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LO-0220-69072

March 3, 2020

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Submittal of Presentation Materials Entitled "ACRS Subcommittee Presentation: NuScale Topic – Hydrogen Monitoring," PM-0220-69071, Revision 0

The purpose of this submittal is to provide presentation materials to the NRC for use during the upcoming Advisory Committee on Reactor Safeguards (ACRS) NuScale Subcommittee Meeting on March 4, 2020. The materials support NuScale's presentation of hydrogen monitoring.

The enclosure to this letter is the nonproprietary presentation "ACRS Subcommittee Presentation: NuScale Topic – Hydrogen Monitoring," PM-0220-69071, Revision 0.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions, please contact Matthew Presson at 541-452-7531 or at mpresson@nuscalepower.com.

Sincerely,

Zackary W. Rad
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Enclosure: "ACRS Subcommittee Presentation: NuScale FSAR Topic – Hydrogen Monitoring," PM-0220-69071, Revision 0

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Enclosure:

"ACRS Subcommittee Presentation: NuScale Topic – Hydrogen Monitoring," PM-0220-69071, Revision 0

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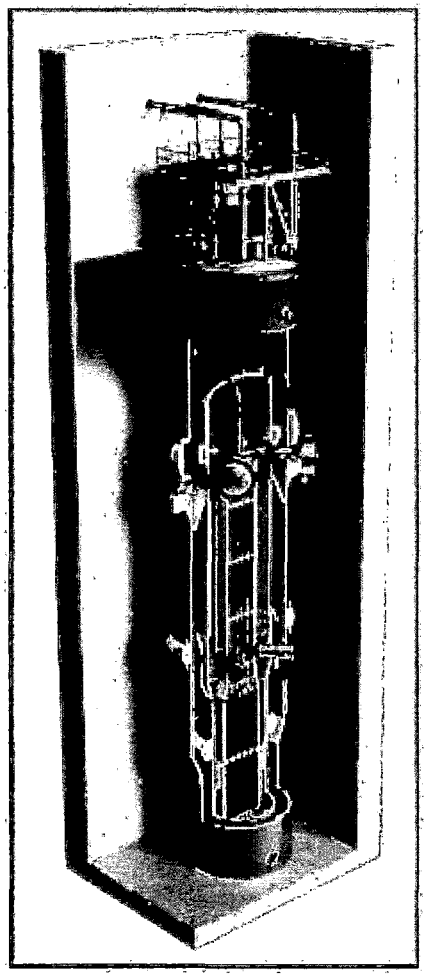
ACRS Subcommittee Presentation



NuScale Topic
Hydrogen Monitoring

March 4, 2020

PM-0220-69071
Revision: 0

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Template #: 0000-21727-F01 R5

Presenters

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Introduction

- Design Basis vs. Beyond Design Basis
- Timing of Detrimental Combustible Mixture
- Operational Decisions for Hydrogen (H2) Monitoring
- Radiation Protection Issue
- Equipment Capability to Withstand Combustion Events
- Containment Mixing and Sampling

Design Basis vs. Beyond Design Basis

- The NuScale facility was designed using a framework of Design Basis and Beyond Design Basis categories for accident mitigation:
- Design Basis Accident (DBA)
  - A postulated accident that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components (SSCs) necessary to ensure public health and safety.
- Beyond Design Basis Accident (BDBA)
  - This term is used as a technical way to discuss accident sequences that are possible but were not fully considered in the design process because they were judged to be too unlikely. In that sense, they are considered beyond the scope of design-basis accidents that a nuclear facility must be designed and built to withstand.
  - As the regulatory process strives to be as thorough as possible, "beyond design-basis" accident sequences are analyzed to fully understand the capability of a design.

Design Basis vs. Beyond Design Basis

- Design Basis Accident (DBA)
  - If an SSC is relied upon to remain functional (to meet regulatory criteria) during and following a DBA, then the SSC must be categorized as (as appropriate):
    - Single Failure Proof
    - Safety-Related
    - Seismic Category 1
    - 1E Power
  - If an SSC is not categorized as such, it cannot be relied upon for accident mitigation
  - Therefore, the safety analysis of an DBA can only credit SSCs that are appropriately categorized, as above
  - SSCs that are categorized in a lesser category cannot be credited in accident analyses
    - Example: Typical Chapter 15 accidents

Design Basis vs. Beyond Design Basis

- Beyond Design Basis Accident (BDBA)
  - Because BDBAs are considered more unlikely than DBAs, nonsafety-related SSCs can be credited for accident mitigation
    - Example: ATWS (10CFR50.62) and SBO (10CFR50.63) allow the use of nonsafety-related equipment for accident mitigation
    - Often include multiple failures beyond those considered for DBEs, and thus more realistic assumptions are allowed in the analyses
  - This is also why 10 CFR 50.44 was revised by the NRC (in 2003) to allow the hydrogen monitoring system to be nonsafety-related, therefore not single failure proof, not seismic category 1, and no 1E power source
  - Therefore, the NuScale hydrogen monitoring system is not safety-related, not single failure proof, not seismic category 1, and does not have 1E power, because it is used only for beyond design basis accidents

