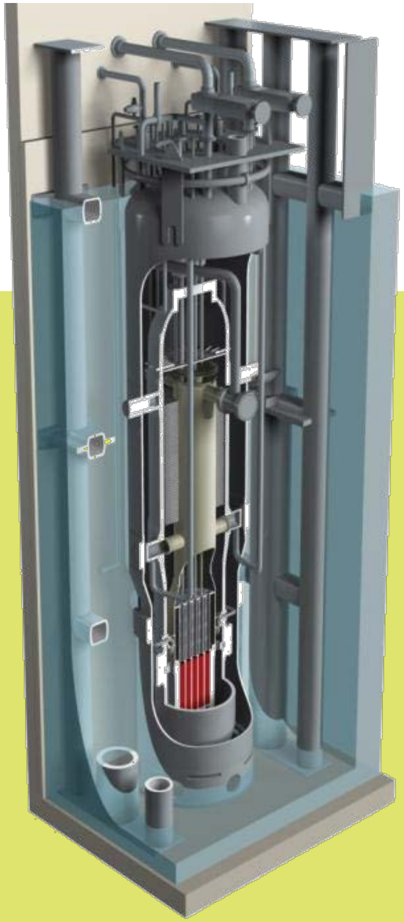


Overview Of New Nuclear Technologies

September 25, 2014

Joint Select Task Force on Nuclear Energy

NuScale Power™

Nuclear Technologies

- Large Light Water Reactors :
  - AP-1000
    - 2 licensees with Combined Licenses (COL) under construction:
      - Vogtle Units 3 and 4
      - V.C. Summer Units 2 and 3
    - Planned (COL application active with NRC) for Progress Energy Florida (Levy County Units 1 and 2), Florida Power and Light (Turkey Point Units 6 and 7) and Duke Energy (William States Lee III, Units 1 and 2)
  - Watts Bar Unit 2 Reactivation (Westinghouse PWR)
  - ESBWR Design Certified by NRC last week
    - Planned (COL application active with NRC) for Dominion Virginia Power (N. Anna, Unit 3) and Detroit Edison Co. (Fermi, Unit 3)
  - U.S. EPR
    - Planned (COL application active with NRC) for PPL Bell Bend (No activity before 2015), Calvert Cliffs Unit 3

Nuclear Technologies

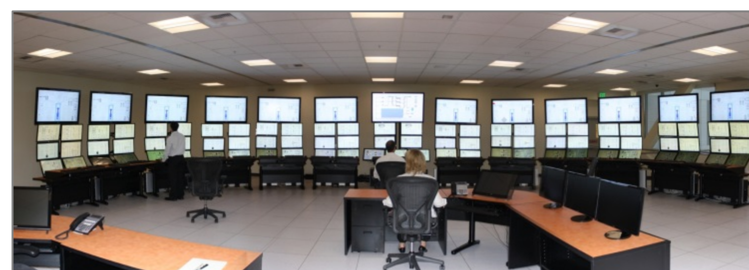
- Small Modular (Light Water) Reactors (SMRs) :
  - NuScale: 50MWe/module, 12 modules per site
  - Generation mPower: 180MWe/unit, typically 2 units per site
  - Holtec: 160MWe
  - Westinghouse: 225MWe
- TerraPower Gen IV Travelling Wave Reactor
  - Projected commercialization late 2020's
- Many other designs exist in varying stages of development and activity.

NuScale Power History

- NuScale first of current US SMRs to begin design of commercial NPP.
- NuScale technology in development and design since 2000 (DOE) MASLWR program, lessons from AP1000 ¼-scale testing
- Electrically-heated 1/3-scale Integral test facility first operational in 2003
- Began NRC design certification (DC) pre-application project in April 2008
- ~380 FTE's currently on project, ~$230MM spent project life-to-date
- Twelve-reactor simulated control room operational in May 2012 for Human Factors Engineering development
- DOE announces FOA win in 2013

NuScale Engineering Offices Corvallis

One-third scale Test Facility



NuScale Control Room Simulator

FLUOR® - an American Company

- Acquired majority interest in NuScale in October 2011
- One of the world's leading publicly traded engineering, procurement, construction, maintenance, and project management companies
- #109 in the FORTUNE 500 in 2014
- More than 1,000 projects annually, serving more than 600 clients in 66 countries
- More than 43,000 employees worldwide
- Offices in more than 28 countries on 6 continents
- Over 100 years of experience

Fluor Corporate Headquarters
Dallas, Texas

Revenue	$27.4 billion
New awards	$25.1 billion
Backlog	$34.9 billion

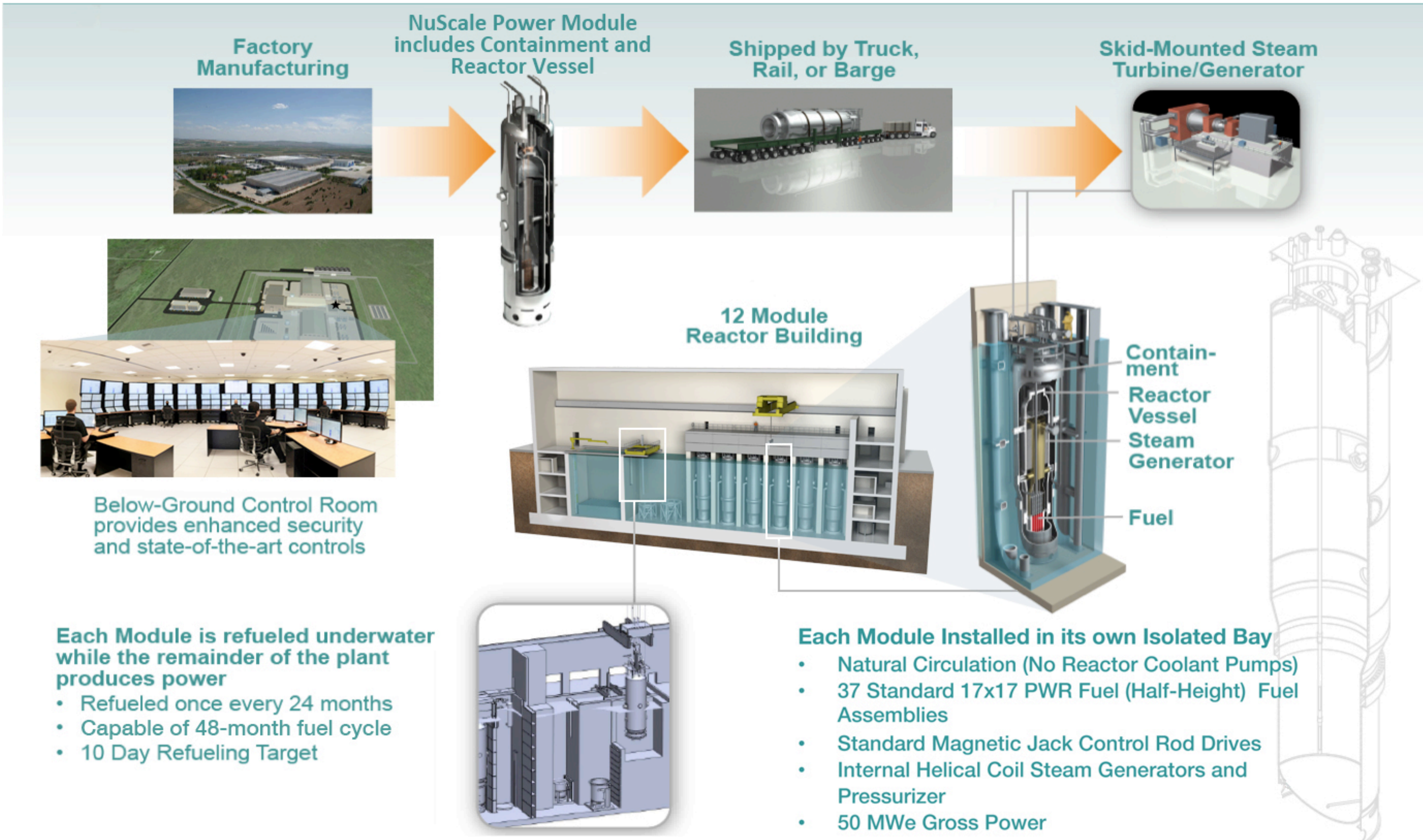
Investment Grade Credit Ratings:

