NuScale Testing Programs

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Testing & Demonstration

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NuScale Power™

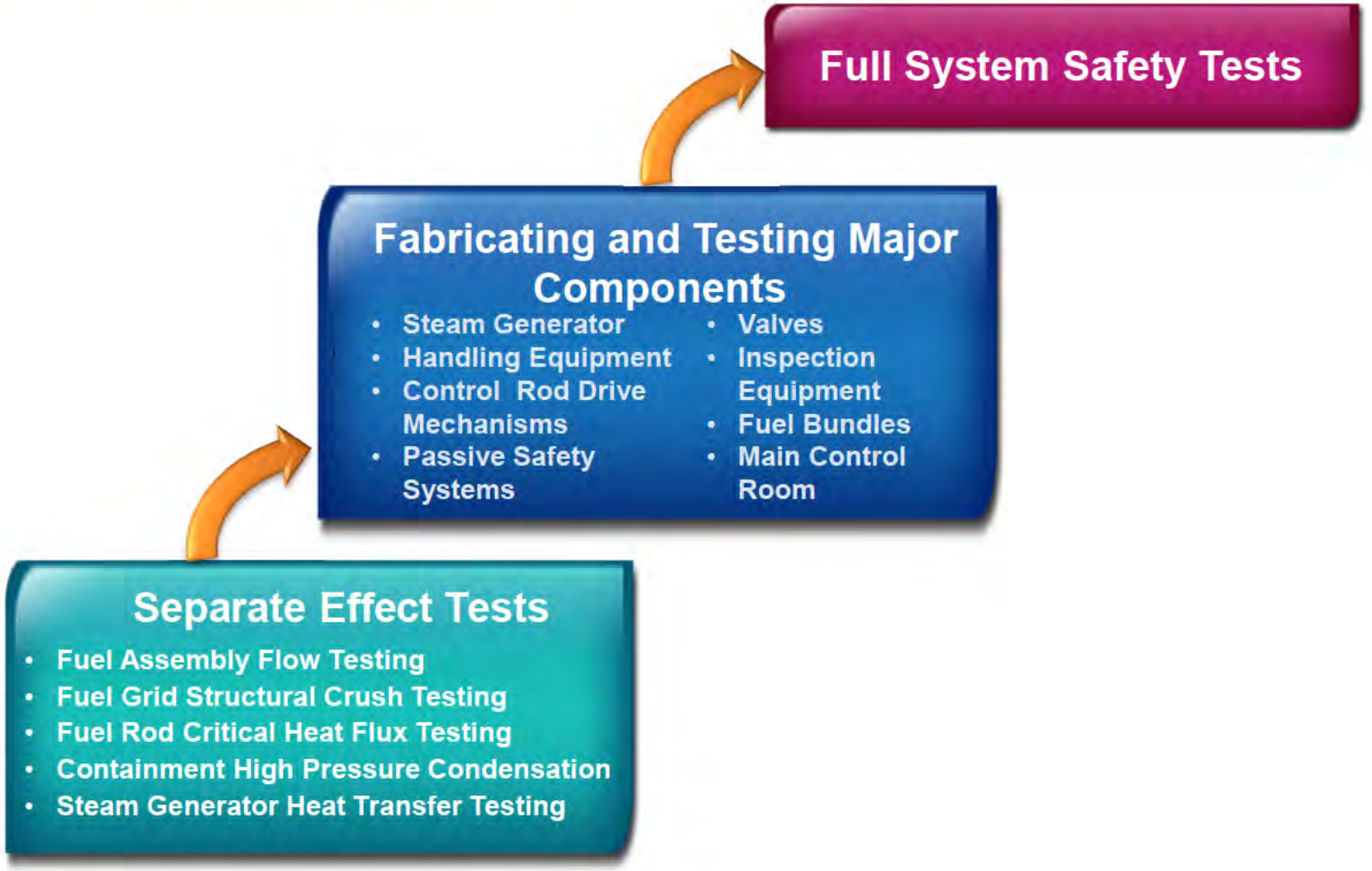
Outline

- Presentation Objectives
- Overview of Test Programs
- Details of Thermal Hydraulic Test Programs
  - Critical Heat Flux Test Program
  - Integral System Test Program
  - Helical Coil Steam Generator Test Programs

