



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

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

**Mission Supporting Transformative Research
Reactor Concepts RD&D (MS-RC1)**

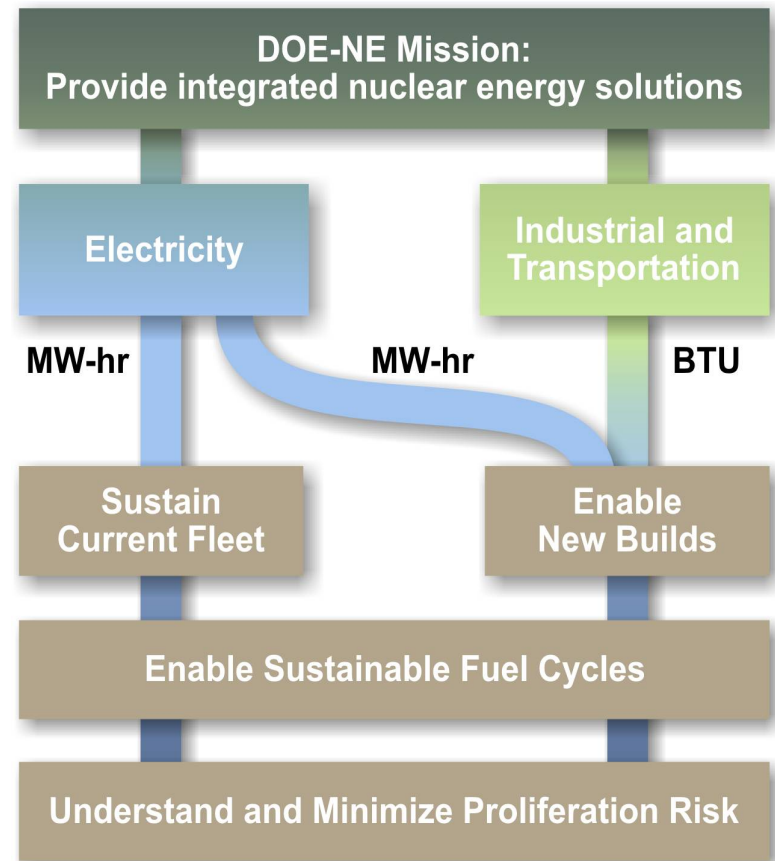
Sal Golub

August 21, 2012



Office of Nuclear Energy Roadmap R&D Objectives

- **Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors**
- **Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals**
- **Develop sustainable nuclear fuel cycles**
- **Develop capabilities to reduce the risks of nuclear proliferation and terrorism**





Nuclear Reactor Technologies (NE-7) Overview

- **Mission: Keep current fleet operating safely and developing new nuclear technologies for deployment**
 - promote technologies that have greatest promise to enable new nuclear power
 - conduct R&D to maintain safe operation of existing fleet
 - honor commitments to other Federal agencies, International partners and universities
 - maintain unique capabilities and facilities to support future USG policy decisions and industry needs
 - explore new high-risk, high-reward technologies

- **NE- 7 consists of three Offices (pending approval):**
 - NE-72: Light Water Reactor Technologies – Rebecca Smith-Kevern
 - NE-74: Advanced Reactor Technologies – Tom O’Connor
 - NE-75: Space and Defense Power Systems – Owen Lowe

- **Research activities are designed to address technical, cost, safety, and security issues associated with various reactor concepts**



