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LO-0419-64807

April 2, 2019

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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11555 Rockville Pike
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SUBJECT: NuScale Power, LLC Submittal of Presentation Materials Entitled "ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, 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 Full Committee meeting on April 4, 2019. The materials support NuScale's presentation of Chapter 9, "Auxiliary Systems" of the NuScale design certification application.

The enclosure to this letter is the nonproprietary version of the presentation entitled "ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0.

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

If you have any questions, please contact Carrie Fosaaen at 541-452-7126 or at cfosaaen@nuscalepower.com.

Sincerely,

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Enclosure: "ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0

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Enclosure:

"ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0

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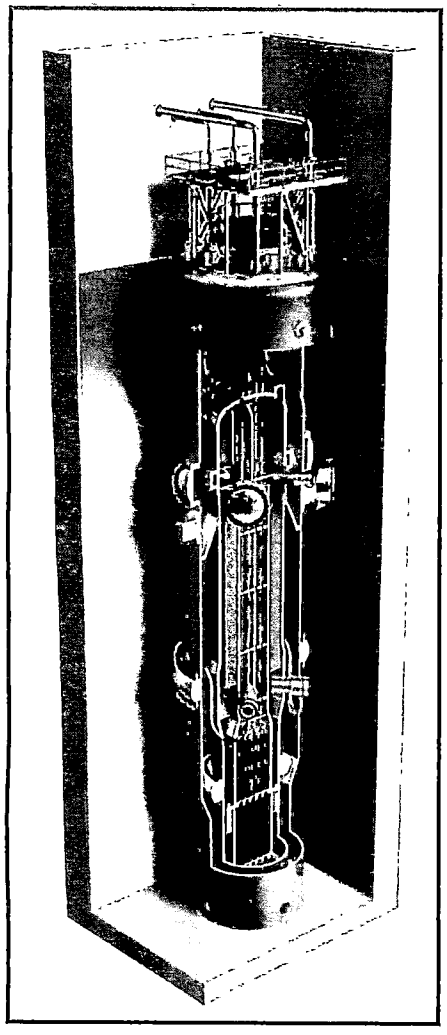

ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems

PM-0319-64807
Revision: 0

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Template #: 0000-21727-F01 R5

Presentation Team

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Refueling and Remote Handling

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Reactor Building Crane

- RBC Design
  - Designed to ASME NOG-1 Type 1 (Meets NUREG-0554 requirements)
  - Designed to be Seismic Category 1 (Required to withstand earthquake stress and retain load.)
  - Movement uses redundant position control system interlocks
- Risk Significant
  - RBC has augmented Quality Control per Part III of the QAPD (because of Risk Significance)
  - Augmented requirements conform to regulatory requirements. (SRP 9.1.5, NUREG-0554, NUREG-0612, and RG 1.13)
- Non-Safety
  - The RBC doesn't perform any functions that meet the regulatory definition of safety-related.

RBC Control System

- Redundant limit switches
  - Hoist overtravel (upper limit switches, lower limit switches)
  - Hoist overload
- Interlocks
  - Slack rope and Hoist drum rope mis-spooling
  - Hoist overspeed
  - Unbalanced load
  - Reactor building crane-fuel handling machine (FHM) interlock
  - Bridge and trolley overtravel limits
- Safe Load Paths
  - Restricted handling path and speed (30 ft/min traverse, 2 ft/min hoist)
  - Operator monitored

RBC Control System

- E-stop system
  - Physical relay controlled – no software
  - Cuts power to motors and brakes (stops motors, sets brakes)
  - Independent of any controls used for normal operation
- Redundant Physical Load Control Systems
  - Redundant gearboxes, cables, brakes on main hoist
  - Redundant elements are all capable of performing their function individually at full load

RBC Control System

- In the event of failure of load lift control system:
  - Redundant upper travel limit switches
  - Two-blocking capable (Hard upper limit doesn't damage RBC)
  - Raise to top of travel – fuel still covered, shielding maintained, reactor module base is 29 feet above the floor
- In the event of a failure of travel control system:
  - Traverse speed limited, operator monitors motion, speed is slow enough to enable operator to protect from impacts (30 ft/min)
  - Energy absorbing hard stops, designed to protect in event of redundant limit switch failure (at end of travel for bridge and trolley)

