RAIO-0917-56162

September 25, 2017

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. 126 (eRAI No. 9048) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 126 (eRAI No. 9048)," dated August 04, 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 Questions from NRC eRAI No. 9048:

- 09.05.01-2
- 09.05.01-3
- 09.05.01-4
- 09.05.01-5

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 Carrie Fosaaen at 541-452-7126 or at cfosaaen@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Anthony Markley, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9048

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9048

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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

eRAI No.: 9048
Date of RAI Issue: 08/04/2017

NRC Question No.: 09.05.01-2

General Design Criterion 3, “Fire protection,” states in part that:

> Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room.

Regulatory Guide 1.189, “Fire Protection for Nuclear Power Plants,” Section 2.1.3, “Flammable and Combustible Liquids and Gases,” states in part that:

> Flammable and combustible liquids and gases are potentially significant fire hazards and procedures should clearly define their use, handling, and storage, which should, at a minimum, comply with the provisions of the National Fire Protection Association (NFPA) 30, “Flammable and Combustible Liquids Code.”

In the FSAR, the applicant describes the hydraulic fluid used for the mechanical valves controlling the various reactor systems under the bioshield as being “noncombustible,” “non-flammable,” and “not flammable.”

In FSAR Tier 2, Section 9A.5.19 through Section 9A.5.30, the fire hazard analysis for the area under the bioshield of each module, the applicant states that

> Based on the minimal combustibles (all conductors in metal conduit, and the use of non-flammable hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection.

NFPA 30, Section 4.2.3 defines a flammable liquid as any liquid that has a flash point below 100° F. NFPA 30, Section 4.2.2 defines a combustible liquid as any liquid that has a flash point at or above 100° F. Liquid mixtures that do not sustain combustion are considered to be

noncombustible.

The applicant is requested to:

1. Define the type of hydraulic fluid used as flammable, combustible, or noncombustible.
2. If the hydraulic fluid used is considered flammable or combustible, postulate a fire beneath the bioshield due to a leak in the hydraulic fluid system. If applicable, the applicant is requested to provide justification for not postulating a fire beneath the bioshield.

Information provided in response to the above request should be included in an update to the FSAR.

NuScale Response:

The hydraulic fluid described in FSAR sections 9A.5.19 through 9A.5.30 should have been specified as "noncombustible." Sections 9A.5.19 through 9A.5.30, and 9A.6.4.3 of the FSAR have been updated with this information.

Impact on DCA:

FSAR Section 9.A has been revised as described in the response above and as shown in the markup provided in this response.

9A.5.19 Reactor Building - Fire Area: 010-022-01

Reference Drawing 1.2-17

Room Name: Module 1 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems: None

Detection Systems: Duct smoke detection is provided in the area.

Manual Suppression: SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.

Fire Extinguishers: None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.20 Reactor Building - Fire Area: 010-022-02

Reference Drawing 1.2-17

Room Name: Module 2 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.21 Reactor Building - Fire Area: 010-022-03

Reference Drawing 1.2-17

Room Name: Module 3 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.22 Reactor Building - Fire Area: 010-022-04

Reference Drawing 1.2-17

Room Name: Module 4 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.23 Reactor Building - Fire Area: 010-022-05

Reference Drawing 1.2-17

Room Name: Module 5 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems: None

Detection Systems: Duct smoke detection is provided in the area.

Manual Suppression: SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.

Fire Extinguishers: None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.24 Reactor Building - Fire Area: 010-022-06

Reference Drawing 1.2-17

Room Name: Module 6 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems: None

Detection Systems: Duct smoke detection is provided in the area.

Manual Suppression: SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.

Fire Extinguishers: None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.25 Reactor Building - Fire Area: 010-022-07

Reference Drawing 1.2-17

Room Name: Module 7 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.26 Reactor Building - Fire Area: 010-022-08

Reference Drawing 1.2-17

Room Name: Module 8 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.27 Reactor Building - Fire Area: 010-022-09

Reference Drawing 1.2-17

Room Name: Module 9 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.28 Reactor Building - Fire Area: 010-022-10

Reference Drawing 1.2-17

Room Name: Module 10 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.29 Reactor Building - Fire Area: 010-022-11

Reference Drawing 1.2-17

Room Name: Module 11 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

9A.5.30 Reactor Building - Fire Area: 010-022-12

Reference Drawing 1.2-17

Room Name: Module 12 Area Beneath Bioshield (Not Labeled On Drawings)

NFPA 101 Hazard Classification: Low **NFPA 13 Hazard Classification:** LH

In Situ Combustibles: Qualified Electrical Cable

In Situ Ignition Sources: None

Transient Combustibles: None

Transient Ignition: None

RAI 09.05.01-2

Postulated Fire:

Based on the minimal combustibles (all conductors in metal conduit, and the use of ~~non-flammable~~noncombustible hydraulic fluid) the only postulated fire during power operations would be located in an electrical junction box caused by a deficient connection. However, during an outage there is the potential for a more severe fire involving the introduction of transient combustibles.

