

Advanced Test Reactor (ATR) Capabilities

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ATR Complex



ATR Specifications

Reactor Type

- Pressurized, light-water moderated and cooled, beryllium reflector

Reactor Vessel

- 12 ft diameter cylinder, 36 ft high
- Stainless steel

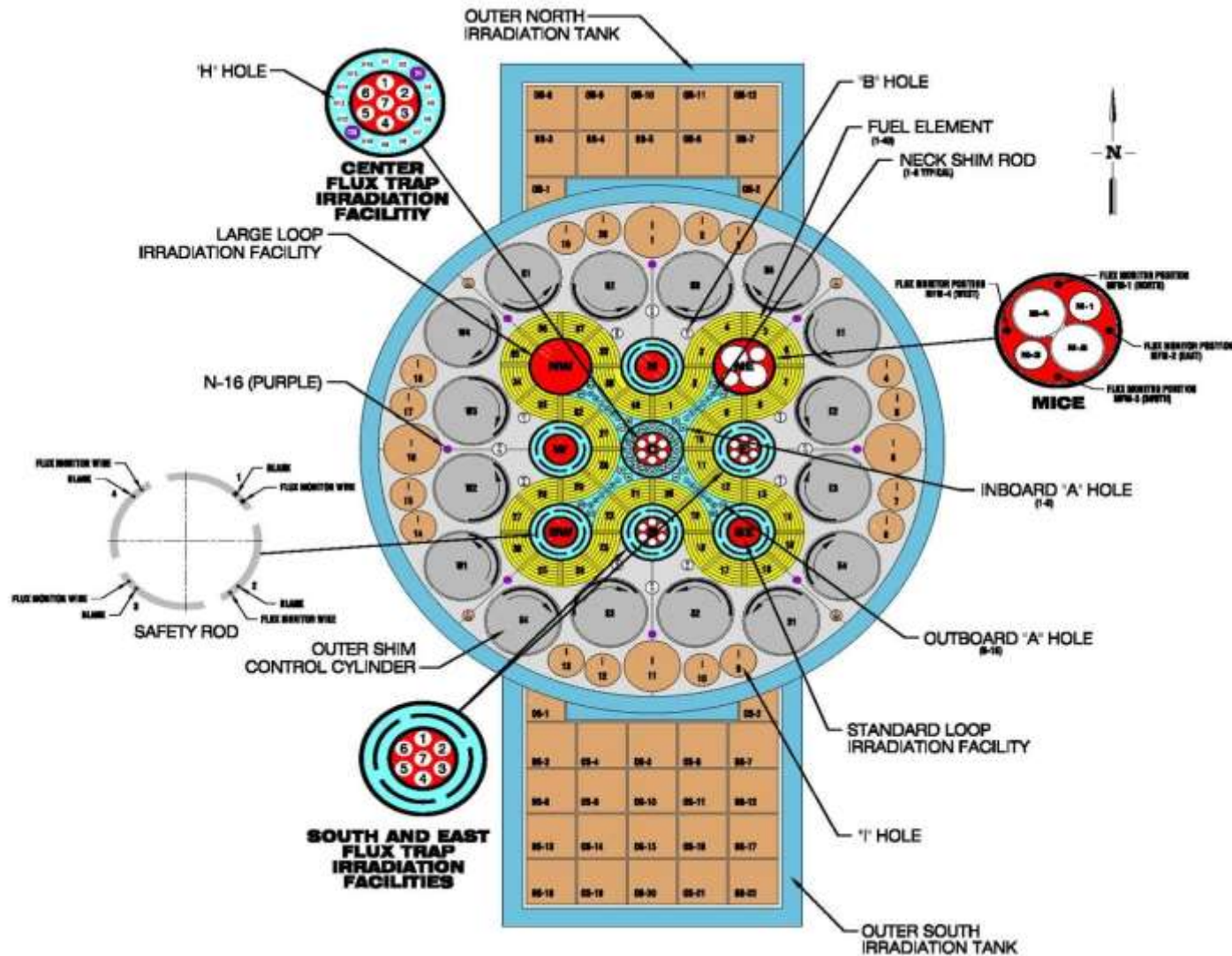
Reactor Core

- 4 ft (diameter & height)
- 40 fuel elements, highly enriched U-235

Coolant Temperatures and Pressure

- 125° F Inlet
- 160°F Outlet
- 390 psig

ATR Fuel & Experiment Layout



ATR Characteristics

- Highest-power research reactor operating in the world (250MW)
- Provides high neutron fluxes while being operated in a radially unbalanced condition
