



U.S. Research Programs and Infrastructure Needs: A Perspective from a National Laboratory

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NEA Steering Committee Policy Debate

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Key questions for debate: A personal viewpoint

- ▶ **What should be done nationally and what should be done internationally?**
- ▶ **How do we cooperate in light of:**
 - **Competition for future markets**
 - **Decay in national infrastructures**
 - **National priorities**

Background for discussion

- ▶ U.S. trends in energy and nuclear energy R&D investment
- ▶ Research priorities and challenges ahead
- ▶ Nuclear engineering and technology infrastructure – opportunities and challenges
- ▶ A view from a national laboratory in the U.S.

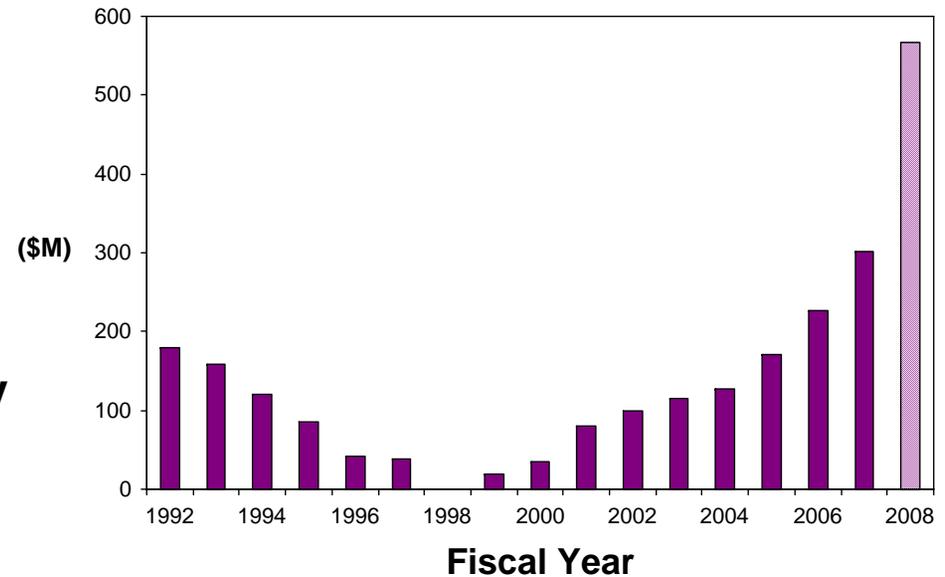
National Laboratories



After years of declining investment, the U.S. is investing again in nuclear energy R&D

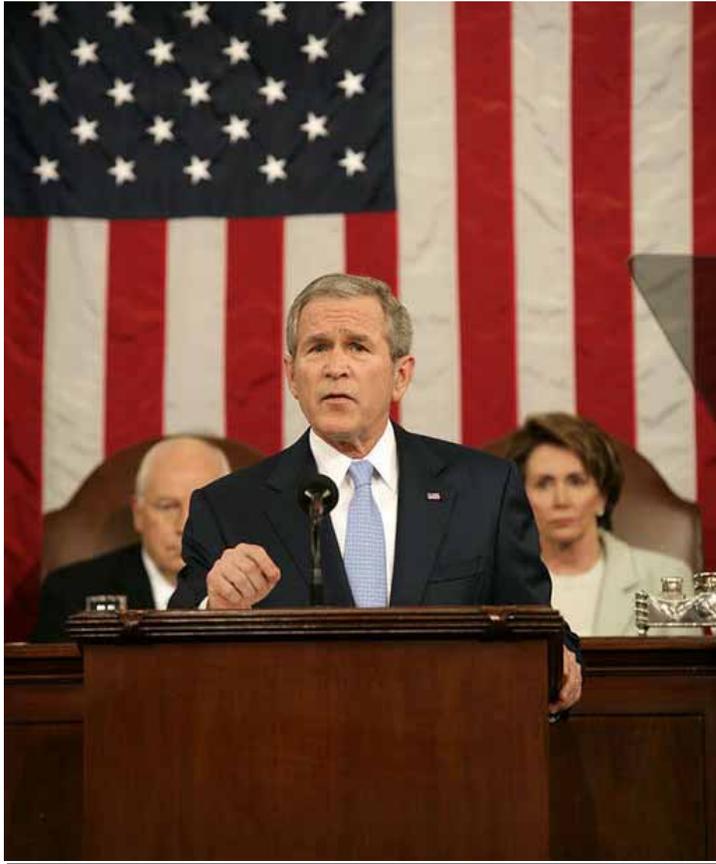
- ▶ Nuclear R&D investment responding to market-pull
 - Chronic volatility and price of fossil fuels
 - Demand and near term need for baseload
 - Carbon management
 - Nuclear energy’s operating performance
- ▶ More than 90% of nuclear energy R&D is federally funded and focused on:
 - Removing barriers to expanded use of nuclear energy in the U.S. and the world
 - Speeding deployment of advanced technologies
 - Addressing proliferation and nuclear waste

