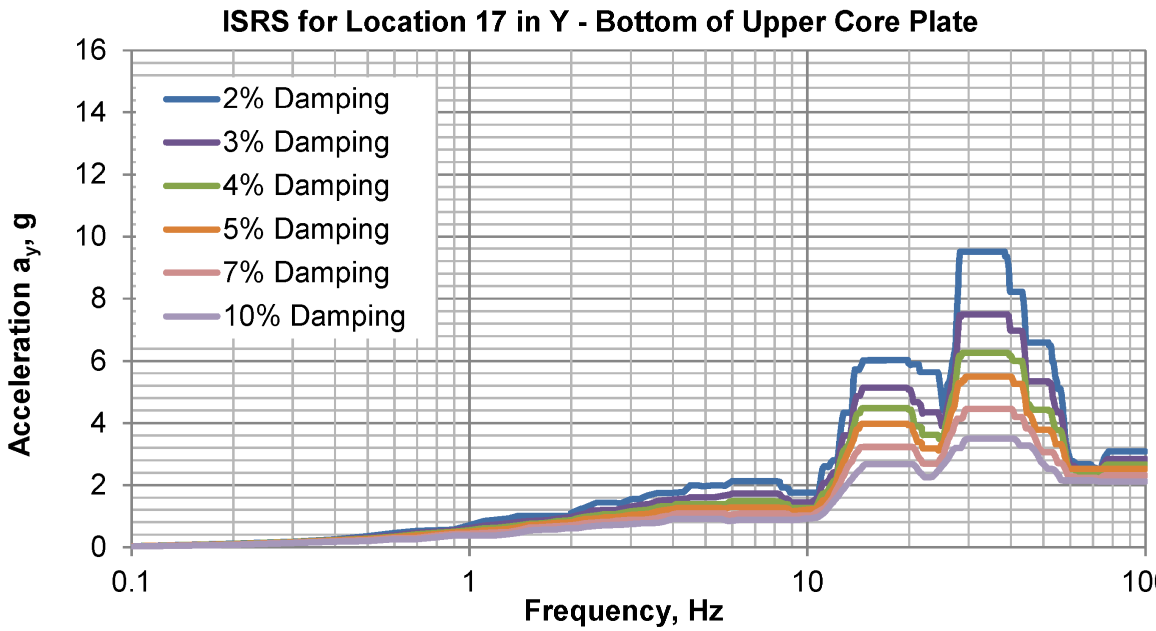


Figure B-39 RFT Model ISRS, bottom of upper core plate, location 17, Y-Direction (vertical)

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0219-64655

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

NuScale Power, LLC

AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
    a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
    b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
    c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
    d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
    e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the method by which NuScale develops its reactor flange tool.

    NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money.

    The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

    If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed response to NRC Request for Additional Information Supplemental RAI No. 38, eRAI No. 8838. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
    a. The information sought to be withheld is owned and has been held in confidence by NuScale.
    b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
    c. The information is being transmitted to and received by the NRC in confidence.
    d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
    e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 25, 2019.

Zackary W. Rad