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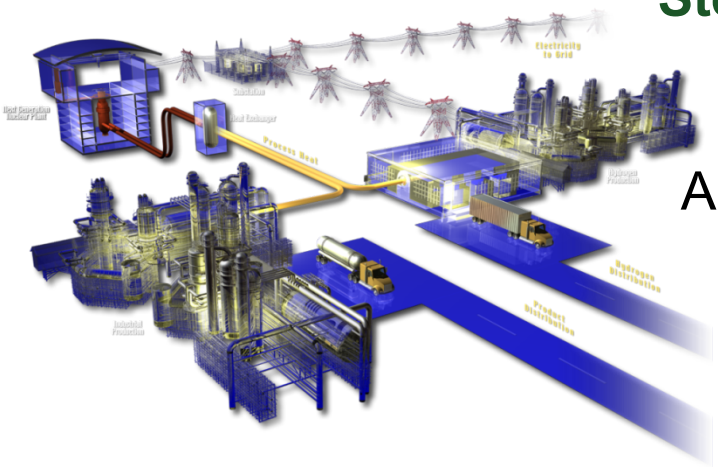
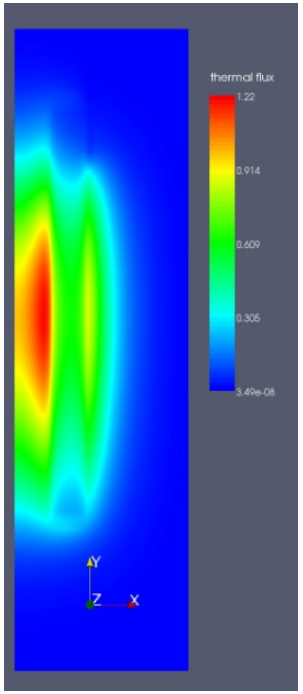
Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2013 Annual Planning Webinar

RC-1: Computational Methodologies

Steven Reeves



August 2012



Computational Methodologies
Overview

- **The Advanced Reactor Concepts (ARC) program recognizes the need for experimental validation of system analyses and core simulation codes**
- **The Next Generation Nuclear Plant (NGNP) Demonstration Project is part of the ARC development effort**
- **ARC is particularly interested in methods proposals related to NGNP R&D activities**

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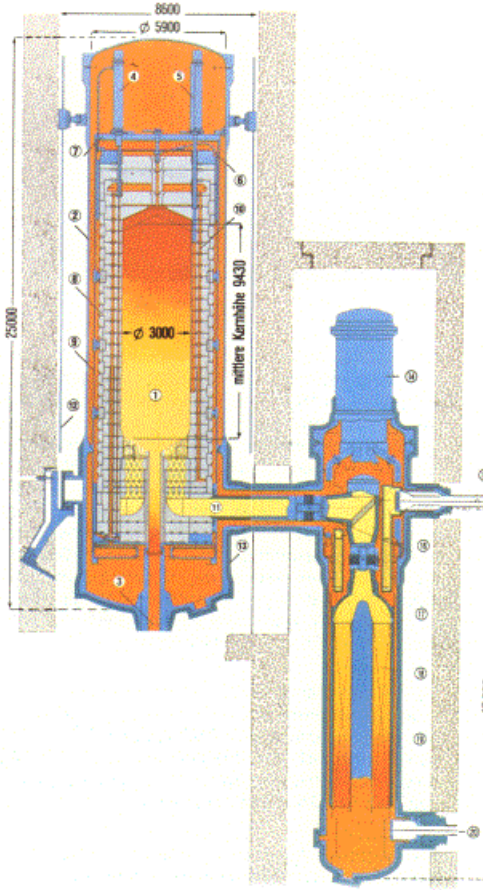
High Temperature Gas-Cooled Reactors (HTGR or VHTR)

- The VHTR is a helium-cooled, graphite moderated reactor with a core outlet temperature between 750 and 850°C with a long-term goal of achieving an outlet temperature of 950°C.
- The reactor is well suited for the co-generation of process heat and electricity and for the production of hydrogen from water for industrial applications in the chemical and petrochemical sectors.



