NuScale Power

RAIO-0717-54810

July 10, 2017

Docket No. 52-048

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

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 55 (eRAI No. 8860) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 55 (eRAI No. 8860)," dated June 07, 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. 8860:

- 12.02-2

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. 8860

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8860

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

eRAI No.: 8860
Date of RAI Issue: 06/07/2017

NRC Question No.: 12.02-2

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. 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 this part as is practical. 10 CFR Part 50 Appendix A, criterion 4 requires applicants to identify the environmental conditions, including radiation, associated with normal operation. 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.

NuScale DCD Tier 2, Revision 0 Figure 12.3-2a,"Radioactive Waste Building Radiation Zone Map - 71' Elevation," shows that the "Class A/B/C HICS Storage Area," (Room 030-034 per DCD Figure 1.2-28,"Radioactive Waste Building 71'-0" Elevation",) as a Radiation Zone VII. DCD Tier 2 Revision 0 Table 12.3-1,"Normal Operation Radiation Zone Designations," shows that areas designated as radiation zone VII have dose rates ≥ 500 Rad/hr, with no upper limit specified.

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. DCD subsection 12.2.1.7 also states that Table 12.2-19, "Solid Radioactive Waste System Component Source Terms – Radionuclide Content," lists the radionuclide inventory of the major SRWS components and Table 12.2-20, "Solid Radioactive Waste System Component Source Terms – Source Strengths" lists the SRWS component source strengths. However, there is no mention of the "Class A/B/C HICS Storage Area," in DCD Table 12.2- 18, Table 12.2-19 or Table 12.2-20.

The radionuclide concentrations listed in DCD subsection 12.2 are the basis of the information used to establish plant source terms, consistent with NuScale DSRS 12.2 Acceptance Criteria, which states that all of the sources of radiation exposure to workers and members of the public (from contained sources) are 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. These acceptance criteria are consistent with the relevant requirements of 10 CFR Part 20 and 10 CFR Part 50 and 10 CFR Part 52. Therefore, the staff is requesting the applicant to revise and update section 12.2 of the NuScale DCD to:

- Provide the radionuclide content of the material used to classify the "Class A/B/C HICS Storage Area," (Room 030-034) as a radiation zone VII,
- Provide the methods, models and assumptions, used to develop the assumed radionuclide concentrations, and associated basis
- Provide the dimensions and configuration (e.g., single layer of storage) of packages stored within the room,
- Identify whether drums from the drum dryer facility are allowed to be stored within this area,

OR

- Provide the specific alternative approaches used and the associated justification.

NuScale Response:

FSAR Section 12.2.1.7 has been revised to explain the assumptions used to develop the radiological source term assumed to be within the Class A/B/C HIC Storage Area (Room 030-034). FSAR Tables 12.2-18, 12.2-19 and 12.2-19 have been revised to include the source term parameters for one dewatered HIC loaded with Class B/C spent resins. The shielding design assumes that there are five HICs loaded with Class B/C spent resins from the Spent Resin Storage Tank, which has been decayed for one fuel cycle (~2 years). This is considered conservative because it assumes all twelve reactor modules are simultaneously operating with the design basis failed fuel fraction for two years while the spent resin was collected in the Spent Resin Storage Tank. Five HICs represents an amount of Class B/C spent resin estimated to be collected for one year. This provides sufficient time to conduct offsite shipments to disposal facilities. The Class A/B/C HIC Storage Area is not an occupied room. Operational plant programs are provided to control the amount of radioactive material in the Class A/B/C HIC Storage Area to limit the radiation levels in the surrounding areas to be compliant with the designated radiation zones.

One HIC source term is assumed to have cylindrical dimensions of 59" diameter, 70" height, and a volume of 112 cubic feet. The five HICs in the Class A/B/C HIC Storage Area are assumed to be arranged in a single layer on the floor near the middle of the room.

Drums from the drum dryer facility are not stored in the Class A/B/C HIC Storage Area, but rather are stored in the Mixed/Chemical Waste Drum Storage Area (Room #030-007).