- Serpentine fuel arrangement affords experimental versatility while ensuring maximum efficiency of core reactivity-control components
- Numerous Test Positions and Large Test Volumes
- Individual Experiment Temperature, Pressure, Flow, and Chemistry Control in Six Pressurized Water Test Loops with a Capacity for Up to Nine Experiment Loops
- Constant Axial Power (flux) Profile
- Operates in short-duration cycles, with (generally) two to weeks between refueling outages

ATR Alignment to the Mission Organizations

The ATR *User's Working Group* integrates the needs of the NSUF, NR and other program customers into the ATR and ATRC Integrated Strategic Operating Plan (ISOP)

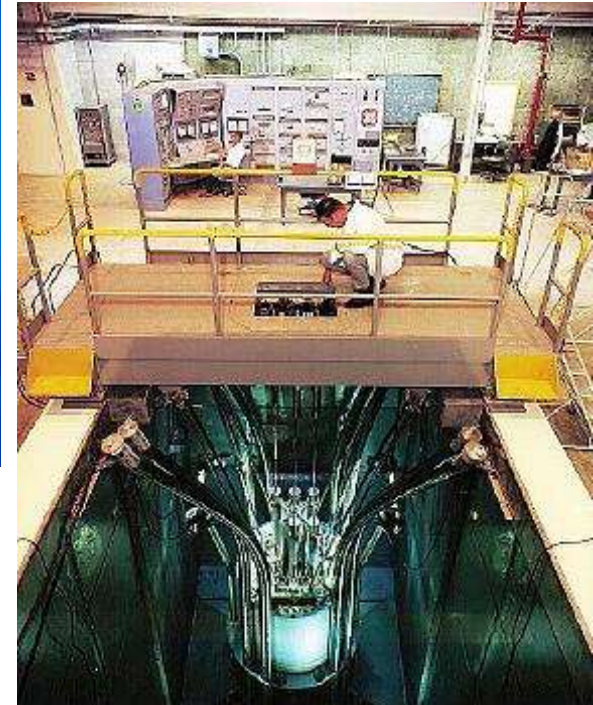
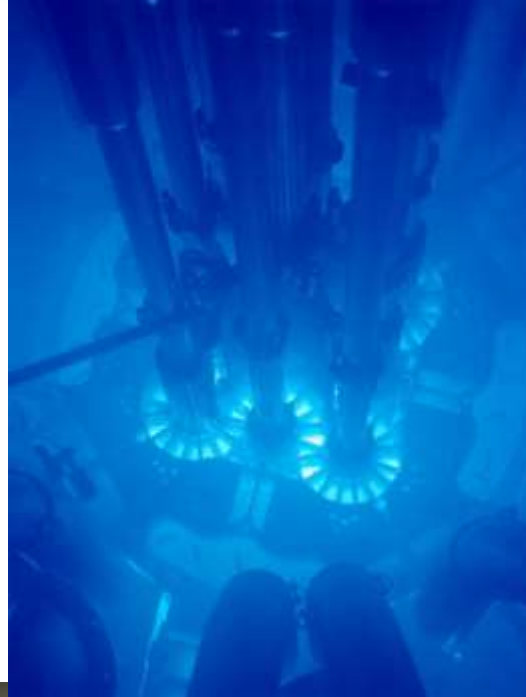