Digital I&C Design and Development

- Design and development of any RBC software-based components follows a rigorous quality assurance program to ensure high quality and reliable operation based on the safety and risk significance.
- RBC Software Integrity Level (SIL)
  - RBC is nonsafety-related, risk-significant which invokes SIL 3
  - Independent verification and validation is required for SIL 3 and SIL 4 digital I&C.
- NuScale Digital I&C Software Quality Assurance Program described in DCA Section 7.2.1, and complies with ASME NQA-1-2008 and NQA-1a-2009

Initial Testing Program

ASME NOG-1 and Other Required Controls Testing (from DCA Table 14.2-52 and 14.2-52a)

- E-stop functionality
- Functional testing of controls and components
- Full load test
- Test limit switches
- Test speed limit at full load
- Two-blocking
- Brake function (redundant brakes for hoist and travel)
- Lowering speed limit and lowering brake test

Initial Testing Program

Prerequisites

- Site Acceptance Testing
- Rated Load Test – ASME NOG-1 – Hoists (Main, Aux and Wet)
- Rated Load Test – ANSI N14.6 – MLA and NPM lift fixture
- Instrument Calibrations completed

Component Testing

- Controls – interlocks and limits on RBC motion tested
- Loss of Control/Power or Seismic event – Results in no movement of bridge trolley, all hoists and brakes are set

Initial Testing Program

Component Testing (continued)

- Load Path Verification includes:
  - speeds - max limits enforced
  - bridge/trolley movement - toggles from full speed to microspeed when in proximity to reference locations – other NPMs or load path boundary
  - Main hoist movement – elevation enforced and proximity
  - Main hoist rotation
  - Full seating of NPM in reactor bay receiver

ITAAC

ITAAC 03.10.01

- ASME NOG-1 Inspection of main hoist machinery – redundant and non-redundant structural components – bridge, trolley, wire rope drum, hook, drive train, two-blocking and overload

ITAAC 03.10.02 and 03.10.03

- ASME NOG-1 Inspection of aux and wet hoist machinery – same scope as ITAAC 03.10.01

ITAAC 03.10.04

- ASME NOG-1 main hoist Full Load (100%) and Rated Load (125%) testing

ITAAC 03.10.05 and 03.10.06

- ASME NOG-1 aux and wet hoists Full Load and Rated Load testing

ITAAC

ITAAC 03.10.07

- ASME NOG-1 NDE of RBC as-built welds

ITAAC 03.10.08

- ASME NOG-1 NDE of wet hoist as-built welds

ITAAC 03.10.09

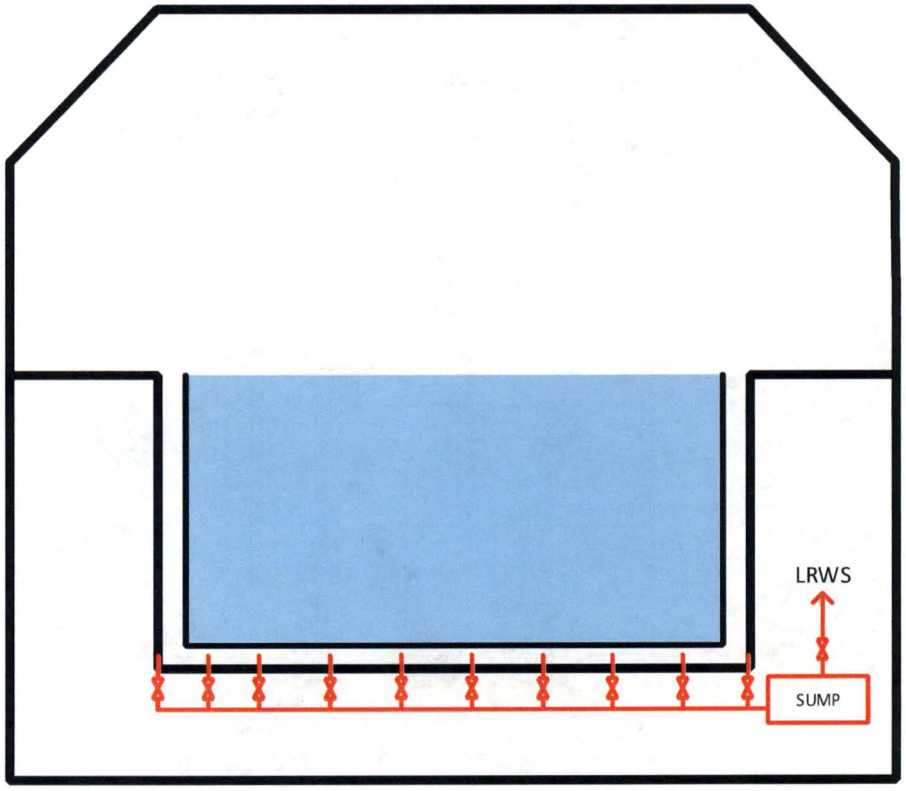
- ANSI N14.6 MLA single load path tested to 300% of Manufacturer's rating
- ANSI N14.6 MLA dual load path tested to 150% of Manufacturer's rating
- ANSI N14.6 MLA load bearing welds undergo NDE testing