Impact on DCA:

FSAR Section 12.2.1.7, Table 12.2-18, Table 12.2-19 and Table 12.2-20 been revised as described in the response above and as shown in the markup provided in this response.

gaseous radioactive waste system (GRWS) comes primarily from the LRWS degasifier, which strips the dissolved gases from the primary coolant that enters the degasifier from the CVCS. The gases from the degasifier are sent to the GRWS for conditioning and processing. Table 12.2-15 lists the assumed values pertaining to the GRWS source geometries and Table 11.3-1 describes the GRWS processing parameters. The GRWS component source terms are provided in Table 12.2-16 and the source strengths are provided in Table 12.2-17.

12.2.1.7 Solid Radioactive Waste System

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The solid radioactive waste system (SRWS) handles solid radioactive waste from various waste streams, as described in Section 11.4. The waste inputs to the SRWS components are collected, resulting in a radionuclide source term for the SRWS components. The assumed values used to develop the SRWS component source terms are listed in Table 12.2-18. Table 12.2-19 lists the radionuclide inventory of the major SRWS components and Table 12.2-20 lists the SRWS component source strengths. As described in Section 11.4, there is storage space provided in the Radioactive Waste Building for processed waste packages that contain spent filters, dewatered resins, and other solid wastes. For shielding design purposes, it is assumed that the Class A/B/C HIC Storage Area contains five HICs loaded with Class B/C dewatered spent resins from the Spent Resin Storage Tank, which has been decayed for approximately two years (one fuel cycle). Storage areas are shielded to limit the radiation level to be compliant with the designated radiation zone.

12.2.1.8 Reactor Pool Water

The reactor pool is housed within the RXB and contains up to 12 NPMs, which are partially immersed in the reactor pool water. Because the spent fuel pool communicates with the reactor pool through the weir wall, radionuclides are mixed with the spent fuel pool water volume. There are two sources of radioactive material considered for the reactor pool water: primary coolant released during refueling outages and direct neutron activation. Because of the low power and low temperatures in the spent fuel pool, the radionuclide contribution to the pool water from defective fuel assemblies in the storage racks is considered negligible. The primary source of radionuclides in the reactor pool comes from the primary coolant system when an NPM is disassembled in the reactor pool during outages. During refueling outages, after the primary coolant crud burst is cleaned by the CVCS, the small remaining quantities of radionuclides are released into the pool water during NPM disassembly. The other major input assumptions for the pool water source term are provided in Table 12.2-9.

The radionuclide contribution resulting from neutron activation of the reactor pool water contents is not significant due to the reduced neutron flux in the reactor pool water. The neutron flux at the outside edge of the containment vessel was calculated to be approximately six orders of magnitude less than the average neutron flux in the core, and continues to quickly decrease in the reactor pool's borated water. The small amount of neutron activation products in the reactor pool water was calculated to be insignificant compared to the amount of primary coolant radionuclides released to the reactor pool water during refueling outages. The reactor pool and RCS water chemistry

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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'; height=24.56'
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'; height=16.46'
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