- **Performance:**
 - Equipment Reliability Focus
 - Human Performance Focus
 - Continuous Improvement Focus
 - Irradiation Throughput
- **Capabilities:**
 - ATR Critical Facility
 - Pressurized Water Loop
 - Hydraulic Shuttle Irradiation System
 - Dry Transfer Cubicle (Sizing)
 - NEW Capabilities

ATR Complex Facilities



Test Train
Assembly



Remote Sizing in Dry Transfer
Cubicle

Test Train Assembly

- Induction brazing of instrument leads (e.g. thermocouples) to penetrate capsule boundaries
- Electro-plating, typically in support of induction brazes
- Thermocouple potting and splicing
- Heat treatment and (specimen) vacuum drying ovens
- processes
- Welding - Standard GTAW and MIG, tube welder
- Pressure and helium leak testing



Experiment Configurations

Simple Static Capsules

- Reflector positions or flux traps
- Isotopes, structural materials, fuel coupons or pellets

Hydraulic Shuttle Capsules

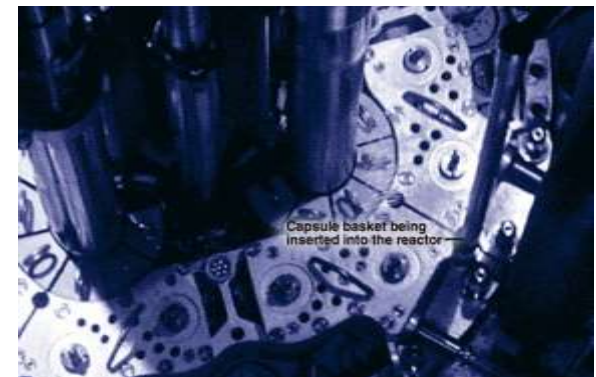
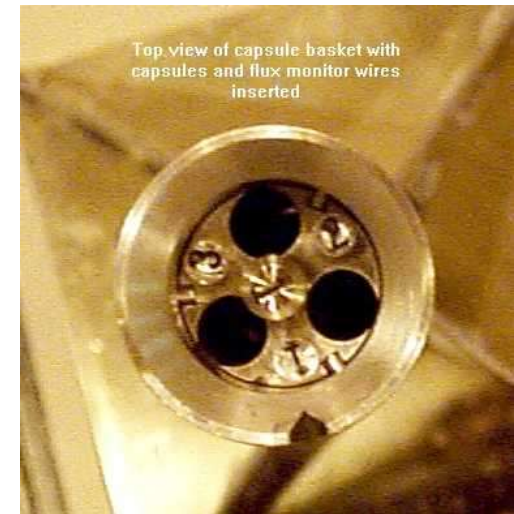
- Isotopes, structural materials, fuel coupons or pellets
- Multiple shuttles transported at same time

Instrumented Lead Experiments

- On-line experiment measurements
- With or without temperature control
- Structural materials, cladding, fuel pins

