February 23, 2018

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. 314 (eRAI No. 9241) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 314 (eRAI No. 9241)," dated December 26, 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. 9241:

- 19.05 Aircraft Impact Assessment (NuScale SMR design)-23

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. 9241

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9241

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

eRAI No.: 9241
Date of RAI Issue: 12/26/2017

NRC Question No.: 19.05 Aircraft Impact Assessment (NuScale SMR design)-23

In accordance with 10 CFR 50.150(a)(1), each applicant listed in paragraph (a)(3) shall perform a design-specific assessment of the effects on the facility of the impact of a large, commercial aircraft. Using realistic analyses, the applicant shall identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions: (i) The reactor core remains cooled, or the containment remains intact; and (ii) Spent fuel cooling or spent fuel pool integrity is maintained. 10 CFR 50.150(b) requires that the FSAR contain a description of the design features and functional capabilities and how the design features and functional capabilities meet the assessment requirements. In addition, NEI 07-13, Revision 8 provides guidance acceptable to staff for satisfying the requirements in 10 CFR 50.150(a) regarding the assessment of aircraft impacts for new nuclear power reactors.

FSAR Tier 2, Section 19.5, Revision 0 contained descriptive information regarding the role of the main control room (MCR) and remote shutdown station (RSS); including, the capability of the design to monitor and control the plant, separation between the MCR and RSS, and the availability of the module protection system and DC power equipment to monitor reactor and containment parameters. In response to RAI 8877 and RAI 9023 this important information was removed and replaced with a sentence that states, "once the operators scram the reactors and initiate DHRS and containment isolation upon warning of a potential aircraft, no further operator actions are necessary to maintain fuel cooling."

The staff recognizes that if the key design features perform as expected there are no control or protective functions that are necessary after the aircraft impact for 72 hours, as described in the FSAR; however, monitoring of plant conditions plays a vital role in the overall success of the plant's ability to cope with the impact of a large commercial aircraft. NEI 07-13 acknowledges that there are unknowns and uncertainties in performing aircraft impact assessments. Thus, 10 CFR 50.54(hh)(2) requires all plants to develop and adopt mitigation strategies to address loss of large areas of the plant due to fire or explosion from any cause, including beyond-design-basis aircraft impact. NEI 07-13 adds, "the guidance and strategies required under 10 CFR 50.54(hh)(2) provide a measure of defense-in-depth should the design features identified as a result of the aircraft impact assessment not perform as expected."

Without monitoring capability operators cannot verify the plant's ability to cope with the impact of a large commercial aircraft through the use of design features. Therefore, the ability for operators to monitor key plant parameters must be maintained in case the key design features credited for core cooling, intact containment, or spent fuel pool integrity are not performing as expected, and a transition to an alternate mitigation strategy is necessary.

The applicant is requested to reinsert the descriptive information (identified in the second paragraph above) regarding the monitoring and protection equipment, and related design features of the MCR and RSS. The applicant is requested to identify and describe, in the FSAR, key plant parameters and their location(s) that are available to the operators to monitor and ensure the identified design features are performing as expected following the impact of a large commercial aircraft.

NuScale Response:

The description of plant monitoring and control was deleted from FSAR Section 19.5 to align with 10 CFR 50.150, 10 CFR 50.54(hh)(2), and associated regulatory guidance.

Plant monitoring following an aircraft impact event is not explictly cited as a requirement in 10 CFR 50.150 and is not described as a requirement in the Standard Review Plan (SRP) NUREG-0800 Section 19.5. The Nuclear Energy Institute (NEI) guidance NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," similarly does not specify requirements for plant monitoring or instrumentation following an aircraft impact event.