U.S. Investment in Nuclear R&D



A Balanced Approach in the U.S.

Policy and politics



It's in our vital interest to diversify America's energy supply - the way forward is through technology. We must continue changing the way America generates electric power, by even greater use of clean coal technology, solar and wind energy, and clean, safe nuclear power.

President George Bush
State of the Union
January 23, 2007

... nuclear power - touted as an emissions-free way to generate electricity — is gaining traction as a way to improve the environment while meeting the nation's growing demands for power... I think it has to be on the table."

Honorable Nancy Pelosi
House Science & Technology Hearing
February 8, 2007

Nuclear Power 2010: Building a new generation of nuclear plants in the U.S.

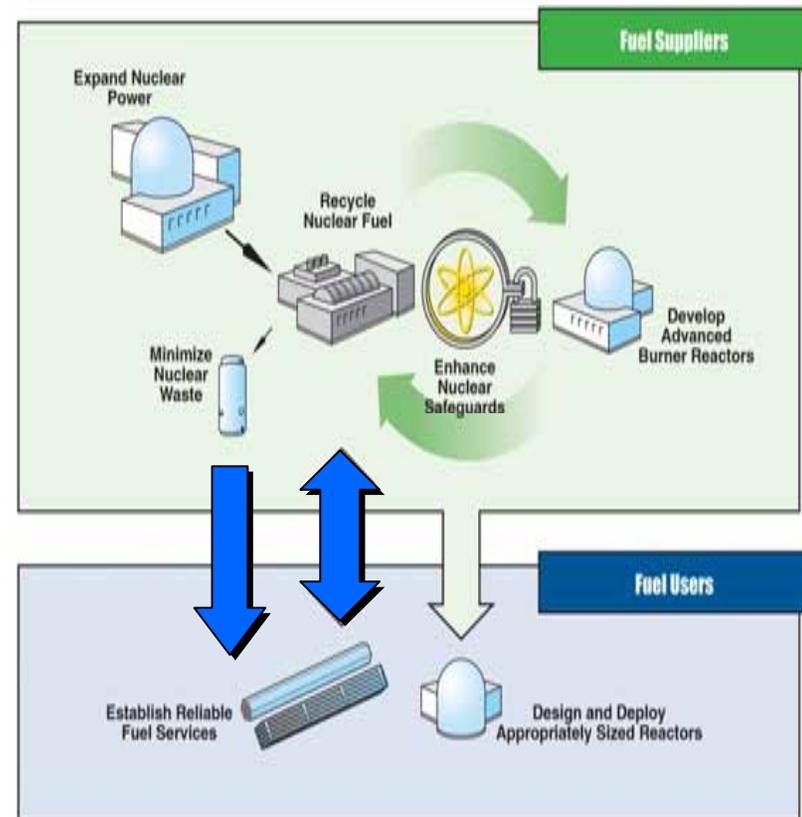


- ▶ Government speeds deployment of advanced technologies to the market by cost-sharing the financial and regulatory risk associated with building new plants
- ▶ Requirements/challenges:
 - There must be a demonstrated market for power
 - Evolutionary technology
 - Regulatory stability and predictability (COL/Part 52)
 - Financial risk/incentives
 - Disposal of a legacy of used fuel
 - Human and capital investments needed to rebuild the infrastructure

How can we stimulate rebuilding both the human and physical infrastructure in the U.S.?

