RELAP5-3D Modeling of Gas Reactor Test Section

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Outline

- **Research Objectives**
- **Test Facility Design and Similarity Features**
- **RELAP5-3D Modeling**
    - **Pre-experimental**
    - **Post-experimental Validation**
- **Current Status**

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Research Objectives

- **Acquire experimental data to validate RELAP5-3D modeling of Generation IV Gas-Cooled reactor concepts**

- **Data to be acquired:**

  - **Lock-exchange flow**

  - **Diffusion properties during LOCA**

  - **Natural circulation properties**

  - **Downward flow stability**


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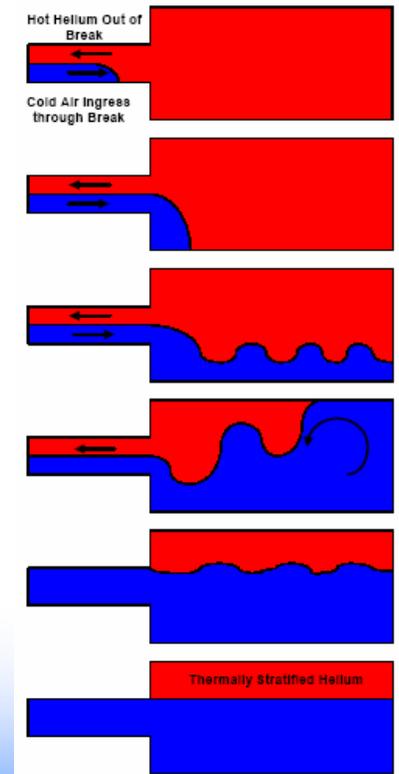
Scaling of Research Facility

- **Data will be acquired with scaled version of the Very High Temperature Reactor (VHTR)**

- **Oregon State University has performed scaling analysis**

Parameter	VHTR	GRTS
Working Fluid	Helium	Helium
3% Decay Power (MW)	18.0	0.188
Core Inlet Temperature (^{o}C)	490	490
Core Outlet Temperature (^{o}C)	1000	1000
Max. Pressure (MPa)	7.0	1.0
Core Geometry	Prismatic Core with Graphite Reflector	Hexagonal Ceramic Heaters with Ceramic Reflectors
Active Core Height (m)	7.92	1.98