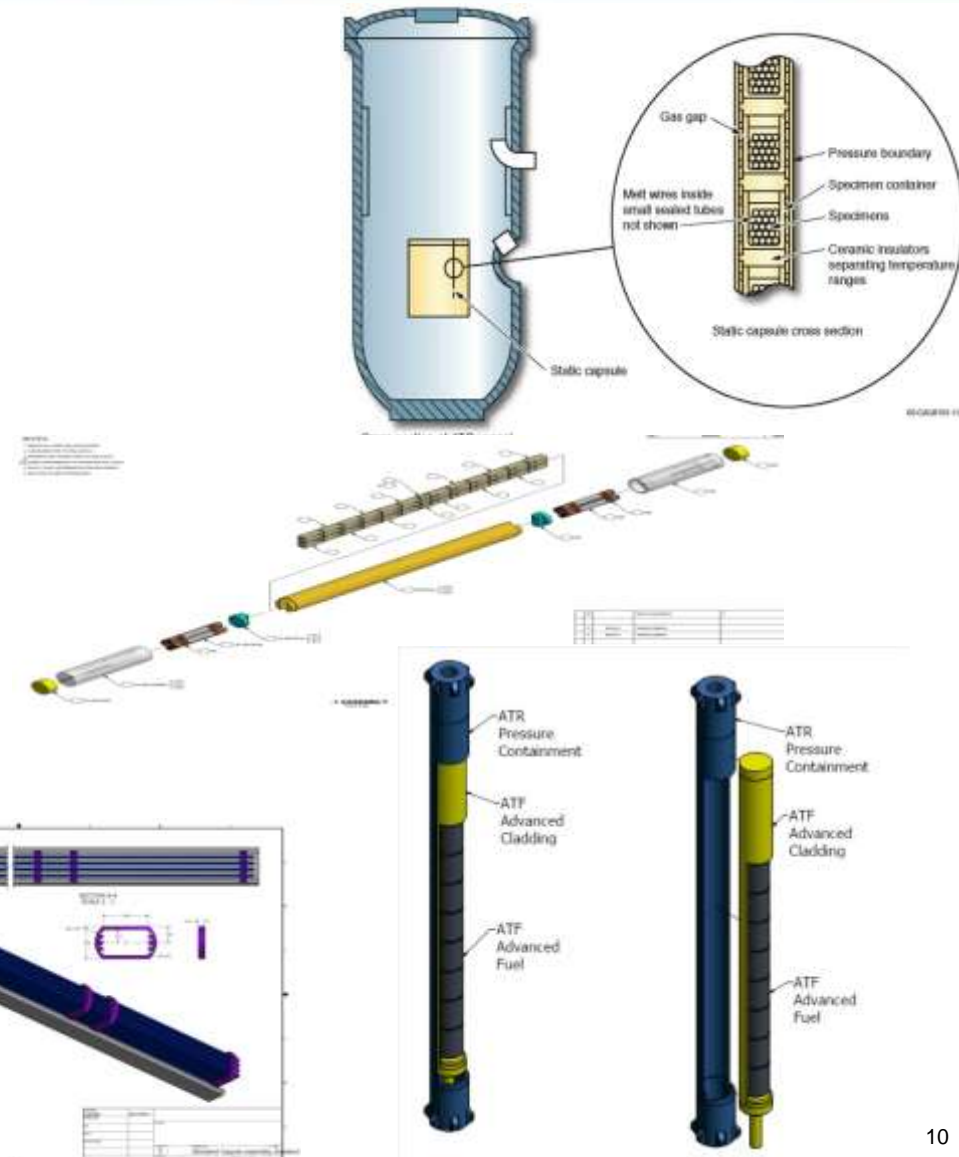
Pressurized Water Loops

- Six presently installed in flux traps
- Control pressure, temperature, chemistry
- Structural materials, cladding, tubing, fuel assemblies