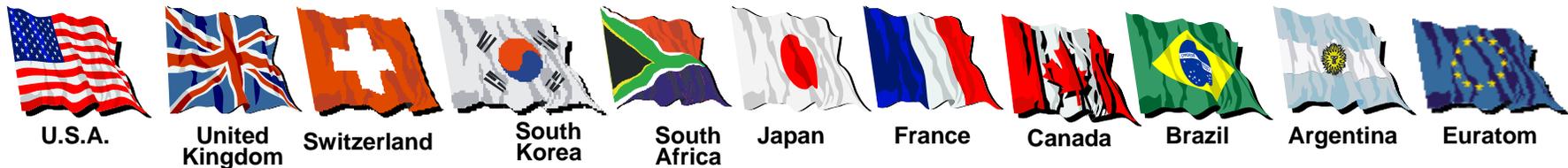
Global Nuclear Energy Partnership

- ▶ A strategy to enable expansion of nuclear power in the U.S. and around the world, promote nuclear nonproliferation goals, and help resolve nuclear waste disposal issues
- ▶ Requirements/challenges
 - Development of transmutation fuels and coordination with separations and fast reactor development is the long pole in the tent
 - Moving from empirical approaches to science/simulation approaches will speed development
 - Diversity of technical alternatives requires robust systems analysis
 - U.S. resources are dispersed and aging



How should industrial partnerships and international collaborations be leveraged to leapfrog to advanced technology and speed deployment?

Generation IV Nuclear Energy Systems

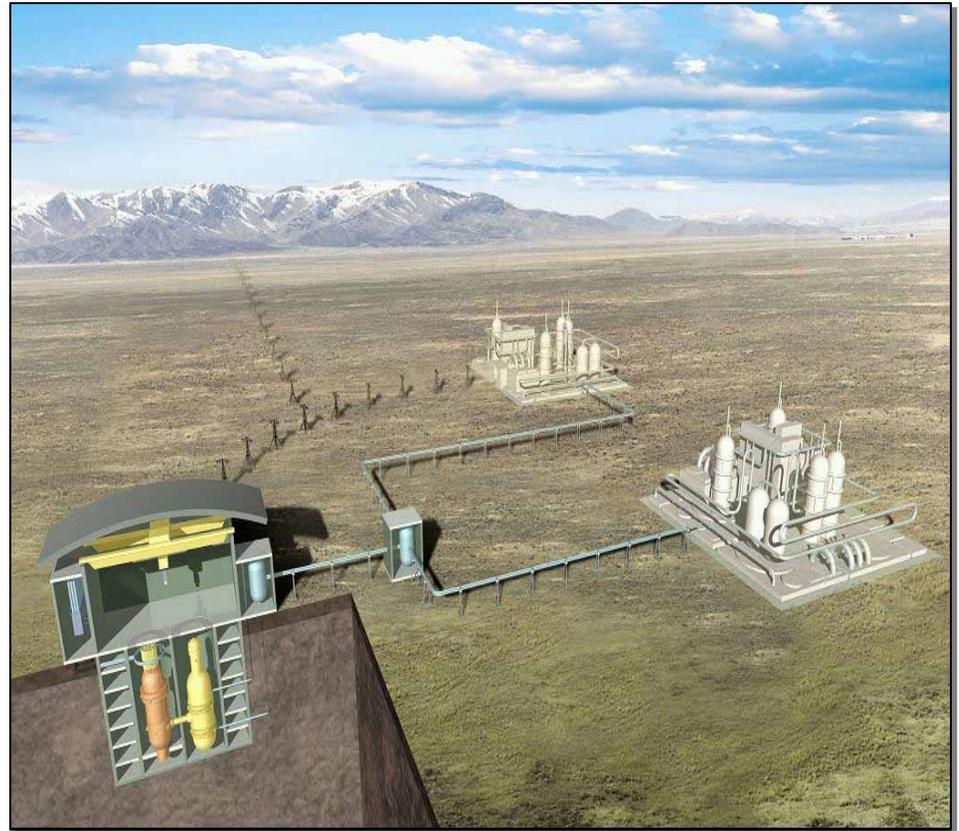


- ▶ **Government sponsoring R&D necessary to establish the viability of next generation nuclear energy systems**
- ▶ **Requirements/challenges**
 - U.S. focus is on very high temperature reactor and sodium cooled fast reactor for actinide burning
 - System arrangements for the SFR and VHTR were signed last year
 - Project arrangement for SFR advanced fuels signed this year
 - Project arrangement underway for VHTR materials
 - Significant benefit to investment from international collaboration

How do we derive more benefit from collaboration?

