Oregon State University's Small Modular Nuclear Reactor Experimental Program

IEEE Conference on Technologies for Sustainability
August 1, 2013
Portland, Oregon

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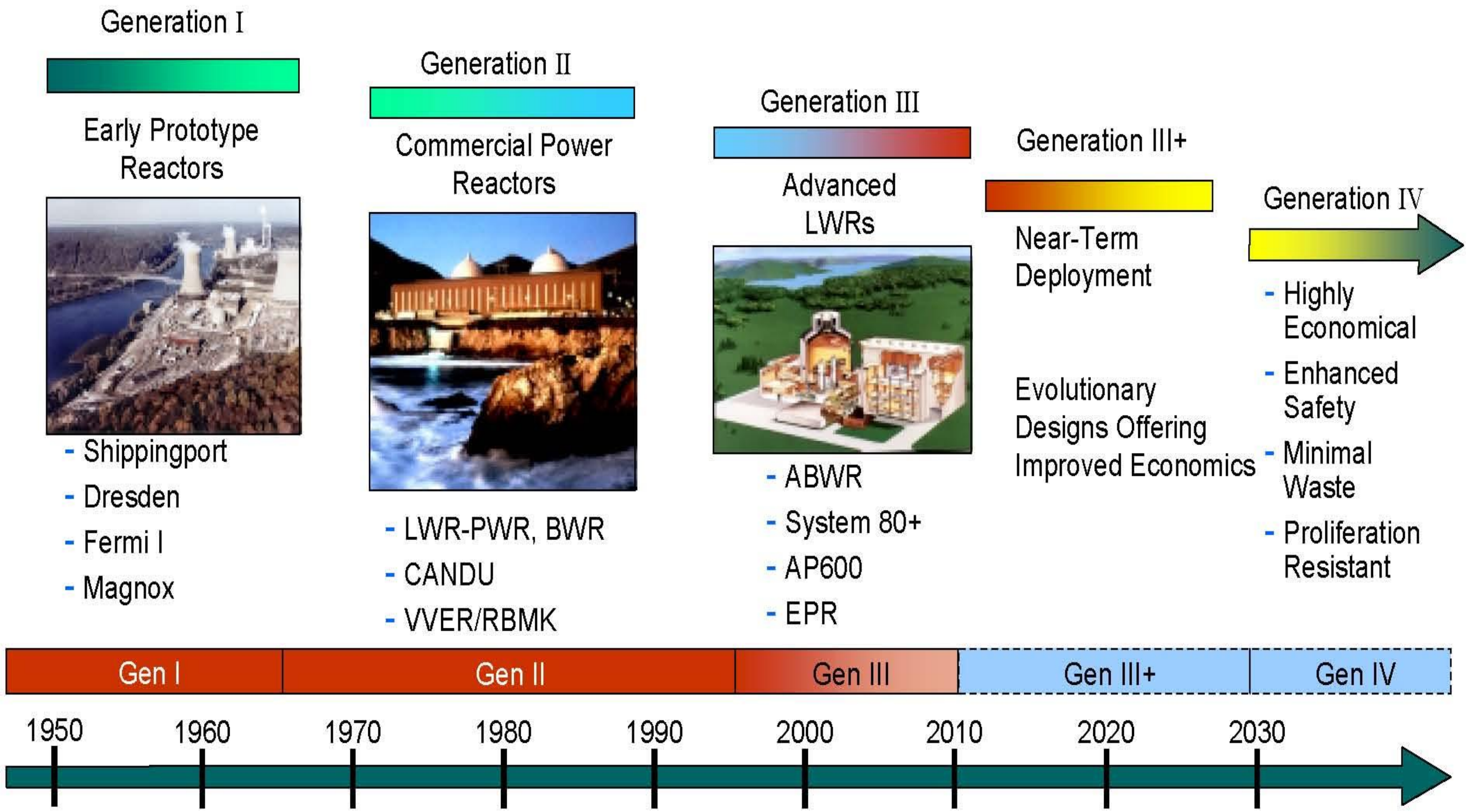
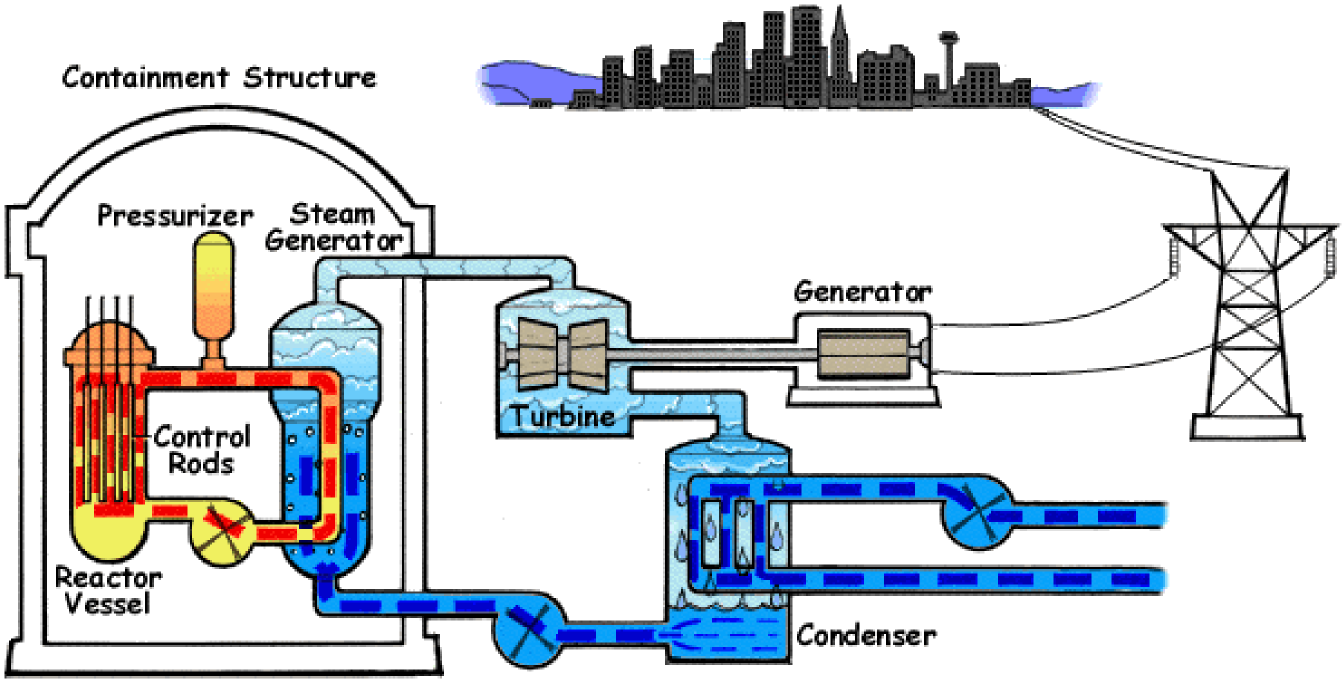
Generation III+ Reactors