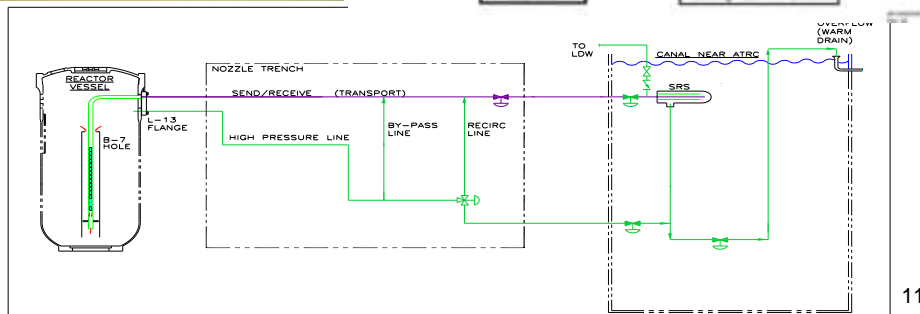
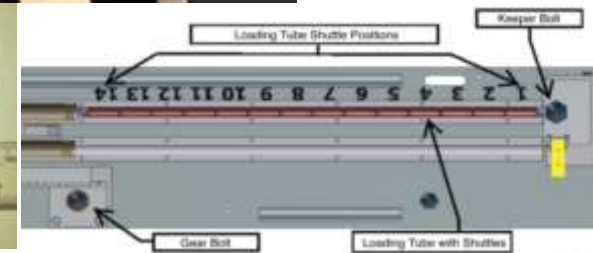
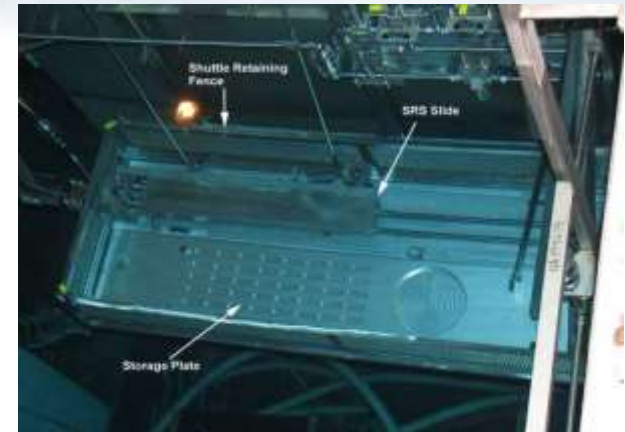
Simple Static Capsule Experiments

- Passive instrumentation (flux wires, melt wires)
- Temperature target controlled by varying gas mixture in conduction gap and with material selection
- Lengths up to 48"; diameter 0.5" – 5.0"
- Six month to 1 year preparation
- Can tailor flux



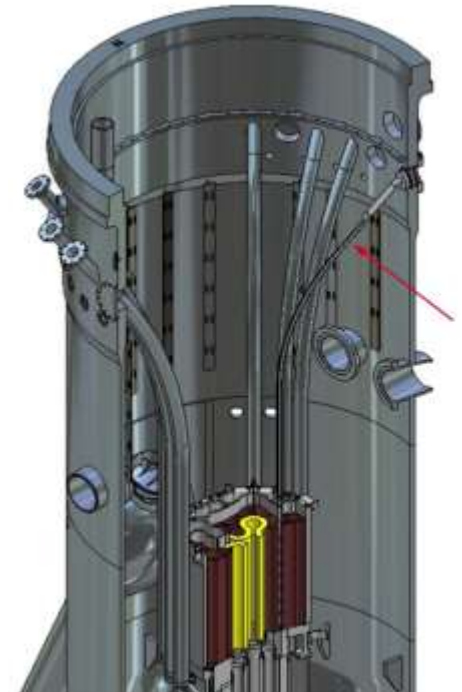
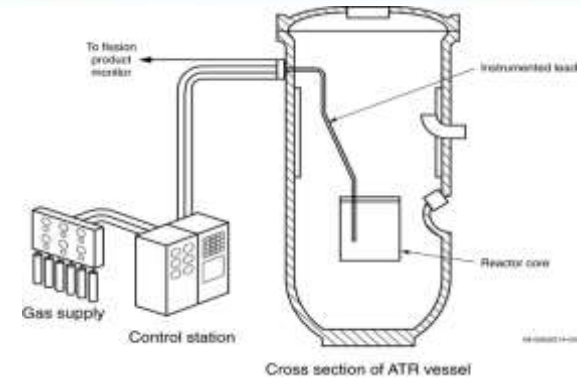
Hydraulic Shuttle

- Passive instrumentation (flux wires, melt wires)
- Temperature target controlled by varying gas mixture in conduction gap and with material selection
- Length of capsule $\sim 2.25''$
- Diameter (ID) $\sim 0.5''$
- 14 shuttles in train
- Inserted/extracted during operating cycle from ATR canal
- Duration of irradiation variable