Fire Protection Features:

Suppression Systems:	None
Detection Systems:	Duct smoke detection is provided in the area.
Manual Suppression:	SSE fire hose installation conforming to NFPA 14 is located within 100 ft. of hazards. This area is inaccessible during normal operations.
Fire Extinguishers:	None

Fire Area/Zone Fire/Smoke Impact on:

Emergency Response:

Fire and smoke impact on manual firefighting is minimal as the area is physically separated from the stairs where the standpipe and fire hose valve are located and manual response will be coordinated. This area is inaccessible during normal operation.

Property Loss:

An unmitigated fire could challenge multiple redundant safety systems. Note: Based on the lack of combustibles under the bioshield a fire under the bioshield is not considered plausible.

Operations/ Post-Fire Recovery:

Unmitigated fire and smoke at the top of the module can potentially affect operation and shutdown of the module and post-fire operation of the module. The NuScale modules do not require the active systems, but may be passively cooled by the reactor pool. The plant systems and operations outside the individual module damaged by the fire should not be affected and allow for post-fire operations for other areas, and allow for other actions to address the impacted module. This is due to a combination of separations, smoke detection to alert the control room and emergency responders, and fire barriers that will restrict fire and smoke

The containment is inaccessible during reactor operation which precludes introduction of transient combustibles at any time that the reactor is in operation. After reactor shut down is complete, and cold shut down is achieved access to containment is only allowed after the containment is separated from the reactor vessel. Once the containment is separated from the reactor vessel and placed in the dry-dock area transient combustibles could be introduced but at the same time manual fire suppression is available and the core cannot be affected as it has remained in the refueling area. Transient combustibles in the containment when accessible (during shutdown) are administratively controlled.

The fire safe shutdown equipment that is located in the containment vessel is the emergency core cooling system valves, the control rod drive mechanisms, and the pressurizer heaters.

9A.6.4.3 Fire at the Top of a Module

A fire in the area at the top of a module (under the bioshield) is virtually impossible as all of the cabling under the bioshield is routed in conduit or is three hour rated cable which results in no intervening combustible loading for an exposure fire impacting other cable or components in the area.

The top of the module area is inaccessible during reactor operation which precludes introduction of transient combustibles at any time that the reactor is operating. After reactor shut down is complete, and cold shut down is achieved then removal of the bioshield is permissible. Once the bioshield is removed transient combustibles could be introduced but at the same time manual fire suppression is available in the area of the top of the module. Administrative controls limit transient combustibles in the area of the top of the module when accessible (during shutdown).

Although not plausible, a fire at the top of the module has the potential to challenge multiple redundant systems required for safe shutdown. The potential for these failures to occur have been minimized through the following design considerations.

Minimal Combustible Loading

The cables routed throughout the area around the top of the module are routed through metal conduit or are three hour rated cable. The conduits are either rigid or flexible, corrugated hose conduits. Based on the use of metal conduit, the insulation of the conductors is sealed from the environment; therefore the contribution of conductor insulation fuel load within the conduits is considered negligible and cannot represent an exposure fire for other SSCs.

RAI 09.05.01-2

The hydraulic fluid for the mechanical valves controlling the various reactor systems is supplied by piping penetrating through the reactor pool wall and terminating at the valve actuators. The hydraulic fluid is ~~not flammable~~noncombustible.

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

eRAI No.: 9048
Date of RAI Issue: 08/04/2017

NRC Question No.: 09.05.01-3

10 CFR 52.47(a)(18) requires a DC application to contain a description and analysis of the fire protection design features for the standard plant necessary to comply with 10 CFR 50.48 and GDC 3 in 10 CFR part 50, Appendix A.

In FSAR Tier 2, Table 9.5.1-2, "Compliance Table versus Regulatory Guide 1.189," for regulatory guide position numbers 3.2.1, 3.2.2, 3.2.3, and 3.3 that applicant states:

> "Additional detailed requirements exist in this section and all will be met or do not apply."