Objectives of the Presentation

- Provide a brief overview of the NuScale testing programs being used to obtain data needed to support safety-related and commercial design and analysis efforts.
- Interact early with the NRC to resolve any potential technical or regulatory issues.
- Elicit feedback on planned TH test programs with respect to adequacy of test matrices to support a high-quality Design Certification Application.
- Identify which TH programs NRC would want to observe or perform additional NRC-sponsored testing

Types of NuScale Test Programs



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Overview of NuScale Test Programs

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Overview of NuScale Test Programs

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Fuel Critical Heat Flux Test Program

Description of NuScale Core Design

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Fuel System Design (NF1)

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CHF Testing Needs and Program Objectives

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Geometry and Range of Test Conditions

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STERN Lab CHF Test Loop

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CHF Test Bundle Parameters

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CHF Test Bundle Parameters

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CHF Test Bundle Instrumentation

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CHF Test Matrix

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CHF Test Schedule

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Helical Coil Steam Generator Test Program

Description of Helical Coil Steam Generator

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NuScale Steam Generator Programs

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HCSG Thermal-Hydraulic Testing Needs and Program Objectives

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Earlier HCSG Tests - Full Scale SIET-ISIS Benchmark Data

- 20 MWt ISIS Helical Coil Steam Generator tests performed by SIET in Piacenza, Italy
- 34 steady-state tests and 20 transient tests
- Subset of 16 steady-state tests were used for ELICA code qualification
- Comparisons of ELICA and RELAP5 Mod 3.2 calculations were within 5% of measured SIET data.
- NuScale preliminary HCSG design developed by Ansaldo.

AnsaldoEnergia
Una Società Finmeccanica

Ansaldo - Helical Coil SG RELAP5 Thermal Analysis

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HCSG Thermal Hydraulic Analysis Activities

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HCSG Test Programs at SIET

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SIET - HCSG Electric Direct Heated Testing

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SIET - HCSG Electric Direct Heated Test Matrix

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SIET - HCSG Electric Direct Heated Test Loop

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SIET - HCSG Electric Direct Heated Test Section

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HCSG Electric Direct Heated Test Loop Instrumentation

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HCSG Electric Direct Heated Test Loop Thermocouples

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SIET- HCSG Electric Direct Heated Test Matrix

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SIET- HCSG Electric Direct Heated Testing Schedule

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SIET - HCSG Fluid Heated Testing

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SIET - HCSG GEST Test Parameters

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SIET – HCSG GEST Facility

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SIET GEST Facility Test Loop

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SIET - GEST Facility Tube Geometry

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GEST Facility Tube Headers

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GEST Facility Instrumentation

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GEST Facility Instrumentation (continued)

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Tube Thermocouple Locations

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SIET- GEST Test Matrix

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SIET- GEST Testing Schedule

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Oregon State University (OSU)/NuScale Integral System Test Program