Next Generation Nuclear Plant: Moving advanced nuclear technologies to the market

- ▶ **Government addressing barriers to development of advanced reactor technology for process heat, electricity, and hydrogen**
- ▶ **Requirements/challenges**
 - Particle fuels development
 - Graphite and high temperature materials development
 - VHTR Design and Safety Analysis Computational Methods
 - Requires infrastructure, hardware and computational investments
 - Requires regulatory framework

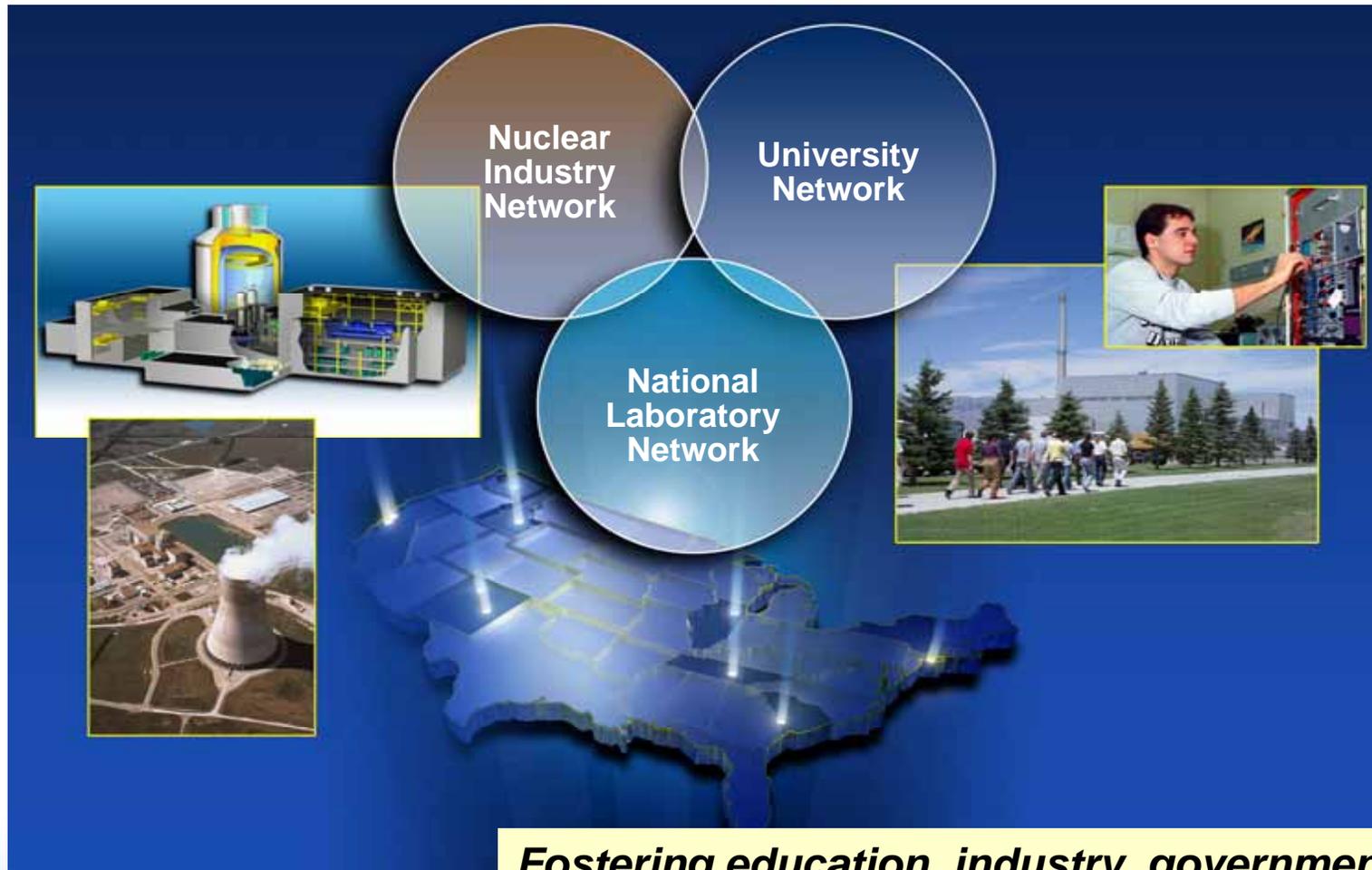


A public/private alliance leads the development of NGNP

Challenges ahead in the U.S.

