RAIO-0218-58685

February 15, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 330 (eRAI No. 9271) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 330 (eRAI No. 9271)," dated January 08, 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 Enclosure to this letter contains NuScale's response to the following RAI Questions from NRC eRAI No. 9271:

- 12.02-21
- 12.02-22

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 Steven Mirsky at 240-833-3001 or at smirsky@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. 9271

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NuScale Response to NRC Request for Additional Information eRAI No. 9271

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

eRAI No.: 9271
Date of RAI Issue: 01/08/2018

NRC Question No.: 12.02-21

Regulatory Basis

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radiation exposures within the limits set forth in 10 CFR Part 20.

10 CFR 20.1101(b) and 10 CFR 20.1003, require the use of engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical. The DSRS Acceptance Criteria section of NuScale DSRS section 12.2, “Radiation Sources,’ states that the applications should contain the methods, models and assumptions used as the bases for all sources described in DCD Section 12.2. The DSRS Acceptance Criteria 12.3-12.4, “Radiation Protection Design Features,” states that the areas inside the plant structures, as well as in the general plant yard, should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified.

Background

NuScale DCD Tier 2, Revision 0 DCD Section 11.4.2.5.1 “Tanks,” regarding the Phase Separator Tanks (PSTs), states that there are two permanently installed PSTs that are provided to receive spent resins from the liquid radioactive waste (LRW) demineralizers and the chemical and volume control system (CVCS) deborating demineralizers.

DCD Tier 2, Revision 0 subsection 12.2.1.7, “Solid Radioactive Waste System,” states that the assumed values used to develop the solid radioactive waste system (SRWS) source terms are listed in Table 12.2-18. NuScale DCD Tier 2, Revision 0 Table 12.2-18: “Solid Radioactive Waste System Component Source Term Inputs,” list the dimensions of the Phase Separator Tanks (PST), including the height of 16.46’. DCD Table 12.2-19, “Solid Radioactive Waste System Component Source Terms – Radionuclide Content,” lists the radionuclide inventory of the PST. DCD Table 12.2-20: “Solid Radioactive Waste System Component Source Terms – Source Strengths,” provides the Phase Separator Tank (PST) gamma emission rate in photon/s. DCD Section 12.2 does not appear to contain any other information about the amount of radioactive material that can be present in the PST, and the sources of that material.

Based on information made available to the staff during the RPAC Chapter 12 Audit, the volume

of radioactive material in the PST occupies less than 1/10th of the height of the tank, as stated in the DCD. In addition, the model of the PST contained in the analytical package reviewed by the staff appears to be significantly different that the model described in DCD Table 12.2-18.

Key Issue 1:

The radionuclide concentrations listed in DCD subsection 12.2 are the basis of the information used to establish plant source terms. NuScale DSRS 12.2 Acceptance Criteria, states that all of the sources of radiation exposure to workers and members of the public (from contained sources) are to be identified, characterized, and considered in the design and operation of the facility. This section of the DSRS also states that unless described within other sections of the FSAR, source descriptions should include the methods, models, and assumptions used as the bases for all values provided in FSAR Section 12.2.

Question 1:

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions, with respect to the descriptions of the sources of radiation present in the facility, the staff requests that the applicant:

- Describe the sources of radioactive material contained in the PST, including the addition rate, source component and specific activity,
- Explain/justify the sources of material in the PST, as it relates to the volume and photon emission rates used in the analytical package,,
- Provide the methods, models and assumptions, used to develop the assumed radionuclide concentrations, and associated basis,
- As necessary, revise DCD Section 12.2 to include the information needed to describe the source contained in the tank,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

As described in FSAR Section 11.4.2.5.1, the two phase separator tanks (PST) receive spent resins from the five liquid radioactive waste system (LRWS) demineralizers and the chemical and volume control system (CVCS) deborating demineralizers, and have a capacity of 5,000 gallons each. To ensure there is sufficient volume capacity in the design, the change-out frequency is conservatively assumed to be once per year for the LRWS demineralizers. The volumes and frequencies of spent resins transferred to the PST are shown in the following table:

Demineralizer	Volume (ft^3)	Frequency ($year^{-1}$)	Annual Volume (ft^3/year)
LWRS Cation	20	1	20
LWRS Anion	20	1	20
LRWS Mixed Bed	26.7	1	26.7
LRWS Cesium	20	1	20
LRWS Antimony	20	1	20
CVCS Deborating	10	6	60
		TOTAL =	**167 (~170)**

FSAR Table 11.4-3 has been revised to reflect this total annual volume of 170 ft^3 (see the FSAR markup provided with NuScale's response to RAI 12.02-7 (eRAI 9267)).

