The Advanced Test Reactor Capabilities and Future Operating Plans

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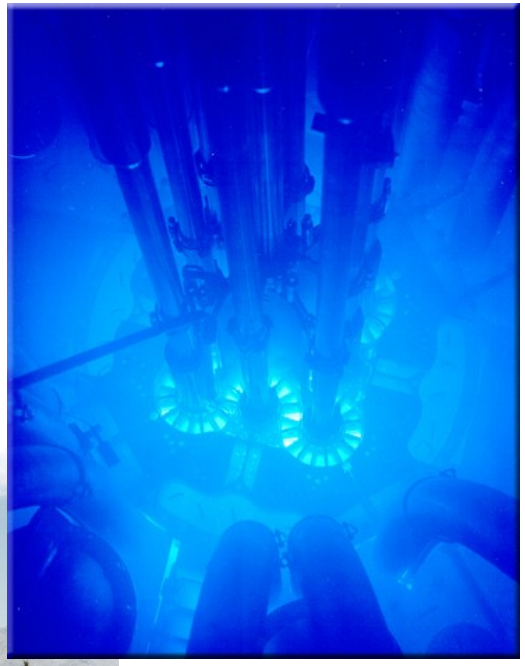
Reactor Technology Complex at the Idaho National Laboratory



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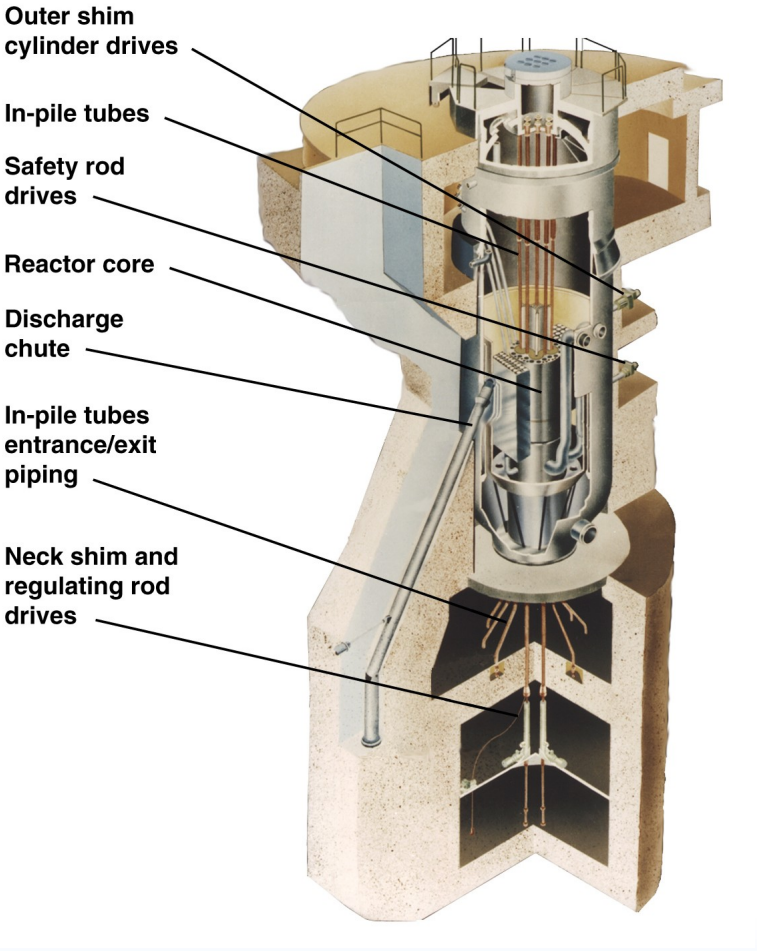
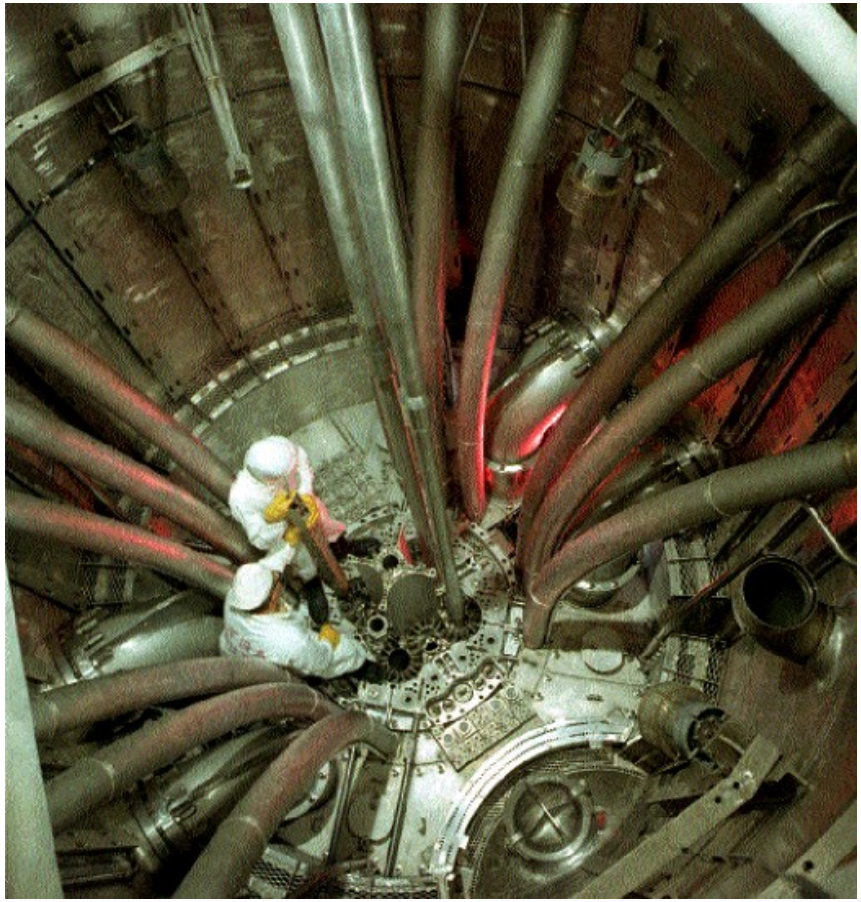
Advanced Test Reactor Description

