RAIO-0718-60789

July 05, 2018

Docket No. 52-048

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

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 38 (eRAI No. 8838)," dated May 26, 2017

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

The Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 8838:

- 03.08.04-1

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

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

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8838

Enclosure 1:

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

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:

<u>RAI 8838 Question 1 Response</u>

Final details of the method/mechanism for restraining a bioshield mounted on an adjacent bioshield, and restraining the upper containment vessel (CNV) on the module inspection rack, during the refueling operations will be provided with the response to eRAI 9447, Question 03.11-19. In addition, the analysis and design criteria (consistent with DSRS Section 3.7.2.II.8) to ensure that no adverse interactions occur between the Seismic Category II bioshields, and inspection racks, with adjacent Seismic Category I SSCs during refueling operations will also be provided with that RAI 9447 Question 03.11-19 response.

<u>RAI 8838 Question 2 Response</u>

Final design for the SC II containment flange tool (CFT) is in progress. Design specifications have been prepared that establish the design criteria for the SC II CFT that address II/I design requirements. The CFT design specification is available for NRC audit.

<u>RAI 8838 Question 3 Response</u>

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 reactor pressure vessel (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 closure flange bolts. The RFT stand is attached to a plate anchored to the pool basemat referred to as the RFT embedded plate.

The base plate of the RFT is placed in the refueling pool centered between the side walls (north and south) of the refueling pool, roughly centered between the wall of the spent fuel pool (west), and the baseplate of the CFT (east). 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.

Applicable Codes, Standards, and Specifications:

ASME Boiler and Pressure Vessel Code, Section III, subsection NF, Division 1, “Rules for Construction of Nuclear Facility Components,” 2013 Edition

Component Weight:

The RFT stand weighs approximately 80,000 lbs. The RFT bolting (bolt tensioning) tools weigh approximately 21,000 lbs. each, conservatively rounded to 25,000 lbs. Four bolting tools operate on the RFT, making the entire RFT assembly weight approximately 180,000 lbs. The lower RPV weighs approximately 206,000 lbs.

Structural Acceptance Criteria:

The RFT stand 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 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.

Per Subparagraph 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), the allowable stress limits for full penetration welds shall not exceed the allowable stress value for the base metal.

Design Analysis Procedures:

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 in single radial directions. To account for the mass of the bolt tensioning equipment, mass elements were added to the rails.

The lateral (shear) loads imposed between the RFT embedded plate and the RFT stand are carried by four pins, located in line with the corners of the RFT stand base plate just outside the bolting tool track. The RFT stand is anchored to the baseplate by means of eight capture bolts, located inside the cylindrical support for the lower RPV.

The results of the RFT stand finite element analysis demonstrate that it provides adequate restraint for the lower RPV section during an SSE event.

Results of the RFT stand finite element model were used as input to embedded plate design.

The RFT embedded 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.

The seismic response of the upper and lower core plates while the lower RPV is in the RFT are being analyzed in response to RAI 9225 Question 04.02-8. The results, including 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, will be contained in the response to RAI 9225 Question 04.02-8.

Materials:

The RFT stand is assembled from forgings or plate material that is 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 SA-479, Type 316L stainless steel and the capture bolts are made from SA-193, B8S.

Quality Control:

Chapter 17 of the DCA details the quality assurance program.

Special Construction Techniques:

The RFT stand and embedded plate are fabricated using conventional fabrication processes.

Testing and Inservice Inspection Requirements:

The Seismic Category I RFT stand is inspected via NDE to qualify it in accordance with applicable requirements of ASME Boiler and Pressure Vessel code Section III, Division 1. During operation of a plant, in-service inspection (ISI) is the responsibility of the operator, and is conducted per ASME B&PV code Section XI. Details of the examination schedule and procedure are documented as COL Item 3.8-1.

The Seismic Category II components of the RFT, primarily the bolting tools, are inspected and demonstrated to be functional by the supplier for the first unit through a number of consecutive cycles, and for each subsequent unit supplied, to ensure proper operation prior to delivery to the plant. Once the design is finalized, a II/I analysis is to be conducted to demonstrate that these tools don’t adversely affect any adjacent Seismic Category I components.

Impact on DCA:

FSAR Tier 2, Section 3.8.4 has been revised as described in the response above and as shown in the markup provided in this response.

3.8.4 Other Seismic Category I Structures

RAI 03.08.04-33, RAI 03.08.04-1

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 embedded 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% of the length of the building. The normal reactor pool level is maintained at 69 feet, which 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

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

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
AISC N690	2012	Specification for Safety-Related Steel Structures for Nuclear Facilities
AISC 325	2014	Steel Construction Manual
AISC 360	2010	Specification for Structural Steel Buildings

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

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.