DOE-NE R&D Portfolio Includes Different Reactor Concepts

Deputy Assistant Secretary for
Nuclear Reactor Technologies
NE-7

Office of
Science
and
Technology
Innovation

NE-4

Office of Fuel
Cycle
Technologies

NE-5

Light Water
Reactor
Technologies

Gas Cooled
Reactor
Technologies

Advanced
Reactor
Concepts

Space and
Defense
Power
Systems

- LWRS
- SMR LTS

Advanced
Reactor
Technologies

- NGNP
- ARC
- Advanced SMR R&D

Advanced Reactor Technologies Research Questions

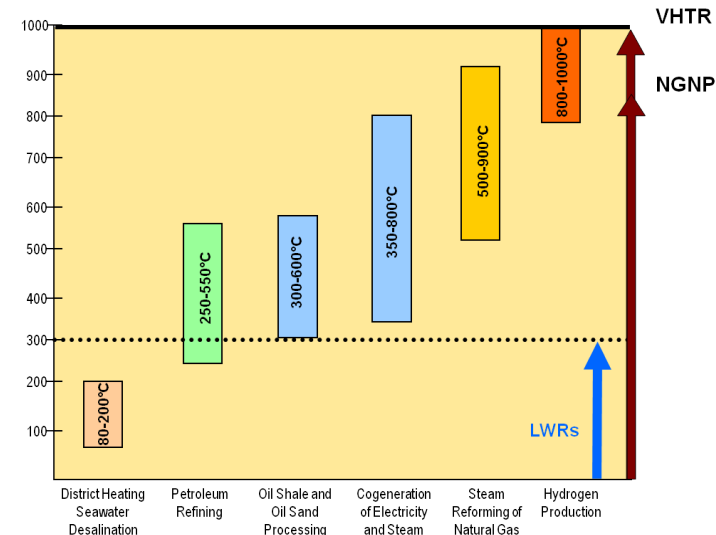
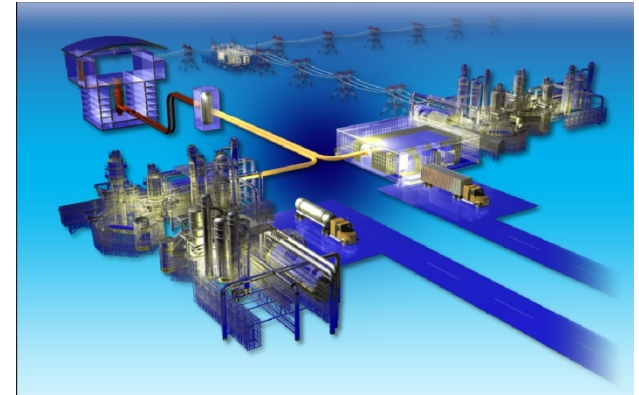
R&D programs are working to address several high level questions related to advanced reactor development and eventual deployment including:

- How can we improve the affordability of nuclear power?
- How can we improve the inherent safety of advanced nuclear reactors?
- How can we improve on the proliferation resistance of advanced reactors?
- How can we address the issue of nuclear waste through advanced fuel cycle options?
- How can we expand nuclear technologies into non-traditional nuclear energy markets?
- How can we increase the performance and efficiency of advanced nuclear plants through new materials, advanced systems or components?



Next Generation Nuclear Plant

- **Demonstrate high-temperature gas-cooled reactor (HTGR) technology to produce electricity and high temperature process heat**
- **Provide process heat for industrial processes needing temperatures 700-900°C**
 - Collaborate with NRC to establish a licensing framework for HTGRs
 - Partner with industry to commercialize HTGR technology
 - Collaborate with national laboratories, universities, and international community to perform R&D to reduce technical risk
- **R&D focus areas:**
 - Fuel qualification
 - Materials (High Temperature Metals and Graphite)
 - Design and Safety Methods
 - Licensing Support