The applicant is requested to:

> List the additional requirements and indicate which requirements will be met or do not apply or provide justification for not listing which requirements will be met or do not apply.

Information provided in response to the above request should be included in an update to the FSAR.

NuScale Response:

Conformance with regulatory positions 3.2.1, 3.2.2, 3.2.3, and 3.3 of Regulatory Guide 1.189, Revision 2 have been evaluated and are provided in FSAR Table 9.5.1-2. The FSAR has been updated with this information.

Impact on DCA:

FSAR Section 9.5.1 has Table 9.5.1-2 been revised as described in the response above and as shown in the markup provided in this response.

RAI 09.05.01-3

Table 9.5.1-2: Compliance Table versus RG 1.189

RG Position Number	Regulatory Guide 1.189, Rev. 2, Regulatory Position (1)	Conformance (2)	Comment
1.	**Fire Protection Program** In accordance with 10 CFR 50.48, each operating nuclear power plant must have a fire protection plan. The plan should establish the fire protection policy for the protection of SSCs important to safety at each plant and the procedures, equipment, and personnel required to implement the program at the plant site.	Conform	COL Applicant will be required to develop and maintain the site-specific elements of the fire protection program. Note: NFPA 805 as referenced by 10 CFR 50.48(c) is not utilized in the development of the FPP.
1.1	**Organization, Staffing, and Responsibilities** The FPP should describe the organizational structure and responsibilities for its establishment and implementation. These responsibilities include FPP policy; program management (including program development, maintenance, updating, and compliance verification); fire protection staffing and qualifications; engineering and modification; inspection, testing, and maintenance of fire protection systems, features, and equipment; fire prevention; emergency response (e.g., fire brigades and offsite mutual aid); and general employee, operator, and fire brigade training.	Conform	COL Applicant
1.2	**Fire Hazards Analysis** A fire hazards analysis should be performed to demonstrate that the plant will maintain the ability to perform safe-shutdown functions and minimize radioactive material releases to the environment in the event of a fire. This analysis should be revised as necessary to reflect plant design and operational changes. The fire hazards analysis has the following objectives:	Conform	COL Applicant FHA is completed/ maintained to reflect the as-built configuration of the plant.

Table 9.5.1-2: Compliance Table versus RG 1.189 (Continued)

RG Position Number	Regulatory Guide 1.189, Rev. 2, Regulatory Position [1]	Conformance [2]	Comment
~~3.2~~	~~**Fire Protection Water Supply Systems**~~	~~Title~~	
~~3.2.1~~	~~**Fire Protection Water Supply** NFPA 22, "Standard for Water Tanks for Private Fire Protection", and NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances", provide guidance on fire protection water supplies. The fire protection water supply system should meet the following criteria:~~	~~Conform~~	~~Additional detailed requirements exist in this section and all will be met or do not apply.~~
~~3.2.2~~	~~**Fire Pumps** Fire pump installations should conform to NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection", and should meet the following criteria:~~	~~Conform~~	~~Additional detailed requirements exist in this section and all will be met or do not apply.~~
~~3.2.3~~	~~**Fire Mains** An underground yard fire main loop should be installed to furnish anticipated water requirements. NFPA 24 provides appropriate guidance for such an installation. NFPA 24 references other design codes and standards developed by such organizations as ANSI and the American Water Works Association.~~	~~Conform~~	~~Additional detailed requirements exist in this section and all will be met or do not apply.~~
~~3.3~~	~~**Automatic Suppression Systems** Automatic suppression systems should be installed as determined by the fire hazards analysis and as necessary to protect redundant systems or components necessary for safe shutdown and SSCs important to safety. (See Regulatory Positions 5.3.1.1.b, 5.3.1.1.c, and 6 of this guide.)~~	~~Conform~~	~~Additional detailed requirements exist in this section and all will be met or do not apply.~~
3.2	**Fire Protection Water Supply Systems**	Title	
3.2.1	**Fire Protection Water Supply** NFPA 22, "Standard for Water Tanks for Private Fire Protection," and NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances," provide guidance on fire protection water supplies. The fire protection water supply system should meet the following criteria:	Conform	
3.2.1, a	Two separate, reliable freshwater supplies should be available. Saltwater or brackish water should not be used unless all freshwater supplies have been exhausted.	Conform	
3.2.1, b	The fire-water supply should be calculated on the basis of the largest expected flow rate for a period of 2 hours, but not less than 1,136,000 liters (L) (300,000 gallons (gal)). This flow rate should be based (conservatively) on 1,900 liters per minute (L/min) (500 gal/min) for manual hose streams, plus the largest design demand of any sprinkler or deluge system, as determined in accordance with NFPA 13, "Standard for the Installation of Sprinkler Systems," or NFPA 15, "Standard for Water Spray Fixed Systems for Fire Protection."	Conform	