For purposes of developing a conservative radiological source term, the CVCS deborating resins were not included in the PST source term volume because the deborating demineralizers are only used for a brief time at the end of an operating cycle and would dilute and self-shield the LRWS spent resins in the PST. In addition, it was also assumed that the two-year accumulation of radionuclides is collected in each demineralizer without being changed out. This results in the same two-year accumulation of radionuclides residing in one half the volume of spent resin shown above (i.e., less self-shielding). In FSAR Table 12.2-18, the PST source term dimensions have been revised to reflect a 10-ft diameter and a height of 1.36 ft, which represents a volume of 107 ft^3 (167 ft^3 minus 60 ft^3). The LRWS demineralizers are modeled to operate for two years assuming a design basis source term. At the end of this two-year period, the spent resins are transferred to a PST.

Prior to the receipt of this RAI, the SRST and PST source dimensions in FSAR Table 12.2-18 were identified as being in error. In addition, the PST activity content provided in FSAR Table 12.2-19 was also discovered to be in error. These errors have been corrected and the associated FSAR markup is included with this response. The PST photon strength source term information in FSAR Table 12.2-20 is unaffected and remains unchanged.

Impact on DCA:

Table 12.2-18 and 12.2-19 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 12.02-2

Table 12.2-18: Solid Radioactive Waste System Component Source Term Inputs

Model Parameter	Value
Spent resin storage tank	
Contents	Spent resins from CVCS and PCUS
Geometry	vertical cylinder
Source dimensions of vessel	diameter=~~10.53~~12.0'; height=~~24.56~~7.94'
Shield thickness of steel shell	0.25"
Phase separator tank	
Inputs	Spent resins from LRWS
Geometry	vertical cylinder
Source dimensions of vessel	diameter=~~8.81~~10.0'; height=~~16.46~~1.36'
Shield thickness of steel shell	0.25"
High Integrity Container (HIC):	
Inputs	Spent resins from SRST
Geometry	Vertical cylinder
Source dimensions of container	Diameter=4.92' Height=5.83'
Array of HICs	One layer of five Class B/C HICs

RAI 12.02-2

Table 12.2-19: Solid Radioactive Waste System Component Source Terms - Radionuclide Content

Isotope	SRST (Ci)	PST (Ci)	HIC (Ci)
Kr83m	4.12E-06	~~1.42E-09~~1.66E-09	1.69E-09
Kr85	-	~~2.09E-12~~7.93E-12	-
Xe131m	1.50E-02	~~7.18E-06~~1.55E-05	1.87E-21
Xe133m	2.00E-10	~~4.75E-07~~1.75E-06	-
Xe133	1.21E-04	~~3.10E-05~~1.11E-04	-
Xe135m	-	~~7.17E-14~~5.09E-13	-
Xe135	-	~~2.71E-10~~1.57E-09	-
Br82	4.54E-15	~~2.18E-08~~8.92E-08	-
I129	1.64E-03	~~2.04E-09~~7.65E-09	2.06E-04
I130	-	~~1.81E-10~~9.31E-10	-
I131	1.52E-01	~~4.76E-04~~1.04E-03	-
I132	1.36E-06	~~7.37E-06~~1.97E-05	-
I133	-	~~5.57E-07~~2.30E-06	-
I135	-	~~4.17E-13~~2.96E-12	-
Rb86	3.25E-02	~~1.35E-04~~1.58E-04	1.29E-14
Cs132	2.70E-06	~~6.64E-07~~7.76E-07	-
Cs134	6.53E+03	~~5.39E-01~~6.28E-01	4.24E+02
Cs136	3.03E-01	~~3.28E-03~~3.83E-03	2.00E-18
Cs137	6.98E+03	~~4.45E-01~~5.19E-01	8.34E+02
P32	2.19E-07	~~8.32E-11~~2.16E-10	2.62E-23
Co57	2.46E-06	~~1.21E-11~~3.13E-11	5.01E-08
Ni63	8.82E+01	~~1.39E-03~~1.73E-03	1.09E+01
Sr89	8.12E-02	~~2.96E-06~~6.92E-06	5.85E-07
Sr90	2.56E+00	~~5.67E-06~~1.47E-05	3.06E-01
Sr91	-	~~2.14E-13~~7.21E-13	-
Y90	2.56E+00	~~5.67E-06~~1.47E-05	3.06E-01
Y91m	-	~~1.38E-13~~4.64E-13	-
Y91	1.68E-02	~~4.24E-07~~1.10E-06	4.58E-07
Y93	-	~~8.79E-14~~3.19E-13	-
Zr95	6.03E+00	~~2.45E-04~~3.06E-04	3.40E-04
Zr97	-	~~1.82E-11~~5.68E-11	-
Nb95	8.33E+00	~~2.55E-04~~3.18E-04	7.50E-04
Mo99	3.15E-07	~~1.28E-05~~3.43E-05	-
Tc99m	3.04E-07	~~1.23E-05~~3.31E-05	-
Ru103	1.17E-02	~~5.22E-07~~1.35E-06	5.08E-09
Ru105	-	~~1.75E-19~~1.09E-18	-
Ru106	6.28E-01	~~2.54E-06~~6.59E-06	2.08E-02
Rh103m	1.15E-02	~~5.16E-07~~1.34E-06	5.03E-09
Rh105	9.87E-16	~~8.14E-09~~2.27E-08	-
Rh106	6.28E-01	~~2.54E-06~~6.59E-06	2.08E-02
Ag110m	1.24E+02	~~9.00E-07~~1.13E-06	2.15E+00
Sb124	5.05E-05	~~1.71E-10~~4.41E-10	1.75E-09
Sb125	2.67E-02	~~1.04E-08~~2.70E-08	2.04E-03
Sb127	1.98E-09	~~1.95E-10~~5.17E-10	-