OSU/NuScale IST Program Objectives

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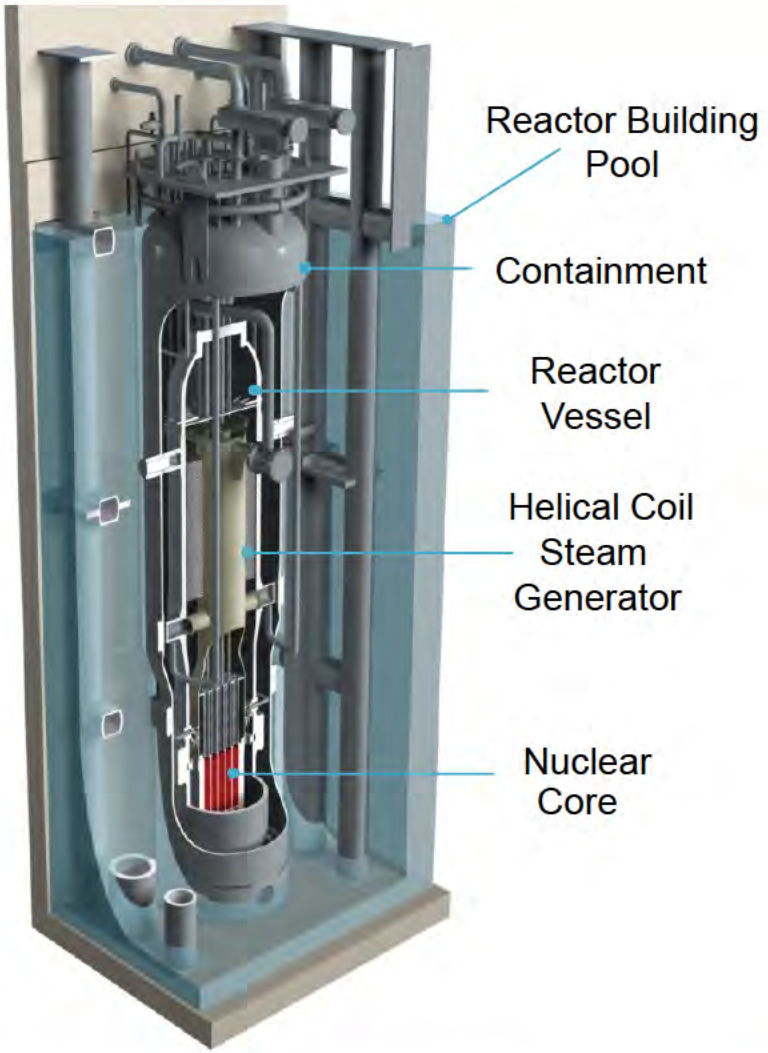
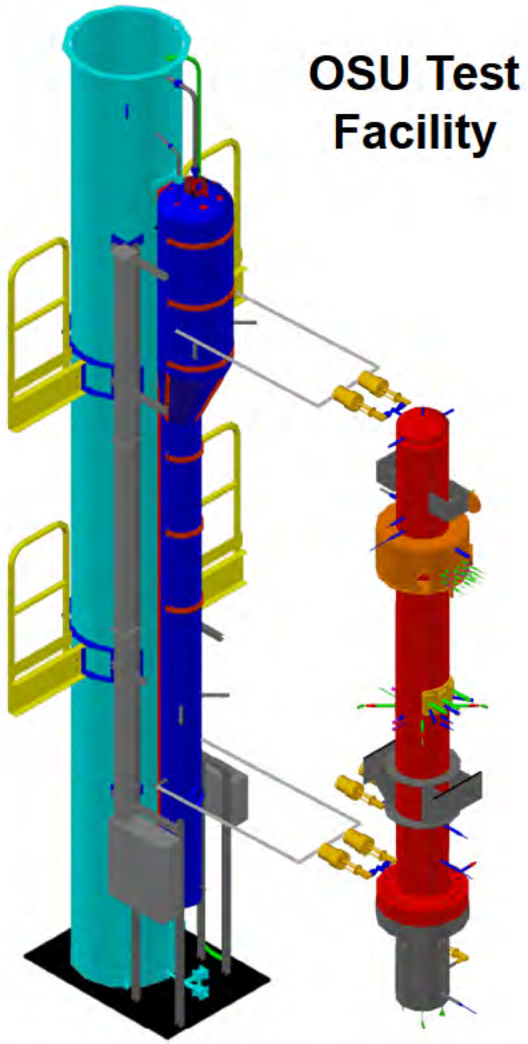
Integral System Tests to model the NSSS, Containment and Pool





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NuScale Power™

NuScale Integral System Test Facility

- One-third scale, integral prototype of NuScale RPV, Containment and Pool
- 1:3 Height and Length scale
- 1:254.7 Volume scale
- Prototypic Pressures & Temperatures
- Stainless steel integral system test facility operating at full system pressure and temperature
  - Reactor vessel
  - Electrically heated rod bundle
  - Core shroud with riser
  - Pressurizer
  - Sump recirculation valves
  - Helical coil steam generator
  - Variable-speed feedwater pump
  - Containment vessel
  - Containment cooling pool
  - Instrumentation

