



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Next Generation Nuclear Plant

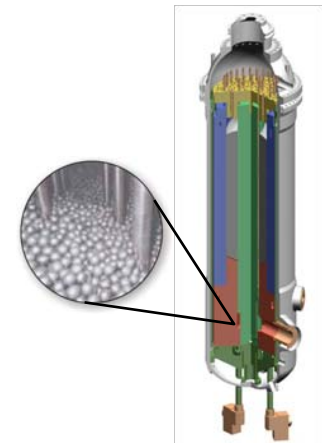
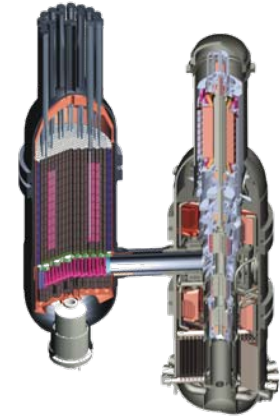
Thomas J. O'Connor, Director
Office of Gas Cooled Reactor Technologies

Nuclear Energy Advisory Committee Meeting
December 18, 2009



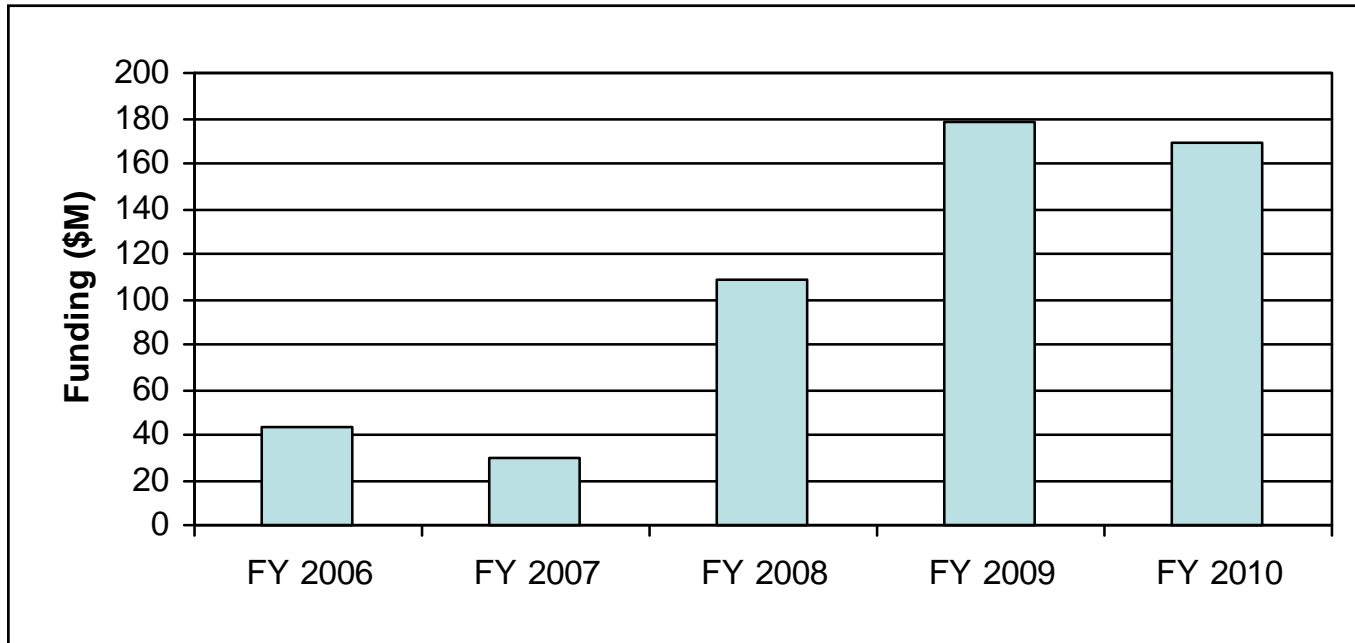
NGNP – Features and Characteristics

- **Helium cooled** – noble gas does not chemically react
- **High outlet temperature** – 700° to 950° C for high energy conversion efficiency and process heat uses
- **Coated particle fuel** – excellent fission product retention under operating and accident conditions
- **Passive safety features** – ensure public health and safety
- **Small to medium power output** – good fit for industrial applications
- **Improved fuel utilization** – up to three times the burnup of light water reactors





NGNP Appropriations



NGNP Appropriation (\$M)				
FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
43.3	29.4	108.8	178.0	169.0



NGNP R&D Focus Areas

■ Fuel Development and Qualification

Establish a licensing basis for gas-cooled reactor coated-particle fuel (several fuel tests in ATR)

■ Graphite Materials Qualification

Used as an internal core structural material, moderator, and reflector (several tests in ATR and HFIR)