ITAAC 03.10.10

- ANSI N14.6 MLA inspection of lifting arms and pinned clevis

Pool Liner

- Liner Functions:
  - Protect concrete from the borated pool water.
  - Collect pool leakage and direct to sumps.
- Seismic Category I
- High sump level alarms in control room



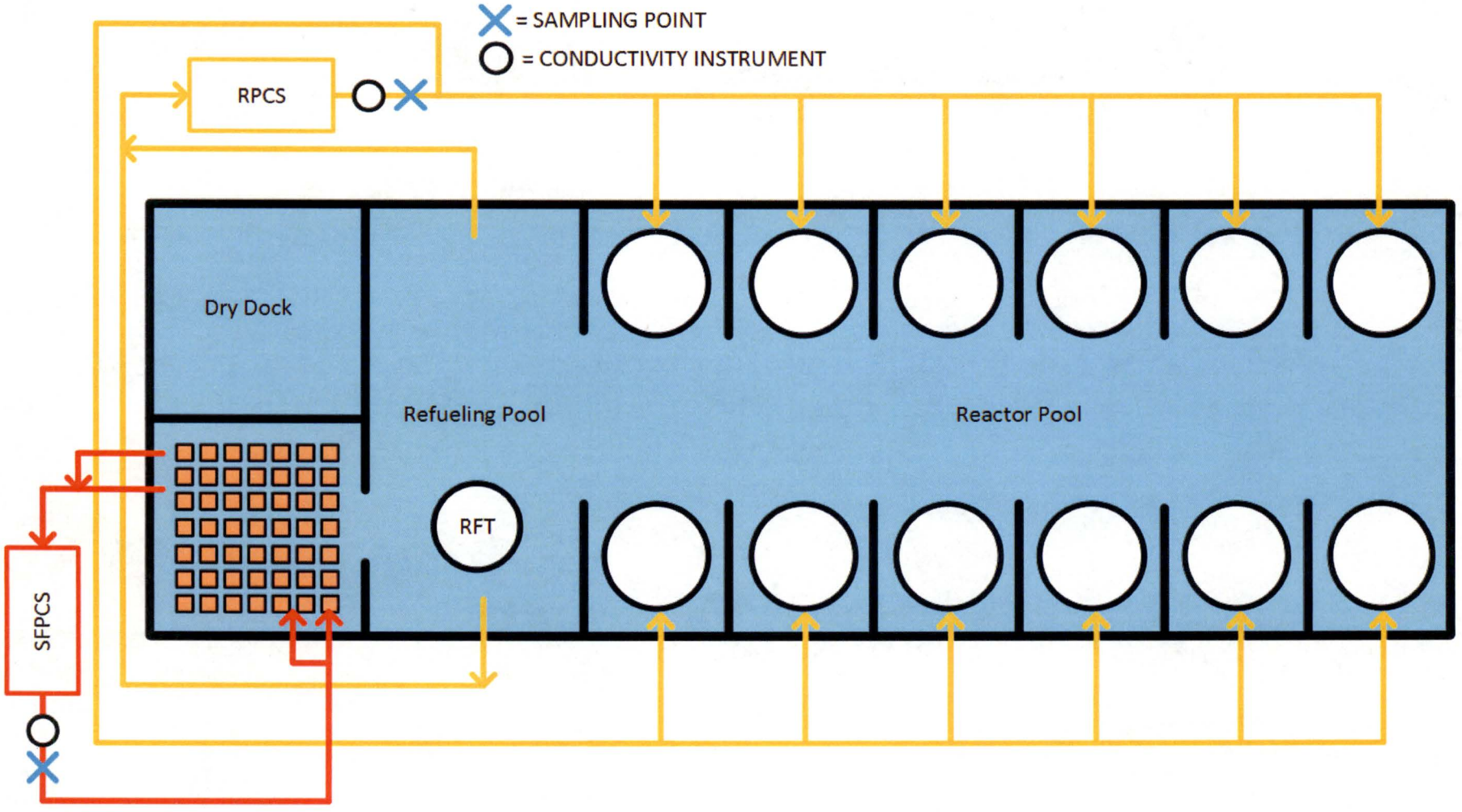
Pool Liner

- RXB floor slab is 10 feet of reinforced concrete
- RXB floor slab is capable of withstanding a module drop from maximum hook height without damaging the concrete in such as a way as to cause significant damage to RXB concrete
- Pool liner rupture would result in negligible loss from UHS inventory
  - Flooding would fill gaps and channels between liner and RXB concrete

Reactor Pool Mixing

- Spent Fuel Pool Cooling System
  - 2x 1250 gpm pump & heat exchanger trains
- Reactor Pool Cooling System
  - 3x 1250 gpm pump & heat exchanger trains
- Combined minimum operating flow (1 SFPCS / 1 RPCS)
  - 3.6 Million gallons / day (~7 Million gallon pool)
- Sample points on discharge of RPCS, SFPCS, and PCUS
- Conductivity monitors on outlet of RPCS, SFPCS, and PCUS
  - Conductivity mismatch between systems could indicate a difference in boron concentration between pools

Reactor Pool Mixing



Reactor Pool Mixing

- Shutdown Margin verified by TS 3.1.1
  - SR 3.1.1.1 (will use samples from RPCS to verify pool boron concentration)