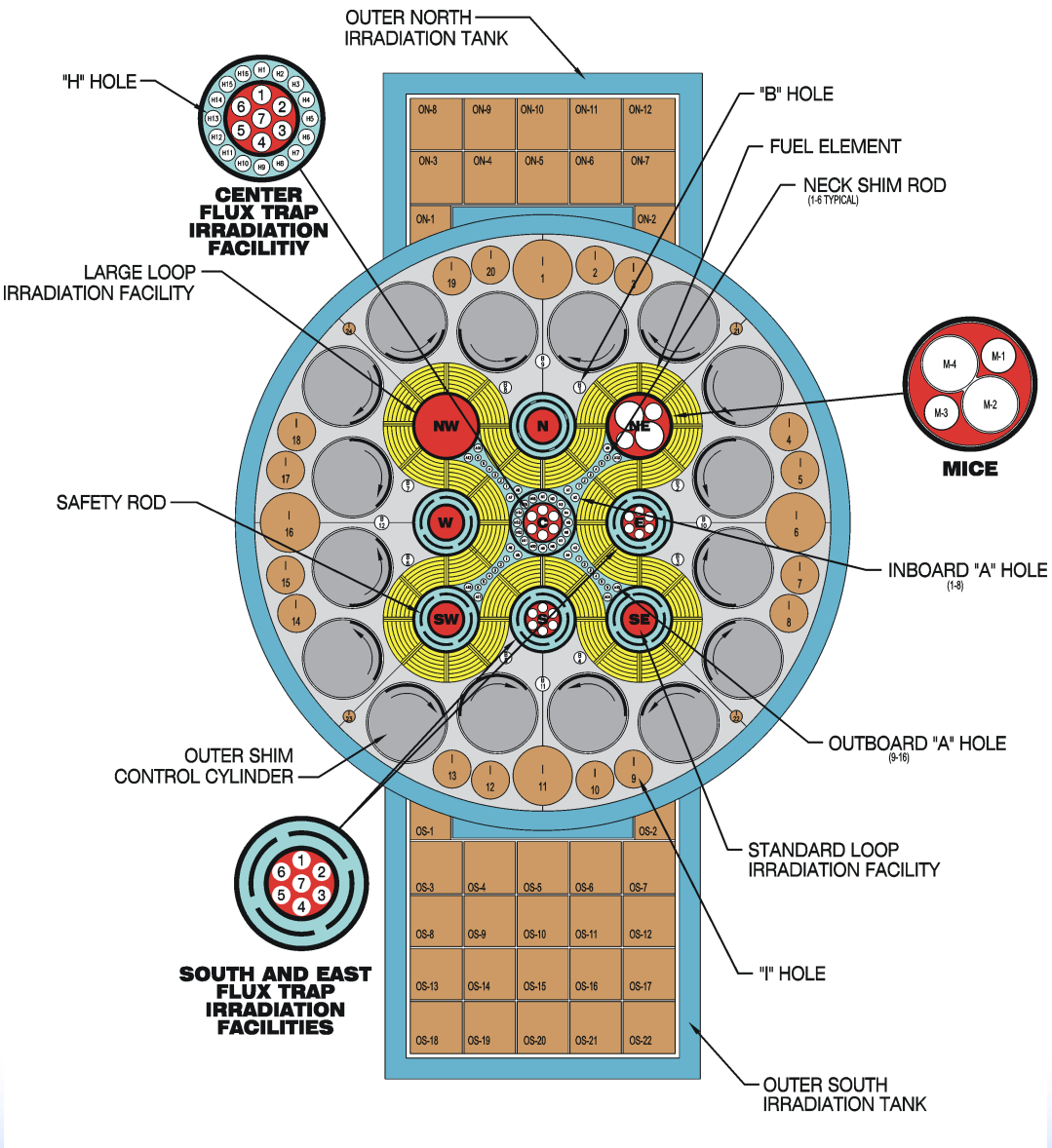
- Pressurized, light-water moderated and cooled, beryllium reflector
- Reactor Vessel, stainless steel, ~12’ diameter cylinder, ~35’ high
- Reactor Core, 40 HEU curved plated elements, 48” (diameter & height)
- Max. Testing Conditions – up to1400°F, 3600 psig
- Maximum Total Core Power – 250MW
- Approximate Peak Flux Values (Unperturbed), Symmetrical Profile
  - 1×10^{15} n/cm^2-sec thermal
  - 5×10^{14} n/cm^2-sec fast