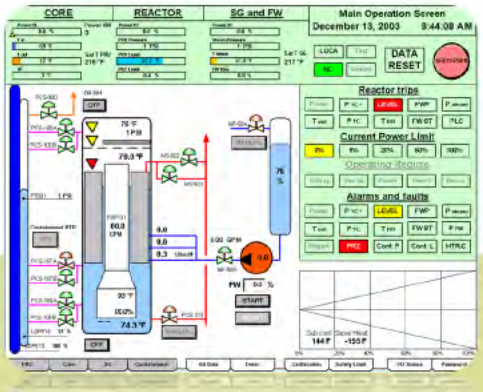
NUSCALE INTEGRAL TEST FACILITY

Scaled Integrated Reactor Facility

- 1:3 Height and Length scale
- 1:254.7 Volume scale
- Prototypic Pressures - Temperatures
- Reactor Vessel
  - Two Reactor Vent Valves (RVV)
  - Two Reactor Recirculation Valves (RRV)
  - Helical Coil Steam Generator
  - Pressurizer
  - Electric Core Bundle Simulator
- Containment
- Cooling Pool

V&V Data Acquisition System (DAS)

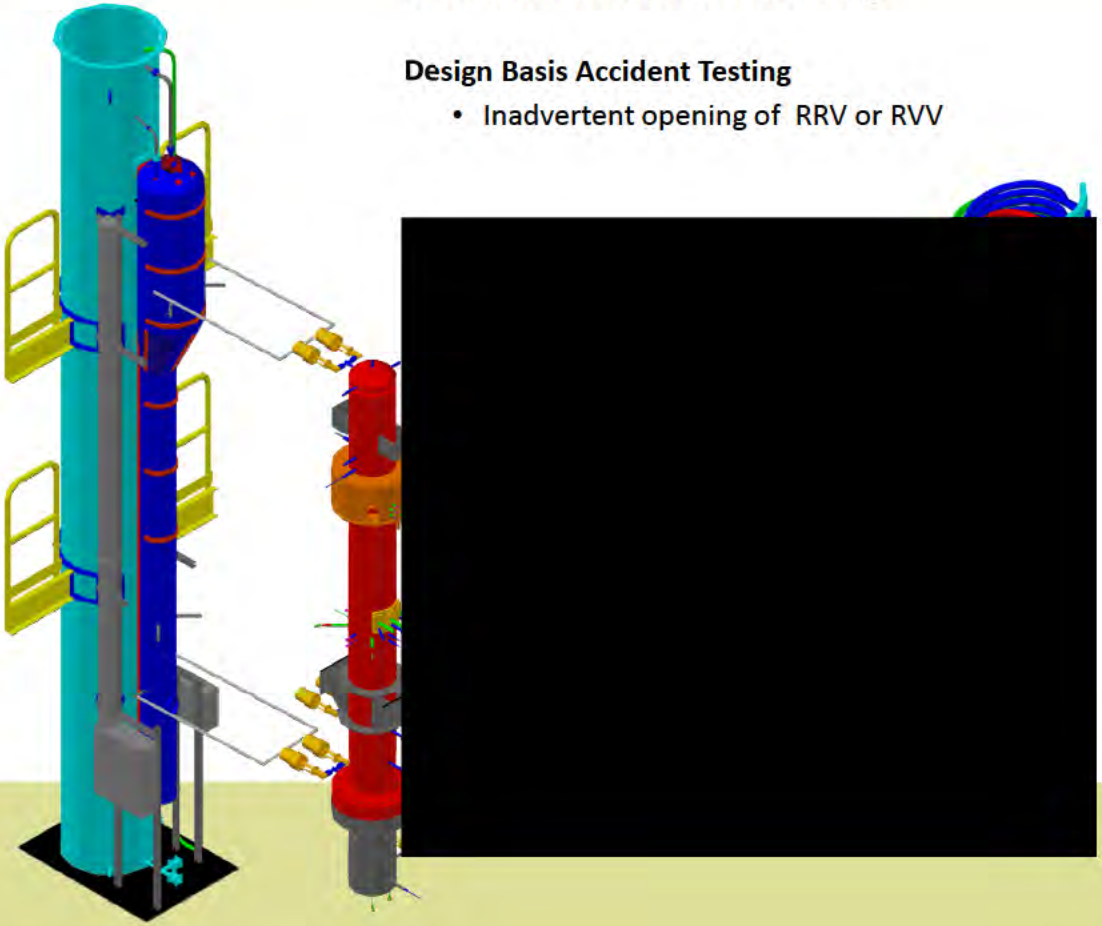
Facility Control System



Shakedown and Operational Testing

Design Basis Accident Testing

- Inadvertent opening of RRV or RVV



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NuScale Test Facility P&ID

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OSU Test Facility Parameters