S&P	A-
Moody's	A3
Fitch	A-

Nonproprietary

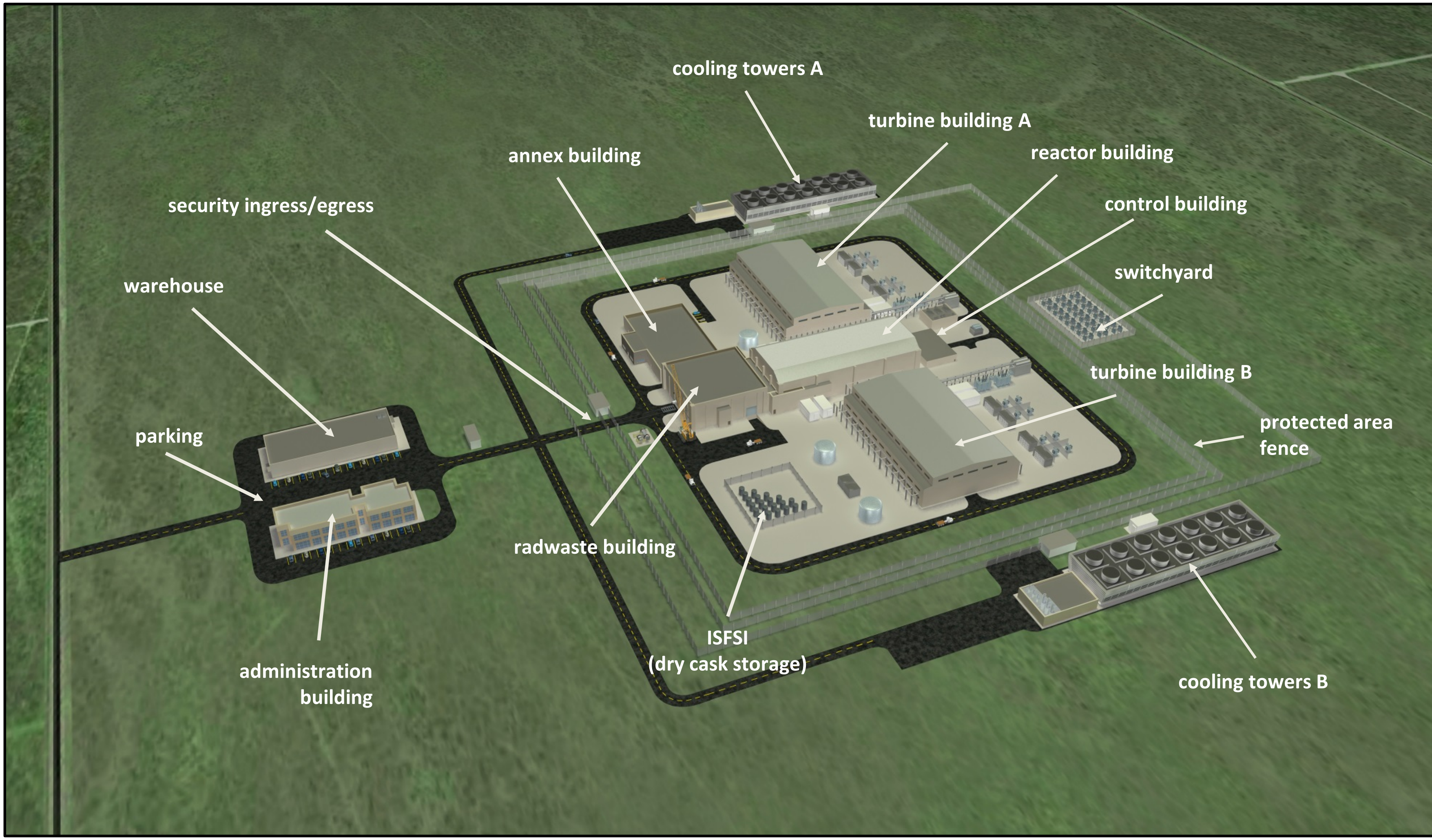
NUSCALE POWER™

Plant Design Overview



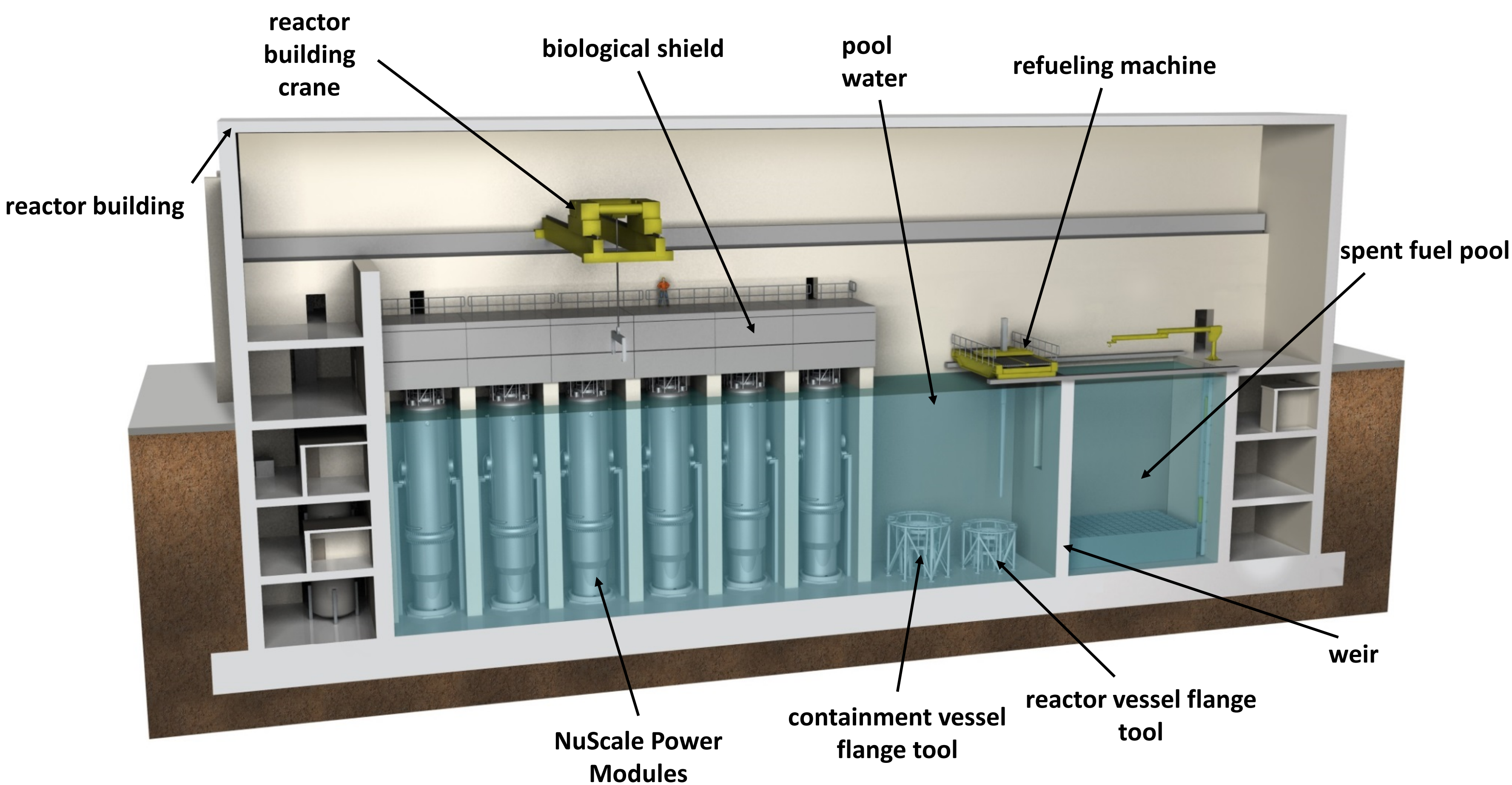
Nonproprietary

Site Aerial View

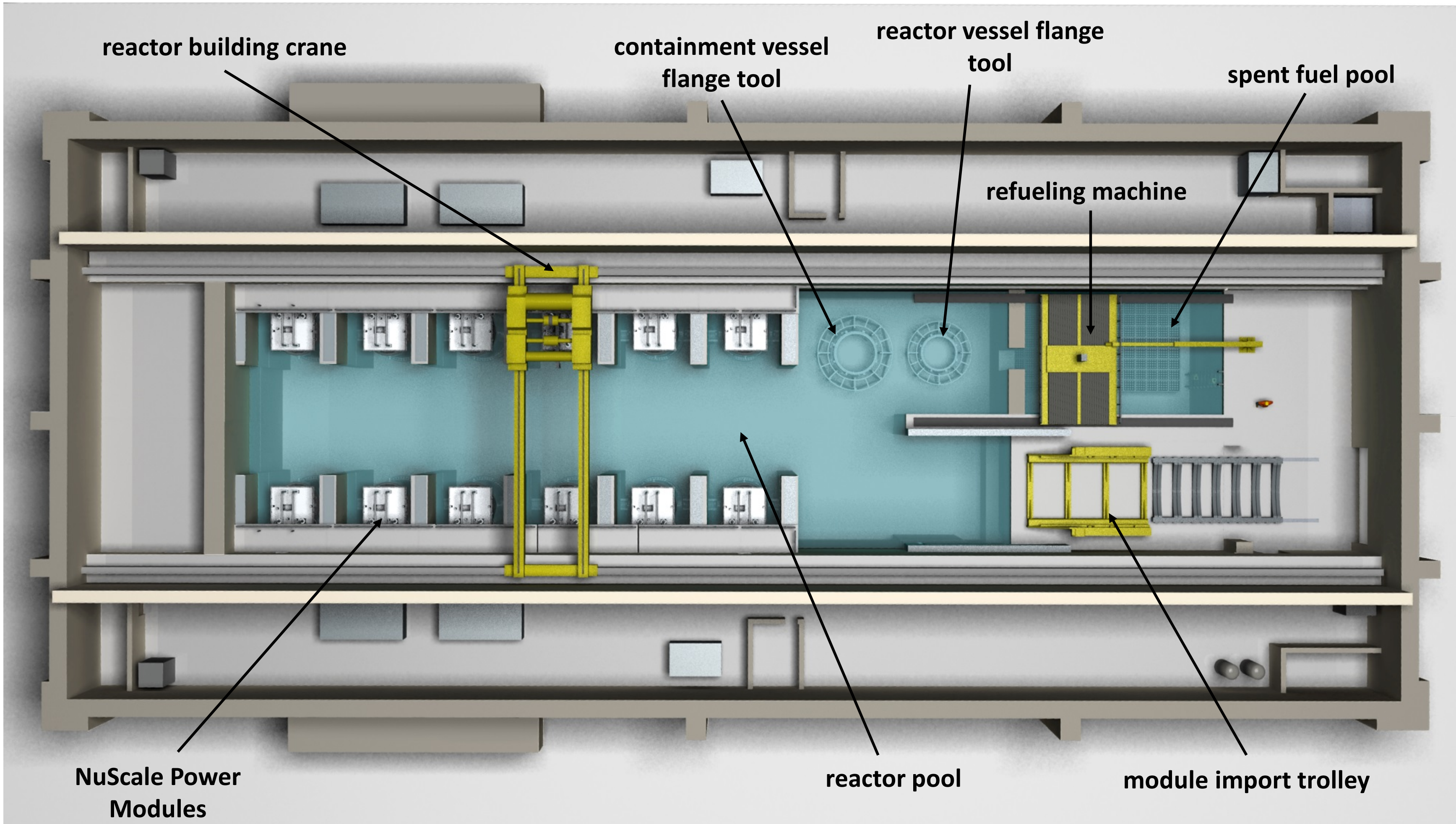


Reactor Building Cross-Section

Reactor building houses reactor modules, spent fuel pool, and reactor pool



Reactor Building Overhead View



NuScale Power™

Basic Plant Parameters

Overall Plant	
• Net electrical output	Up to 570 MWe (nominal)
• Plant thermal efficiency	> 30%
• Number of power generation units	Up to 12
• Nominal plant capacity factor	> 95%
• Total plant area	~44 acres
Power Generation Unit	
• Number of reactors	One
• Gross electrical output	50 MWe
• Steam generator number	Two independent tube bundles (50% capacity each)
