RAIO-1217-57491

December 05, 2017

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 Response to NRC Request for Additional Information No. 252 (eRAI No. 9183) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 252 (eRAI No. 9183)," dated October 13, 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 Questions from NRC eRAI No. 9183:

- 03.13-1
- 03.13-2
- 03.13-3
- 03.13-4

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
NuScale Power, LLC

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9183

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9183

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

eRAI No.: 9183
Date of RAI Issue: 10/13/2017

NRC Question No.: 03.13-1

Regulatory Basis:

Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," General Design Criteria (GDC) 1 requires that structures, systems, and components (SSCs) important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

GDC 4 requires that SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents (LOCAs).

GDC 14 requires that the reactor coolant pressure boundary (RCPB) shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

GDC 30 requires that components which are part of the RCPB shall be designed, fabricated, erected, and tested to the highest quality standards practical. Means shall be provided for detecting and, to the extent practical, identifying the location of the source of reactor coolant leakage.

GDC 31 requires that the RCPB shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a nonbrittle manner and (2) the probability of rapidly propagating fracture is minimized.

10 CFR Part 50, Appendix G specifies fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor pressure boundary to provide adequate margins of safety during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime.

DCD Tier 2, FSAR, Section 3.13.1.3, is titled (emphasis added):

"Fracture Toughness Requirements for Threaded Fasteners **Made from Ferritic Materials**,"

This section states (emphasis added):

> The pressure-retaining Class 1, 2 and 3 components **made of ferritic material** meet the requirements of ASME BPVC, Section III (Reference 3.13-1), Subsections NB-2300, NC-2300 and ND-2300 respectively (Table 3.13-1). For pressure-retaining components of the reactor coolant pressure boundary, the requirements are supplemented by the additional requirements set forth in 10 CFR 50, Appendix G.

As written, this section only states that these requirements are applicable to ferritic steels.

However, the NuScale design uses SA-564, Grade 630, Condition H1100, which is a precipitation-hardened, martensitic steel. This grade would require impact testing according to ASME Code, Section III, Subsections NB-2300, NC-2300 and ND-2300. Therefore, DCD Tier 2, FSAR, Section 3.13.1.3 is unclear that it would apply to this threaded fastener material.

Revise DCD Tier 2, FSAR, Section 3.13.1.3 to remove the specific reference to ferritic steels.

NuScale Response:

NuScale Tier 2 FSAR Section 3.13 used the term “ferritic materials” to be consistent with the wording used by NUREG-0800 Chapter 3.13 and RG 1.206 Chapter C.I.3.13.1.3. Furthermore, 10 CFR 50 Appendix G, which is referenced by NUREG-0800 and RG 1.206, has the following definition of “ferritic material”:

> *Ferritic material means carbon and low-alloy steels, higher alloy steels including all stainless alloys of the 4xx series, and maraging and precipitation hardening steels with a predominantly body-centered cubic crystal structure.*

ASME BPVC Section III NX-2300 exempts only non-ferrous alloys and austenitic steels from impact test. Further, NX-2300 requires impact test specimen locations be determined per NX-2200, which is under the heading “ferritic materials”. Effectively, NX-2000 uses “ferritic materials” as defined in 10 CFR 50 Appendix G. NuScale use of SA-564 Grade 630 Class 1 bolting is in accordance with other recent applications docketed with NRC. This shows that there is no ambiguity that SA-564 Grade 630 is “ferritic material” not only for NX-2300, but also for FSAR Section 3.13.

Therefore, removing the term “ferritic materials” from NuScale FSAR Section 3.13 is unnecessary, and could be misinterpreted that NuScale imposes NX-2300 to all threaded fastener materials.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

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eRAI No.: 9183
Date of RAI Issue: 10/13/2017

NRC Question No.: 03.13-2

In the public meeting on May 15, 2017 (Meeting Summary ADAMS Accession Number: ML17143A140), the staff informed the applicant that verbatim compliance with the ASME Code alone may not be adequate and sufficient to meet the quality requirements in GDC 1:

> Structure, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

Specifically, parts of the ASME Code are written with an underlying assumption that small diameter components may be less safety significant than larger components. The staff informed the applicant that additional controls and requirements may be necessary for small diameter components.

The staff provides the following example from ASME Code Section III, which illustrates the issue:

- NCA 3862.1(g) and NCA-3862.1(h) allow a Certificate of Compliance instead of a certified material test report (CMTR) for bolting 1" and less. The Certificate of Compliance is not required to state the heat or lot traceability. NCA-3856.3(b) also states that for materials where a Certificates of Compliance is allowed, heat□number identification need not be indicated on the material or the certificate.
- NCA-3812, "Exclusions," provides exclusions for Metallic Material Origination's Quality System Programs (NCA-3800). NCA-3812 states:

> Material falling within the small products exclusion of NB-/NC-/ND-/NE-/NF-/NG-2610 or material that is allowed by this Section to be furnished with a Certificate of Compliance, is exempted from the requirements of NCA-3800, except
>
> (a) Certified Material Test Reports or Certificates of Compliance shall meet the requirements of NCA-3862.1
>
> (b) for Class 1 construction only, material identification and marking shall meet the

requirements of NCA-3856.3

The ASME Code, Section III, NB-2600 has similar requirements specifically for Class 1 bolting.