ATR Vessel & Internals





ATR Core Cross Section



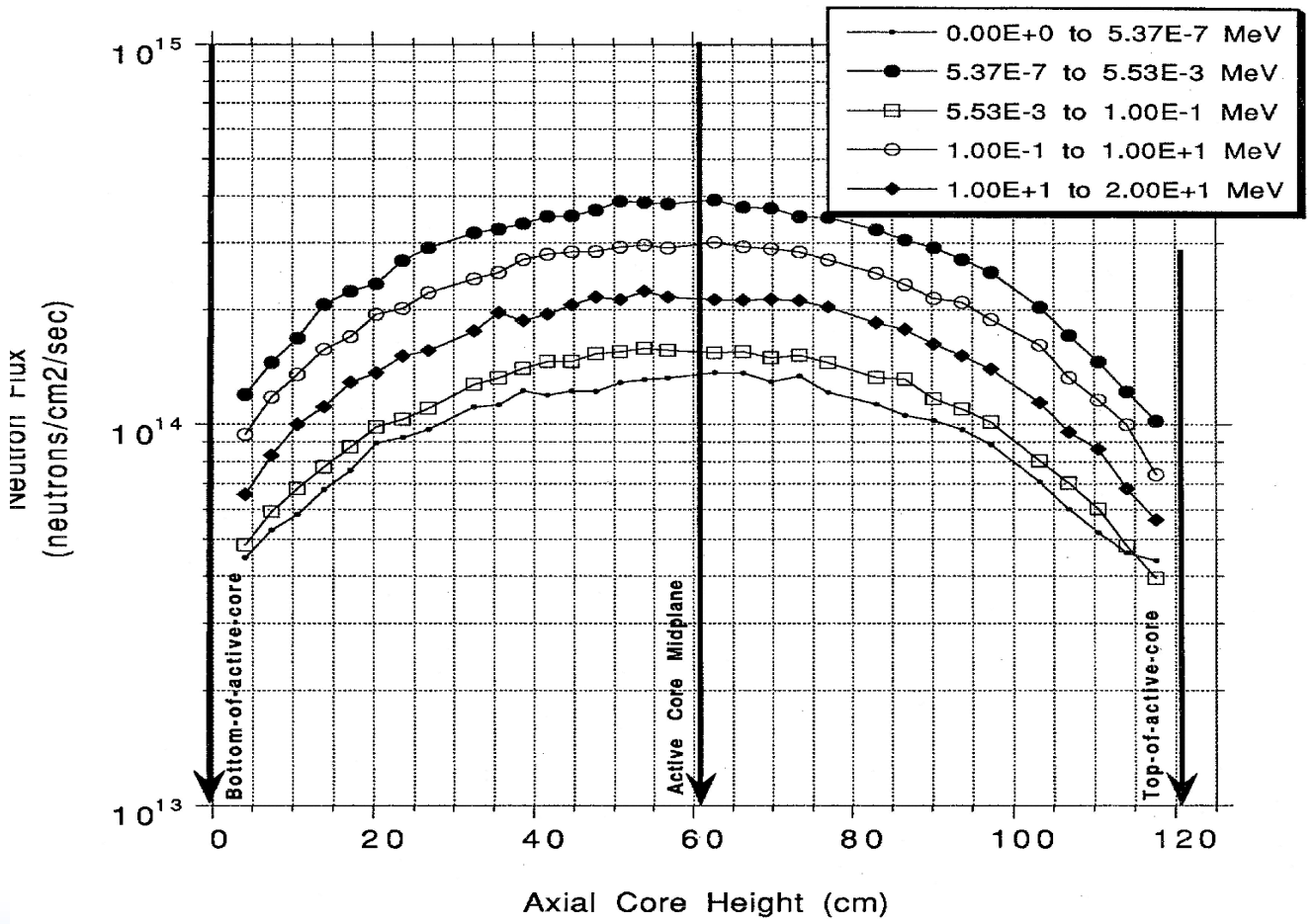
Test Capabilities:

Test size - up to 5.0” D

77Irradiation Positions:

- 4 Flux Traps
- 5 In-pile Tubes
- 68 in Reflector

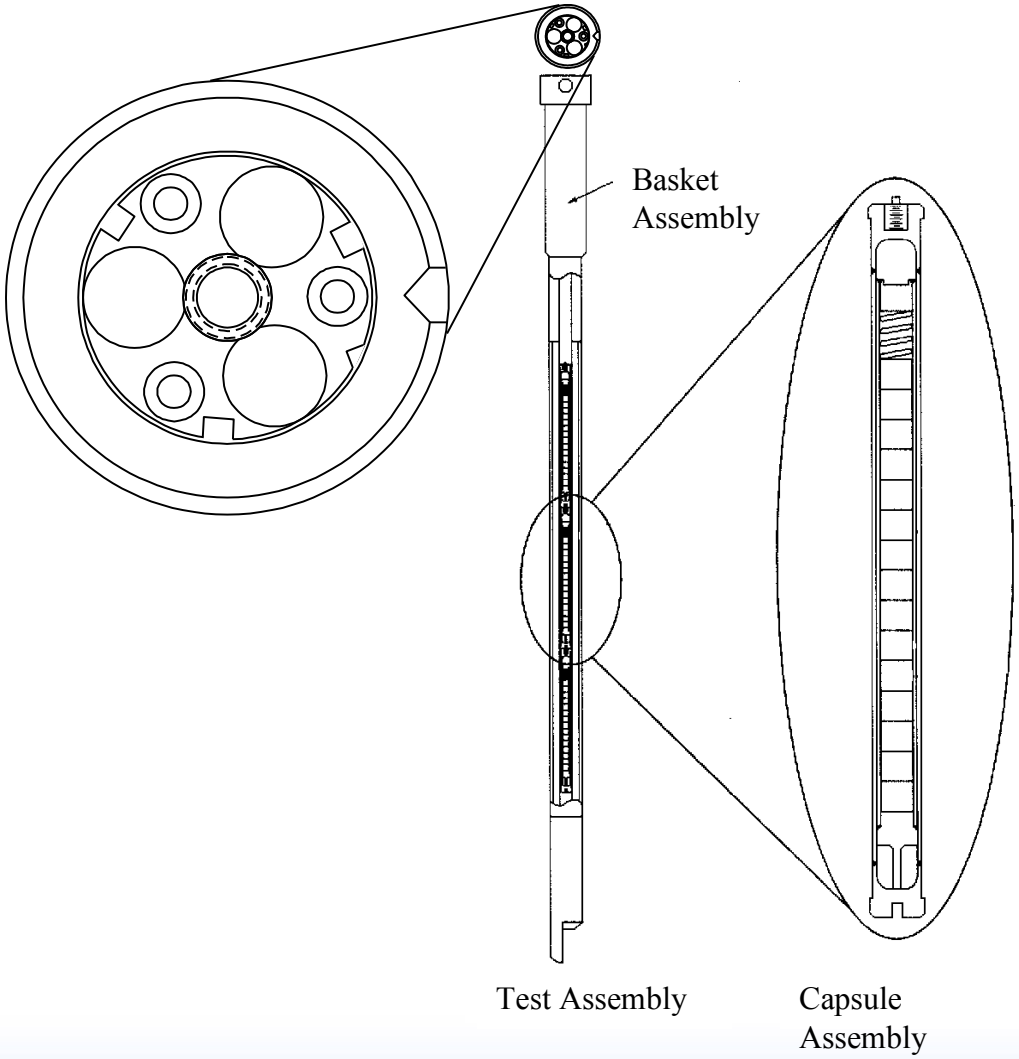
Center Flux Trap Typical Flux Profile



Simple Capsule Testing in the ATR

- Many are non-instrumented (e.g, radioisotopes)
- Passive instrumentation (flux wires, melt wires)
- Reflector positions or flux traps
- Isotopes, structural materials, fuel samples
- Lengths up to 48”; diameter, 0.625” - 5”
- Usually the least expensive testing configuration
- Six month lead time