Pressurized Water Reactor



- **Currently 104 operating nuclear power reactors in the U.S.**
- **20% of total electrical generation**

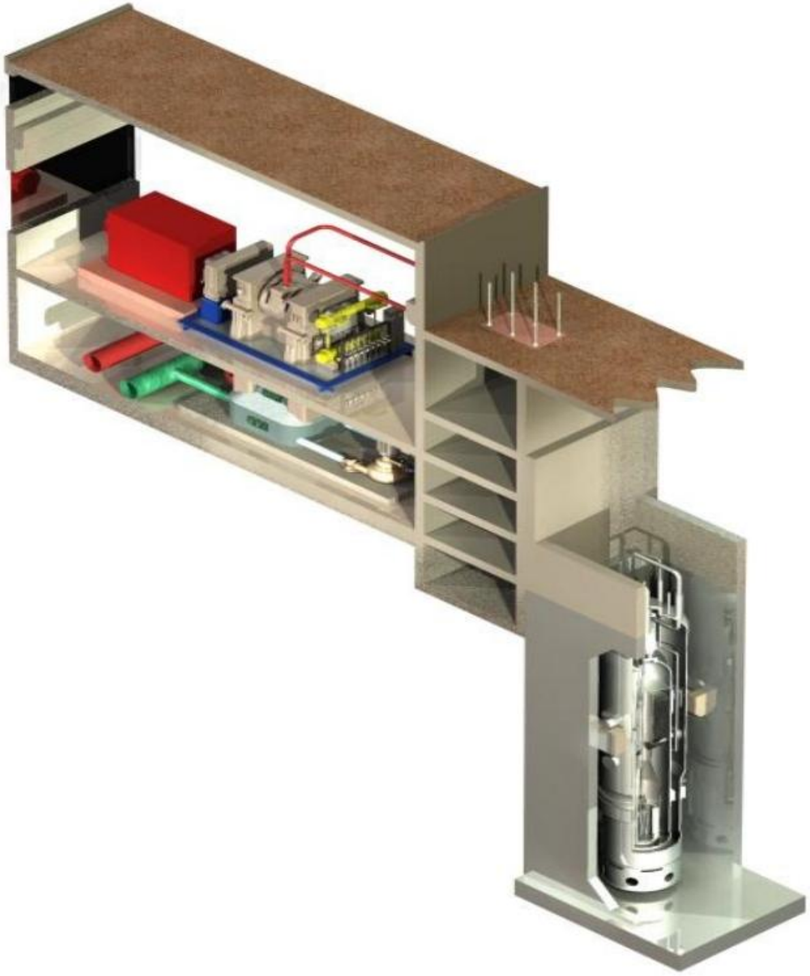
Small Modular Reactors

- **300MWe or less.**
- **Current generation of reactors are typically greater than 1000MWe.**
- **Benefits.**
  - Lower capital cost.
  - Modularity.
  - Infrastructure flexible.
- **Candidate Designs**
  - Pressurized Water Reactors.
    - mPower.
    - NuScale.
    - Westinghouse.
    - Holtec.
  - High Temperature Gas Reactors.