Table 9.5.1-2: Compliance Table versus RG 1.189 (Continued)

RG Position Number	Regulatory Guide 1.189, Rev. 2, Regulatory Position (1)	Conformance (2)	Comment
3.2.1, c	If tanks are used for water supply, two 100-percent system capacity tanks (minimum of 1,136,000 L (300,000 gal) each) should be installed. They should be interconnected to allow pumps to take suction from either or both. However, a failure in one tank or its piping should not cause both tanks to drain. Water supply capacity should be capable of refilling either tank in 8 hours or less.	Conform	
3.2.1, d	Common water supply tanks are acceptable for fire and sanitary or service water storage. When they are used, however, minimum fire-water storage requirements should be dedicated by passive means; for example, use of a vertical standpipe for other water services. Administrative controls, including locks for tank outlet valves, are unacceptable as the only means to ensure minimum water volume.	N/A	The NuScale plant's FP system uses two 100-percent system capacity tanks that are independent of other water systems.
3.2.1, e	Freshwater lakes or ponds of sufficient size may qualify as the sole source of water for fire protection but require separate redundant suctions in one or more intake structures. These supplies should be separated, so that a failure of one supply will not result in a failure of the other supply.	N/A	The NuScale plant's FP system uses two 100-percent system capacity tanks.
3.2.1, f	When a common water supply is permitted for fire protection and the ultimate heat sink, the following conditions should also be satisfied:	N/A	The NuScale plant's FP system is not connected to the ultimate heat sink therefore 3.2.1, f does not apply.
3.2.2	**Fire Pumps** Fire pump installations should conform to NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection," and should meet the following criteria:	Conform	
3.2.2, a	If fire pumps are required to meet system pressure or flow requirements, a sufficient number of pumps is provided to ensure that 100-percent capacity will be available, assuming failure of the largest pump or loss of offsite power (e.g., three 50-percent pumps or two 100-percent pumps). This can be accomplished, for example, by providing either electric-motor-driven fire pumps and diesel-driven fire pumps or two or more seismic Category I Class 1E electric-motor-driven fire pumps connected to redundant Class 1E emergency power buses.	Conform	
3.2.2, b	Individual fire pump connections to the yard fire main loop are separated with sectionalizing valves between connections. Each pump and its driver and controls are located in a room separated from the remaining fire pumps by a fire wall with a minimum rating of 3 hours.	Conform	
3.2.2, c	The fuel for the diesel fire pumps is separated so that it does not provide a fire source that exposes equipment important to safety.	Conform	
3.2.2, d	The control room contains alarms or annunciators to indicate pump running, driver availability, failure to start, and low fire main pressure.	Conform	

Table 9.5.1-2: Compliance Table versus RG 1.189 (Continued)

RG Position Number	Regulatory Guide 1.189, Rev. 2, Regulatory Position (1)	Conformance (2)	Comment
3.2.3	**Fire Mains** An underground yard fire main loop should be installed to furnish anticipated water requirements. NFPA 24 provides appropriate guidance for such an installation. NFPA 24 references other design codes and standards developed by such organizations as ANSI and the American Water Works Association.	Conform	
3.2.3, a	The type of pipe and water treatment are design considerations, with tuberculation as one of the parameters. i. The means for inspecting and flushing the fire main are provided. ii. Sectional control valves should be visually indicating (e.g., post indicator valves). iii. Control and sectionalizing valves in fire mains and water-based fire suppression systems are electrically supervised or administratively controlled (e.g., locked valves with key control, tamper-proof seals). The electrical supervision signal indicates in the control room. All valves in the fire protection system are periodically checked to verify position. iv. The fire main system piping is separate from service or sanitary water system piping, except as described in Regulatory Position 3.2.1 of this guide, with regard to providing a seismically designed water supply for standpipes and hose connections. v. A common yard fire main loop may serve multiunit nuclear power plant sites if cross-connected between units. Sectional control valves permit independence of the individual loop around each unit. For multiple-reactor sites with widely separated plants (approaching 1.6 kilometer (km) (1 mile (mi)) or more), separate yard fire main loops are used. vi. Sectional control valves are provided to isolate portions of the fire main for maintenance or repair without shutting off the supply to primary and backup fire suppression systems serving areas that contain or expose equipment important to safety. vii. Valves are installed to permit isolation of outside hydrants from the fire main for maintenance or repair without interrupting the water supply to automatic or manual fire suppression systems in any area containing or presenting a fire hazard to equipment important to safety. viii. Sprinkler systems and manual hose station standpipes have connections to the yard main system, so that a single active failure or a line break cannot impair both the primary and backup fire suppression systems. Alternatively, headers fed from each end are permitted inside buildings to supply both sprinkler and standpipe systems, provided that steel piping and fittings meeting the requirements of ASME B31.1 are used for the headers, up to and including the first valve supplying the sprinkler systems, when such headers are part of the seismically analyzed hose standpipe system. When provided, such headers are considered an extension of the yard main system. Each sprinkler and standpipe system should be equipped with an outside screw and yoke gate valve or other approved shutoff valve and water flow alarm.	Conform	