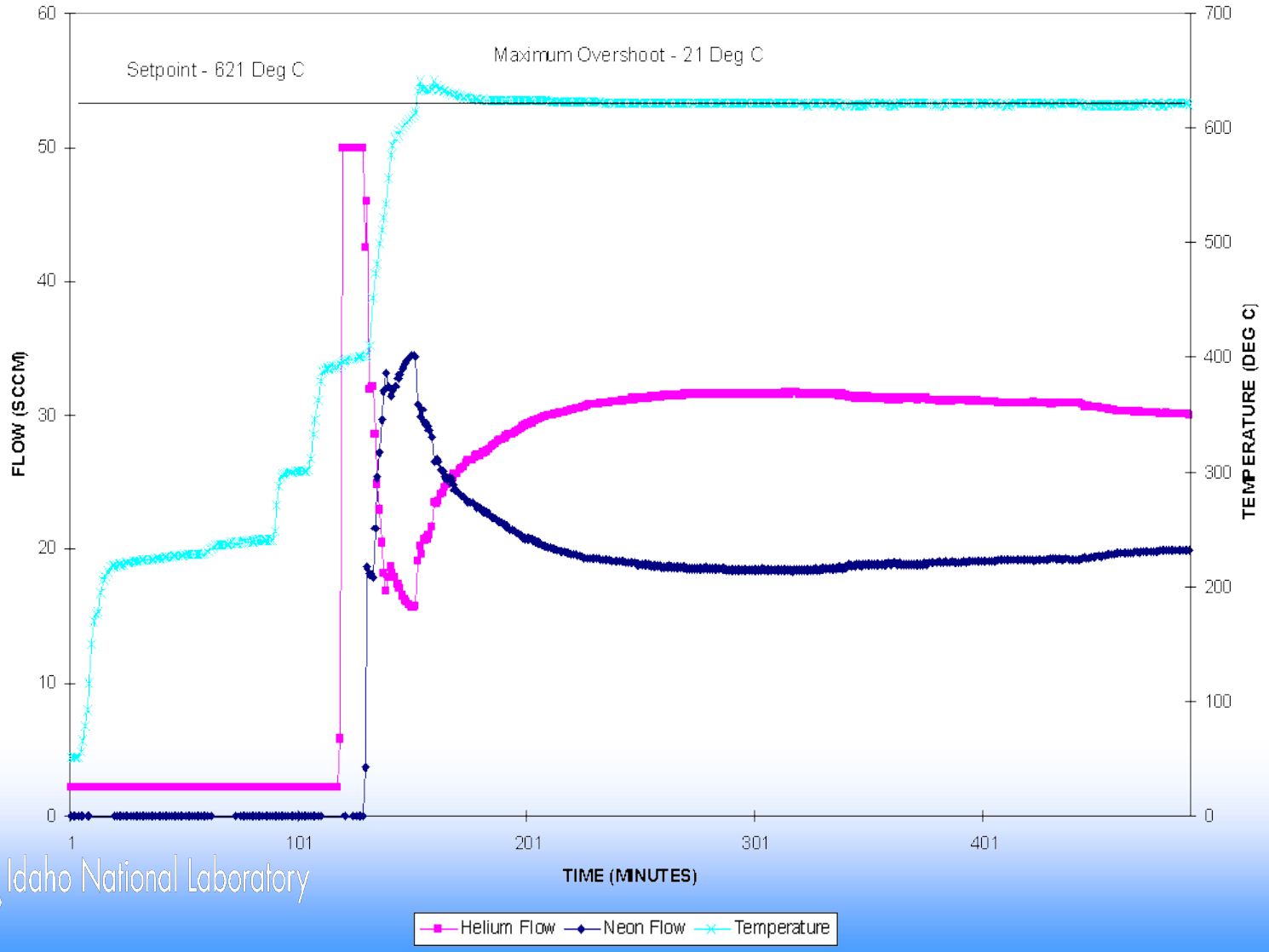
Capsule Assembly for MOX Fuel Test



Instrumented Lead Experiments

- On-line instrument (temperature) measurements
- With or without active temperature control
- Structural materials, cladding, fuel
- One year lead time for new test design and installation
- Irradiation Test Vehicle
  - Three mini-in-pile tubes, each with five temperature control zones
  - Capsules up to 1” diameter
  - Temperature control range 480-1400°F, +/- 9°F
  - Temperature controlled by varying gas mixture in conduction gap
  - Could be re-installed