Timing of Detrimental Mixture

- A detrimental mixture is a combustible mixture which can threaten containment integrity
- Analysis shows there is a minimum of 72 hours before a detrimental mixture can be developed
- 100% core damage is not the most limiting scenario relative to time
- 72 hours is NuScale's design basis passive coping period
  - "...after 72 hours, the applicant states that this represents a reasonable period of time to implement severe accident management guidelines to mitigate the accumulation of combustible gases. This time period aligns with that used in current regulatory precedent and is therefore acceptable." Chapter 6 SER, Section 6.2.5.4
- Exemption from 10CFR50.44(c)(4) is not recommended

Operational Decisions for H2 Monitoring

- Analyses show there is at least 72 hours before a combustible mixture could threaten containment
  - Therefore, the plant personnel have time to weigh options and inspect systems before use
- Reg Guide 1.7 provides a risk-informed decision process
  - Appropriate priority with other activities
  - Need for the information by decision-makers
  - Insights from experience or evaluation
- Therefore, in the unlikely use of the H2 monitoring system, evaluations and inspections can occur

Radiation Protection Issue

- The system is unlikely to leak because:
  - Included in the Leakage Control Program
  - Used during normal operations
  - Operators have sufficient time to inspect system prior to use
- If the H2 monitoring system leaks during its use, operators could isolate and repair the leak
- The ERO to develop ad hoc, unplanned operator actions performed under 10 CFR 50.47(b)(11)
- NRC Staff states that the DCA scope of design does not provide enough information to perform this dose analysis
- Staff position is that this will be carved out of the rule to be resolved at a future time

Equipment Capability to Withstand Combustion

- The containment can withstand any combustion event for the first 72 hours
- Per FSAR Table 3.2-1, the pressure boundary of monitoring path can withstand combustion events, like the containment
- NuScale and NRC Staff agree that this design capability is provided for the monitoring pathway

Containment Mixing and Sampling

- ANSI N13.1-2011 requires sampling be representative
- Regulations [10 CFR 50.44(c)(1)] require that containments ensure a mixed atmosphere during design basis and beyond design basis accidents
- Mixing described in FSAR Section 6.2.5 and RAI 8862 response
- Analysis shows that containment is well-mixed, even neglecting ECCS flow, with plant conditions stable
- NuScale and NRC Staff are in agreement regarding compliance with 10 CFR 50.44(c)(1).
  - "Given the large margin between the calculated Ra and conditions indicative of turbulence, the staff finds it reasonable to conclude that the entirety of containment will be mixed (even before considering the effect of additional flow stimulated by steam flow from the RVVs and condensation on the walls)." –Chapter 6 SER, Section 6.2.5.4

Summary and Conclusions

- Core melt accident is a beyond design basis accident
  - Consistent with industry practice, allows nonsafety-related SSCs
  - The low frequency of a NuScale core melt accident makes it hard to see how it can be considered credible
- Bounding analyses shows there is a minimum of 72 hours before containment can be threatened
- Decision to place system into service would follow RG 1.7 risk-informed process and appropriate precautions
  - There is sufficient time to inspect and evaluate system condition
  - If excessive leaks develop, can isolate and repair
- Monitoring path can withstand combustion events
- Containment is well-mixed and representative sampling is required

Acronyms

ATWS	Anticipated Transient Without SCRAM
BDBA	Beyond Design Basis Accident
CES	Containment Evacuation System
CNV	Containment Vessel
DBA	Design Basis Accident
FCI	Fuel-Coolant Interaction
FR	Federal Register
GDC	General Design Criteria
Mcyr	module critical year
ms	milli-second
SBO	Station Blackout
SER	Safety Evaluation Report
SRM	Staff Requirements Memo
SSC	Structure, System, or Component
TMI	Three Mile Island

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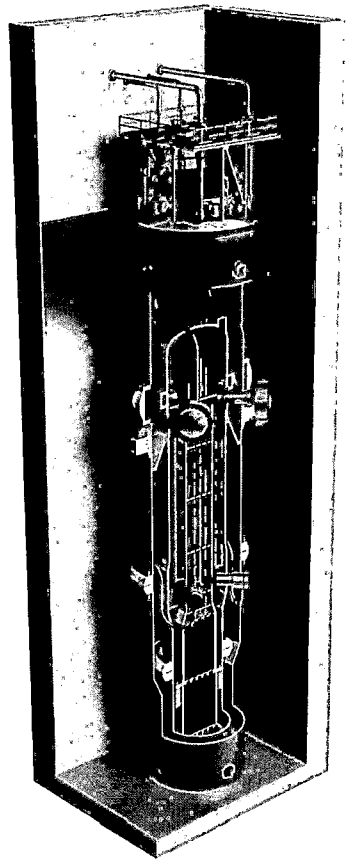

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Backup Slides

Containment Isolation Failure

- Chapter 19 documents an assessment of whether a severe core damage event, with a steam explosion that results in containment failure (e.g., CES containment isolation failure) could lead to a large release (NUREG-0396)
- The conclusion is that "at the earliest possible time of fuel-coolant interaction (FCI), the airborne fraction of volatile fission product aerosols is less than the calculated threshold for a large release."
  - 6.8 hours is the earliest possible time of FCI for intact containment accidents

Containment Isolation Failure

- If containment is unisolated for the purpose of combustible gas monitoring resulting in a leak, this would be a similar situation, except that it would be expected to occur at a later time, potentially as late as 72 hours
  - This would result in additional containment aerosol deposition
  - The release would not be directly to the atmosphere
- Therefore, under the bounding assumption that the CES piping were to be completely sheared at the time isolation, it is reasonable to conclude this would not result in a large release or threaten public safety