Advanced Reactor Concepts: Fast Reactor Development R&D

■ Concept Development and Technology Maturation

- Assessments to guide innovative R&D
- Conduct of small-scale testing in METL

■ Advanced Materials

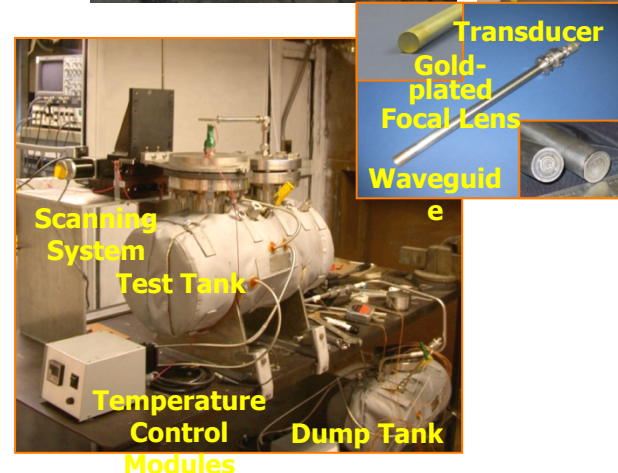
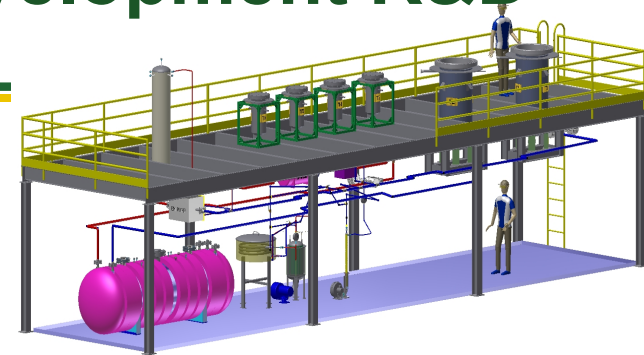
- Alloy development completed in FY12
- Testing of two candidate alloys

■ Safety Technology

- International and validation studies
- Licensing aspects

■ Ultrasonic Viewing Technology

- Key for under-sodium inspection
- International demonstration





Advanced Reactor Concepts: FHR Development R&D

■ Concept Development and Technology Maturation

- Assessments to guide innovative R&D
- Small-scale testing in ORNL Liquid Salt Loop
 - Hydraulic performance
 - Materials
 - Key Components (fluidic diode)

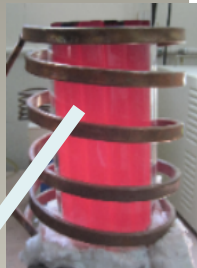
■ Closely coordinated with the NEUP-IRP



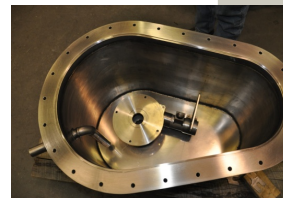
SiC test section – 600
graphite spheres -
1.25 kw/sphere (max)