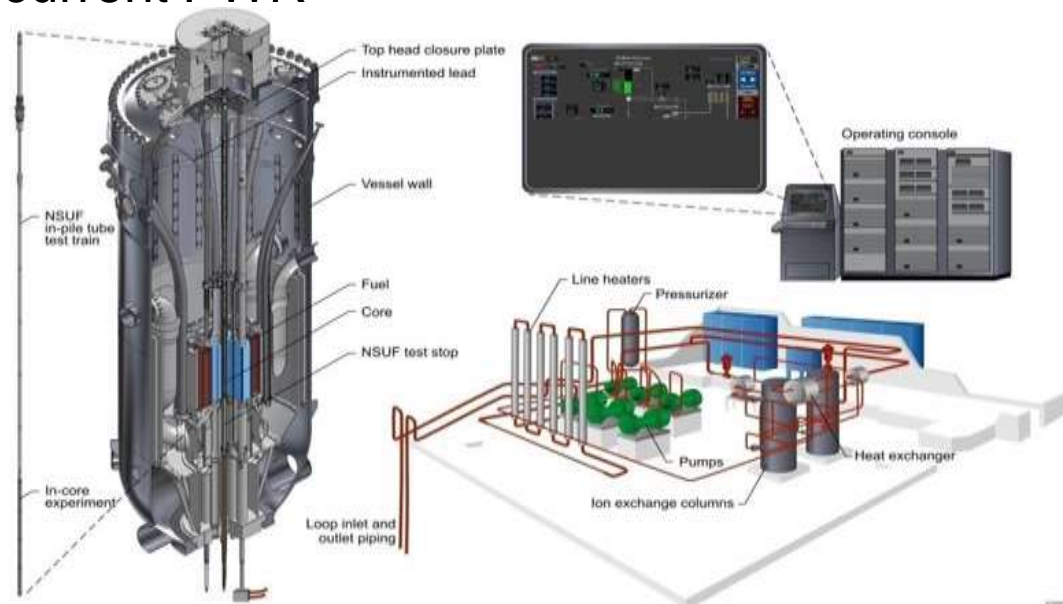
Instrumented Lead Experiments

- On-line experiment measurements
- With or without active temperature control
- Temperature control range 250 - 1200° C, within +/- 5° C
- Monitoring of temperature control exhaust gases for experiment performance (e.g., Fission products, etc.)
- Specialized gas environments (oxidized, inert, etc.)
- Removal and replacement of experiment through discharge chute or reactor top (with cask)
- ~18 months preparation for new test design and installation

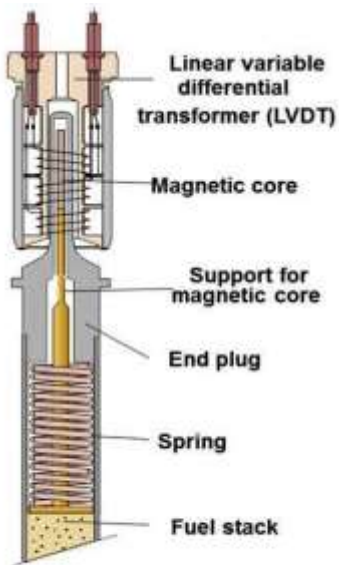


In-Pile Tube Experiments

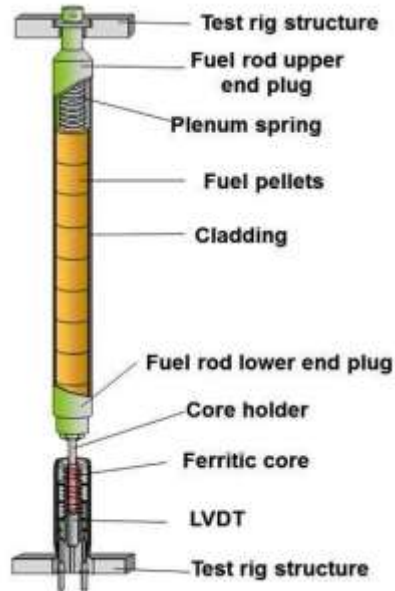
- Six flux trap positions currently have pressurized water in-pile loop tests (1 large diameter, 5 small diameter)
- Separate from ATR primary coolant system
- Each loop has its own temperature, pressure, flow, and chemistry control systems – can exceed current PWR operating conditions
- Transient testing capabilities (cycle/seconds)
- Up to two year preparation for new test programs