• Steam generator type	Vertical helical coil tube (secondary coolant boils inside tube)
• Steam cycle	Superheated
• Turbine throttle conditions	3.3 MPa (475 psia)
• Steam flow	67.5 kg/s (536,200 lb/hr)
• Feedwater temperature	149° C (300 °F)
Reactor Core	
• Thermal power rating	160 MWth (gross)
• Operating pressure	12.7 MPa (1850 psia)
• Fuel design	UO_2 (< 4.95% U^{235} enrichment); 37 half height 17x17 geometry lattice fuel assemblies; Zircaloy-4 or advanced cladding material; negative reactivity coefficients
• Refueling interval	24 months

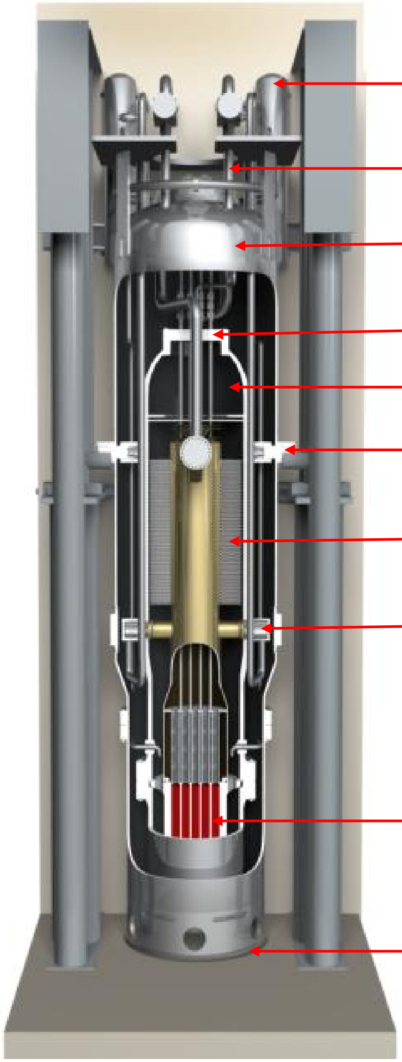
Reactor Module Overview

Natural convection for cooling

- passively safe, driven by gravity, natural circulation of water over the fuel
- no safety-related pumps, no need for emergency generators