Table 9.5.1-2: Compliance Table versus RG 1.189 (Continued)

RG Position Number	Regulatory Guide 1.189, Rev. 2, Regulatory Position (1)	Conformance (2)	Comment
3.3	**Automatic Suppression Systems** Automatic suppression systems should be installed as determined by the fire hazards analysis and as necessary to protect redundant systems or components necessary for safe shutdown and SSCs important to safety. In areas of high seismic activity, licensees should consider the need to design the fire suppression systems to be functional following a safe-shutdown earthquake. The fire suppression systems should retain their original design capability for (1) natural phenomena of less severity and greater frequency than the most severe natural phenomena (approximately once in 10 years), such as tornadoes, hurricanes, floods, ice storms, or small-intensity earthquakes that are characteristic of the geographic region, and (2) potential manmade site-related events, such as oil barge collisions or aircraft crashes, that have a reasonable probability of occurring at a specific plant site. For water suppression systems and fire detection systems that use metal plates for heat collection above individual sprinkler heads or detectors that are located well below the ceiling of a fire area (e.g., at some intermediate height in the room, below a ceiling-mounted pipe and cable tray), licensees should demonstrate that this design will ensure acceptable actuation times. In general, the use of such plates has not been shown to provide adequate heat collection to effectively activate the sprinkler head or detector and may impair system response.	Conform	
3.3.1	**Water-Based Systems** Equipment important to safety that does not itself require protection by water-based suppression systems, but is subject to unacceptable damage if wetted by suppression system discharge, should be appropriately protected (e.g., water shields or baffles). Drains should be provided as required to protect equipment important to safety from flooding damage.	Conform	
3.3.1.1	**Sprinkler and Spray Systems** Water sprinkler and spray suppression systems are the most widely used means of implementing automatic water-based fire suppression. Sprinkler and spray systems should, at a minimum, conform to requirements of appropriate standards such as NFPA 13 (and NFPA 15.	Conform	
3.3.1.2	**Water Mist Systems** Water mist suppression systems may be useful in specialized situations, particularly in those areas where the application of water needs to be restricted. Water mist systems should conform to appropriate standards, such as NFPA 750, "Standard on Water Mist Fire Protection Systems".	Conform	
3.3.1.3	**Foam-Water Sprinkler and Spray Systems** Certain fires, such as those involving flammable liquids, respond well to foam suppression. Licensees should consider the use of foam sprinkler and spray systems, which should conform to appropriate standards, such as NFPA 16, "Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems", and NFPA 11, "Standard for Low-, Medium-, and High- Expansion Foam".	Conform (when utilized)	COL Applicant (where specified by as-built FHA)

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

eRAI No.: 9048
Date of RAI Issue: 08/04/2017

NRC Question No.: 09.05.01-4

10 CFR 52.47(a)(18) requires a DC application to contain a description and analysis of the fire protection design features for the standard plant necessary to comply with 10 CFR 50.48 and GDC 3 in 10 CFR part 50, Appendix A.

In FSAR Tier 2, Section 9A.7.1, “Preparation for the Expert Panel Meeting,” the applicant stated that the expert panel was trained on the generic pressurized water reactor MSO List from NEI 00-01 Revision 3, as applicable for the NuScale design”

The staff note that the NRC has not endorsed NEI 00-01 Revision 3.