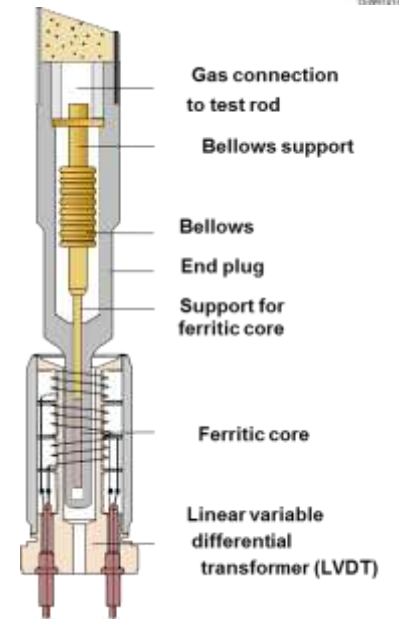
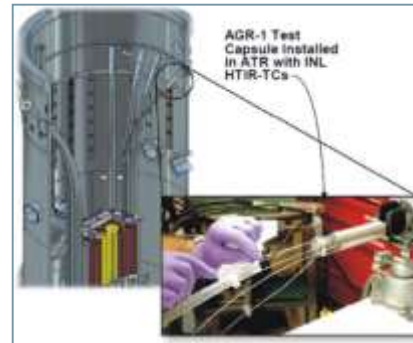
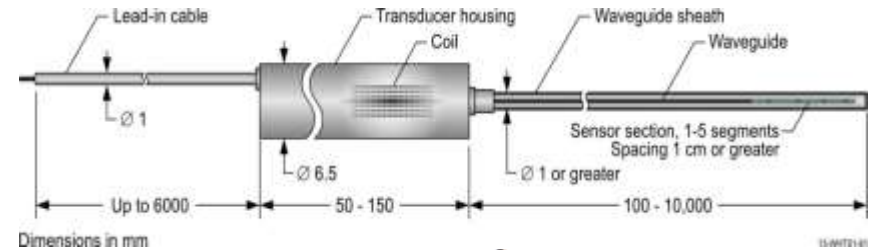
New Capabilities