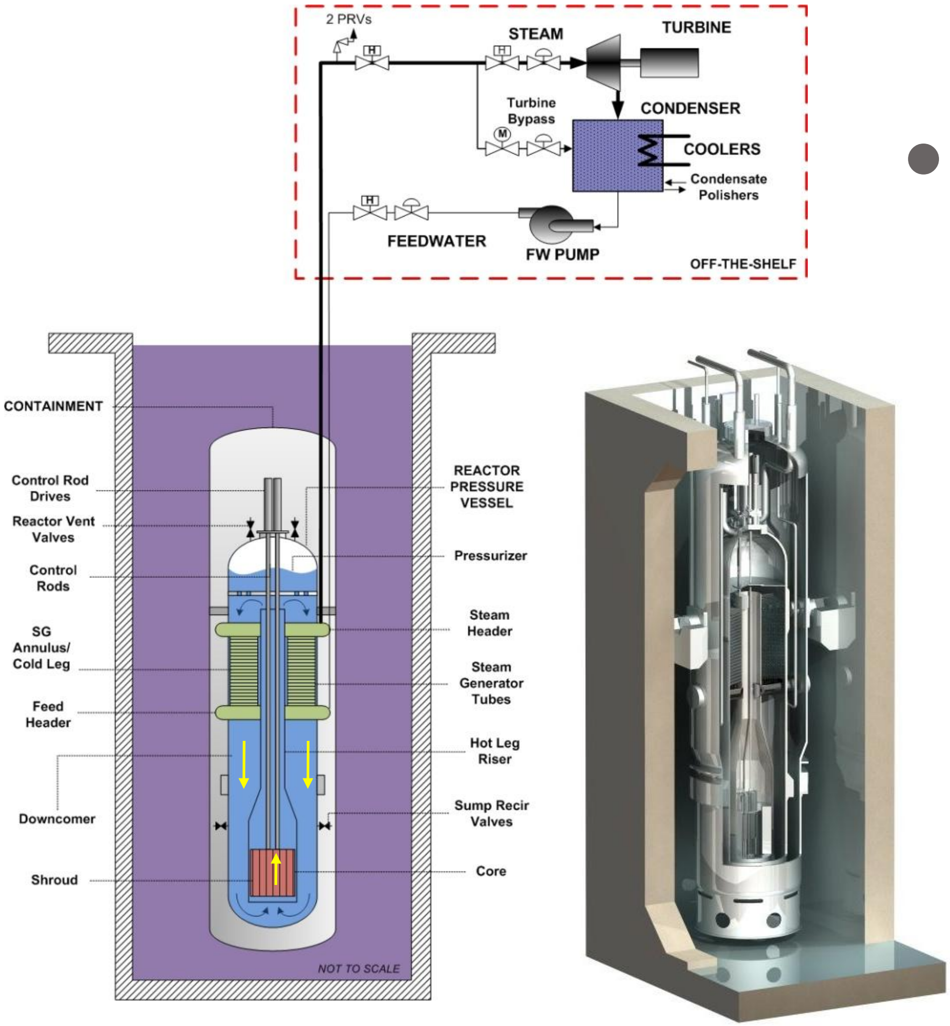
New Nuclear Plant Designs

NuScale Power Unit

- Original design MASLWR developed through a Joint OSU, Idaho National Laboratory, and Nexant-Bechtel. Sponsored by the U.S. Department of Energy
- NuScale Incorporated established in 2007 to commercialize advanced design
  – Self-contained, Factory Built, Power Reactor Modules
  – 40 MW electric power
  – "Off-the-Shelf" Steam Turbine/Generator Sets



New Nuclear Plant Designs - NuScale Power Unit



- **Construction Simplicity:**
  - **Entire NSSS is 60’ x 15’.** ***Prefabricated and shipped by rail, truck or barge***

Natural Circulation cooling:

- ***Enhances safety*** **– eliminates large break LOCA; strengthens passive safety**
- ***Improves economics*** **-- eliminates pumps, pipes, auxiliary equipment**

Below grade configuration enhances security

OSU MASLWR Test Facility Description

- **Complete Internal Primary System**
  - 1:3 Length Scale
  - 1:1 Time Scale
  - 1:254 Volume Scale
  - Stainless Steel Construction
  - 14-Tube Helical Coil Steam Generator
  - Internal Pressurizer
  - Reactor Vessel with an Electrically Heated 60-Rod Bundle
- **Passive Safety Systems**
  - Passively Cooled High Pressure Containment with scaled active heat transfer area and volume
  - Exterior Cooling Pool
  - Steam Vent and ADS System

