RAIO-0718-60989

July 23, 2018

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. 232 (eRAI No. 9113) on the NuScale Design Certification Application

REFERENCES:

1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 232 (eRAI No. 9113)," dated September 21, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 232 (eRAI No.9113)," dated November 15, 2017
3. NuScale Power, LLC Response to NRC "Request for Additional Information No. 232 (eRAI No.9113)," dated July 18, 2018

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

The Enclosures to this letter contain NuScale's response to the following RAI Questions from NRC eRAI No. 9113:

- 03.06.03-2
- 03.06.03-9

The response to RAI Questions 03.03.03-1, 03.03.03-4, 03.03.03-5, 03.03.03-6, 03.03.03-7, 03.03.03-8,and 03.03.03-10 was previously provided in Reference 2. The response to RAI Questions 03.03.03-3 was previously provided in Reference 3. This completes all responses to eRAI 9113.

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 232 (eRAI No. 9113). 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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
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Marieliz Vera, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9113, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9113, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0718-60990

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9113, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9113, nonproprietary

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

eRAI No.: 9113
Date of RAI Issue: 09/21/2017

NRC Question No.: 03.06.03-2
FSAR Section 3.6.3.1.2 states that "The use of cold worked austenitic stainless steel is generally avoided, however, if used, the yield strength as determined by the 0.2 percent offset method does not exceed 90 ksi." Fabrication practices, for example the cold bending of small-diameter piping, can affect the material properties of the piping and potential make it more susceptible to stress corrosion cracking (SCC), raise the strength and lower the toughness. Provide clarification regarding whether any stainless steel (SS) piping systems will have cold bent piping which NuScale proposes to qualify for LBB. If it will be cold bent, state the magnitude of the strain induced from the cold bending. Please state if the cold-worked piping will be solution-annealed after bending. If not solution annealed then justify the magnitude of the cold-bending strain on SCC susceptibility. Also if the pipe material is to be left in the cold bent condition, determine how the toughness changes and revise the LBB analyses, if necessary. The limit-load evaluation for TP304 stainless steel is only applicable to solution annealed TP304.

NuScale Response:

If cold bending is used, the maximum strain that could be induced in MS and FW pipes is {{ }}$^{2(a),(c)}$. If the fracture toughness reduction affects the applicability of the limit load analysis methodology (determined by the DPZP screening parameter), the cold-worked pipes are followed by a solution annealing process, which is changed from the controlling material's yield strength approach stated in the existing FSAR. The statement of "the yield strength as determined by the 0.2 percent offset method does not exceed 90 ksi" has been replaced by this statement in FSAR Section 3.6.3.1.2:

> "the cold worked LBB pipes are followed by a solution annealing process if the fracture toughness reduction affects the applicability of the limit load analysis methodology."

Since solution annealing process is used after cold bending as necessary, the limit-load method is applicable in the MS and FW piping LBB calculations.

Impact on DCA:

The FSAR Tier 2, Section 3.6.3.1 has been revised as described in the response above and as shown in the markup provided with this response.

Stainless steel piping and components, such as letdown orifices, are potentially susceptible to erosion by cavitation under specific RCS flow conditions. Cavitation erosion has been observed in stainless steel piping in chemical and volume control systems of PWRs downstream of letdown orifices. Piping downstream of valves that significantly drop the pressure of the fluid in the system are also possible locations of cavitation erosion.

The main steam and feedwater piping inside the CNV do not have inline components that significantly decrease the pressure of the fluid in the piping in the direction of flow. Therefore, conditions conducive to fluid cavitation do not exist.

Based on the above discussion, erosion/corrosion induced wall thinning is not an issue for the main steam and feedwater piping subject to LBB.

3.6.3.1.2 Stress Corrosion Cracking

If any one of the following three conditions is present, stress corrosion-cracking (SCC) is possible. The three conditions are:

- There must be a corrosive environment.
- The material itself must be susceptible.
- Tensile stresses must be present in the material.

The main steam and feedwater piping is not susceptible to SCC because the piping is not exposed to a corrosive environment, the material is SCC resistant, and tensile stresses that could initiate SCC are not present.

The secondary water chemistry monitoring and control program described in Section 10.3.5 ensures that chloride, oxygen, fluoride, and sulfate levels do not cause SCC in austenitic stainless steel in the main steam and feedwater piping.

During reactor shutdown conditions, the outside surfaces of some piping inside the CNV are exposed to borated water. Minimizing the chloride levels in the water along with the low levels of oxygen in the water reduces the potential for SCC. The temperature of the water on the outside of the piping is maintained near room temperature, which prevents SCC initiation in conjunction with minimizing chlorides in solution. Water chemistry conditions during shutdown conditions are controlled to preclude SCC initiation from the outer surface of the piping, using water treatment methods discussed in Section 10.3.5.

