August 14, 2017

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. 74 (eRAI No. 8915) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 74 (eRAI No. 8915)," dated June 28, 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. 8915:

- 05.02.05-5

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,

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8915

**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 8915

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

**eRAI No.:** 8915
**Date of RAI Issue:** 06/28/2017

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**NRC Question No.:** 05.02.05-5

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.
GDC 30, "Quality of reactor coolant pressure boundary," states, in part, "[M]eans shall be provided for detecting and, to the extent practical, identifying the location of the source of reactor coolant leakage."
RG 1.45, Revision 1, Regulatory Positions C.2.3 provide guidance on leakage detection systems:

> "In addition to the monitoring systems detailed in the technical specifications, the plant should use other systems to detect and monitor for leakage, even if it does not have the capabilities specified in Regulatory Position C.2.2. These **supplemental instruments/methods** may include, but are not limited to, the following:
>
> (a) monitoring airborne gaseous radioactivity,
> (b) monitoring the humidity of the containment,
> (c) monitoring the temperature of the containment,
> (d) monitoring the pressure of the containment,
> (e)monitoring acoustic emission, and
> (f) ) conducting video surveillance."

In addition, RG 1.45, Section B, Subject "Methods for Monitoring Leakage and Identifying Its Source," states the following to explain the function of these **supplemental instruments/methods**:

> "Effective methods for monitoring (including detecting) any leakage and **locating its source** are important…
>
> … Because of the need **to identify the source of leakage** to assess its safety significance,

plants should install monitoring systems to assist in locating the source of leakage during reactor operation. Plants can accomplish this, in part, by installing a number of instruments throughout containment and monitoring the response of each of these instruments to leakage. An instrument that is closer to a leak is likely to respond sooner than an instrument that is further away, assuming that the two instruments have similar capabilities (e.g., sensitivity). …"

The staff reviewed FSAR Tier 2, Section 5.2.5, "Reactor Coolant Pressure Boundary Leakage Detection," and Section 9.3.6, "Containment Evacuation System and Containment Flooding and Drain System," and found information about the containment evacuation system (CES) condensate water level and containment pressure, which are used for plant Technical Specifications for leakage detection. Other than a brief discussion of CES gaseous discharge radioactivity monitoring to identify the source of leakage, there is basically no further discussion about these "**supplemental instruments/methods"** for identifying the location and source of leakage. It is not clear why even containment temperature and containment humidity are not discussed for satisfying the above guidance.
The applicant is requested to provide the information, to the extent practical, regarding the supplemental instruments/methods for identifying the location of the source of reactor coolant leakage.

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**NuScale Response:**

The methods for leakage monitoring and detection listed in Regulatory Guide (RG) 1.45 are discussed below. In addition to those methods, two additional methods not covered in the RG 1.45 list are provided as methods to determine leakage source. There is no method within the NuScale design to identify exact location of the leakage during power operation, only source of leakage.

(a) Monitoring airborne gaseous radioactivity: The containment evacuation system (CES) has the capability to monitor radioactivity. The CES allows for both liquid and gaseous sampling of effluent removed from the containment (CNV). The liquid effluent is sampled using a grab sampler connected to the drain of the CES sample vessel. The grab sampler allows for samples to be taken and analyzed in the laboratory. The gaseous effluent is sent to the process sampling system sample panel for continuous analysis and collection of gas grab samples if needed. Using the different radioisotope characteristics of systems, the location of a leak could be determined. FSAR Section 11.5 provides discussion on the use of radioisotopes to aid in determining the source of leakage.

(b) Monitoring the humidity of the containment: CES maintains the CNV atmosphere below saturation pressure, as a result monitoring for humidity to identify the location of a leak is not practical to identify the location of a leak. Water vapor removed from the CNV using the CES vacuum pumps is condensed and collected in the CES sample vessel. The CES sample vessel uses vessel level instrumentation to detect and quantify leak rates into the CNV.

(c) Monitoring the temperature of the containment: The containment does include temperature monitors that would provide an indication of leakage. However due to the characteristics of containment (i.e. size and operating pressure) using temperature as a means to detect location of a leak is not practical. With containment held at a vacuum, convective heat transfer is much less pronounced, thus if a temperature element was installed near a valve, the temperature probe would be more influenced by conductive and radiative heat transfer from the nearby reactor pressure vessel. Unless the leak is flowing directly past the temperature element, it will likely go undetected.

(d) Monitoring the pressure of the containment: Leakage rates of consequence into containment would cause a rise in containment pressure. Excessive leakage into containment would ultimately result in a trip when the containment pressure exceeded the setpoint. While containment pressure is an indication of leakage, pressure is not a viable method to detect the location of the leak.

(e) Monitoring acoustic emission: The NuScale design does not include provisions to monitor acoustic emission. Monitoring acoustic emission would not be practical as sound is measured through pressure waves in a fluid medium such as air or water. As the containment vessel is held at a vacuum pressure, pressure waves cannot physically travel throughout the containment vessel atmosphere. The containment volume/area is much smaller than existing containment systems and is subject to environmental conditions not expected in existing designs, thus, added any acoustic emission equipment would not be practical.

(f) Conducting video surveillance: The NuScale design does not include video surveillance monitoring of containment. The containment volume/area is much smaller than existing containment systems and is subject to environmental conditions not expected in existing designs. Video surveillance is not practical.

Additional Methods:

- Chemistry analysis: Analysis of samples as described in Section 9.3.2.2.1 and 11.5.2.2.7 could be used to provide information on the source of leakage. Tracer gases could be injected into the various systems to aid in isolating the source of the leakage. The NuScale containment and CES design is uniquely suited to efficiently perform this process. The sources of potential leakage into containment are limited and include: reactor component cooling water system, the reactor coolant system, feedwater system, main steam system, reactor pool water, or ambient external air.
- Inventory mass balance method: In addition to the methods described above, the licensee will regularly perform a reactor coolant system inventory balance to determine RCS leakage quantity as part of Surveillance Requirement 3.4.5.1. Using the inventory mass balance will augment radiation instrumentation and CES leak detection methods to determine the source of a leak as described in Section 5.2.5.

**Impact on DCA:**
There are no impacts to the DCA as a result of this response.