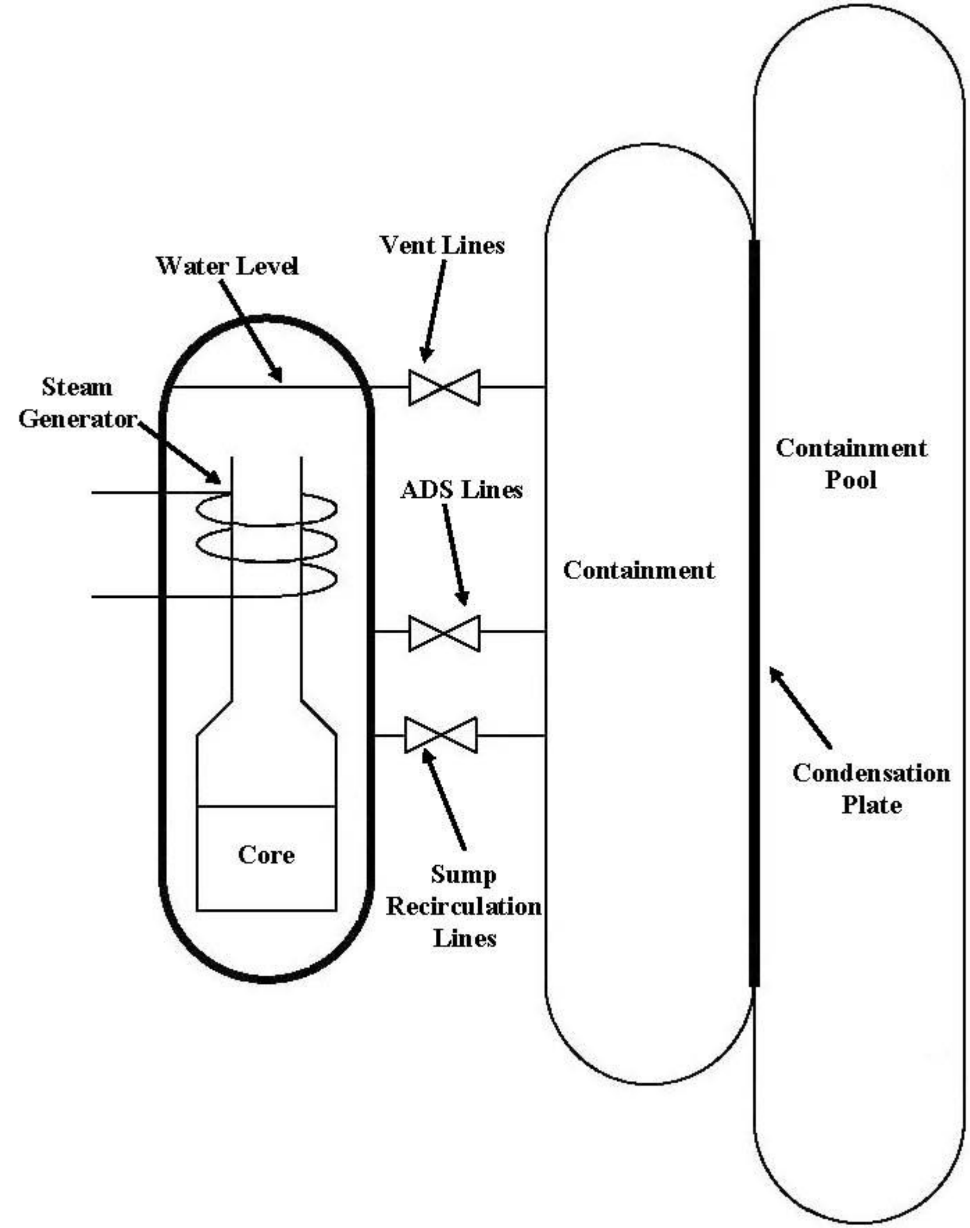
OSU MASLWR Test Facility Description

- **Operating Conditions:**
  - Core Power →0.6 MW
  - Steam Generator Tube Side Pressure →2 MPa (prototypical)
  - Primary Pressure →11.4 MPa (prototypical)
  - Design Temperature →590K (prototypical)
- **Testing Capabilities:**
  - SBLOCA
  - Inadvertent ADS and Steam Vent Opening
  - Long Term Recirculation

OSU MASLWR Test Facility Description

<u>Differences</u>

- Scaling
- Vessel, Containment and Pool are separate tanks
- Condensation plate models heat transfer between containment and pool