RAI 03.06.03-2

SA-312 TP304/304L dual certified stainless steel is also resistant to SCC given adequate control of dissolved oxygen levels. The alloy contains 0.03 maximum weight percent carbon, which mitigates sensitization. The use of cold worked austenitic stainless steels is generally avoided; however, if used, the cold worked LBB pipes are followed by a solution annealing process if the fracture toughness reduction affects the applicability of the limit load analysis methodology.~~the yield strength as determined by the 0.2 percent offset method does not exceed 90 ksi.~~

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

eRAI No.: 9113
Date of RAI Issue: 09/21/2017

NRC Question No.: 03.06.03-9
The equations presented in FSAR Section 3.6.3.3 have been used to generate the SBAC Figures referenced in FSAR Section 3.6.3.4 showing normal operating (N) and maximum (N+SSE) stresses for LBB locations. Many of these graphs presented in Figures 3.6-23 through 3.6-32 are unusual in that the maximum (N+SSE) stresses are lower than the normal stresses for some cases. To assist the staff in understanding these graphs, please provide the following;

- Provide a table of stresses or forces and moments at the girth weld (node points) from the piping stress analysis and indicate which of these locations are used in the LBB analysis. In these tables, also identify the different stress components, i.e., thermal expansion, pressure, dead-weight, seismic/inertial, seismic/anchor motion, etc.
- The normal stress versus maximum stress plots shown Figure 3.6-23 to Figure 3.6-32 for various segments for MS and FW system show that there were some data points below 1:1 line indicating that N+SSE stresses are lower than normal stress. Please explain.

NuScale Response:

Subquestion 1:

The weld locations on main steam (MS) and feedwater (FW) lines are shown in Figures 1 and 2, respectively. All weld locations are included in the LBB analyses. Forces and moments at these locations are tabulated in Tables 1 and 2 for MS and FW, respectively. In these tables, loads are calculated based on the local Cartesian coordinate system at each weld location; Fa is axial force and Mr is resultant moment.

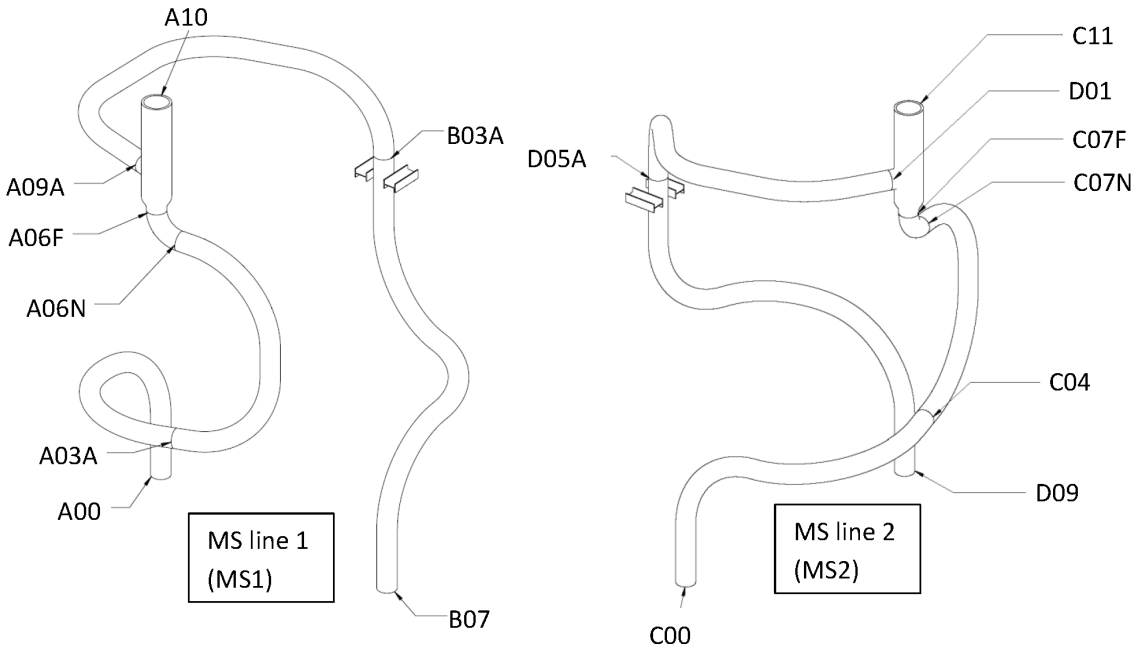

Figure 1: MS line weld locations

Table 1: MS line weld location forces and moments

MS1 Point	Load Combination	Fa (lbf)	Mr (ft-lbf)		MS2 Point	Load Combination	Fa (lbf)	Mr (ft-lbf)
{{								
								}}$^{2(a)(c)}$

{{								

}}2(a)(c)

Note (1): Thermal Expansion
(2): Seismic Anchor Motion
(3): Straight pipe side of the data: “F+” and “N-”; bent pipe side: “F-” and “N+”