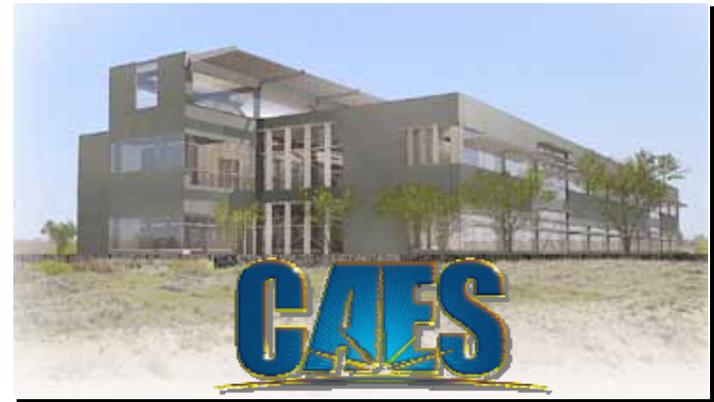
- ▶ **Can R&D funding be sustained?**
- ▶ **How best to integrating R&D across labs, with universities, and international collaboration?**
- ▶ **How should technologies be industrialized?**
- ▶ **Where are the gaps in U.S. infrastructure and how should these gaps be filled?**
- ▶ **How do we create a pipeline of engineers, scientists, craft, technicians?**

Idaho National Laboratory: A collaborative model to deliver capability



Idaho National Laboratory: Fostering education to produce the needed investment in expertise

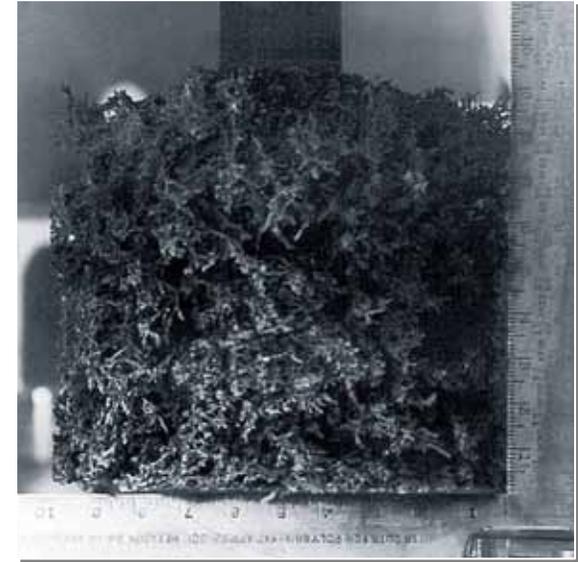
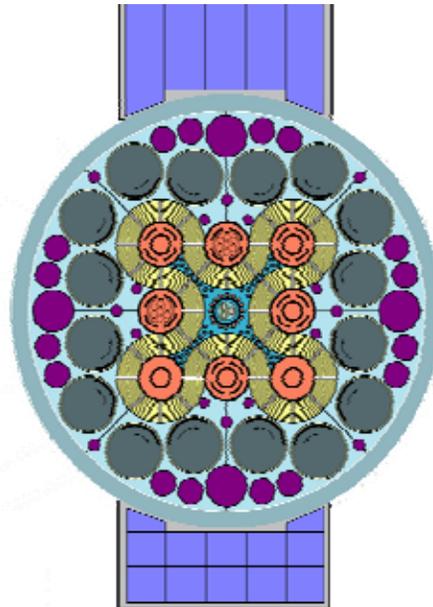
- ▶ Massachusetts Institute of Technology leads the Nuclear University Consortia
- ▶ Strengthening nuclear engineering education through the Idaho Universities Consortia
 - Establish Associates Degree program for technicians
- ▶ Center for Advanced Energy Studies is a gateway to the lab