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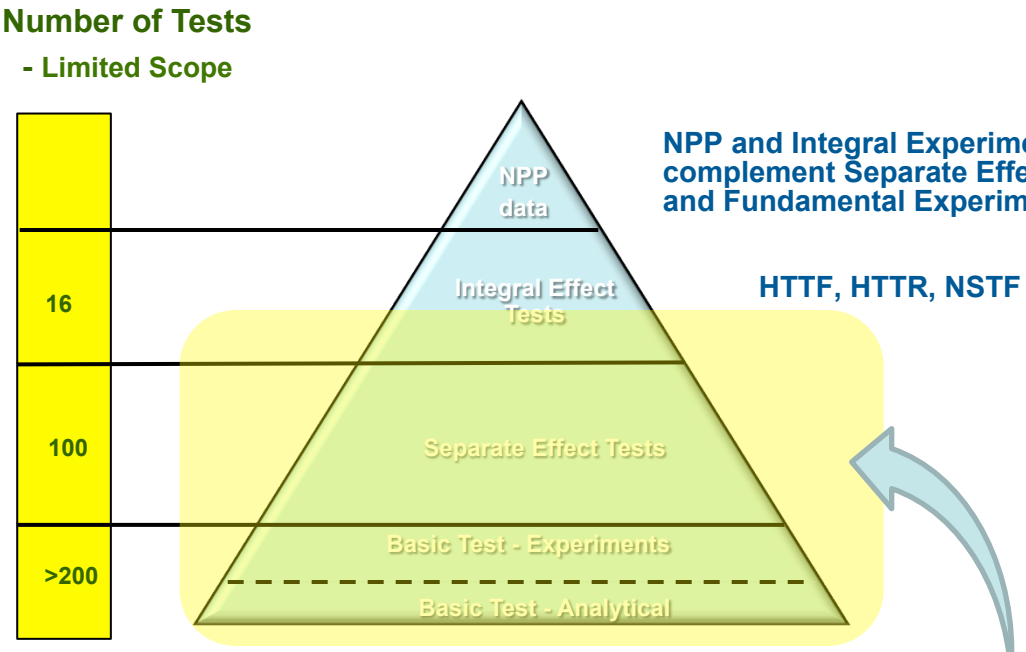
Current needs in NGNP Thermal Fluids

- **Acquisition of high quality data for validation of CFD and System Codes and models**
  - The ability of current tools to simulate certain thermal fluid phenomena and scenarios has not been proven.
  - Computational Fluid Dynamics (CFD) may provide answers not captured by low order system codes but experimental validation of CFD is a greater challenge.
  - An matrix of integral and separate effects experiments is needed to validate codes and instill confidence in their results.



Validation Triangle

Avenues for university participation (NEUP)