■ High Temperature Material Qualification

Metals used in heat exchangers will be exposed to temperatures far greater than seen in Light Water Reactors

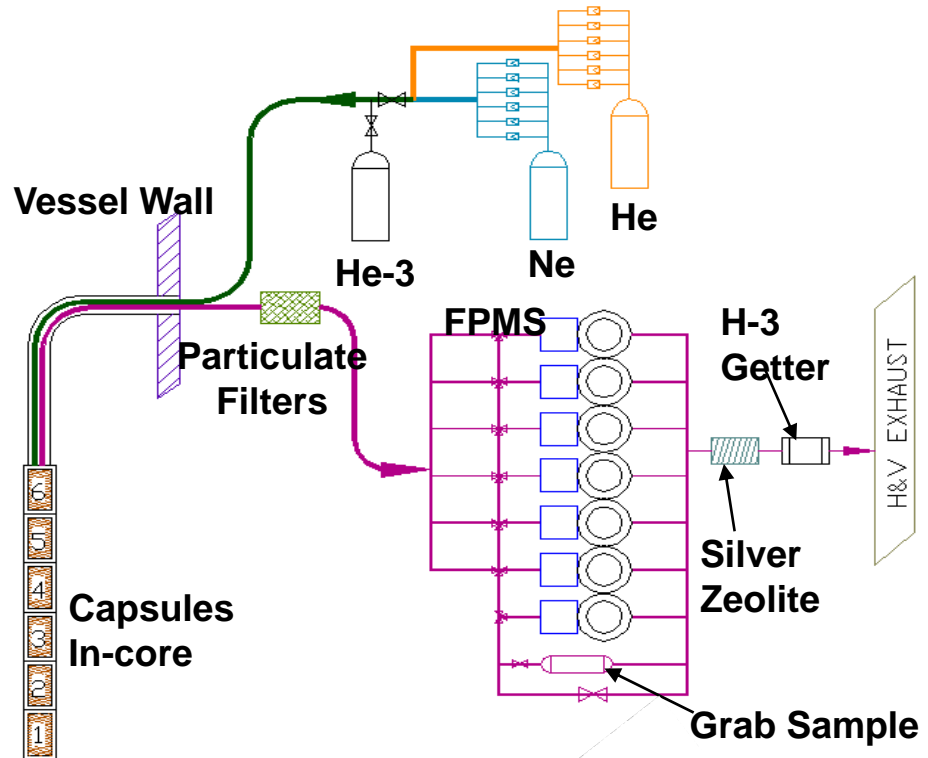
■ Design and Safety Methods and Validation

Develop and benchmark improved simulation techniques, analytical codes and methods

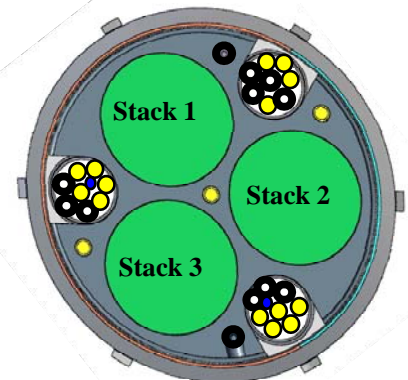


Fuel Development and Qualification

- Establish U.S. know-how in the manufacture of coated particle fuels
 - Multi-year experimental campaign of irradiations and testing
 - Development and application of state-of-the-art analytical codes and methods for fuel performance
 - Development and application of world-class techniques for assessing fuel quality during manufacture and post-irradiation
- First fuel test began in December 2006 and completed November 6, 2009:
 - 620 full power days of irradiation with no particle failure
 - Peak fluence 4.05×10^{25} n/m² (3.32 avg)
 - Peak burn-up 19.5% FIMA (16.53 avg)