Therefore, components that meet the small parts exclusion have lower quality assurance requirements.

In order to determine if the NuScale design meets GDC 1, provide justification that verbatim compliance with the ASME Code meets GDC 1 related to the quality assurance requirements for bolting 1" and less.

NuScale Response:

NuScale considers the quality standards as defined in the ASME Section III are technically adequate and are appropriate to apply to 1" and less, Class 1, 2 and 3 threaded fasteners in the NuScale design without modification or supplementation. As stated in NuScale response to RAI 9109, Question 06.06-1, NuScale will follow the ASME BPVC as required by 10 CFR 50 to ensure compliance with the GDC requirements specified in 10 CFR 50 Appendix A. Refer to NuScale response to RAI 9109, Quesiton 06.06-1 for the technical basis of this statement.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

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

eRAI No.: 9183
Date of RAI Issue: 10/13/2017

NRC Question No.: 03.13-3

DCD Tier 2, FSAR, Section 3.13, COL Item 3.13-1 states (emphasis added):

> A COL applicant that references the NuScale Power Plant design certification will provide an inservice inspection program for ASME Class 1, 2 and 3 threaded fasteners **or** describe the implementation program, including milestones, completion dates and expected conclusions. The program will identify the applicable edition and addenda of ASME BPVC, Section XI and ensure compliance with 10 CFR 50.55a.

The staff understands the COL Item to mean that a COL applicant is required to either provide an ISI program, **or** describe some type of implementation program that complies with ASME Code, Section XI and 10 CFR 50.55a. Given that ASME Code, Section XI provides requirements for an inservice inspection program, the staff is unsure of the intent of the "or" statement.

Please clarify the COL Item with what is meant by describing the "implementation program" and how a program would be different than a traditional inservice inspection program that complies with the requirements of ASME Code, Section XI and 10 CFR 50.55a.

If the term "implementation program" is not intended to be different than a traditional inservice inspection program that complies with the requirements of ASME Code, Section XI and 10 CFR 50.55a, then revise the COL item to remove the term. For example,

> A COL applicant that references the NuScale Power Plant design certification will provide an inservice inspection program for ASME Class 1, 2 and 3 threaded fasteners. The program will identify the applicable edition and addenda of ASME BPVC, Section XI and ensure compliance with 10 CFR 50.55a.

Ensure that DCD Tier 2, FSAR, Table 1.8-2, "Combined License Information Items," is also revised appropriately.

NuScale Response:

NuScale is in agreement that the term "implementation program" in COL Item 3.13-1 is not intended to be different than a traditional inservice inspection program. The wording in FSAR Tier 2, Section 3.13.2 referencing "implementation program" has been deleted.

Impact on DCA:

FSAR Tier 2, Section 3.13.2 and Table 1.8-2 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 02.04.13-1, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI-03.06.02-15, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.13-3, RAI 06.04-1, 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 10.03.06-1, RAI 10.04.07-3 RAI 10.04.10-2, 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 19-31

Table 1.8-2: Combined License Information Items

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL ~~Applicant~~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~~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~~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~~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~~applicant that references the NuScale Power Plant design certification will list additional site-specific P&IDs and legends as applicable.	1.7
COL Item 1.8-1:	A COL ~~Applicant~~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~~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~~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 any 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~~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~~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~~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~~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~~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, as applicable.	2.4