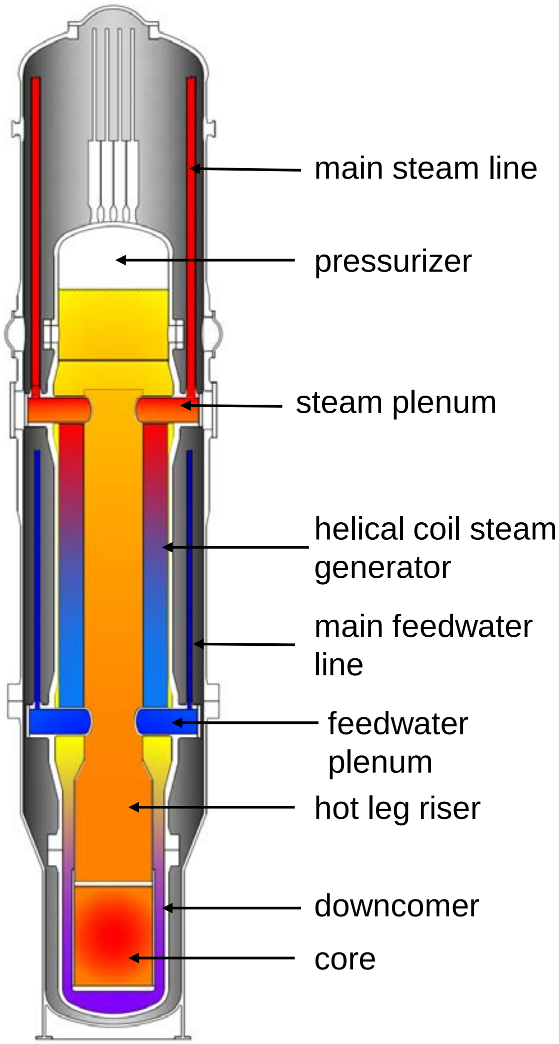
Simple and small

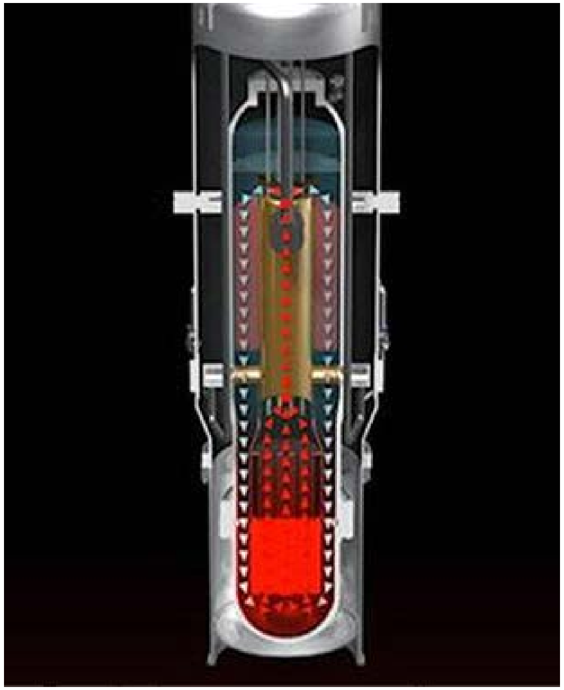
- reactor is 1/20th the size of large reactors
- integrated reactor design, no large-break loss-of-coolant accidents



Module Normal Operation

- Primary side
  - natural circulation
  - integral pressurizer
- Secondary side
  - feedwater plenums
  - two helical steam generatc
  - steam plenums





primary coolant flow path

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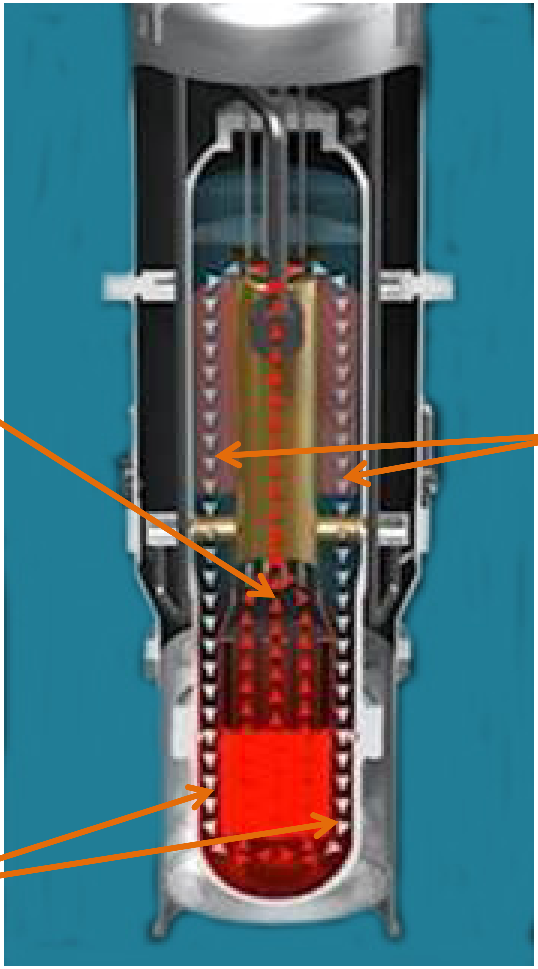
Coolant Flow Driven by Physics

Convection—energy from the nuclear reaction heats the primary reactor coolant causing it to rise by convection and natural buoyancy through the riser, much like a chimney effect



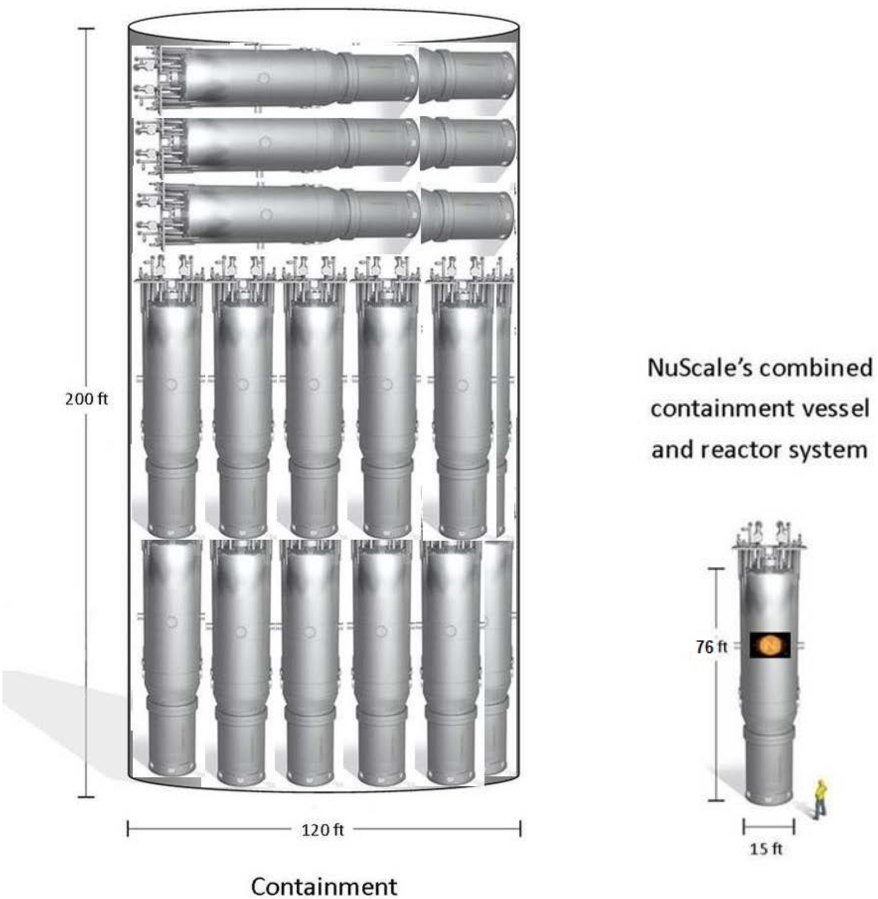
Conduction—heat is transferred from the primary coolant through the walls of the tubes in the steam generator, heating the water (secondary coolant) inside them to turn it to steam

Gravity—colder (denser) primary coolant "falls" to bottom of reactor pressure vessel, cycle continues