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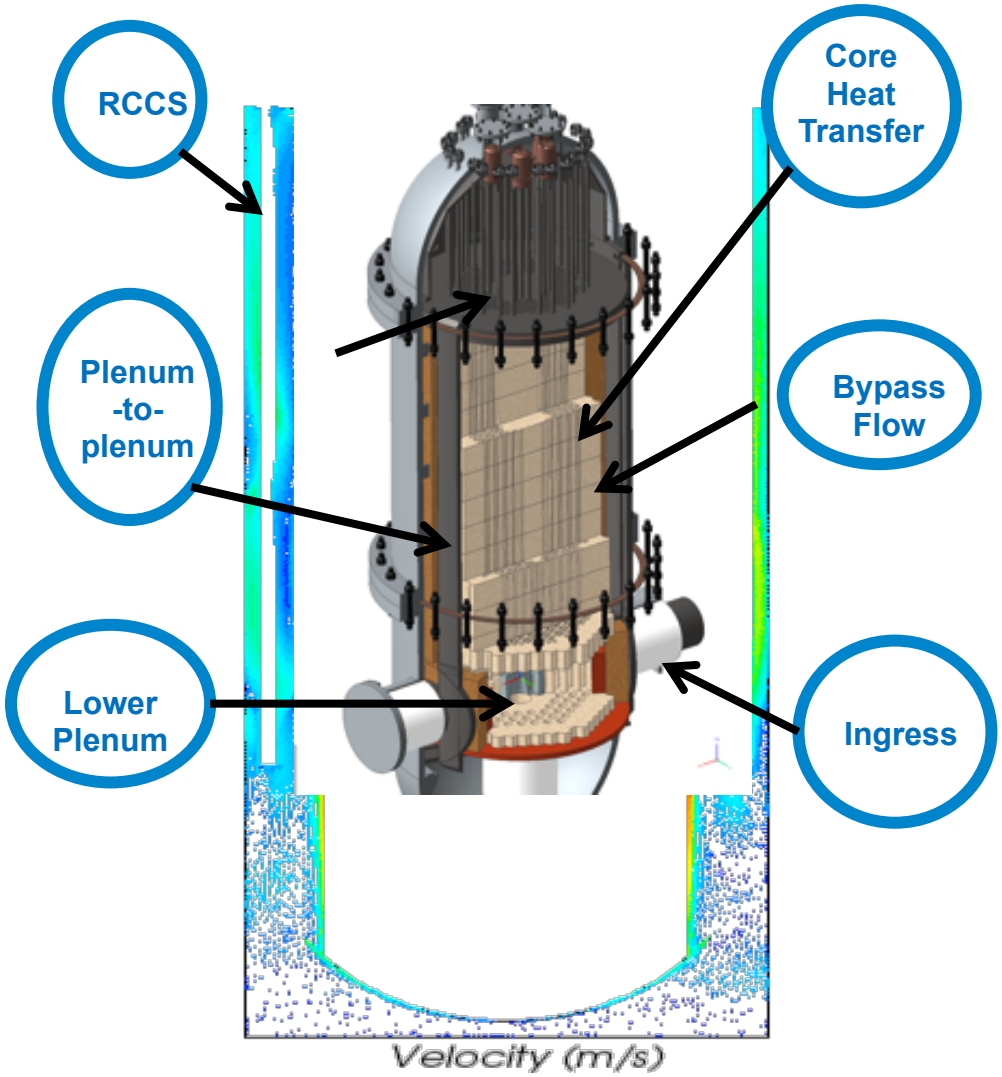
Workscope – RC- 1.1

- **Proposals being sought in the areas of:**
  - Steam ingress flow and effects upon graphite
  - Plenum-to-plenum heat transfer under natural circulation conditions
  - Complex, heated flow behavior around core structures (e.g. lower plenum and bypass flow between blocks)
  - Core heat transfer under low flow conditions
  - Reactor cavity cooling (air and water-cooled systems)
  - Externally initiated events integrated with core / reactor dynamics and structures vibrations



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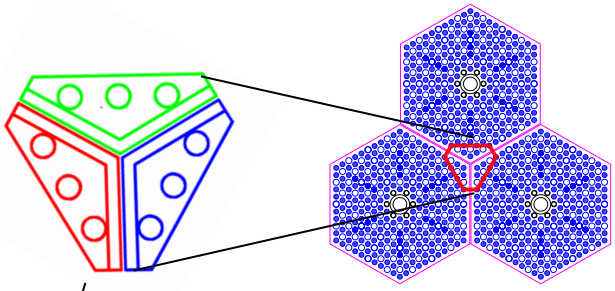
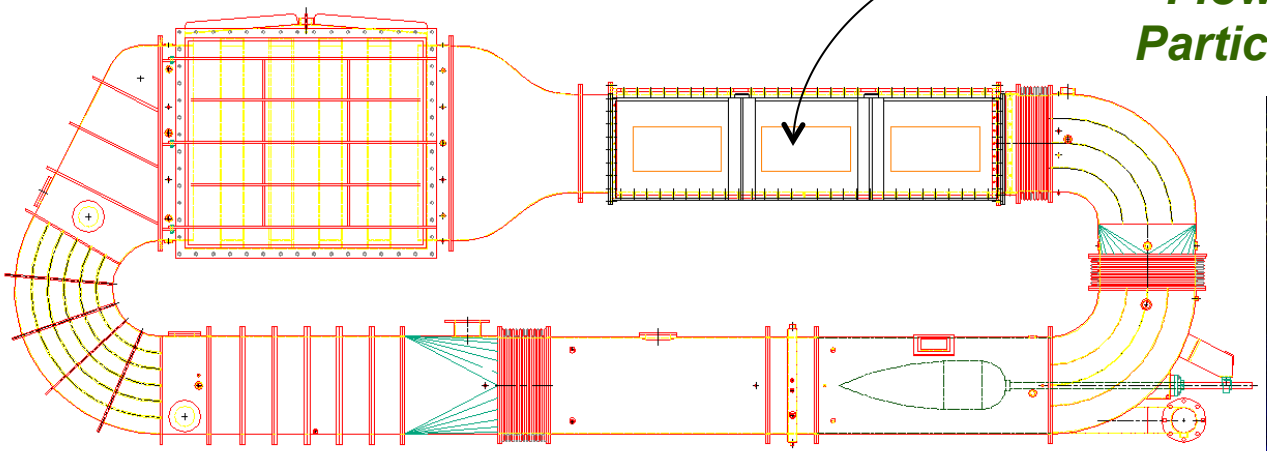
Workscope – RC- 1.1 continued