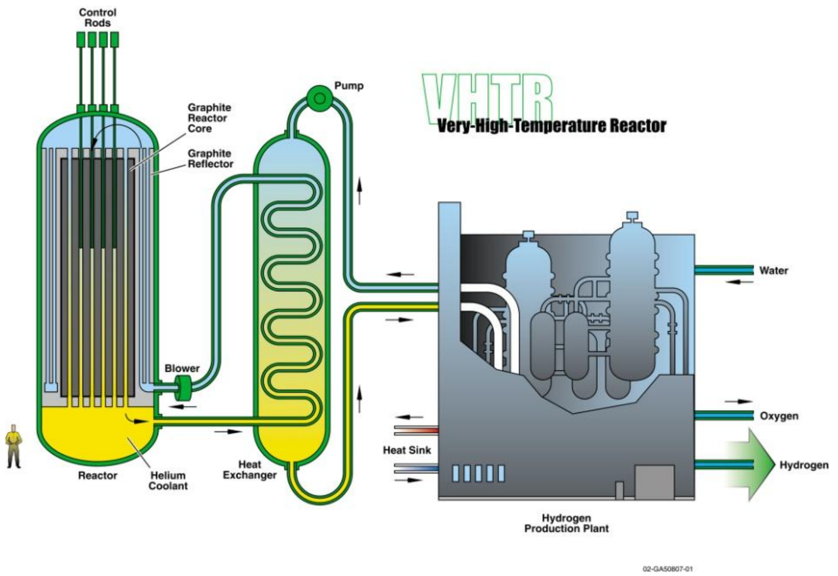


One-Third Height Scale Prototype Confirms Design

New Nuclear Plant Design

Generation IV- High Temperature Gas Reactor

- **OSU Academic Center of Excellence (ACE) for Thermal Fluids and Reactor Safety**
  - **Study of Thermal fluid behavior in the Very High Temperature Nuclear Reactor**
- **The VHTR will be capable of producing 200 metric tons of Hydrogen per day.**
  - **Energy equivalent of 200,000 gallons of gasoline per day.**