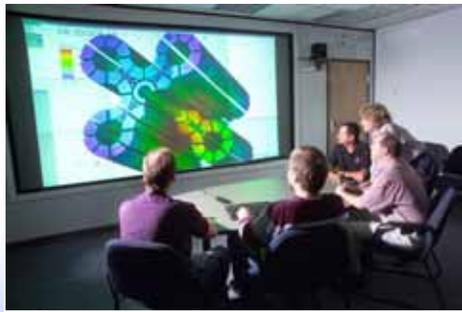
DOE is investing in critical infrastructure at the Idaho National Laboratory



Advanced Test Reactor



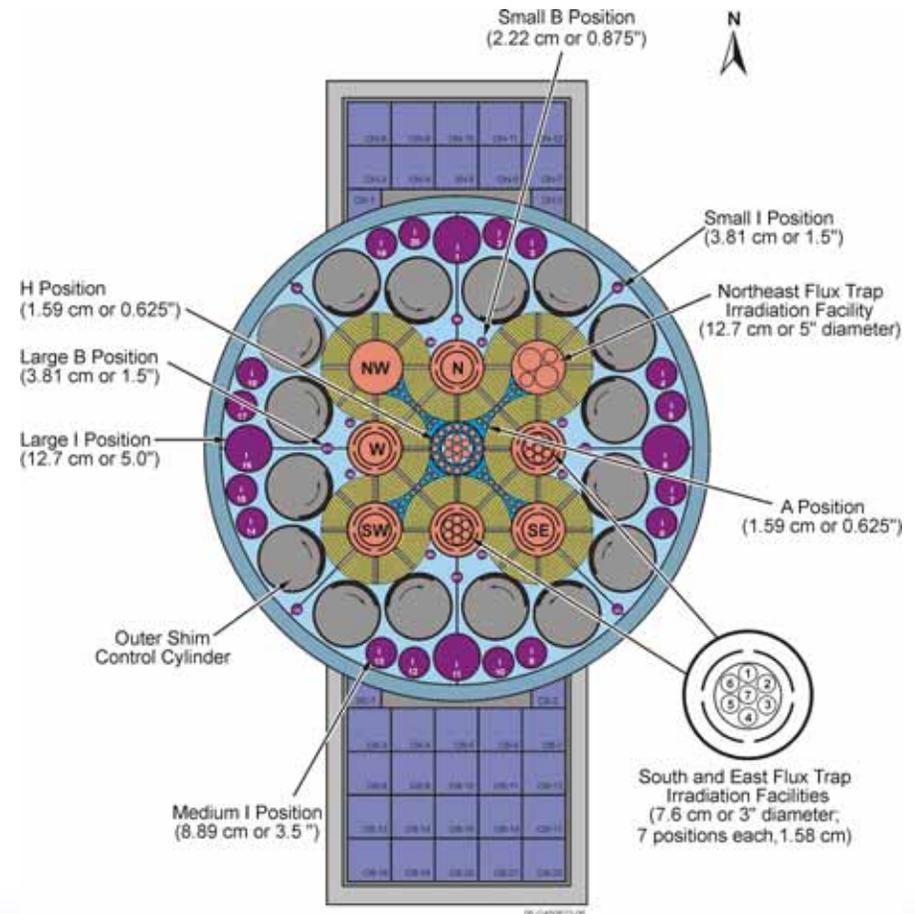
Fuel Conditioning Facility



Hot Fuel Examination Facility

INL's Advanced Test Reactor will transition to scientific user facility this year

- ▶ A 250 MW pressurized light-water cooled, beryllium reflected research reactor
- ▶ Only U.S. reactor capable of providing large-volume, high-flux neutron irradiations in a prototypic reactor environment
- ▶ Able to replicate up to several different reactor environments concurrently
- ▶ Many additional test locations
- ▶ Co-location of Post-Irradiation Examination capabilities at INL



The Issues

- ▶ **Is there market-pull for advanced nuclear reactor and fuel cycle technologies?**
 - **How do we accelerate development through international collaboration, making the most of our respective resources?**
 - **How do we stimulate rebuilding the infrastructure in the U.S., including the education infrastructure?**
 - **In addition to sharing facilities, is it possible to combine resources to build international demonstration facilities that facilitate infrastructure and speed deployment of an international closed fuel cycle?**
 - **What is the role of NEA in international facilities and knowledge management?**