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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	1.69E-09
Kr85	-	2.09E-12	-
Xe131m	1.50E-02	7.18E-06	1.87E-21
Xe133m	2.00E-10	4.75E-07	-
Xe133	1.21E-04	3.10E-05	-
Xe135m	-	7.17E-14	-
Xe135	-	2.71E-10	-
Br82	4.54E-15	2.18E-08	-
I129	1.64E-03	2.04E-09	2.06E-04
I130	-	1.81E-10	-
I131	1.52E-01	4.76E-04	-
I132	1.36E-06	7.37E-06	-
I133	-	5.57E-07	-
I135	-	4.17E-13	-
Rb86	3.25E-02	1.35E-04	1.29E-14
Cs132	2.70E-06	6.64E-07	-
Cs134	6.53E+03	5.39E-01	4.24E+02
Cs136	3.03E-01	3.28E-03	2.00E-18
Cs137	6.98E+03	4.45E-01	8.34E+02
P32	2.19E-07	8.32E-11	2.62E-23
Co57	2.46E-06	1.21E-11	5.01E-08
Ni63	8.82E+01	1.39E-03	1.09E+01
Sr89	8.12E-02	2.96E-06	5.85E-07
Sr90	2.56E+00	5.67E-06	3.06E-01
Sr91	-	2.14E-13	-
Y90	2.56E+00	5.67E-06	3.06E-01
Y91m	-	1.38E-13	-
Y91	1.68E-02	4.24E-07	4.58E-07
Y93	-	8.79E-14	-
Zr95	6.03E+00	2.45E-04	3.40E-04
Zr97	-	1.82E-11	-
Nb95	8.33E+00	2.55E-04	7.50E-04
Mo99	3.15E-07	1.28E-05	-
Tc99m	3.04E-07	1.23E-05	-
Ru103	1.17E-02	5.22E-07	5.08E-09
Ru105	-	1.75E-19	-
Ru106	6.28E-01	2.54E-06	2.08E-02
Rh103m	1.15E-02	5.16E-07	5.03E-09
Rh105	9.87E-16	8.14E-09	-
Rh106	6.28E-01	2.54E-06	2.08E-02
Ag110m	1.24E+02	9.00E-07	2.15E+00
Sb124	5.05E-05	1.71E-10	1.75E-09
Sb125	2.67E-02	1.04E-08	2.04E-03
Sb127	1.98E-09	1.95E-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	5.02E-04
Te127m	8.05E-01	9.22E-06	1.09E-03
Te127	7.89E-01	9.03E-06	1.07E-03
Te129m	1.35E-01	7.76E-06	7.11E-09
Te129	8.52E-02	4.90E-06	4.49E-09
Te131m	1.72E-15	8.68E-08	-
Te131	4.51E-16	2.28E-08	-
Te132	1.32E-06	7.15E-06	-
Ba137m	6.61E+03	4.21E-01	7.90E+02
Ba140	1.49E-03	7.99E-07	2.96E-21
La140	1.71E-03	9.05E-07	3.41E-21
Ce141	5.59E-03	3.39E-07	1.80E-10
Ce143	1.83E-17	8.96E-10	-
Ce144	4.69E-01	2.23E-06	1.04E-02
Pr143	2.74E-04	1.21E-07	5.62E-21
Pr144	4.69E-01	2.23E-06	1.04E-02
Np239	2.49E-10	1.06E-07	-
Na24	-	8.86E-08	-
Cr51	1.12E+01	3.00E-06	2.60E-08
Mn54	1.81E+02	3.86E-05	4.66E+00
Fe55	2.74E+02	4.95E-03	2.09E+01
Fe59	2.59E+00	1.27E-04	4.96E-06
Co58	7.03E+02	2.25E-03	8.33E-02
Co60	1.46E+02	3.67E-04	1.41E+01
W187	1.21E-17	1.74E-07	-
Zn65	4.54E+01	1.12E-03	7.52E-01
C14	4.68E+02	1.01E-03	5.85E+01

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

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Table 12.2-20: Solid Radioactive Waste System Component Source Terms - Source Strengths