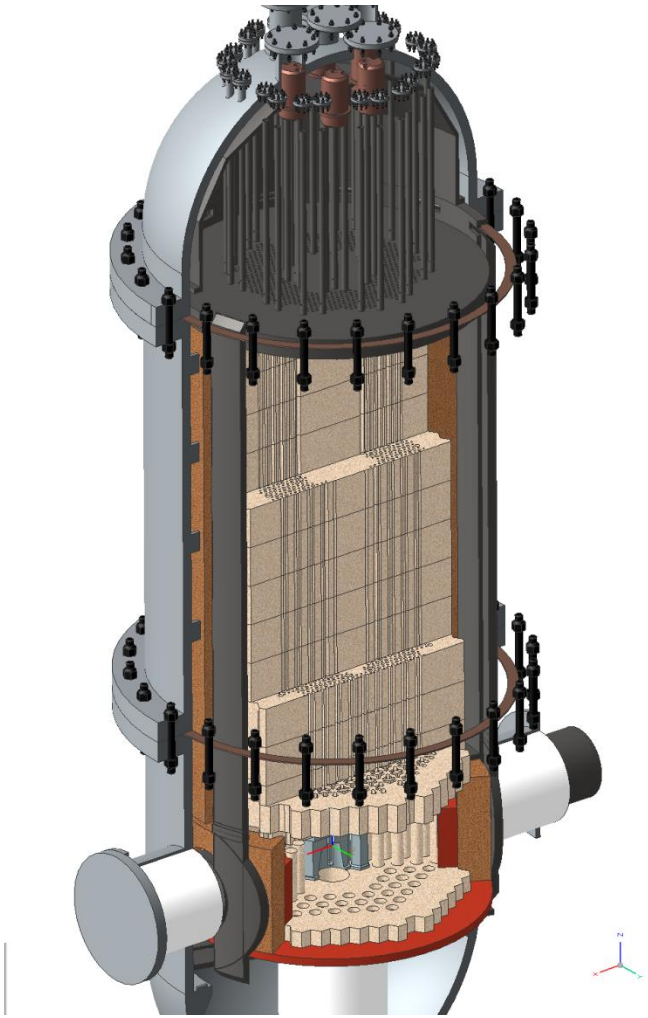


The OSU High Temperature Test Facility

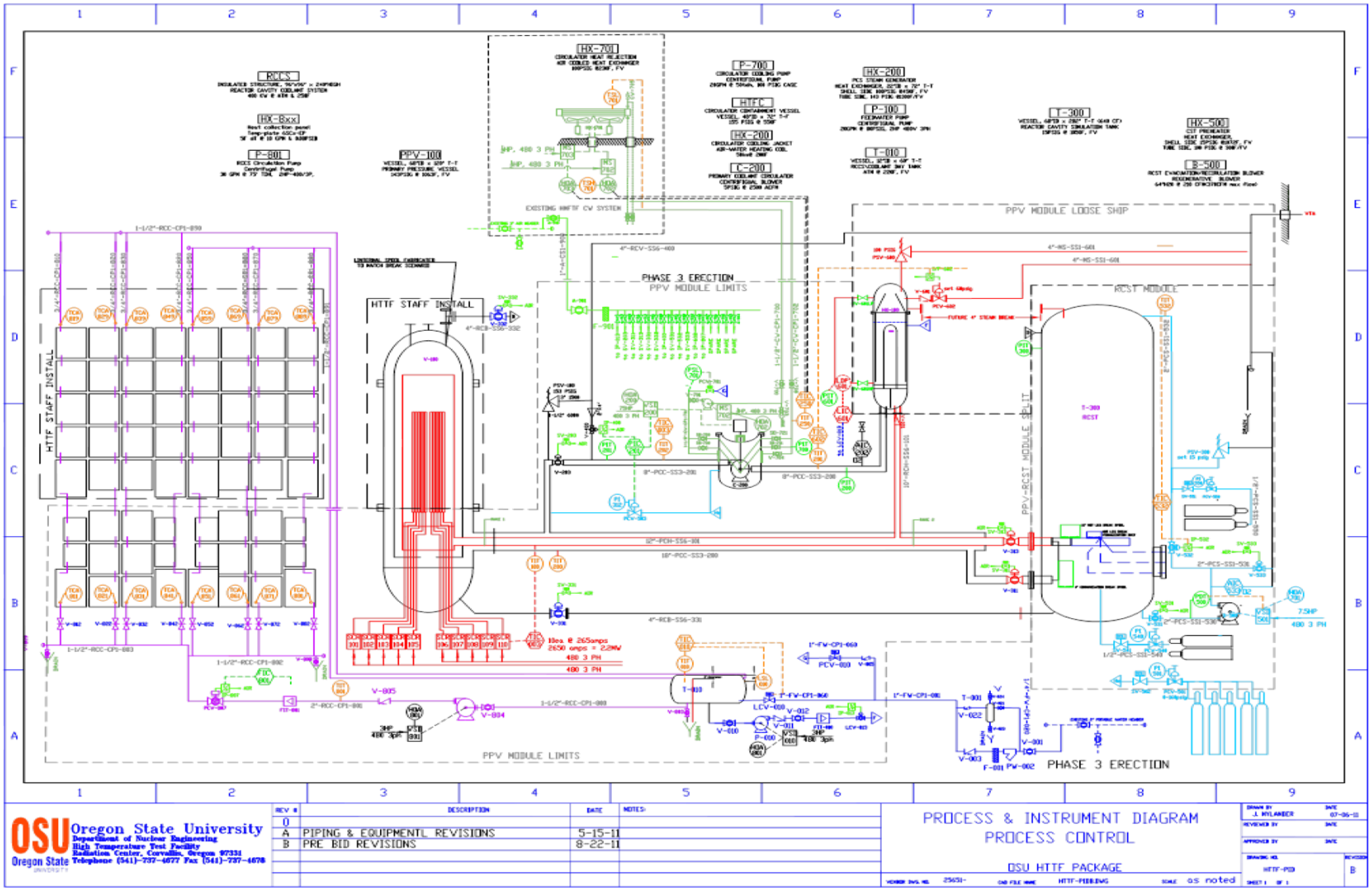
- **High Temperature Test Facility**
  - **Provide data for system code validation.**
  - **Primarily designed to model the depressurized conduction cooldown transient.**
    - Variety of break size and location.
    - Four distinct phases.
    - Reactor Cavity Cooling System as boundary condition.
    - Modular design to allow for the examination of different core types.
  - **Other scenarios examined for applicability of facility.**
    - Pressurized Conduction Cooldown.
    - Normal operations.
  - **Facility Scaling.**
    - ¼ length scale.
    - ¼ diameter scale.
    - Reduced pressure.
    - Prototypical temperature.
- **Reference Design**
  - **Modular High Temperature Gas Reactor.**

The OSU High Temperature Test Facility

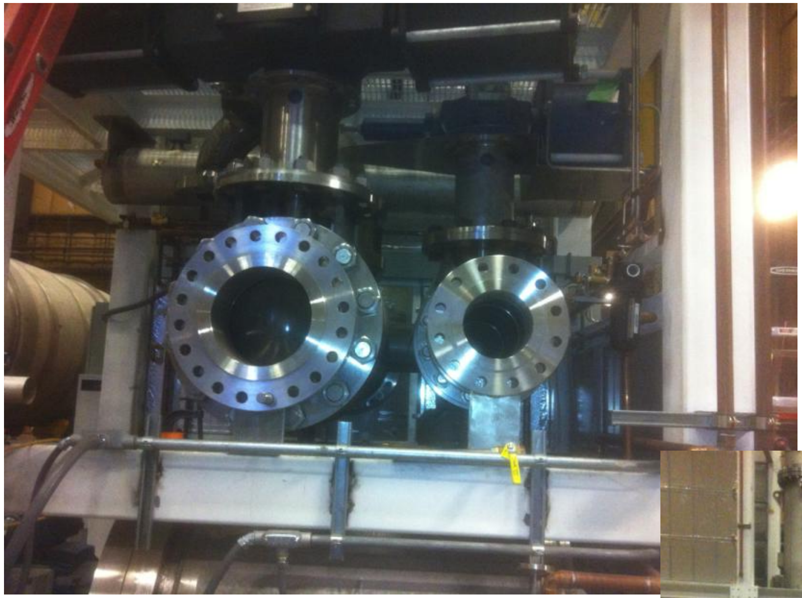
- **High Temperature Test Facility Vessel**
  - ¼ length scale—6.1 meters tall.
  - ¼ diameter scale—1.92 meters vessel outside diameter.
  - Material—Stainless steel (SS304).
  - ASME pressure rating of 9.65 bar at 550ºC.
  - Pressure scale of facility 1:8.0 at 8.0 bar.
  - Upper and lower heads utilize an inner ceramic liner.
  - The lower head provides for instrument taps and penetration of the electric heater rods.
  - Prismatic block core.