    - Every 24 hours
- UHS boron concentration verified by TS 3.5.3
  - SR 3.5.3.3
    - Every 31 Days
    - And within 6 hours after each solution volume increase of ≥ 15,000 gal

Acronyms

- ANSI – American National Standards Institute
- ASME – American Society of Mechanical Engineers
- aux – Auxiliary
- CNV – Containment Vessel
- DCA – Design Certification Application
- E-Stop – Emergency Stop
- FHM – Fuel Handling Machine
- ft – feet
- gpm – gallons per minute
- I&C – Instrument and Control
- ITAAC - Inspections, Tests, Analyses, and Acceptance Criteria
- MCS – Module Control System
- min – minute
- MLA – Module Lifting Adapter
- NDE – Nondestructive Examination
- NPM – NuScale Power Module
- PCS – Plant Control System
- QAPD – Quality Assurance Program Description
- PCUS – Pool Cleanup System
- RBC – Reactor Building Crane
- RFT – Refueling Tool
- RG – Regulatory Guide
- RPCS – Reactor Pool Cooling System
- RPV – Reactor Pressure Vessel
- RXB – Reactor Building
- SFPCS – Spent Fuel Pool Cooling System
- SIL – Software Integrity Level
- SR – Surveillance Requirement
- SRP – Standard Review Plan
- TS – Technical Specification
- UHS – Ultimate Heat Sink

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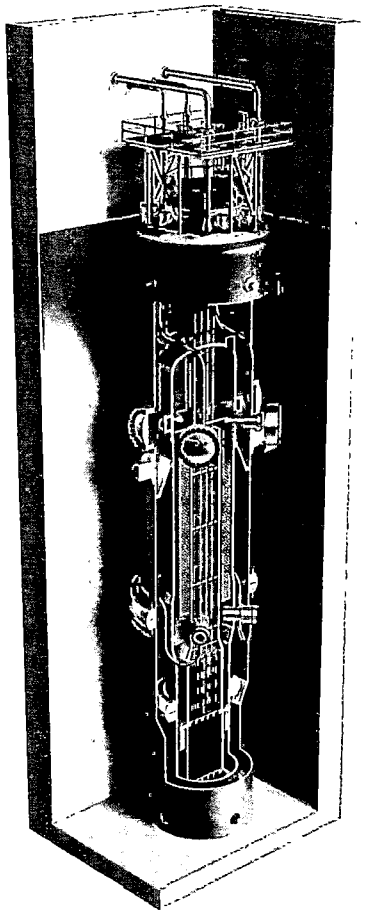

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