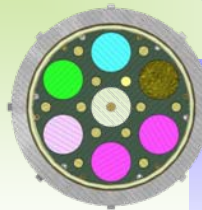
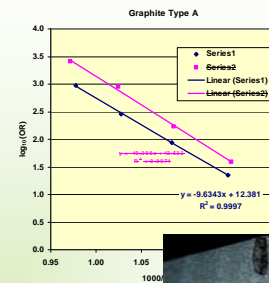
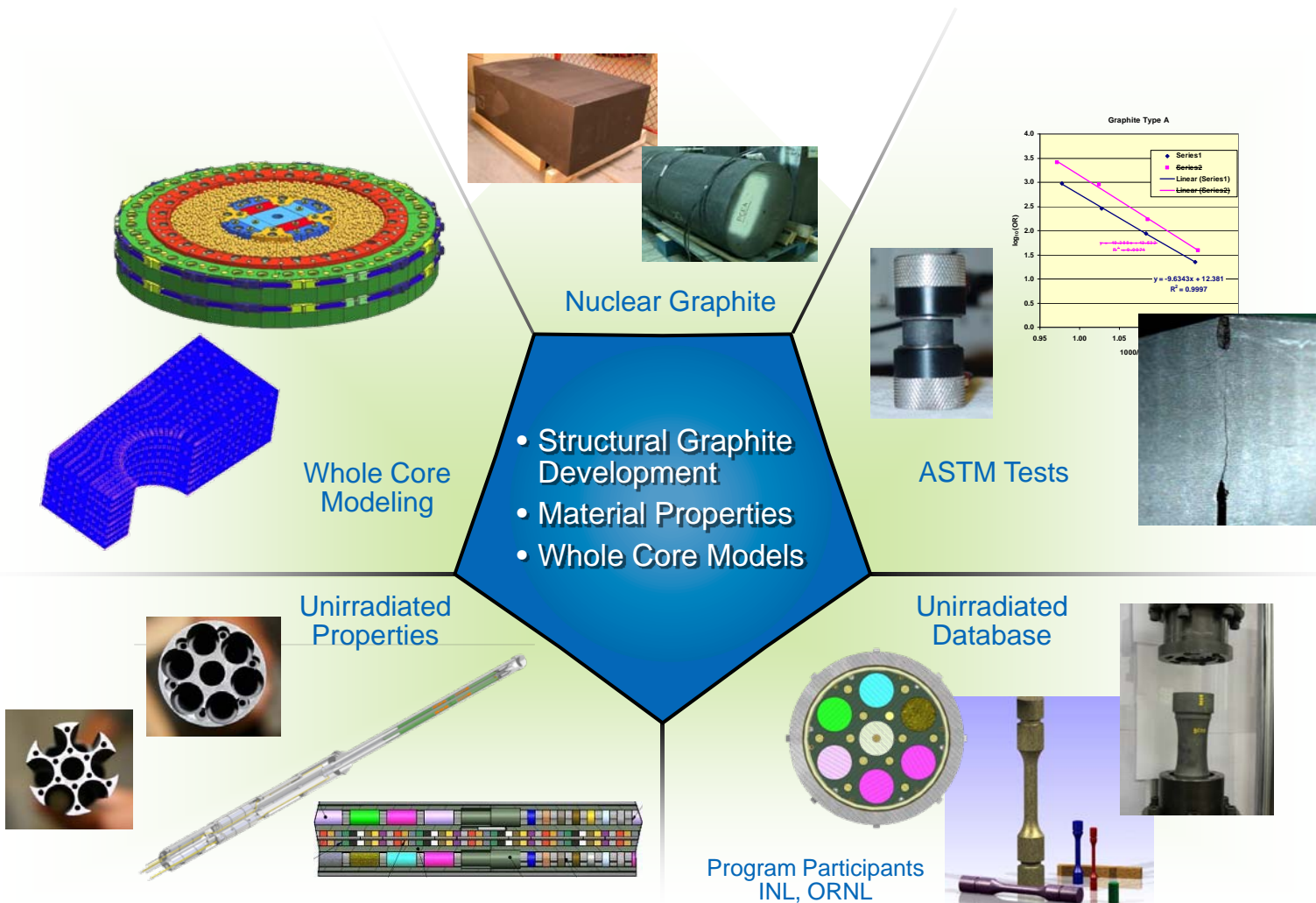


Capsule Cross-section





Graphite Materials Qualification



Program Participants
INL, ORNL

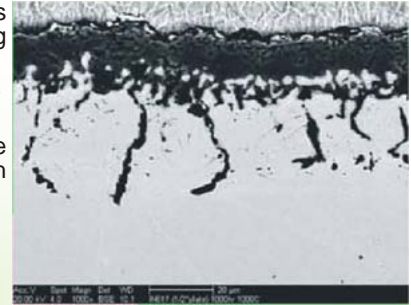


High Temperature Materials



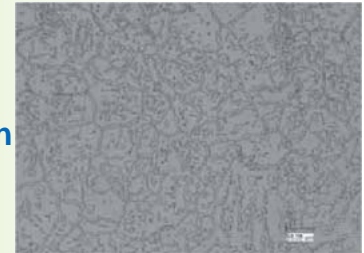
Development of Material Properties and Design Rules and ASME Codification

Ni from Watts bath plating
Cr Oxide surface layer
Al Oxide intergrowth

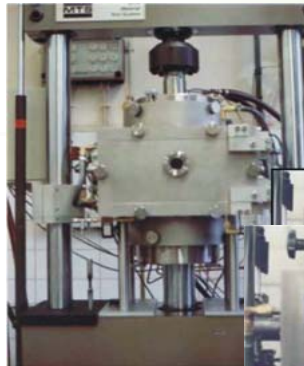


- Materials:**
- Pressure vessel steels
 - Alloys for heat exchangers (up to 800 °C)
 - Control rod sleeves and other core internals