The OSU High Temperature Test Facility



Technical Highlights



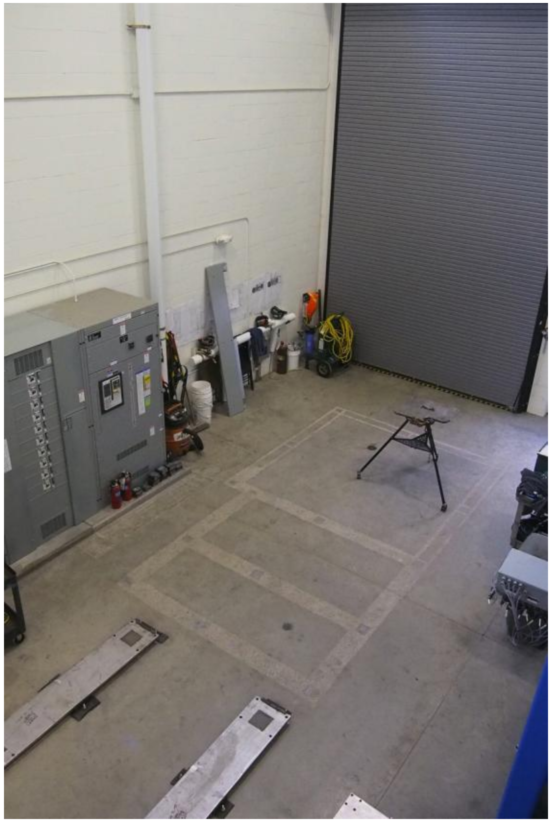
HTTF Fabrication

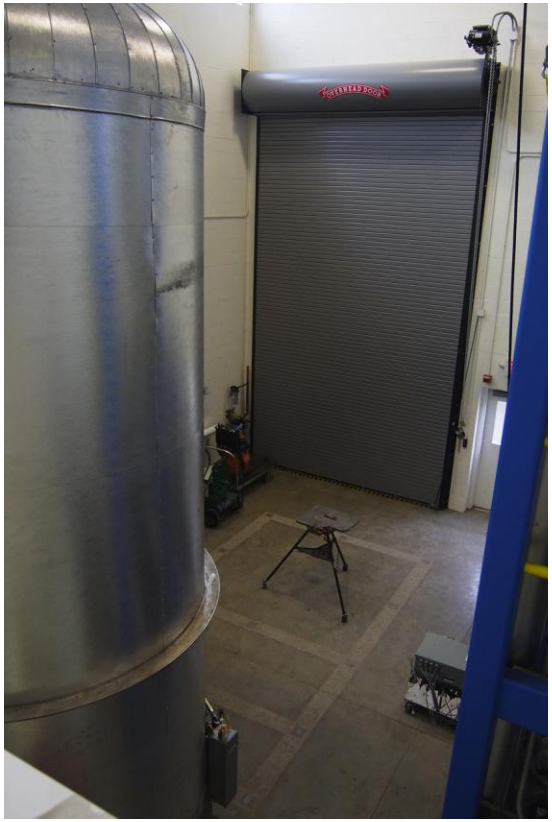
Technical Highlights

HTTF Delivery

Technical Highlights

HTTF Install





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Technical Highlights

HTTF Install



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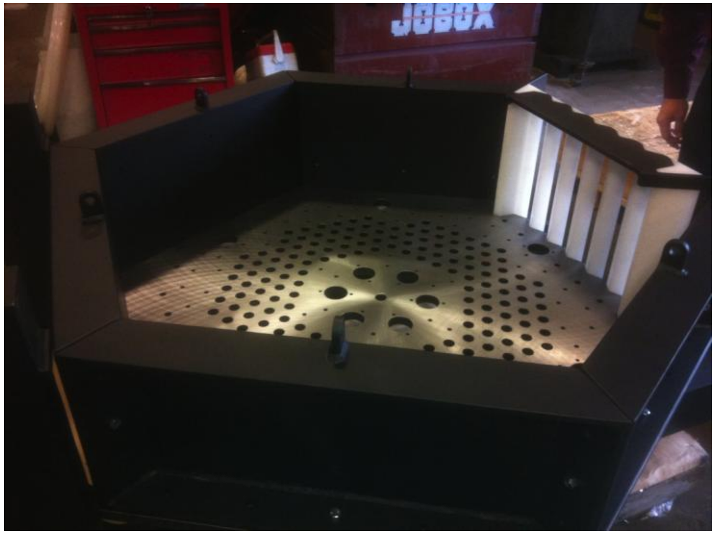
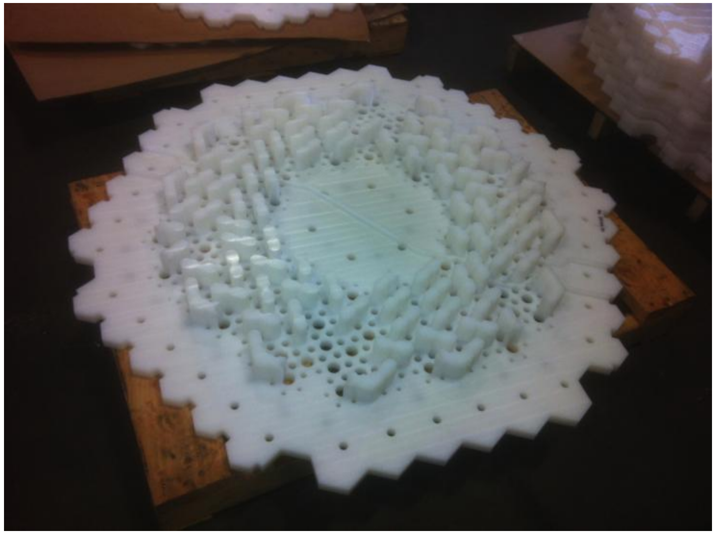
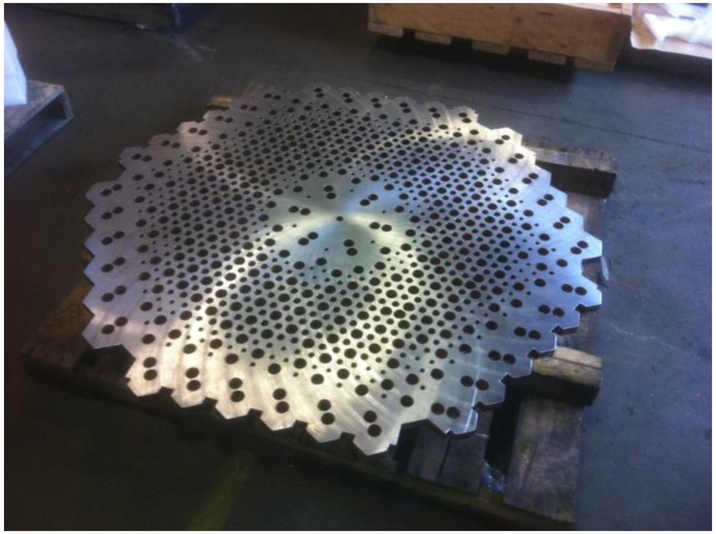
Technical Highlights