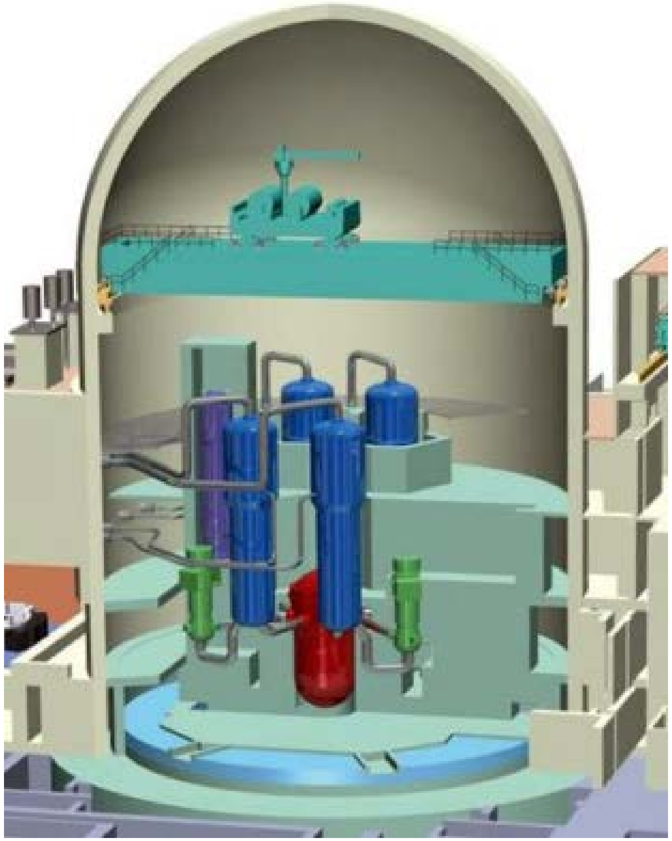
NuScale Power™

Size Comparison

126 NuScale Power Modules



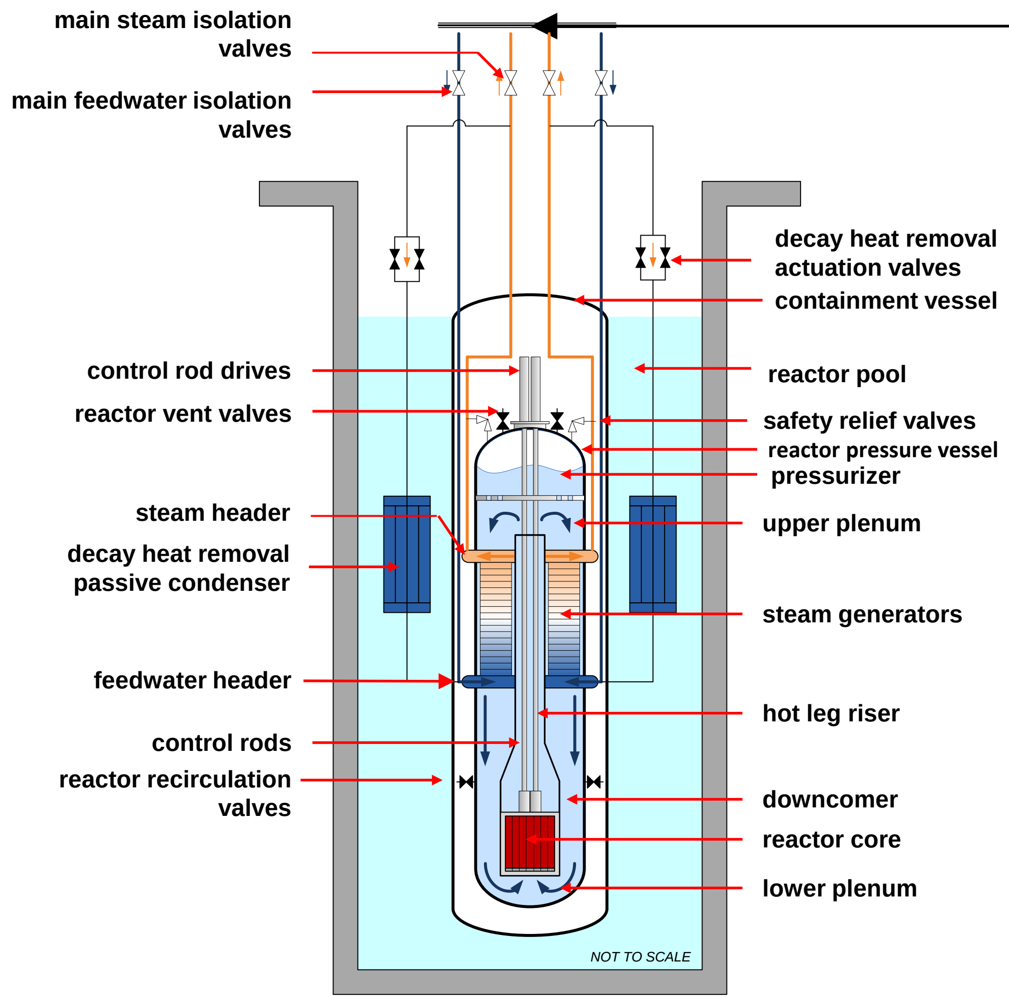
Typical Pressurized-Water Reactor

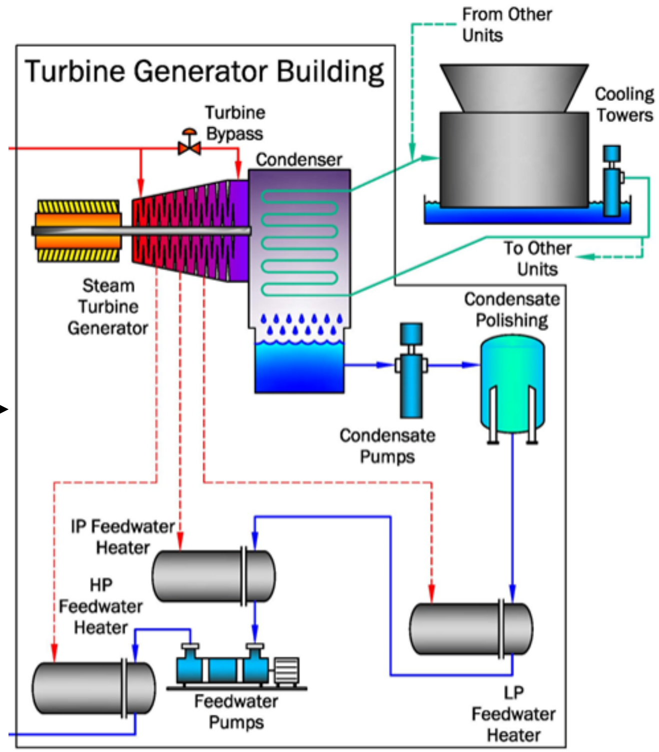


*Source: NRC

Nonproprietary

NuScale Power Train





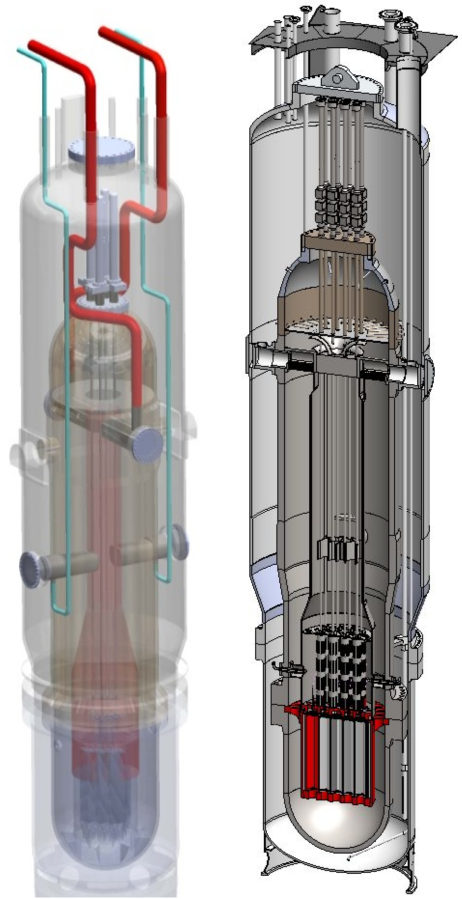
- Each reactor module feeds one turbine-generator (T-G) train eliminating single-shaft risk
- Small, simple components support short simple refueling outages