Temperature Response During Reactor Startup for Temperature Controlled Capsule



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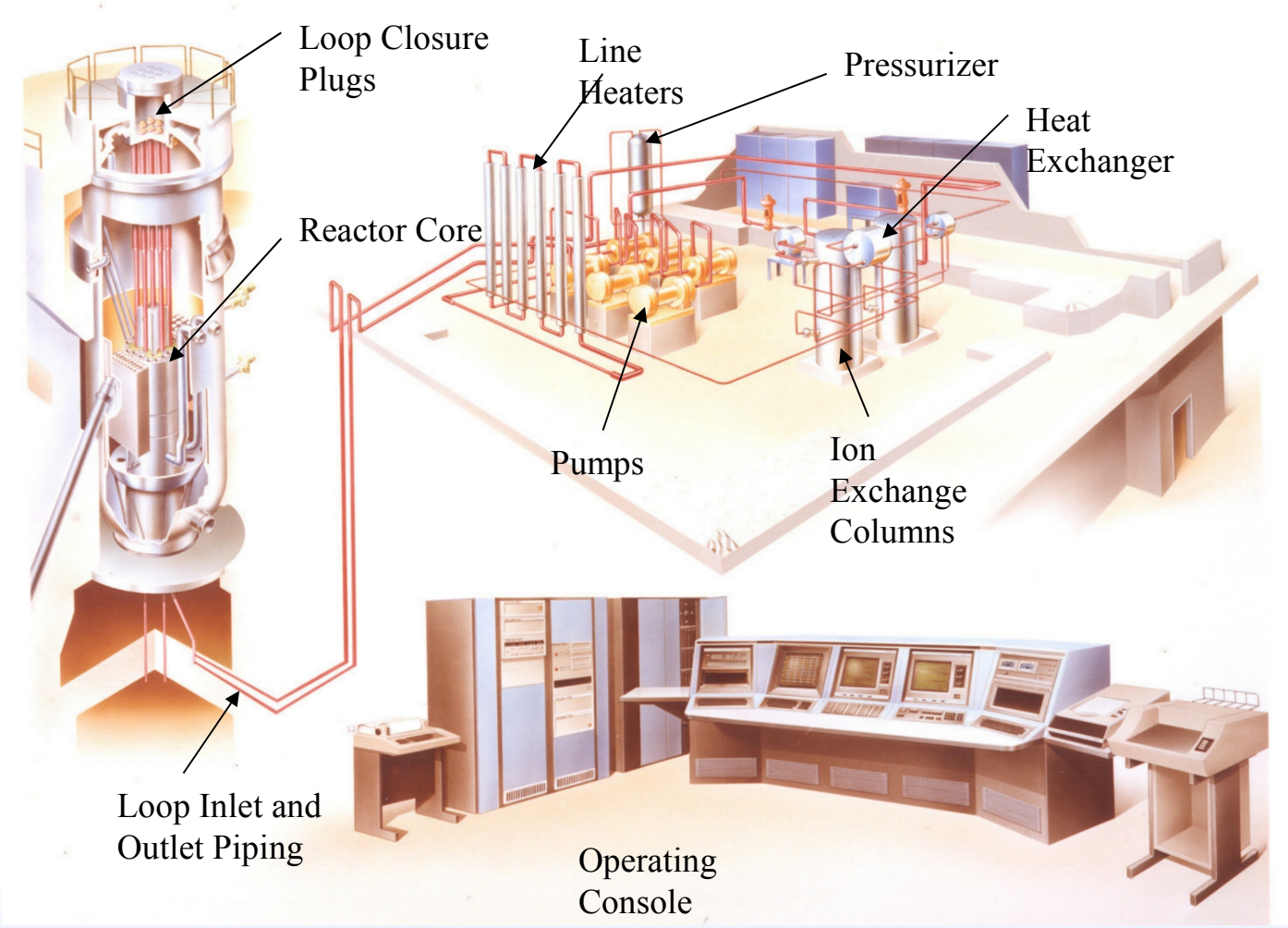
In-Pile Loop Tests

- Five flux trap positions currently have pressurized water in-pile loop tests
- Past operations have had as many as nine loop tests
- Each loop has its own temperature, pressure, flow & chemistry control systems – not in contact with the primary coolant system
- Structural materials, cladding, fuel
- Flux tailoring and transient testing capabilities
- Up to two year lead time for new test programs