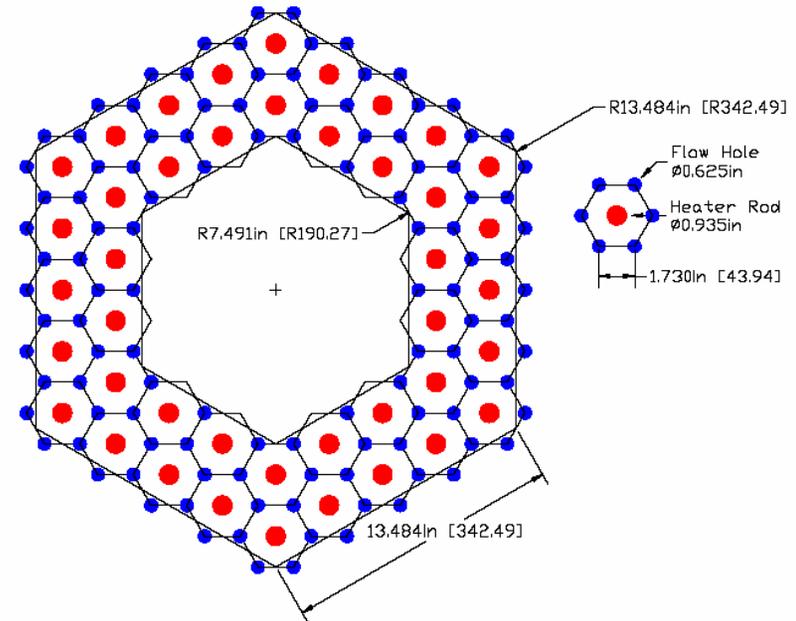Idaho National Laboratory

Preliminary Design of Research Facility
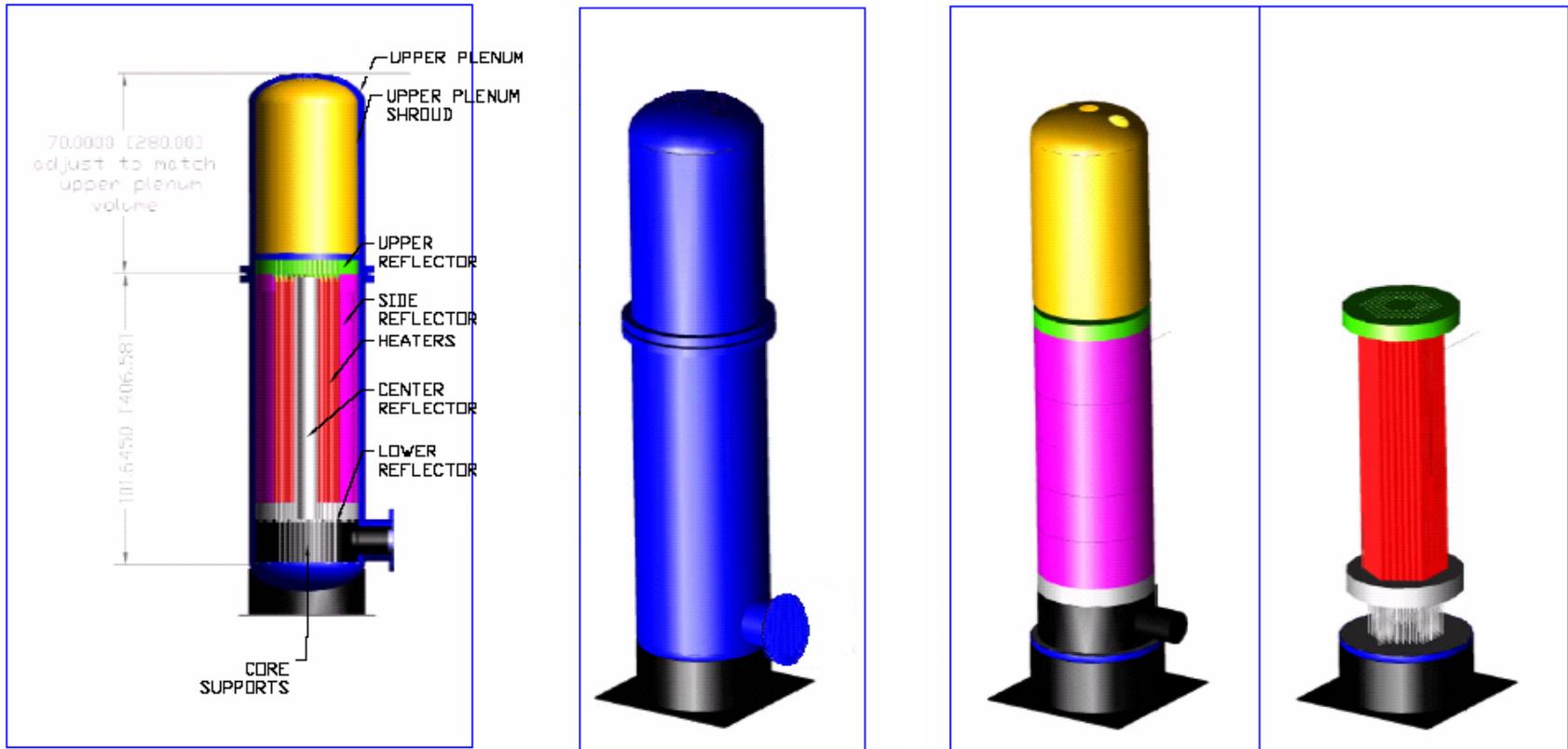

- **Gas Reactor Test Section (GRTS)**

VHTR–Specific GRTS Features

- **Center and side reflectors are ceramic with graphite properties**

- **Zoned core heaters**
    - **Axial thermal profile**
    - **Radial thermal profile**

- **Core support columns**

- **Downward flow through core**

Pre-Experiment RELAP5-3D Modeling

- **Literature suggests extended suppression of onset of natural circulation for VHTR**

- **There are uncertainties with RELAP5-3D's capability to model lock exchange**

- **RELAP5-3D decks have been created for VHTR and GRTS**

- **Experiment data will be used to validate or improve RELAP5-3D models for GRTS and VHTR**