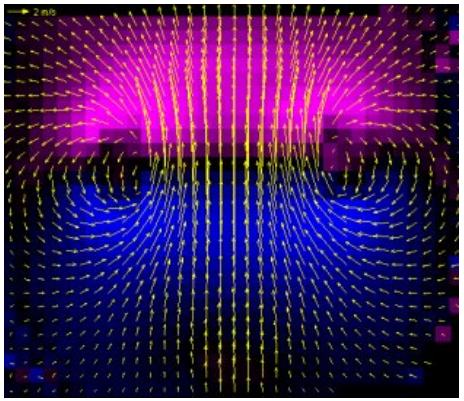
- Experiments must be scaled to reproduce anticipated conditions in the reference system (MHTGR 350) and complement those underway in the High Temperature Test Facility (OSU) and Natural Circulation Shutdow Test Facility (ANL)
- Experiments must conform to NQA-1 standards.
- New measurement techniques are encouraged



Interstitial Block Flow Model to be inserted into the MIR Flow Loop

Flow field captured with Particle Image Velocimetry





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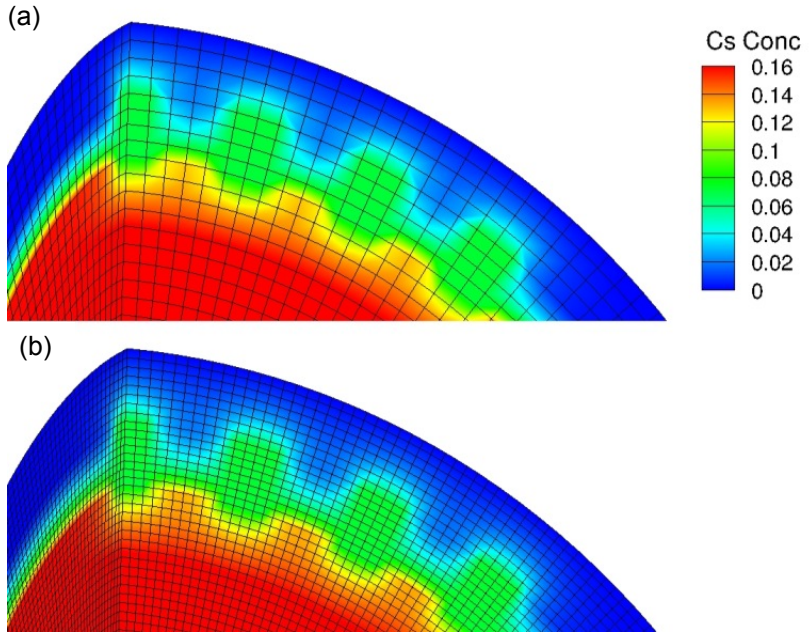
Workscope RC- 1.2

Characterizing fission product transport mechanisms

- dust and fission product transport
- integral benchmark experiments,
- dispersion and reaction that investigate fission product release phenomena inside the reactor vessel, turbo-machinery, piping systems during severe accident conditions.

These proposals should take into account historical gas-reactor test data (COMEDIE, KUFA, etc.), which could be used to benchmark computational fission product/source term methods/algorithms compatible with NRC's severe accident simulation codes and methodology, including MELCOR.



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Summary of RC-1 Solicitation

- Thermal fluid experimental validation – fundamental, separate and mixed effects experiments that complement integral experiments and plant data
- Dust and fission product transport – model development and experimental validation

Steven Reeves@nuclear.energy.gov
Hans.Gougar@inl.gov