ATR Standard Loop Layout



Previous Testing in the ATR

- U.S. Naval Nuclear Propulsion Program
- Material and Fuels for New Production Reactor (project cancelled in 1992)
- Graphite Oxidation and Aging Studies for Magnox
- Pu-238 Production Studies
- Weapons Grade Mixed Oxide Fuel
- Reduced Enrichment for Research and Test Reactors (RERTR) – High Density, Low Enrichment
- Plant Maintenance Technology & Welding of Irradiated Materials (stainless steel)

Current ATR Irradiation Projects

- Advanced Fuel Cycle (AFC)
  - Fuel tests expected to continue through 2010
  - Gas Fast Reactor material tests 2004 – 2008
- Cobalt-60
- Zirconium Tests, 1997 – 2006
- RERTR
  - Mini plate testing 2005 – 2006
  - Full fuel plate testing, 2006 – 2009
- Neptunium tests - Cross Section Data, 2005 - 2006
- Advanced Gas Reactor, Fuel Tests, 2006 - 2015

Proposed Irradiation Tests

- Next Generation Nuclear Plant, Graphite, 2006 – 2008
- Fuel Qualification for the new ATR Gas Test Loop, 2006 – 2007
- Isotopes
- Plutonium-238 for Radioisotope Power Systems
- Simulation of BWR Conditions for Various Tests
- Material Tests for International Research on Aging, New Reactor Designs (steel, graphite)

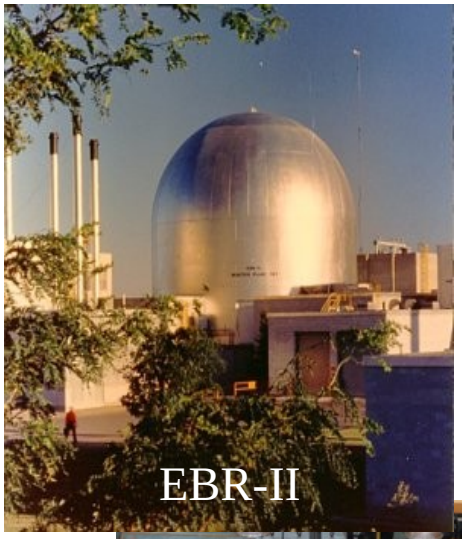
Planned Investments in the ATR

- Gas Test Loop - Fast Flux 10^{15} n/cm^2-s
- Redesign and Reinstallation of the Irradiation Test Vehicle
- Hot Cell Use and Need Determination
- Hot Cell PIE Equipment Upgrade
- Reactivation of Pressurized Water Loop
- Installation of “Rabbit” System
- Fuel Fabrication Facility Equipment Upgrades
  - Existing ATR fuel
  - Uranium-molybdenum production capability

Materials and Fuels Complex

INL History in Fuels Development

- Development and qualification of fuels for EBR-I, EBR-II, and the IFR concept
- DBA testing in SPERT, PBF, & LOFT – model LWR fuel behavior under DBAs and severe accidents
- Development and licensing of reduced-enrichment fuels for research reactors
- Testing and evaluation of a variety of fuel types, including metallic, oxide, nitride, carbide, and dispersion fuels
- Expertise in fuel fabrication, irradiation performance, safety analysis and safety experimentation
- Spent fuel dry storage technology



Postirradiation Examination Capabilities

- Neutron radiography
- Element/capsule NDE
  - Visual examinations
  - Physical measurements
  - Eddy Current Oxide Layer Test
  - Fission/activation product distributions
- Laser puncturing and gas sampling
- Sample cutting and preparation
- Metallography (microhardness measurements)
- Scanning electron microscopy

Analytical Chemistry Laboratory

Capabilities

- Analytical chemistry of fission products, actinides, and other radionuclides in various matrices

- Shielded hot cells
- Gloveboxes
- Fuel casting laboratory
- NDA laboratory

Summary of INL Capabilities

- Advanced Test Reactor
  - Multiple test positions and configurations available
  - High flux and large volume test positions
  - Long history of irradiation tests and future plans
- Post Irradiation Examinations
  - Fuel development experience
  - HFEF – destructive and non-destructive examinations
  - Analytical laboratory support