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

Item No.	Description of COL Information Item	Section
COL Item 3.11-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will submit a full description of the Environmental Qualification Program and milestones and completion dates for program implementation.	3.11
COL Item 3.11-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will develop the equipment qualification database and ensure equipment qualification record files are created for the structures, systems, and components that require environmental qualification.	3.11
COL Item 3.11-3:	A COL applicant that references the NuScale Power Plant design certification will implement an EQ operational program that incorporates the above aspects specific to the EQ of mechanical and electrical equipment.	3.11
COL Item 3.11-4:	A COL applicant that references the NuScale Power Plant design certification will ensure the Environmental Qualification Program cited in COL Item 3.11-1 includes a description of how equipment located in harsh conditions will be monitored and managed throughout plant life. This description will include methodology to ensure equipment located in harsh environments will remain qualified if the measured dose is higher than the calculated dose.	3.11
COL Item 3.12-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification may use a piping analysis program other than the programs listed in Section 3.12.4.1; however, the applicant will implement a benchmark program using the models for NuScale Power Plant standard design.	3.12
COL Item 3.12-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will confirm that the site-specific seismic response is within the parameters specified in Section 3.7. A COL applicant may perform a site-specific piping stress analysis in accordance with the methodologies described in this section, as appropriate.	3.12
COL Item 3.13-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide an inservice inspection program for ASME Class 1, 2 and 3 threaded fasteners~~ or describe the implementation program, including milestones, completion dates and expected conclusions~~. The program will identify the applicable edition and addenda of ASME BPVC, Section XI and ensure compliance with 10 CFR 50.55a.	3.13
COL Item 5.2-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification and uses a later Code edition or addenda other than American Society of Mechanical Engineers Boiler and Pressure Vessel Code 2013 will perform and document with a code reconciliation an American Society of Mechanical Engineers Design Report as required by American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III, Paragraph NCA-3554, "Modification of Documents and Reconciliation With Design Report."	5.2
COL Item 5.2-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide a certified Overpressure Protection Report in compliance with American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III, Subarticles NB-7200 and NC-7200 to demonstrate the reactor coolant pressure boundary and secondary system are designed with adequate overpressure protection features, including low temperature overpressure protection features.	5.2
COL Item 5.2-3:	~~A COL Applicant that references the NuScale Power Plant design certification will establish measures to control the on-site cleaning of RPV and pressure retaining components associated with the RCPB during construction.~~Not Used	5.2
COL Item 5.2-4:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will develop and implement a Strategic Water Chemistry Plan. The Strategic Water Chemistry Plan will provide the optimization strategy for maintaining primary coolant chemistry and provide the basis for requirements for sampling and analysis frequencies, and corrective actions for control of primary water chemistry consistent with the latest version of the Electric Power Research Institute Pressurized Water Reactor Primary Water Chemistry Guidelines.	5.2
COL Item 5.2-5:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will develop and implement a Boric Acid Control Program that includes: inspection elements to ensure the integrity of the reactor coolant pressure boundary components for subsequent service, the type of visual or other nondestructive inspections to be performed, and the required inspection frequency.	5.2

3.13.2 Inservice Inspection Requirements

Inservice Inspection for ASME Class 1, 2, and 3 threaded fasteners is in accordance with the ASME BPVC, Section XI (Reference 3.13-5) (see Table 3.13-2), as required by 10 CFR 50.55a, except where specific written relief has been granted by the NRC.

RAI 03.13-3

COL Item 3.13-1: A COL applicant that references the NuScale Power Plant design certification will provide an inservice inspection program for ASME Class 1, 2 and 3 threaded fasteners ~~or describe the implementation program, including milestones, completion dates and expected conclusions~~. The program will identify the applicable edition and addenda of ASME BPVC, Section XI and ensure compliance with 10 CFR 50.55a.

3.13.3 References

3.13-1 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, 2013 Edition, Section III, "Rules for Construction of Nuclear Facility Components," American Society of Mechanical Engineers.

3.13-2 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, 2013 Edition, Section II, "Materials," American Society of Mechanical Engineers.

3.13-3 A. R. McIlree, "Degradation of High Strength Austenitic Alloys X-750, 718 and A286 in Nuclear Power Systems," 1st International Symposium on Environmental Degradation of Materials in Nuclear Power Systems - Water Reactors, NACE, 1984.

3.13-4 U.S. Nuclear Regulatory Commission, “Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants,” NUREG-1339, June 1990.

3.13-5 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, 2013 Edition, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," American Society of Mechanical Engineers.

3.13-6 Electric Power Research Institute, “Boric Acid Corrosion Evaluation (BACE) Program, Phase - Task 1 Report,” TR-101108, Palo Alto, CA, December 1993.

3.13-7 Electric Power Research Institute, “Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Components in PWRs,” NP- 5985, Palo Alto, CA., August 1988.

3.13-8 Electric Power Research Institute, “Boric Acid Application Guidelines for Intergranular Corrosion Inhibition,” NP-5558, Palo Alto, CA, December 1987.

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Docket No. 52-048

eRAI No.: 9183
Date of RAI Issue: 10/13/2017

NRC Question No.: 03.13-4

Several threaded fasteners in the NuScale Design are manufactured out of SB-637 UNS N07718 (Alloy 718). DCD Tier 2, FSAR, Section 3.13.1.1 states:

> In order to improve SCC resistance, the bolting materials receive a final solution anneal in the range of 1800-1850 degrees F for one hour followed by a two-step aging treatment consisting of 8 hours at 1325 degrees F and 8 to 10 hours at 1150 degrees F. This heat treatment process provides better resistance to SCC and is within the limits of ASME Section II (Reference 3.13-2) material specification for Alloy 718.

ASME BPVC, Section II, Part B, Specification SB-637, Table 2 lists the heat treatments for N07718.