Energy Group	Energy Boundary (MeV)			Spent Resin Storage Tank (photon/s)	Phase Separator Tank (photon/s)	High Integrity Container (HIC) (photon/s)
1	1.00E-02	-	2.00E-02	1.44E+12	1.17E+08	1.31E+11
2	2.00E-02	-	3.00E-02	8.13E+11	6.30E+07	6.88E+10
3	3.00E-02	-	4.50E-02	1.79E+13	1.38E+09	2.02E+12
4	4.50E-02	-	6.00E-02	3.84E+11	3.10E+07	3.45E+10
5	6.00E-02	-	7.00E-02	1.73E+11	2.09E+07	1.54E+10
6	7.00E-02	-	7.50E-02	7.20E+10	5.79E+06	6.42E+09
7	7.50E-02	-	1.00E-01	2.60E+11	3.04E+07	2.29E+10
8	1.00E-01	-	1.50E-01	2.33E+11	1.96E+07	1.97E+10
9	1.50E-01	-	2.00E-01	1.21E+11	3.19E+07	9.74E+09
10	2.00E-01	-	2.60E-01	1.26E+11	1.12E+07	8.65E+09
11	2.60E-01	-	3.00E-01	2.58E+10	1.95E+07	1.91E+09
12	3.00E-01	-	4.00E-01	1.23E+11	9.72E+07	4.76E+09
13	4.00E-01	-	4.50E-01	1.81E+11	3.45E+05	3.41E+09
14	4.50E-01	-	5.10E-01	3.54E+12	3.42E+08	2.30E+11
15	5.10E-01	-	5.12E-01	7.80E+12	2.97E+07	1.87E+09
16	5.12E-01	-	6.00E-01	5.84E+13	5.62E+09	3.80E+12
17	6.00E-01	-	7.00E-01	4.49E+14	3.77E+10	4.11E+13
18	7.00E-01	-	8.00E-01	2.33E+14	2.22E+10	1.50E+13
19	8.00E-01	-	9.00E-01	4.51E+13	1.17E+09	8.82E+11
20	9.00E-01	-	1.00E+00	1.56E+12	1.73E+05	2.70E+10
21	1.00E+00	-	1.20E+00	1.35E+13	8.00E+08	1.01E+12
22	1.20E+00	-	1.33E+00	2.88E+12	3.93E+07	2.74E+11
23	1.33E+00	-	1.44E+00	1.09E+13	6.99E+08	7.38E+11
24	1.44E+00	-	1.50E+00	1.92E+11	1.79E+04	3.34E+09
25	1.50E+00	-	1.57E+00	6.71E+11	1.70E+05	1.16E+10
26	1.57E+00	-	1.66E+00	1.18E+09	8.30E+04	1.97E+07
27	1.66E+00	-	1.80E+00	1.31E+11	4.79E+05	2.97E+07
28	1.80E+00	-	2.00E+00	8.02E+08	1.45E+04	1.42E+07
29	2.00E+00	-	2.15E+00	5.79E+07	6.07E+03	1.16E+06
30	2.15E+00	-	2.35E+00	1.84E+08	4.77E+03	8.75E+06
31	2.35E+00	-	2.50E+00	1.48E+07	2.00E+03	4.67E+05
32	2.50E+00	-	2.75E+00	5.00E+06	7.87E+03	9.68E+04
33	2.75E+00	-	3.00E+00	1.22E+06	4.18E+03	3.82E+04
34	3.00E+00	-	3.50E+00	4.21E+05	2.83E+01	1.34E+04
35	3.50E+00	-	4.00E+00	1.68E+02	6.55E+00	5.57E+00
36	4.00E+00	-	4.50E+00	3.46E-08	7.19E-02	4.33E-09
37	4.50E+00	-	5.00E+00	1.74E-08	-	2.17E-09
38	5.00E+00	-	5.50E+00	8.74E-09	-	1.09E-09
39	5.50E+00	-	6.00E+00	4.39E-09	-	5.49E-10
40	6.00E+00	-	6.50E+00	2.21E-09	-	2.76E-10
41	6.50E+00	-	7.00E+00	1.11E-09	-	1.39E-10
42	7.00E+00	-	7.50E+00	5.58E-10	-	6.98E-11
43	7.50E+00	-	8.00E+00	2.81E-10	-	3.51E-11

Table 12.2-20: Solid Radioactive Waste System Component Source Terms - Source Strengths (Continued)

Energy Group	Energy Boundary (MeV)			Spent Resin Storage Tank (photon/s)	Phase Separator Tank (photon/s)	High Integrity Container (HIC) (photon/s)
44	8.00E+00	-	1.00E+01	2.55E-10	-	3.19E-11
45	1.00E+01	-	1.20E+01	8.52E-12	-	1.06E-12
46	1.20E+01	-	1.40E+01	-	-	-
47	1.40E+01	-	2.00E+01	-	-	-
Total				8.48E+14	7.04E+10	6.54E+13

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