Fuel Extensometer

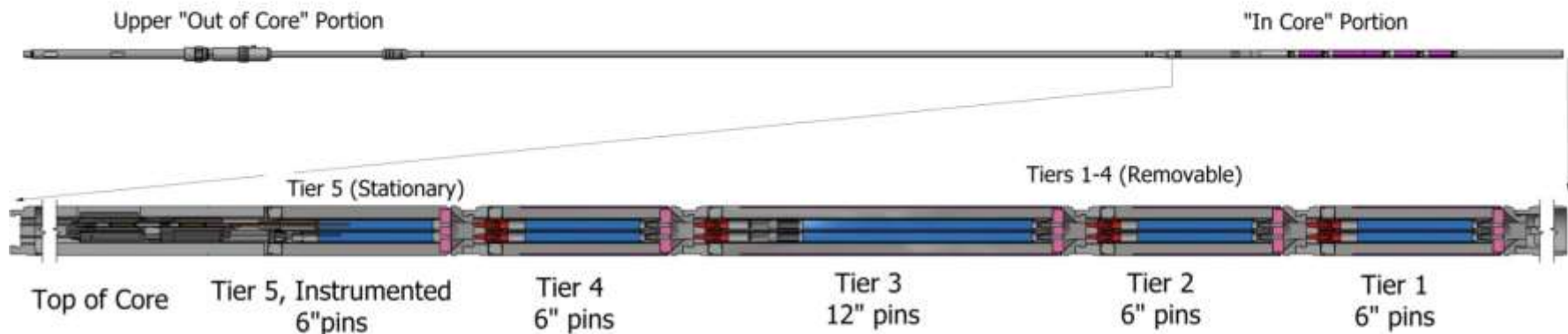


Cladding Extensometer

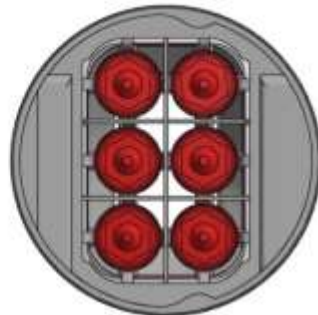


New Capabilities

ATF Water Loop Configuration for Safety Analysis Purposes



Instrumented Lead Sensors are located above the core region in Tier 5 to reduce potential irradiation damage

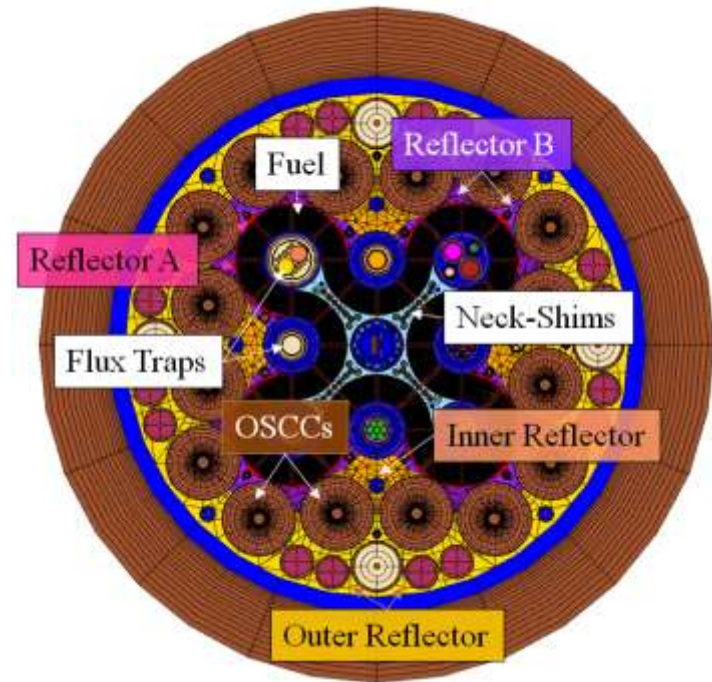
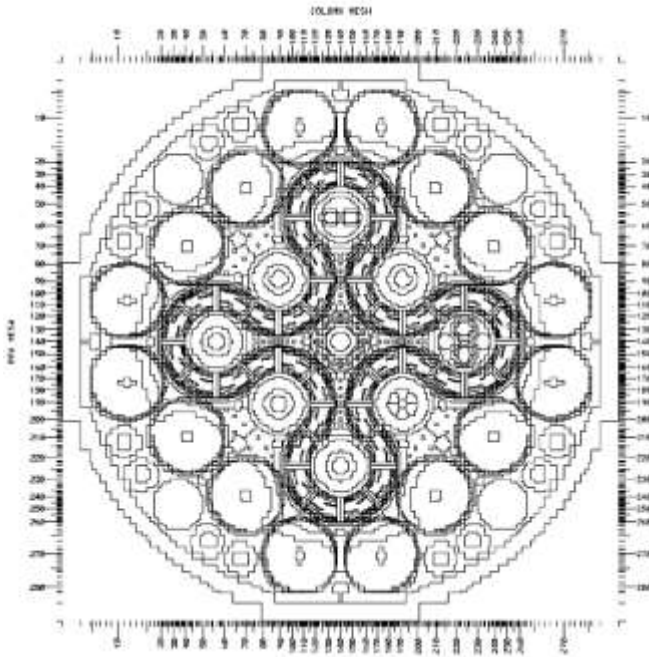


Tiers 1-4 may contain in-rod ferritic cores that allow measurements between irradiation cycles.

All tiers will have a 2x3 configuration as shown.

New Capabilities

Recent conversion to HELIOS





Idaho National Laboratory