Alloy	Recommended Solution Treatment	Precipitation Hardening Treatment
N07718	1700 to 1850°F (924 to 1010°C), hold 1⁄2 h min, cool at rate equivalent to air cool or faster	1325 ± 25°F (718 ± 14°C), hold at temperature for 8 h, furnace cool to 1150 ± 25°F (621 ± 14°C), hold until total precipitation heat treatment time has reached 18 h, air cool

As written, the solution treatment in the DCD is within the allowable Code temperature range, but the DCD does not discuss the cooling method.

The DCD proposes a two-step aging process of "8 hours at 1325 degrees F and 8 to 10 hours at 1150 degrees F."

The Code states that the second step of the heat treatment should be held until the total heat treatment has reached 18 hours. The DCD states that the first heat treatment should be for 8 hours and the second step can be from 8 to 10 hours. Therefore, unless the maximum time is selected, the total heat treatment time does not sum up to 18 hours in accordance with the Code. The cooling methods are also not discussed in the DCD for the aging heat treatment.

Revise the DCD to match the allowed heat treatments within the Code, specifically the cooling methods and the total required heat treatment time.

NuScale Response:

FSAR Tier 2 Section 3.13.1.1 concerning Alloy 718 heat treatment description has been updated to match the allowed heat treatment wording in the code.

Impact on DCA:

FSAR Tier 2, Section 3.13.1 has been revised as described in the response above and as shown in the markup provided in this response.

(Reference 3.13-2) provides the material properties for threaded fasteners for ASME Class 1, 2, and 3 applications. The applicable criteria used for material selection for ASME Class 1, 2, and 3 threaded fasteners are listed in Table 3.13-1. Materials used for the threaded fasteners are selected for the associated environmental conditions for the lifetime of the plant. Only proven materials for the specific application and environment are used. Bolting material selection satisfies applicable requirements of EPRI TR-101108, "Boric Acid Corrosion Evaluation (BACE) Program, Phase - Task 1 Report," (Reference 3.13-6), EPRI NP-5985, "Boric Acid Corrosion of Carbon and Low-Alloy Steel Pressure-Boundary Components in PWRs," (Reference 3.13-7), and EPRI NP-5558-SL, "Boric Acid Application Guidelines for Intergranular Corrosion Inhibition," (Reference 3.13-8).

The reactor pressure vessel closure studs, nuts, and washers use SB-637 UNS N07718 (Alloy 718), instead of low alloy steels such a SA-540 Grade B23 or B24. The diameter of Alloy 718 threaded fasteners is 6 inches or less. The selection of Alloy 718 over traditional low alloy steels is to prevent general corrosion when the bolting is submerged during plant startup and shutdown process. Because of its resistance to general corrosion, the concerns addressed by RG 1.65 position 2(b) do not apply to Alloy 718. Alloy 718 is an austenitic, precipitation hardened, nickel-base alloy permitted for bolting materials by ASME BPVC Code Section lll (Reference 3.13-1), Subsection NB-2128.

Being a nonferrous material, the fracture toughness requirements of ASME B&PV Code, Section III (Reference 3.13-1), Subsection NB-2311 exempts Alloy 718 from fracture toughness test requirement in NB-2300. The minimum required room temperature yield strength of SB-637 Alloy 718 is 150 ksi, exceeding the 150 ksi maximum limit in RG 1.65 position 1(a)(i). Because Alloy 718 is nonferrous, it is not subject to the fracture toughness requirements in 10 CFR 50 Appendix G or RG 1.65. Hence, the concern addressed by RG 1.65 position 1(a)(i) is not applicable to Alloy 718.

RAI 03.13-4

Alloy 718 is resistant to stress corrosion cracking (SCC) when exposed to high temperature primary reactor coolant, although limited SCC was observed inside reactor vessel internals (Reference 3.13-3). However, SCC is unlikely for reactor vessel closure bolting because it will be submerged at a much lower temperature than reactor coolant temperature. In order to improve SCC resistance, ~~the bolting materials receive a final solution anneal in the range of 1800-1850 degrees F for one hour followed by a two-step aging treatment consisting of 8 hours at 1325 degrees F and 8 to 10 hours at 1150 degrees F~~the solution treatment temperature range prior to precipitation hardening treatment is restricted to 1800°F to 1850°F. Except for the more restrictive solution temperature range, the heat treatment is identical to SB-637 UNS N07718. This heat treatment process provides better resistance to SCC and is within the limits of ASME Section II (Reference 3.13-2) material specification for Alloy 718.

This same heat retreatment for the mitigation of SCC is applied to Alloy 718 threaded fasteners in all environments and applications where they are used in the NuScale design associated with Class 1, 2, and 3 pressure retaining joints. This includes Alloy 718 applications in low flow areas and low temperature systems.