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. The hydrostatic pressure varies linearly from the pool surface to the bottom of the pool floor.

These hydrodynamic loads are due to the seismic response from the water in the pools, which exert a water pressure on the structural pool walls in contact with the water. The hydrodynamic load effect is taken into account by distributing the water mass on each affected structural wall in the pool. The entire pool water mass is considered to participate in the hydrodynamic response for the two horizontal and vertical directions. i.e., the water mass in the East-West (X) direction is applied as lumped masses on all wall surface nodes which would resist the fluid motion in the X direction.

Figure 3.8.4-13 shows the water mass regions that contribute to the hydrodynamic response in the longitudinal X-direction. Similarly,
Figure 3.8.4-14 shows the water mass regions corresponding to the hydrodynamic response in the transverse Y-direction. The vertical hydrodynamic effect is simply attained by evenly distributing the entire water mass along the bottom of the pool floor.

21 through Figure 3.8.4-26 show the CRB SAP2000 model in various isometric and perspective views. Table 3.8.4-8 tabulates the total number of joints and elements developed in both the uncracked and cracked SAP2000 analysis models.

The CRB finite element models are developed to represent the primary structural members including walls, beams, columns, pilasters, floors and roofs. Walls, floors, metal decking and wind siding elements are represented by shell elements and the beams, columns, braces and pilasters are modeled by frame (beam) elements. The basemat foundation is modeled by solid elements and shell elements. The excavated soil is modeled by solid elements only. All shell and frame elements are 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

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

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

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

Results of the RFT stand finite element model were used as input to embedded plate design. The RFT embedded 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

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

Aggregates conform to the requirements of ASTM C33.

ASTM Standards C1260 and C1293 are used in testing aggregates for potential alkali-silica reactivity. Low-alkali cement is used in concrete with aggregates that are potentially reactive.

Admixtures

Steel studs meet the requirements of ASTM A108 and Structural Welding Code-Steel AWS D1.1/D1.1M.

Anchor Bolts

Anchor bolts are of type ASTM F1554, 36 ksi or 55 ksi yield strength material. Where higher strengths are required ASTM F1554, 105 ksi yield strength material are used.

If post-installed anchors are used for supports, the flexibility of base plates is accounted for, in determining the anchor bolt loads. Post-installed anchors are also qualified for seismic loading if required.

Welds

Welding electrodes shall be E70XX or unless otherwise noted on drawings or within specification for ASTM A36 steel and E308L-16 or equivalent for ASTM A240, type 304- L stainless steel.

3.8.4.6.1.4 Other

Grating

Grating is welded and galvanized steel, "Metal Bar Type", conforming to the specification contained in ANSI/NAAMM MBG 531-00 and ANSI/NAAMM MBG 532-00. Grating is stainless steel.

Masonry Walls

There are no safety-related reinforced masonry walls in Seismic Category I structures.

Steel-Concrete Modules

The NuScale Power Plant primary safety-related structure design does not use steel-concrete modules.

RAI 03.08.04-1

RFT Stand

RAI 03.08.04-1

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

Modular construction, where wall or slab elements (or the rebar reinforcement) is pre-fabricated and then incorporated into the building, 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 embedded plate will be fabricated using conventional fabrication processes.

3.8.4.7 Testing and Inservice Inspection Requirements

RAI 03.08.04-1

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 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

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 Table 2.0-1 and that the forces experienced within the building from the site-specific earthquake are less than those produced from the CSDRS and CSDRS-HF.

COL Item 3.8-2: A COL applicant that references the NuScale Power Plant design certification will confirm that the site independent Reactor Building and Control Building are acceptable for use at the designated site.

3.8.4-3 ANSYS Computer Program, Release 16.0, January 2015. ANSYS Incorporated, Canonsburg, Pennsylvania.

3.8.4-4 TR-0816-49833, "Fuel Storage Rack Analysis," NuScale, December 2016

3.8.4-5 ACI 349-06, "Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary", American Concrete Institute, 2006

3.8.4-6 ANSI/AISC N690-12, "Specification for Steel Safety-Related Steel Structures for Nuclear Facilities", American Institute of Steel Construction, 2012.

3.8.4-7 ACI 349.1R, "Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures, American Concrete Institute, 2007.

RAI 02.03.01-3

3.8.4-8 American Society of Civil Engineers/Structural Engineering Institute, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-05, Reston, VA, 2005.

RAI 03.08.04-1

3.8.4-9 ASME Boiler and Pressure Vessel Code, Section III, subsection NF, Division 1, “Rules for Construction of Nuclear Facility Components”, 2013 Edition.