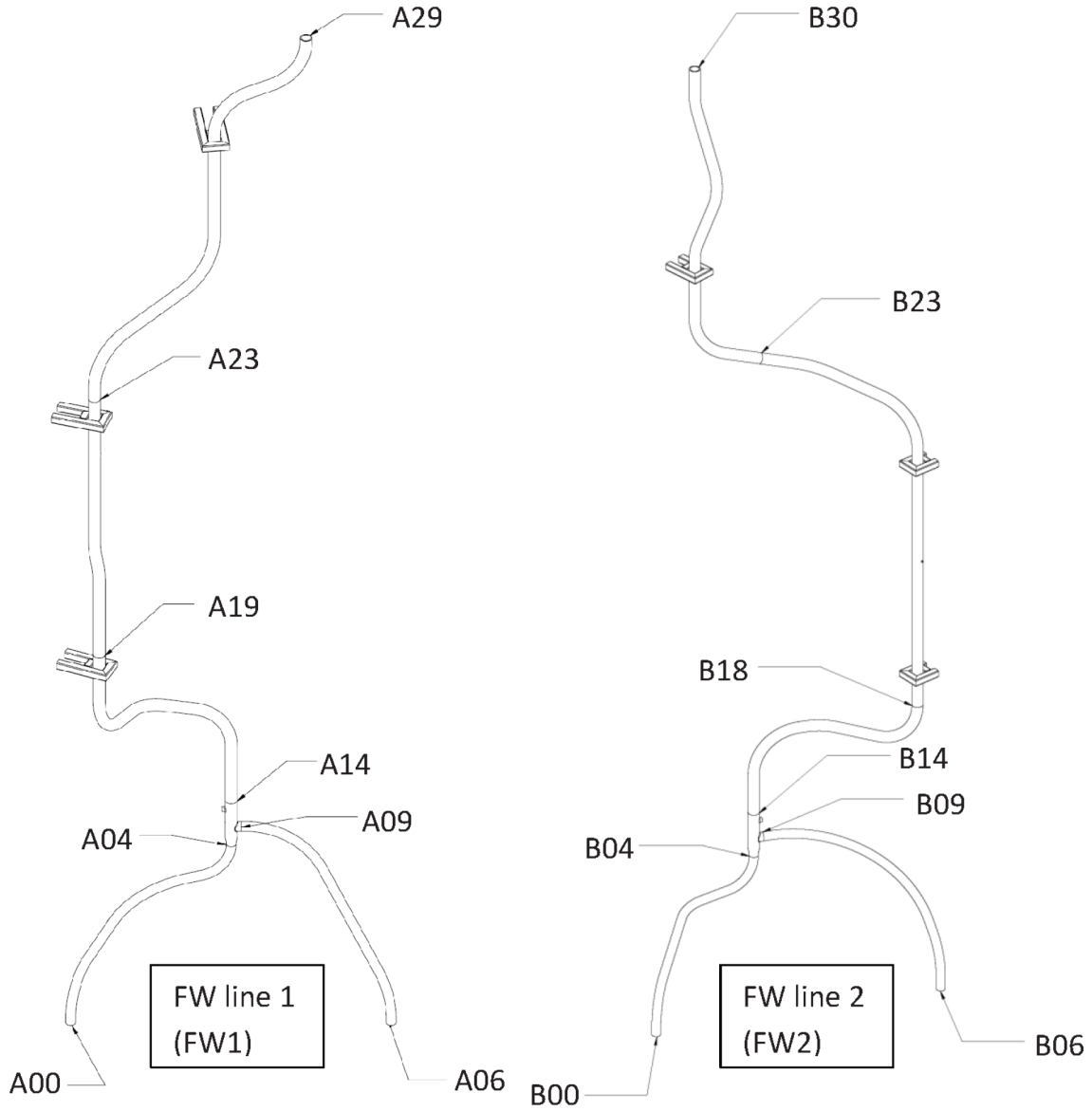

Figure 2: FW line weld locations

Table 2: FW line weld location forces and moments

FW1 Point	Load Combination	Fa (lbf)	Mr (ft-lbf)
{{			

FW2 Point	Load Combination	Fa (lbf)	Mr (ft-lbf)

}}$^{2(a)(c)}$

Subquestion 2:

The normal and maximum stresses shown in FSAR Figure 3.6-23 to Figure 3.6-32 are calculated based on normal loads and maximum loads, which are determined using Equations 3.6-6 and 3.6-8 in FSAR, respectively. The differences between normal loads and maximum loads are thermal and SSE loads. Thermal load is only included in normal load, while SSE load

is only included in maximum load. Therefore, when the thermal load is larger than the SSE load in a data point, its normal load would be larger than the maximum load.

Impact on DCA:

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

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0718-60990

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 and analyses by which NuScale evaluates it power module systems.

   NuScale has performed significant research and evaluation to develop a basis for this method and analyses 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 No. 232, eRAI No. 9113. 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 July 23, 2018.

Zackary W. Rad