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Reactor Pressure Vessel Layout

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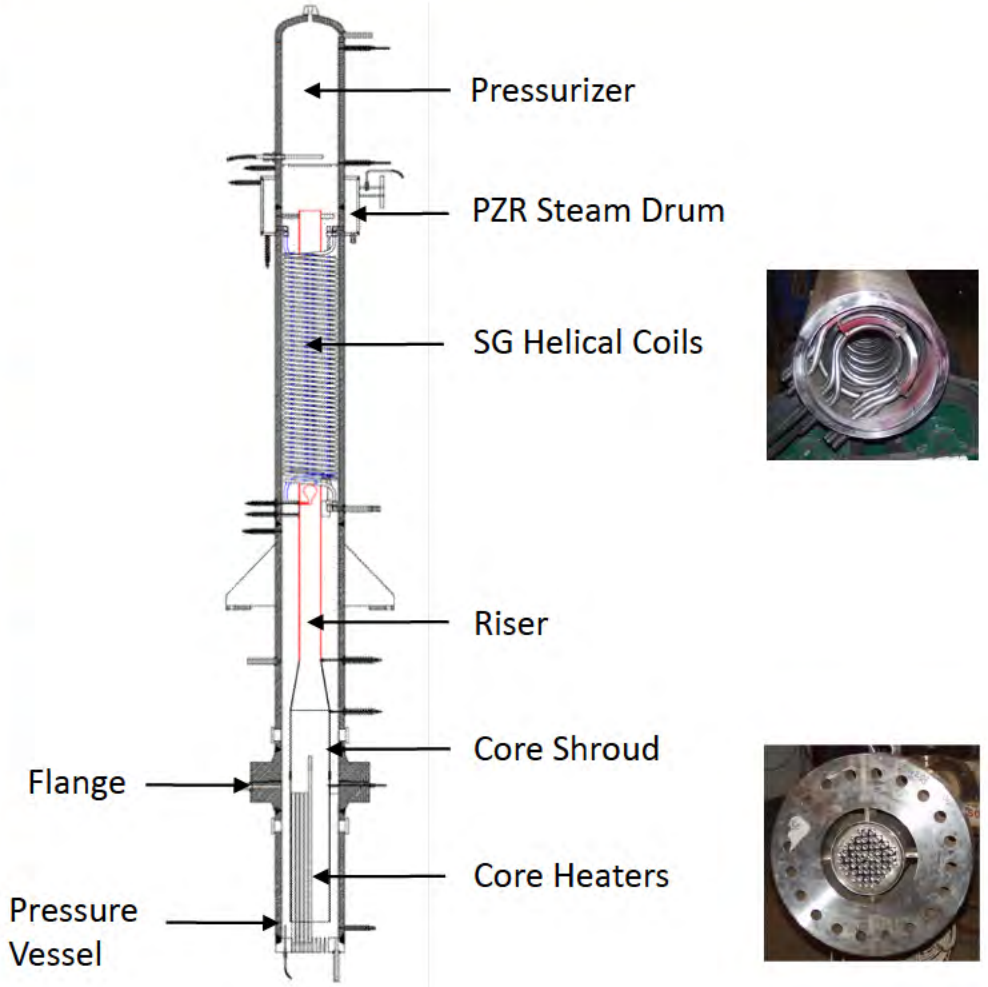
Reactor Pressure Vessel



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Core Layout

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Core Internal Structure

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Core Shroud

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HCSG Layout

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Containment and Cooling Pool

Containment and Cooling Pool

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NuScale IST Instrumentation

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NuScale IST Instrumentation

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NuScale IST Instrumentation

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Thermocouple Locations

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Pressure Measurement Locations

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Facility Upgrades

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Phase 2 Integral Tests

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Phase 2 Integral Tests

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Phase 2 Integral Tests

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Phase 3 Integral Tests

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Summary and Conclusions

- NuScale has developed a testing program that provides data to support commercial and safety related design and analysis efforts.
  - Nine test programs are in the planning phase (budgeted and scheduled)
- Three major thermal hydraulic test programs are underway:
  - Critical Heat Flux Testing
  - Helical Coil Steam Generator Testing
  - Integral System Testing
- Thermal hydraulic test data from these facilities will be available prior to DCA submittal.