NuScale Power™

Containment Design

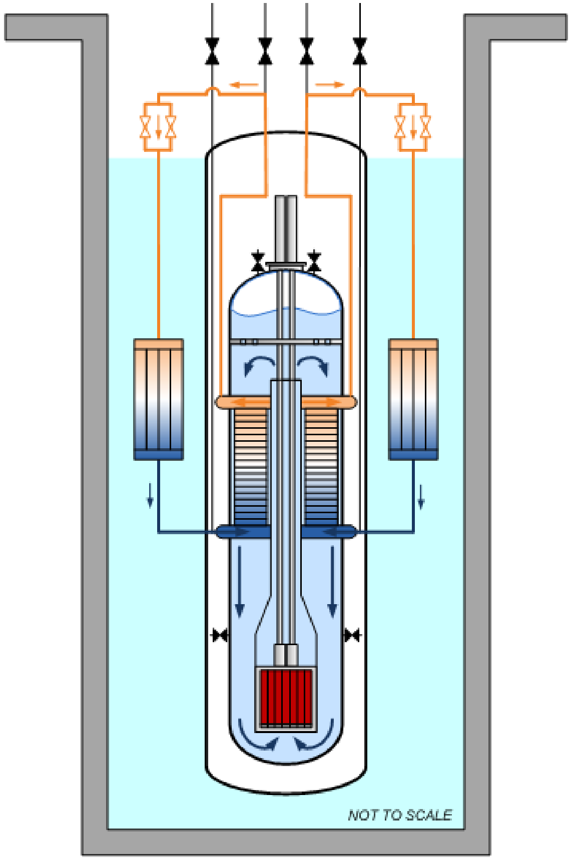
Evacuated Containment—Enhanced Safety

- Containment volume sized so that core does not uncover following a LOCA
- Large reactor pool keeps containment shell cool and promotes efficient post-LOCA steam condensation
- Insulating vacuum
  - significantly reduces conduction and convection heat transfer during normal operation
  - eliminates requirement for insulation on the reactor vessel, therefore, no sump screen blockage issue (GSI-191)
  - improves LOCA steam condensation rates by eliminating air
  - prevents combustible hydrogen mixture in the unlikely event of a severe accident (i.e., little or no oxygen)
  - reduces corrosion and humidity problems inside containment



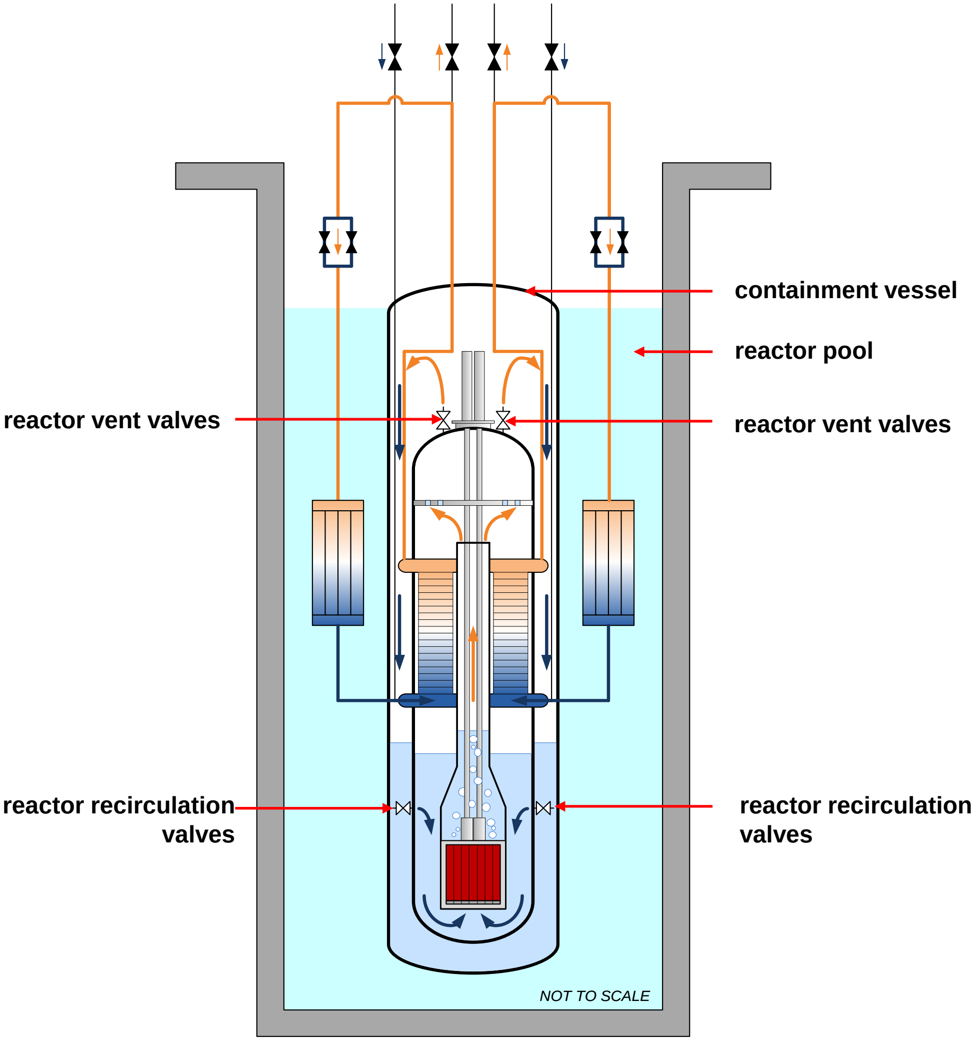
Passive Decay Heat Removal System

- Main steam and main feedwater isolated
- Decay heat removal (DHR) valves opened
- Decay heat passively removed via the steam generators and DHR heat condensers to the reactor pool
- DHR system is composed of two independent single failure proof trains (1 of 2 trains needed)