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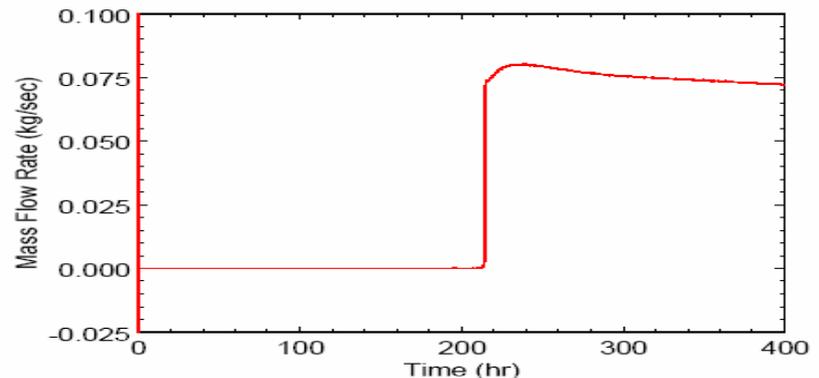
RELAP5-3D Nodalization Scheme
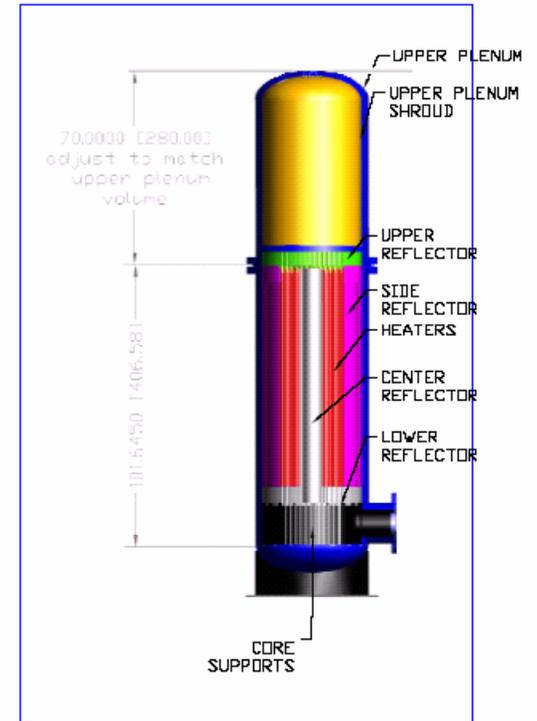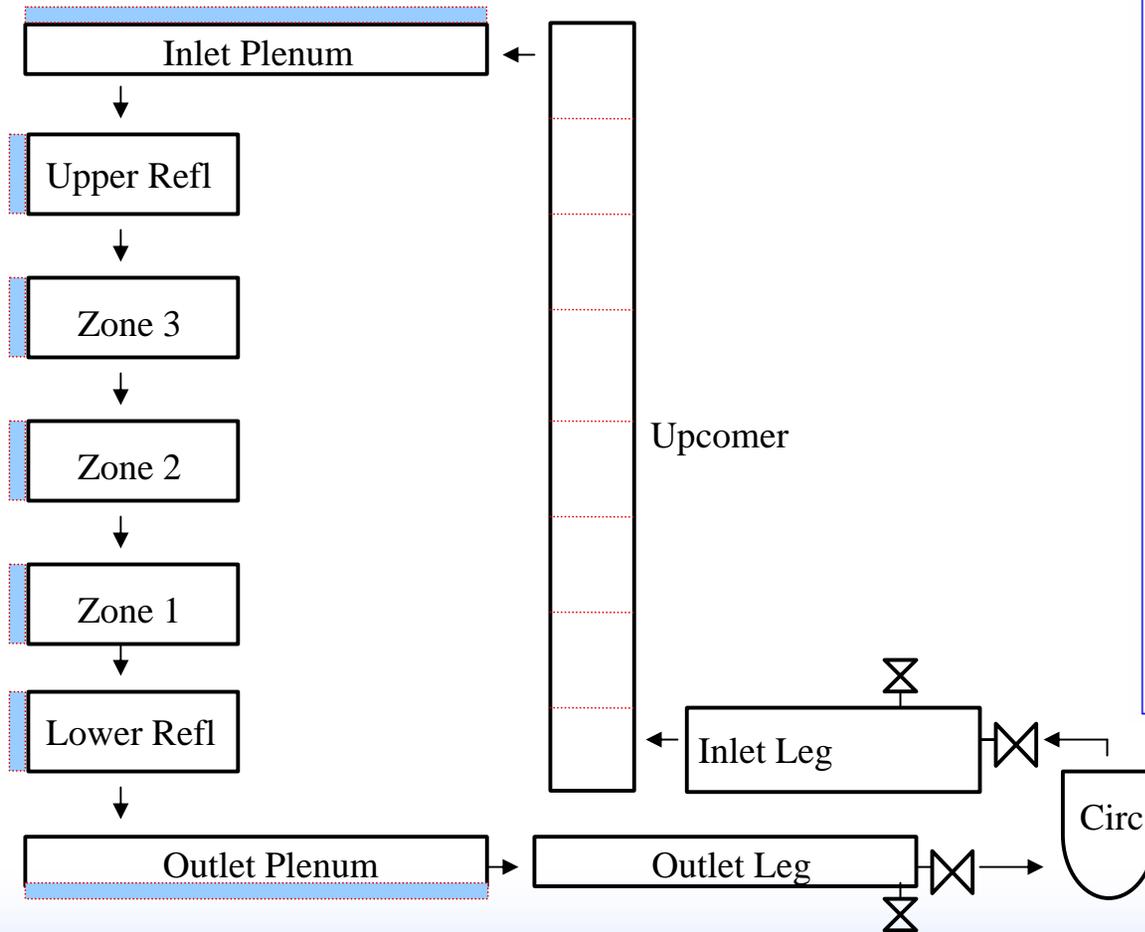
Experiment Data To Be Acquired

- **Standard**
  - T_{core} - wall temperature
  - T_{gas} - upper and lower plenum
  - Oxygen concentration
  - T_{wall} - vessel
- **Optional**
  - Flow velocity - dependent upon sensor sensitivity

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Validation of RELAP5-3D

- Compare RELAP5-3D predictions with experimental data
    - Onset of natural circulation
    - Thermal profiles
- Compare RELAP5-3D predicted thermal profiles with CFD predicted flows
- Model flows entering and exiting core with CFD

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Current Status and Future Work

- **Scaling Analysis**
  - **Independent review**
- **Preliminary Design**
  - **Pre-experimental computer modeling**
- **Design Certification**
- **Experiment Runs**
- **Finish CFD Model**
- **Validate Codes**

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