Finned tube
air cooler – 200
kw



Inductive
heating test
section – 200
kw

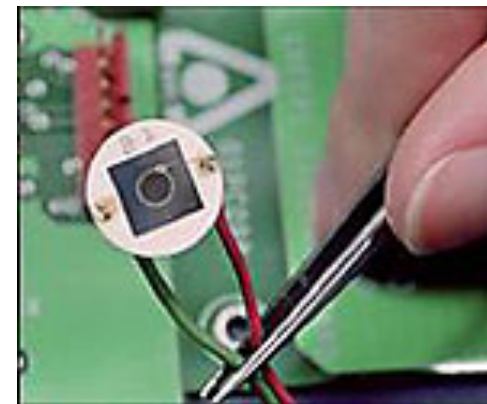


Pump & Sump



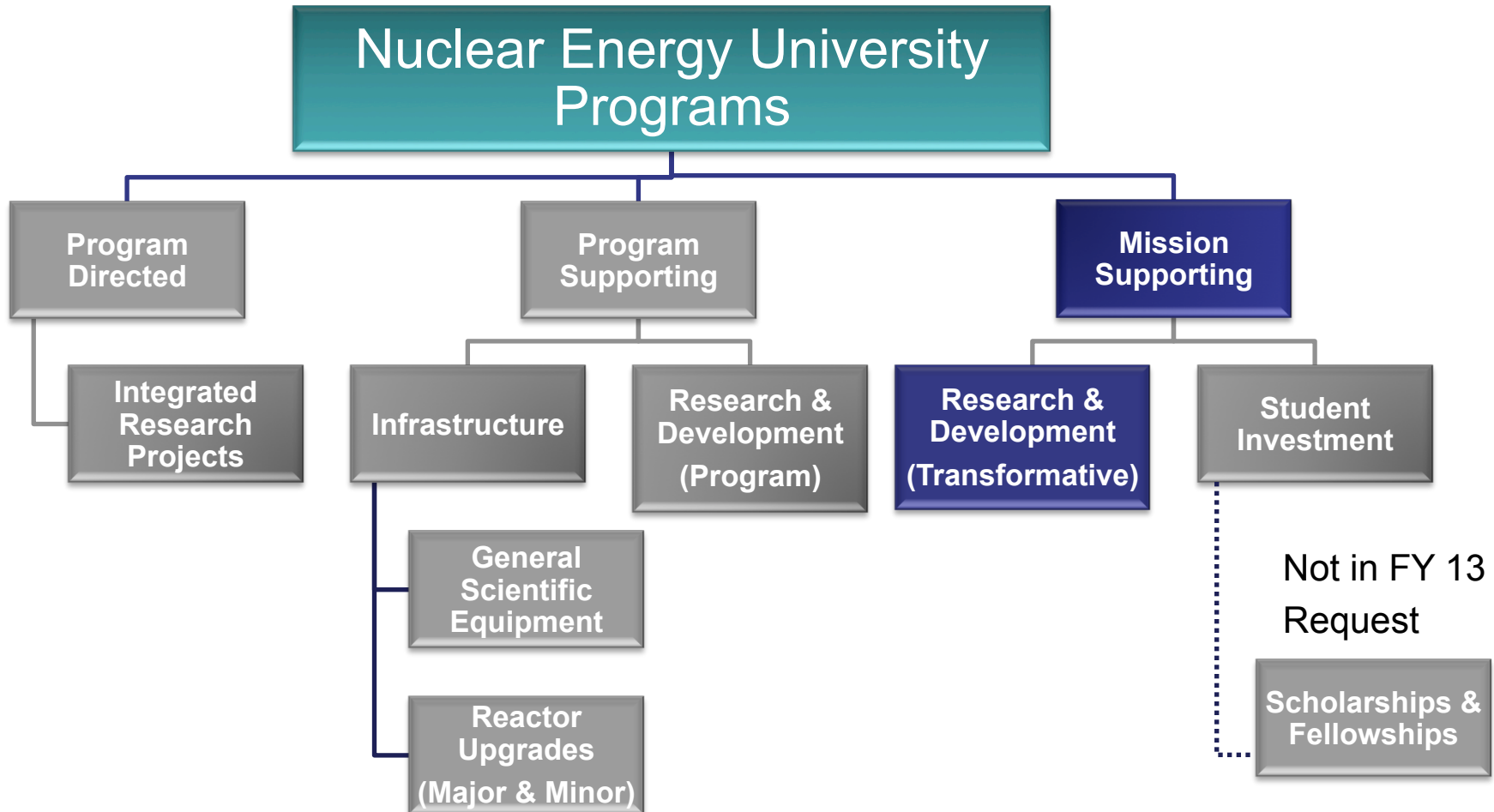
Advanced Small Modular Reactor (SMR) Research Needs

- **Instrumentation and Controls, Human Machine Interface (ICHMI)**
 - Advanced high temperature instrumentation for liquid metal reactors
 - In-service inspection technology/techniques
- **Component and Technology Development**
 - Advanced reactor technologies with emphasis on operations, compact configurations, and energy conversion systems
 - Advanced Materials
- **Safety and Licensing**
 - Advanced Modeling and Simulation
 - Seismic Isolation Technology
 - Seismic modeling