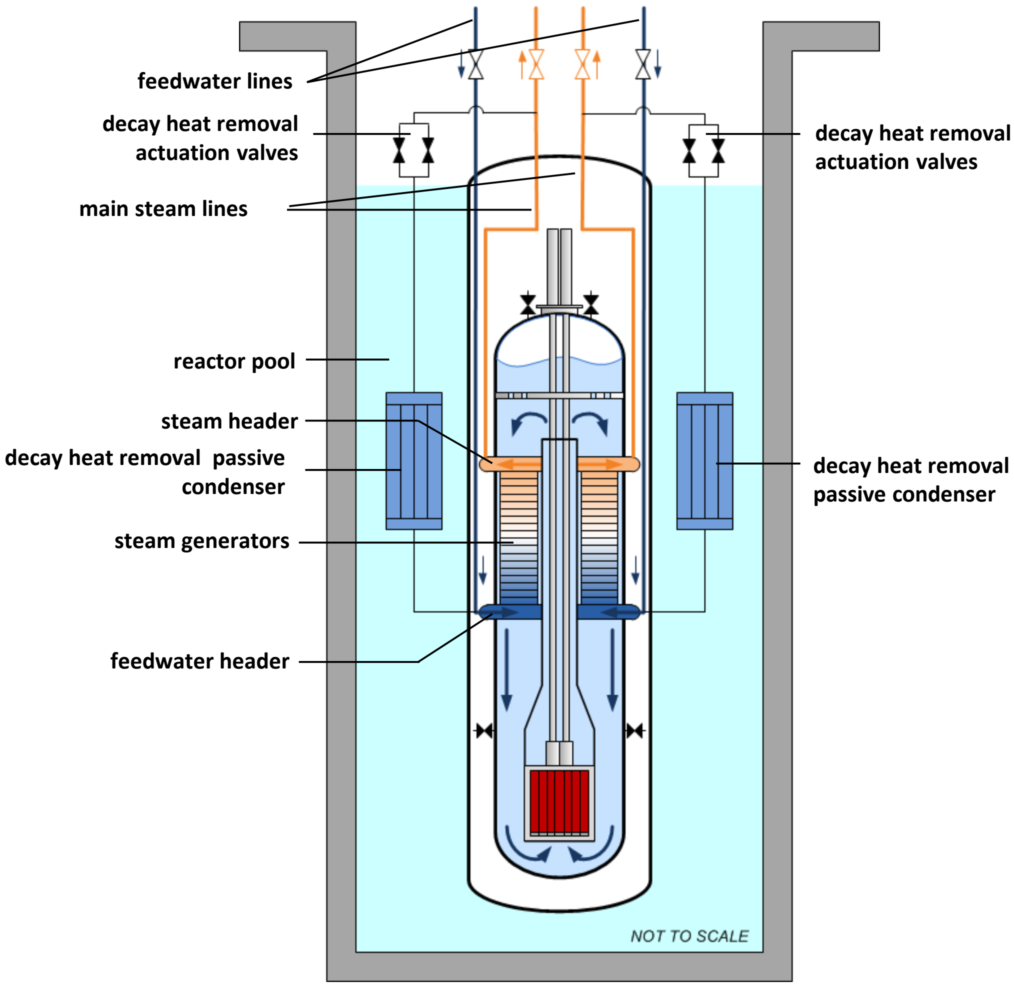
Emergency Core Cooling System and Containment Heat Removal

- Adequate core cooling is provided without the need for safety-related injection
  - Reactor vent valves opened on safety signal
  - Reactor recirculation valves open when containment liquid level is high enough
  - Decay heat removed
    - condensing steam on inside surface of containment vessel
    - convection and conduction through liquid and both vessel walls

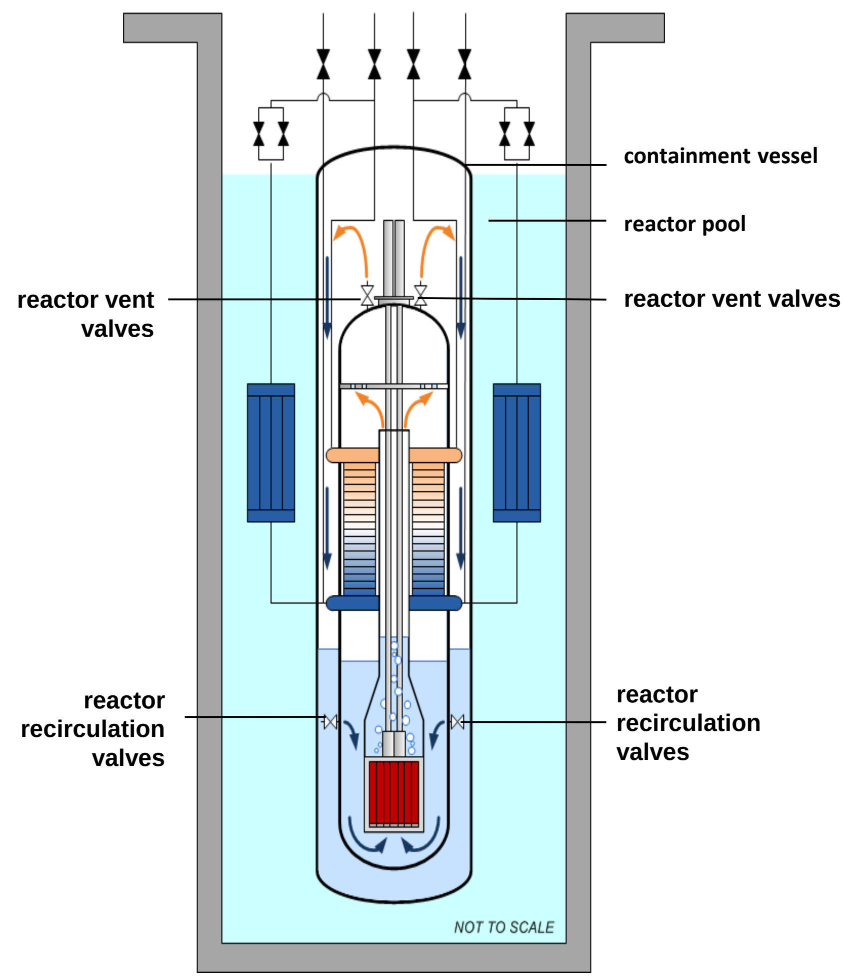


Normal and LOCA Configurations

Normal Operation



LOCA Operation (ECCS)



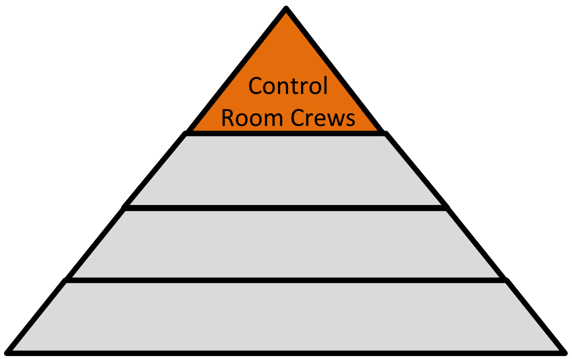
Plant Reliability

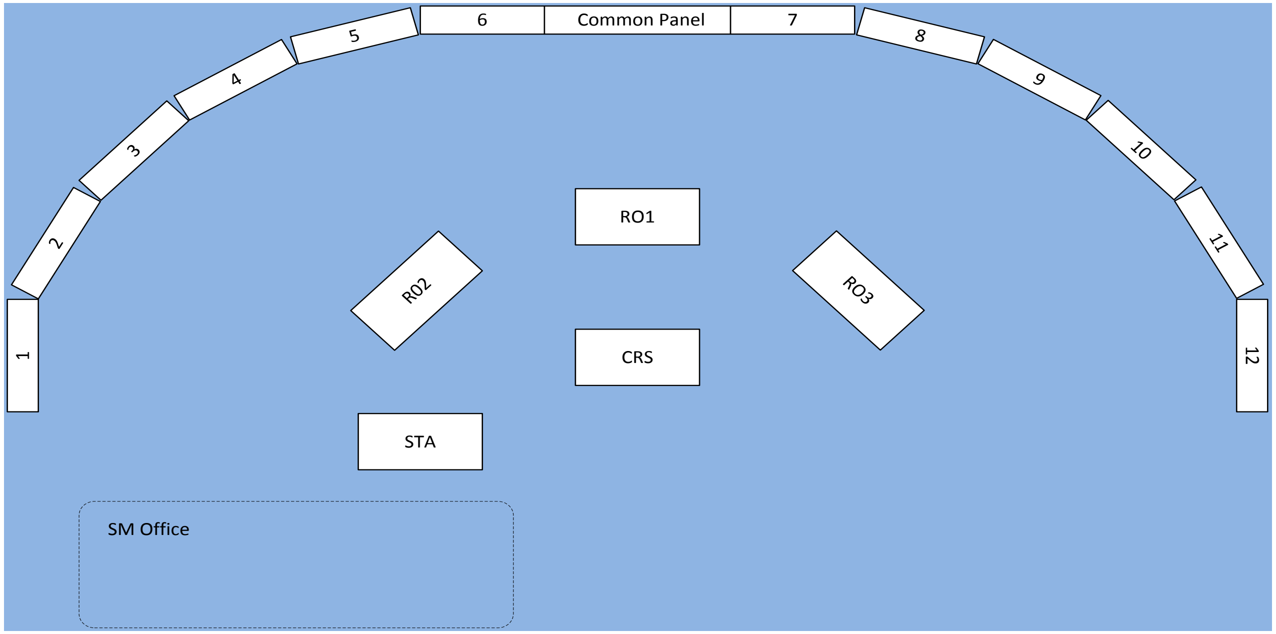
Improved Reliability Through the Use of Multiple Small Units:

- Relatively small and simple turbine generators:
  - economic
  - generator housing air filled and water cooled (no hydrogen, seal oil or stator water cooling systems)
  - single case turbine (no reheat)
  - commercial grade turbine (no missile threat to nuclear safety)
  - single heater train, cascading drains
- No single shaft risk – Independent turbine generators for each reactor module; plant output drops to 92% with 1 of 12 units out of service.
- Refueling Outages – Refueling 1 of 12 units drops plant output to 92%.
- Full turbine steam bypass capability – No reactor trip required for a turbine trip allowing quick return to power after trip condition corrected.
- Island Mode Operation – Allows the plant to stay online after a loss of grid event; house loads remain powered by one turbine generator.

NUSCALE POWER™

Concept of Operations





- 6 Crews of 10 operators provide 24/7 staffing
- 4 Non-Licensed Operators
- 3 Reactor Operators (In Control, Admin, Maintenance Support)
- 3 Senior Reactor Operators

Control Room Simulator

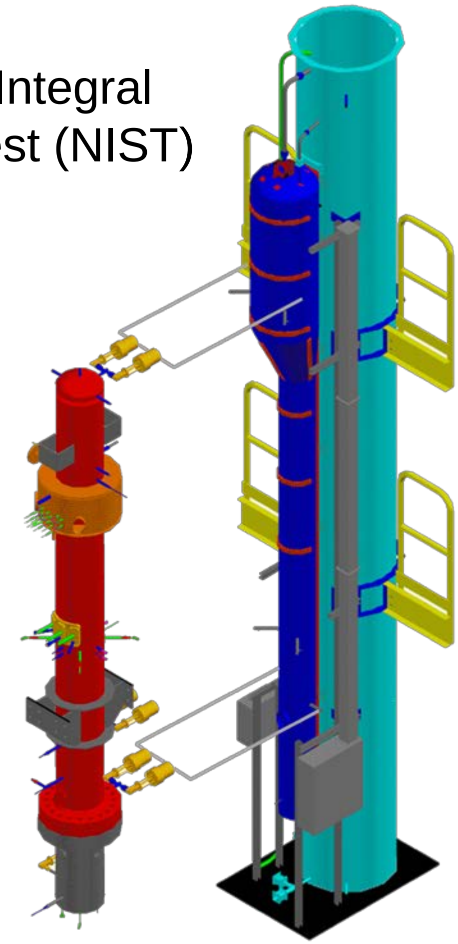
Integral Systems Test at OSU

Objective: Obtain large-scale real-time integral-effects systems data for SBLOCAs, long-term core cooling, and high pressure condensation for validating our NRELAP5 code.

Status:

- successfully tested:
  - SBLOCAs
  - long term core cooling transients
  - high pressure condensation runs
  - station blackout (SBO) transient
- testing shows core never uncovers and fuel never overheats for SBLOCAs & SBO
- results support long term cooling without cooling pool water

NuScale Integral Systems Test (NIST)



NUSCALE POWER™

Integral Systems Test Upgrade

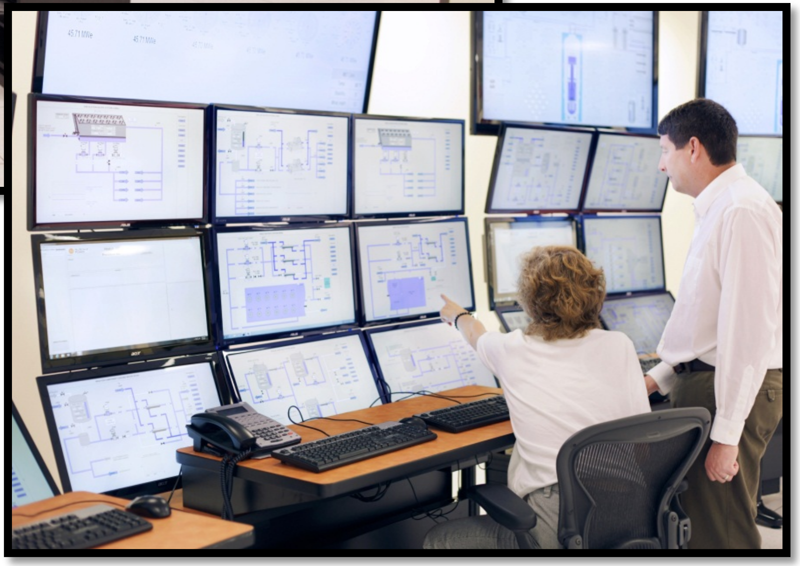
Objective: Reconfigure facility so that it aligns with the current NuScale plant design, increase the pressure rating of the containment vessel, add instrumentation needed for safety code and reactor design validation.

- Replace containment and reactor pool module
- Modify portions of integral reactor vessel
- Add DHRS
- 3X containment vessel pressure rating for blowdowns
- 3X instrumentation for validation

Upgraded facility enables new types of transients, more prototypic testing, and produces higher fidelity data.

Full-Scale Main Control Room Simulator for HFE/HMI Studies

- NRC Review of HFE Program and Site Visit January 2013



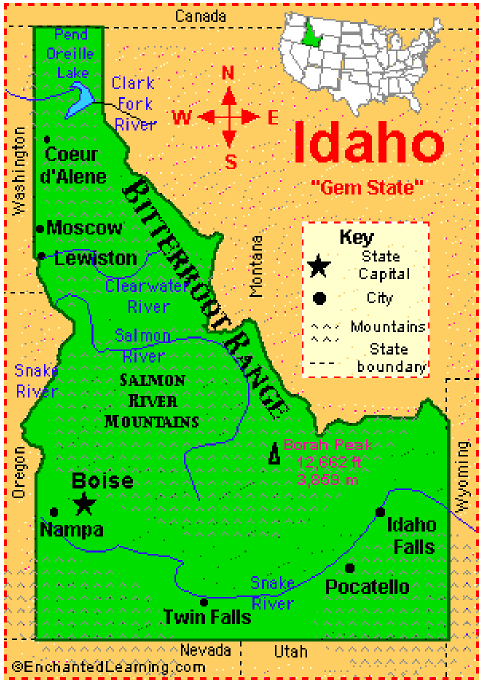
NuScale Power™

Project WIN Details

- First commercial demonstration project: a multi-module NuScale plant with a potential location within the Idaho National Laboratory (INL) Site.
- Expected to become operational in 2023.
- A 12 module plant (574 MWe, net) is anticipated based on a preliminary evaluation of potential generating capacity needs.
- Will provide immediate advantages to the Western region:
  - Provide clean, affordable energy and professional jobs
  - Demonstrate the operations and benefits of this SMR technology
  - Act as a catalyst for subsequent SMR energy facilities throughout the Western states

NuScale COL Application

- NuScale is working with a consortium of parties to deploy its SMR in Idaho.
- The Idaho location could serve as the R-COLA for NuScale
- Plans to start the R-COLA are in the development stage



COMING SOON TO AN
ELECTRIC GRID NEAR YOU!

Dale Atkinson
Chief Operating Officer
datkinson@nuscalepower.com

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