The applicant is requested to:

Perform an evaluation for the effects of multiple spurious actuations due to a fire that is consistent with NEI 00-01, Revision 2, as modified in Regulatory Guide 1.189, Revision 2, or, if an alternative approach is used, justify how the alternative approach complies with NRC regulations.

Information provided in response to the above request should be included in an update to the FSAR.

NuScale Response:

In developing a post-fire safe shutdown strategy, NuScale considered the potential for multiple spurious operations (MSOs) of components following a fire. The methodology used in performing this analysis was based on application of the guidance in NEI 00-01, Revision 2 as described in Regulatory Guide 1.189, Revision 2. NuScale did not take credit for spurious operation terminating, e.g., through a hot short eventually going to ground.

Despite the uniqueness of NuScale’s design as compared to the operating fleet of nuclear reactors, the list of generic MSOs compiled by the nuclear industry provided valuable insights and perspective into the types of failures that were considered in this analysis. In an effort to

perform a complete and thorough analysis, NuScale based the review of generic MSOs using the list provided in NEI 00-01 Revision 3 as opposed to the list provided in NEI 00-01 Revision 2. Aside from minor editorial and administrative differences, the MSO lists are generally consistent with one another but NEI 00-01 Revision 3 provides additional perspective on the classification of MSOs and also represents a more complete list of scenarios. The scenarios described in NEI 00-01 Revision 2 continue to be addressed in Revision 3, however, Revision 3 also includes Scenarios 33b, 49.1, and 56b.

While Scenarios 33b, 49.1, and 56b were found not to be applicable to the NuScale design, they provided additional perspective regarding the applicability of MSOs 33a, 49, 49.2, and 56 which were found to be applicable to the design.

The goal of the MSO expert panel was to identify the combinations of component failures which could challenge safe shutdown of a NuScale plant. The analysis showed that the simple and passive actuation of NuScale's safety systems and the fact that operator actions are not required to achieve safe shutdown combine to minimize the effects of fires on the safety of a NuScale plant.

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

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

eRAI No.: 9048
Date of RAI Issue: 08/04/2017

NRC Question No.: 09.05.01-5

General Design Criterion 3, “Fire protection,” states in part that:

Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions.

In FSAR Tier 2, Section 9A.5.82, “Reactor Building – Fire Area 010-208, 010-242, 010-275,” the applicant states:

> Unmitigated fire could result in loss of one division of safety-related equipment for 12 reactor modules.

In FSAR Tier 2, Table 19.1-44, “Fire Induced Initiating Events,” fire initiating event IE-FIRE-3-ECCS indicates that a fire in this fire area will affect both Divisions I and II.

The applicant is requested to reconcile the inconsistency of whether a fire in this fire area will affect one or both divisions of safety-related equipment or provide justification as to why the inconsistency is acceptable.

Information provided in response to the above request should be included in an update to the FSAR.

NuScale Response:

Both statements are accurate as written. Section 9A.5.82, "Reactor Building - Fire Area 010-208, 010-242, 010-275," correctly states that, "Unmitigated fire could result in loss of one division of safety-related equipment for 12 Reactor Modules."

The Description column for Fire Initiating event IE-FIRE-3-ECCS in FSAR Table 19.1-44 states that *"Fire Induces Spurious ECCS Actuation - Division I and II Affected"* is also correct. This description means that Division I and II are modeled for this initiating event since each division

is potentially capable of actuating the ECCS following a fire in fire compartments 010-208, 010-242, 010-275 or in the main control room. The fire induced failures of concern in the initiating event are actuations of ECCS, not failures of the ECCS to actuate. This is not meant to convey that both divisions of ECCS may fail to actuate in the subject fire compartments.

The actuation of ECCS is relied upon, in part, for achieving safe shutdown following a fire as described in Appendix 9A.6 of the FSAR. As such, separation of SSCs, e.g. cabling, that are capable of actuating ECCS is not strictly required to assure safe shutdown following a fire so long as successful operation of the ECCS is not compromised.

Cable routing and control circuit design layouts are identified areas of uncertainty in the NuScale internal fire PRA, as these designs are not complete. The key assumptions made in the internal fire PRA, including cable routing and control circuit designs, are described in FSAR Table 19.1-46.

The evaluation of safe shutdown capability following a fire in any area of the plant will be addressed via ITAAC. Specifically, an as-built safe shutdown analysis will be performed in accordance with Part 2, Tier 1, Table 3.7-1, Item 3. Finally, COL Item 19.1-8 addresses the need for a COL applicant to confirm the applicability of assumptions and data and modify as necessary for the as-built, as-operated plant.

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