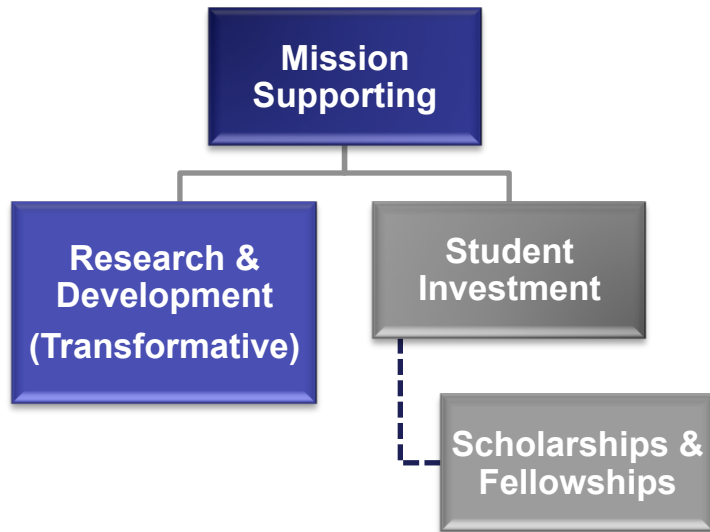


FY 2013 NEUP Structure





Mission-Supporting Component



- **R&D Component:**
 - Anticipate continuing maximum of \$450K for three year projects (~\$150k/yr)
 - Pre-applications and full proposals continue to undergo peer and relevancy review
- **Evaluation criteria weighting will be 20% program relevance and 80% technical quality**
 - **Versus 35% program relevance and 65% technical quality for Program Supporting**

FY 2013 MS-RC1 Work Scope

- A variety of reactor technologies are being pursued in the current DOE-NE R&D portfolio
 - High temperature gas reactor in NGNP
 - Sodium-cooled fast reactor and molten salt coolant in ARC
 - Five different technologies (advanced LWR, SFR, VHTR, LFR, FHR) have been proposed for advanced small reactors
- MS-RC1 scope includes both
 - Major innovations to these advanced reactor concepts; e.g.
 - Advanced systems of components
 - New fuel type or engineered coolant
 - Radically different (new) technology options
 - Advanced systems of components
 - New fuel type or engineered coolant





Recent Reactor Concept RD&D NEUP Awards

Examples of awarded Mission-Supporting - Reactor Concept proposals:

FY12

- Fuel and Core Design Options to Overcome the Heavy Metal Loading Limit and Improve Performance and Safety of Liquid Salt Cooled Reactors
- Stationary Liquid Fuel Fast Reactor Concept for TRU Burning
- ABR for TRU Transmutation with Breed & Burn Thorium Blanket for Improved Economics and Resource Utilization

FY11

- Feasibility and Safety Assessment for Advanced Reactor Concepts using Vented Fuel
- Transient Safety Analysis of Fast Spectrum TRU Burning LWR with Internal Blankets

FY10

- Developing a High Thermal Conductivity Fuel with Silicon Carbide Additives
- Improved LWR Cladding Performance by EPD Surface Modification Technique
- Maximum Fuel Utilization in Fast Reactors without Chemical Reprocessing

Questions?

Backup



Work Scope Description

Mission Supporting Reactor Concepts

REACTOR CONCEPTS RD&D (MS-RC1)

FEDERAL POC – SAL GOLUB

TECHNICAL POC – BOB HILL

Development of new reactor concepts that may offer the potential for revolutionary improvements to reactor performance and/or safety is sought. Such advanced reactor concepts could include the incorporation of advanced systems or components into existing concepts, inclusion of innovative design alternatives (e.g., new fuel type, nano-engineered coolants, etc.), or designs employing radically different technology options (e.g., advanced coolants, fuel, or operational regimes). Concepts could also include small modular reactors with unique capabilities to address operational missions other than the delivery of baseload electric power, such as industrial process heat or mobile reactors that can provide temporary power during emergency situations. The scope of the proposed project should include a thorough viability assessment of the concept, a detailed technology gap analysis and a comprehensive technology development roadmap that identifies research needed on key feasibility issues.