Core Block Molds







Technical Highlights

Core Block (Lower Plenum Roof) And Side Reflector Block Casting

Technical Highlights

Core Block (Lower Plenum Roof)
and
Side Reflector Block

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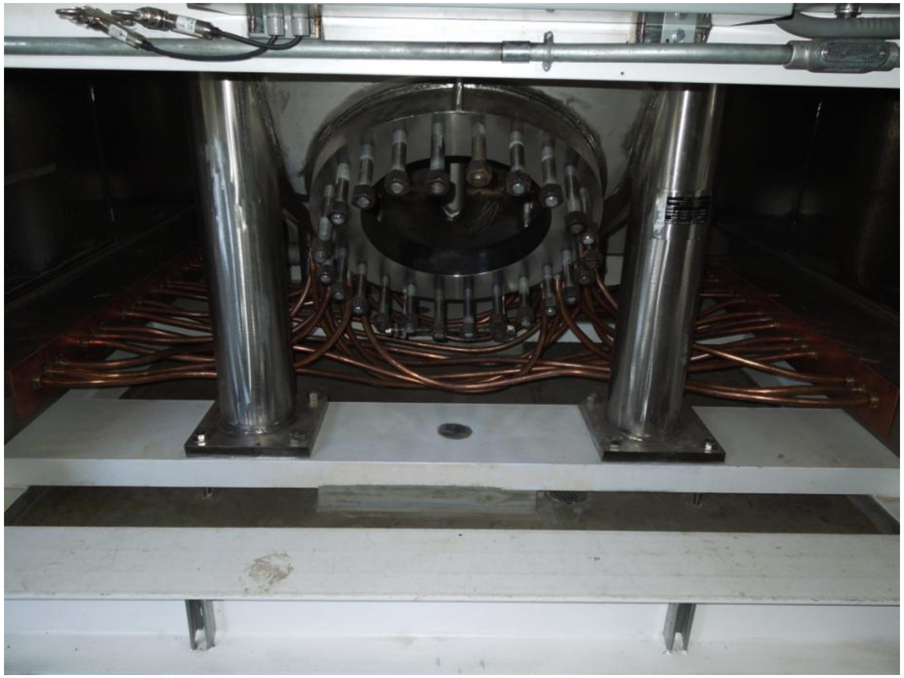
Technical Highlights

Circulator

Power Distribution



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Technical Highlights

Technical Highlights

- **Preliminary Shakedown Plan.**
  - Startup from a cold depressurized condition to a hot pressurized condition.
  - Shutdown from a hot pressurized condition to a cold depressurized condition.
  - Low power (200kW) steady-state operation.
  - Low-intermediate power (700kW) steady-state operation.
  - High-intermediate power (1.5MW) steady state operation.
  - High power (2.2MW) steady-state operation.
  - Cold exchange flow and diffusion transient operation.

Technical Highlights

- **Preliminary Test Plan.**
  - Double Ended Inlet-Outlet Crossover Duct Break.
    - Repeat.
    - Gas similarity test.
    - Degraded RCCS.
  - Control Rod Drive Nozzle Break.
  - Instrumentation Port Break.
  - Inlet Crossover Duct Break.
  - Pressure Relief Valve Break.
    - Repeat.
  - Complete Loss of Flow.
    - Degraded RCCS.
  - Outlet Crossover Duct Break.
  - Inlet Plenum Mixing.
  - Outlet Plenum Mixing.

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Questions?

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