In accordance with 10 CFR 50.150(a)(1) and SRP Section 19.5, NuScale incorporated design features and functional capabilities into the NuScale Power Module (NPM) design to reduce the operator actions required to cool the reactor core and spent fuel pool, and maintain containment integrity following an aircraft impact event. 10 CFR 50.54(hh)(2) mitigating strategies are allowed. Additionally, NEI 06-12 defines the following as a boundary condition for entering mitigating procedures for another beyond-design-basis accident, the loss of large area (LOLA) event:

"The entry conditions for this EDMG might include loss of plant control and monitoring capability due to a large explosive or fire. This could take the form of damage to the control room and alternate shutdown capabilities, or loss of all AC and DC power, or all of these. An example of such a condition might involve a large fire or explosion that affected the main control room, control room personnel, and alternate shutdown capability. In such a condition, it is possible that remote instrumentation may not be available and the availability of main control room personnel may be in question. In such a condition, a number of immediate actions could be required, without the benefit of normal command and control functions."

From the NuScale technical report, "Loss of Large Areas Due to Explosions and Fires Assessment," TR-0816-50796, the NPM is a self-contained nuclear steam supply system consisting of a reactor core, a pressurizer, and two steam generators integrated within the reactor pressure vessel (RPV), and housed in a compact steel containment vessel (CNV). Following a beyond-design-basis event due to a loss of a large area (LOLA), the plant design relies on passive systems for core cooling and maintaining containment.

As a result of the reliance on passive systems for these functions, operator actions necessary to respond to the event are minimized.

For the aircraft impact event, required operator actions occur prior to the aircraft impact, upon notification of the threat. Operators trip the individual NPMs and initiate containment isolation and decay heat removal systems. Indications are available for the operators to verify the establishment of the coping strategy at the time of initiation. Because further operator actions are not necessary to maintain core cooling, containment integrity, or spent fuel cooling, plant monitoring is not required per 10 CFR 50.150(a)(1).

FSAR Section 20.2 provides discussion of the mitigating strategies for the LOLA beyond-design-basis event. These mitigation strategies address the requirements of 10 CFR 50.54(hh)(2) and any operator actions needed to respond to this beyond-design-basis events.

FSAR Section 19.5.5.5, Plant Monitoring and Control, was revised to clarify the function of plant monitoring and control following the aircraft impact event, as described in this response.

Impact on DCA:

The FSAR Tier 2, Section 19.5.5.5 has been revised as described in the response above and as shown in the markup provided in this response.

constructed as described in Section 3B.2. The north SFP wall is a 6 foot thick interior concrete wall with 4 layers of #11 reinforcing bar spaced 12 inches on center in both the horizontal and vertical direction on both faces of the wall. The foundation of the SFP is constructed as described in Section 3.8.5. The reinforced concrete walls and floor have a stainless steel liner as described in Section 3.8.4. The SFP is integrated into the RXB structure and is located below grade. Because the SFP is completely below grade, an aircraft impact cannot strike the pool or the pool liner. Because there is no damage to the pool structure or liner, there is no loss of water level and SFP integrity is maintained. The location of the SFP, as described in Section 9.1.2 and shown on Figure 1.2-10 through Figure 1.2-16, is a key design feature for maintaining SFP integrity from a direct aircraft impact.

RAI 19.05 Aircraft Impact Assessment (APR1400)-1

There are three hoist systems inside the RXB that can be operated over the SFP area: the fuel handling machine, the new fuel jib crane, and the new fuel elevator. Provisions are in place to prevent the RBC from being moved over the SFP, as described in Section 9.1.5.3 and shown on Figure 9.1.5-1 and Figure 9.1.5-2. There are seismic restraints on the RBC, as shown on Figure 9.1.5-3. Because the exterior wall of the RXB is not perforated, the trolleys cannot be dislodged to fall into the reactor pool. Additionally, there are seismic restraints on the fuel handling machine, as described in Section 9.1.4.2.2 and shown on Figure 9.1.4-2. The design and location of the fuel handing equipment, as described above, is a key design feature for ensuring the hoists remain intact and cannot fall into the SFP and perforate the SFP liner.