Table 12.2-19: Solid Radioactive Waste System Component Source Terms - Radionuclide Content (Continued)

Isotope	SRST (Ci)	PST (Ci)	HIC (Ci)
Te125m	6.41E-02	~~1.50E-06~~3.86E-06	5.02E-04
Te127m	8.05E-01	~~9.22E-06~~2.39E-05	1.09E-03
Te127	7.89E-01	~~9.03E-06~~2.34E-05	1.07E-03
Te129m	1.35E-01	~~7.76E-06~~2.01E-05	7.11E-09
Te129	8.52E-02	~~4.90E-06~~1.27E-05	4.49E-09
Te131m	1.72E-15	~~8.68E-08~~2.44E-07	-
Te131	4.51E-16	~~2.28E-08~~6.40E-08	-
Te132	1.32E-06	~~7.15E-06~~1.91E-05	-
Ba137m	6.61E+03	~~4.21E-01~~4.91E-01	7.90E+02
Ba140	1.49E-03	~~7.99E-07~~2.07E-06	2.96E-21
La140	1.71E-03	~~9.05E-07~~2.35E-06	3.41E-21
Ce141	5.59E-03	~~3.39E-07~~8.79E-07	1.80E-10
Ce143	1.83E-17	~~8.96E-10~~2.52E-09	-
Ce144	4.69E-01	~~2.23E-06~~5.78E-06	1.04E-02
Pr143	2.74E-04	~~1.21E-07~~3.15E-07	5.62E-21
Pr144	4.69E-01	~~2.23E-06~~5.78E-06	1.04E-02
Np239	2.49E-10	~~1.06E-07~~2.88E-07	-
Na24	-	~~8.86E-08~~2.32E-07	-
Cr51	1.12E+01	~~3.00E-06~~3.75E-06	2.60E-08
Mn54	1.81E+02	~~3.86E-05~~4.79E-05	4.66E+00
Fe55	2.74E+02	~~4.95E-03~~6.14E-03	2.09E+01
Fe59	2.59E+00	~~1.27E-04~~1.58E-04	4.96E-06
Co58	7.03E+02	~~2.25E-03~~2.56E-03	8.33E-02
Co60	1.46E+02	~~3.67E-04~~4.57E-04	1.41E+01
W187	1.21E-17	~~1.74E-07~~3.29E-07	-
Zn65	4.54E+01	~~1.12E-03~~1.39E-03	7.52E-01
C14	4.68E+02	~~1.01E-03~~2.62E-03	5.85E+01

Note: Assumes the plant consists of 12 NPMs operating on a two-year refueling cycle.

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

eRAI No.: 9271
Date of RAI Issue: 01/08/2018

NRC Question No.: 12.02-22

The Regulatory Basis and Background are in RAI-9271 Question 31003

Key Issue 2:

The DSRS Acceptance Criteria 12.3-12.4, “Radiation Protection Design Features,” states that the areas inside the plant structures, as well as in the general plant yard, should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified. The source size, magnitude and configuration are elements of the model used to establish the effects of the contained sources on areas adjacent to the contained source. Because the geometry of the source described in the DCD does not appear to model the analytical method used to evaluate the radiation effects, the staff is unable to assess the validity of the radiation zone designations.

Question 2:

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions, with respect to the descriptions of the sources of radiation present in the facility and the resultant radiation zone designations, the staff requests that the applicant:

- Explain/justify the parameters of the dose rate calculation model used to describe the PST,
- As necessary, revise DCD Section Table 12.2-18 to include the information needed to describe the tank,
- As necessary, revise DCD Section 12.3-12.4 radiation zone figures,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

See the response to RAI 12.02-21.

Impact on DCA:

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