



## NRC Research in Support of New and Advanced Reactor Licensing

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### Outline

- NRC Safety R&D Objectives
- New Reactors
- Advanced Reactors
  - NGNP and PIRT
  - HTGR R&D
  - Thermal-fluids
  - Fuels & Fission Products Transport
  - High Temp Materials including Graphite

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### NRC Safety R&D Objectives

- Develop staff knowledge, expertise, capabilities and review guidance
- Independently confirm technical basis for requirements and criteria
- Develop independent analytical capabilities
- Confirm/interpret technical information for which there is significant uncertainty
- Validate/scope-out technical issues requiring follow-up resolution by an applicant

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### New Reactors Research

- Development of Design-Specific Research Plans
- Design-specific Input Decks for TRACE and MELCOR
- Supporting calculations for staff review of DCD.

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### Advanced Reactor Research

- Gas Cooled Reactor Activities
  - NGNP Licensing Strategy
  - PBMR Pre-application
- Liquid Metal Reactor Activities
  - 4S Pre-application
  - GNEP Burner Reactor
- Other Technologies
  - Hyperion
  - NuScale
  - IRIS

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### What is NGNP and What is PIRT?

- Next Generation Nuclear Plant (NGNP)
  - An advanced reactor concept for nuclear electricity production and hydrogen cogeneration
  - Very high-temperature gas-cooled reactor (VHTGR)
- Phenomena Identification and Ranking Technique (PIRT)
  - A structured elicitation process to identify safety relevant phenomena and assess their importance
  - A tool for identifying and prioritizing research needs
  - Results documented in Phenomena Identification and Ranking Tables

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### HTGR R&D Technical Areas

- Nuclear Analysis
- Thermo-Fluid Analysis
- Fuel Performance
- Accident Analysis
- Metallic & Graphite Components
- Structural/Seismic
- Process Heat Applications
- PRA
- Human Factors
- Advanced I&C
- Consequence Analysis
- Fuel Cycle/Materials Safety
- Material Protection

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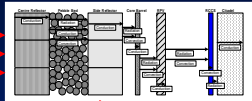
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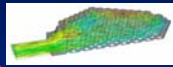


### TF Technical Challenges

- Combined Mode Heat Transfer
- Core heat transfer
- Bypass Flow
- Hot streaking
- RCCS performance
- Fluid properties
- Air Ingress / Oxidation
- Graphite dust
  - Characterization
  - Location before blowdown
  - Transport during blowdown
  - "Gray Gas" effect
- Hydrogen cogeneration
  - Intermediate heat exchanger failure



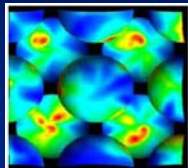
Multi-mode heat transfer



LP Flow & HT, Air Ingress



Graphite Dusting / Corrosion Integrity



Core Temperature and Power Distribution

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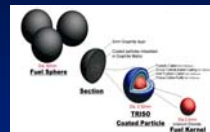
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### HTGR Fuels R&D Objectives

- Develop, validate and utilize NRC independent fuels analysis methods, data and insights for safety and licensing reviews
- Integrate the fuels analysis models and data into NRC fission product transport analysis methods for accident source term calculations.
- Develop NRC inspection capability to ensure quality and performance of the production fuel supply.
- Develop sufficient NRC staff KSAs to effectively review an HTGR application in the fuel performance area



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### Key Materials Safety and Licensing Issues

- Development of fabrication of material and design codes and standards
- Development of inspection requirements
- Quantification of material performance and variability (including scaling and property prediction)
- Assessment of aging-related degradation mechanisms



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### Closing

- Technical support for both new LWR and advanced reactor designs
- Need for infrastructure development for advanced reactors
- Collaboration with DOE on NGNP and GNEP
- Potential for international collaboration

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