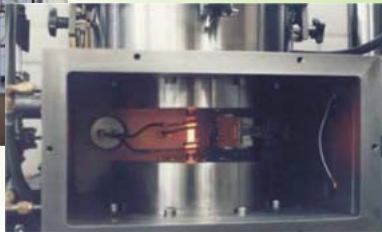
Material Characterization



Mechanical Testing



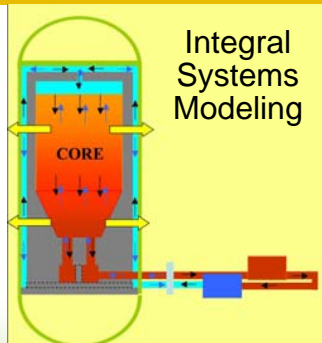
Environmental Testing



Program Participants
INL, ORNL, ANL

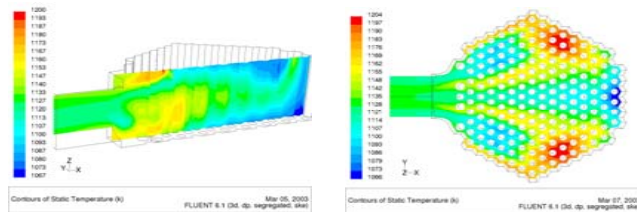


Design & Safety Methods

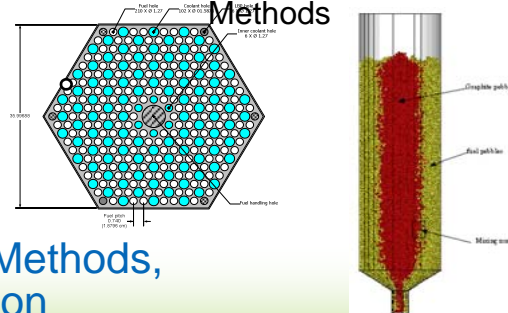


Integral Systems Modeling

Multi-dimensional CFD Simulations



Pebble and Prismatic Physics Methods

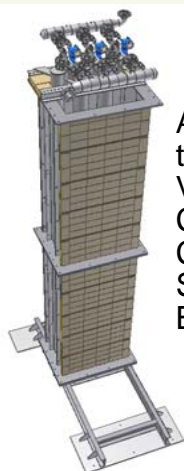


Physics, Thermal and System Safety Methods, Code Development and Application

Design Methods and Validation

Separate Effects & Integral Testing Under Normal & Off-Normal Conditions

Scaled Vessel Testing



ANL Facility to Validate VHTR Cavity Cooling System Behavior



INL's Matched Index of Refraction (MIR) Facility to Study 3-D Flow Effects in Plena

Cross-section Measurements at LANL



Graphite/Air Reaction Rate Testing





NGNP Licensing Activities

- **DOE and NRC collaborate on Research and Development Needs**
 - DOE and NRC collaborated to develop a phenomenon identification ranking table (PIRT) for NGNP
 - DOE structures R&D to meet PIRT needs as well as designer data needs
 - Examples of R&D collaborations include Reactor Cavity Cooling System experiments, construction of a High Temperature Test Facility and collaboration on graphite dust issues
- **DOE is preparing several white papers to initiate regulatory review of gas reactor issues including:**
 - Defense in Depth
 - High Temperature Materials
 - Fuel Qualification
 - Mechanistic Source Term
- **Formal pre-application licensing review scheduled to commence in FY 2011**



Funding Opportunity Announcement

- Issued on September 18 – Proposals received November 16
- Federal Assistance is for conceptual design, cost and schedule estimates, and business plan preparation
- Requires cost-share from industry In accordance with Section 988 of the Energy Policy Act of 2005
- Supports more than one design
- The total estimated federal contribution for the Phase 1 FOA is \$40M
- Schedule is to announce selections in January 2010
- Conceptual Design Reports are due August 31, 2010

Future NEAC Task

■ NEAC Review Fall 2010

- Review status of R&D
- Review status of licensing activities
- Review Conceptual Designs
 - Designs
 - Management plans
 - Cost and schedule estimates

■ NEAC Recommendation to NE-1

Have the accomplishments in the areas of R&D, licensing activities and conceptual design been sufficient to support initiation into Phase II for the development of a final design and, ultimately, construction of a demonstration reactor?



Schedule

Nuclear Energy

Date	Activity
08/31/10	Detailed conceptual design reports due to DOE
11/15/10	NEAC recommendation to S-1 on proceeding to Phase 2
12/15/10	Submit NEAC report to Congress
01/11/11	S-1 announcement on path forward to Phase 2
01/15/11 – 09/30/11	Procurement process for Phase 2 Award
09/30/11	Award cooperative agreement for final design and licensing