RAI 19.05 Aircraft Impact Assessment (APR1400)-1

19.5.5.4 ~~Design Features for Maintaining Spent Fuel Pool Integrity~~Spent Fuel Pool Cooling

RAI 19.05 Aircraft Impact Assessment (APR1400)-1

~~The SFP is constructed of thick, reinforced concrete walls and floor. The SFP is integrated into the RXB structure and is located below grade. This design is a key design feature that prevents SFP perforation and maintains SFP integrity.~~Spent fuel pool cooling is not maintained for the postulated strike locations due to shock or to loss of power. However, as described in Section 19.5.5.3, SFP integrity is maintained, and SFP cooling is not required. Although forced cooling is lost, the SFP is part of the UHS, which provides a very large water inventory and ensures an adequate water level is maintained above the spent fuel assemblies for beyond the mission time, even with the loss of forced SFP cooling, as described in Section 9.1.3.3.5.

RAI 19.05 Aircraft Impact Assessment (APR1400)-1

19.5.5.5 ~~Reactor Building~~Plant Monitoring and Control

RAI 19.05 Aircraft Impact Assessment (APR1400)-1, RAI 19.05 Aircraft Impact Assessment (NuScale SMR design)-23

~~The RXB is a reinforced concrete structure that prevents aircraft perforation, limits physical damage, and prevents fire from entering the building. Vulnerable exterior openings are protected with aircraft impact resistant barriers (e.g., awnings, equipment door). The combination of the RXB exterior wall and roof thickness, rebar ratios, concrete strength, structural supports (including roof and crane supports), and external~~

~~penetration fire barriers are key design features for ensuring continued core cooling and spent fuel cooling capability. (See Section 3.8.4 for a description of the RXB structure.)~~After the operators scram the reactors and initiate the DHRS and containment isolation upon warning of a potential aircraft impact, no further operator actions are necessary to maintain core cooling.

RAI 19.05 Aircraft Impact Assessment (NuScale SMR design)-23

Mitigating strategies for a loss of large area event are described in FSAR Section 20.2. These mitigating strategies address the requirements of 10 CFR 50.54(hh)(2) and any operator actions needed to respond to this beyond design basis event.

RAI 19.05 Aircraft Impact Assessment (APR1400)-1

~~19.5.5.6 General Arrangement~~

~~The general arrangement of the structures, specifically the location of the RWB in relation to the RXB, is a key design feature that limits potential strike locations to the west end of the RXB. The RWB is located approximately 16'-6" to the west of the RXB (Figure 1.2-1 and Figure 1.2-4). The roof of the RWB is approximately 49 feet above grade. For the structural analysis, the RWB is credited as an intervening structure and protects of a portion of the west wall of the RXB. However, for the heat removal analysis, crediting intervening structures did not reduce the consequences of an aircraft impact, so no credit for intervening structures was used. (See Section 3.8.4 for a description of the RWB structure.)~~

RAI 19.05 Aircraft Impact Assessment (APR1400)-1

~~19.5.5.7 Plant Systems~~

~~The locations and functions of the main control room and remote shutdown station are key design features that allow monitoring and control of the plant. The main control room is located on the 76'-6" elevation of the Control Building, which is located to the east of the RXB. The remote shutdown station is located on the 75'-0" elevation at the west end of the RXB. Figure 1.2-4 shows the overall site layout, Figure 1.2-13 shows the location of the remote shutdown station, and Figure 1.2-22 shows the location of the main control room. Physical separation between the main control room and remote shutdown station ensures at least one location will remain operable after a postulated aircraft impact. The module protection system cabinets and associated DC power equipment are available to monitor reactor pressure, reactor temperature, reactor water level, containment pressure, and containment water level after an aircraft strike.~~

~~The DHRS and ECCS, including any supporting equipment, are key design features for maintaining core cooling.~~

~~The Reactor Building crane design meets ASME NOG-1, Type 1 requirements and accommodates the effects of an aircraft impact to the RXB structure without falling. When not in use the crane is parked over the west end of the reactor pool (east of the spent fuel pool) with the trolley positioned at the north side over the drydock fence area. Additional information for the RXB crane is provided in Section 9.1.5.~~