Irradiation Facilities at the Advanced Test Reactor

International Topical Meeting on Research Reactor Fuel Management
Lyon, France

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March 12, 2007

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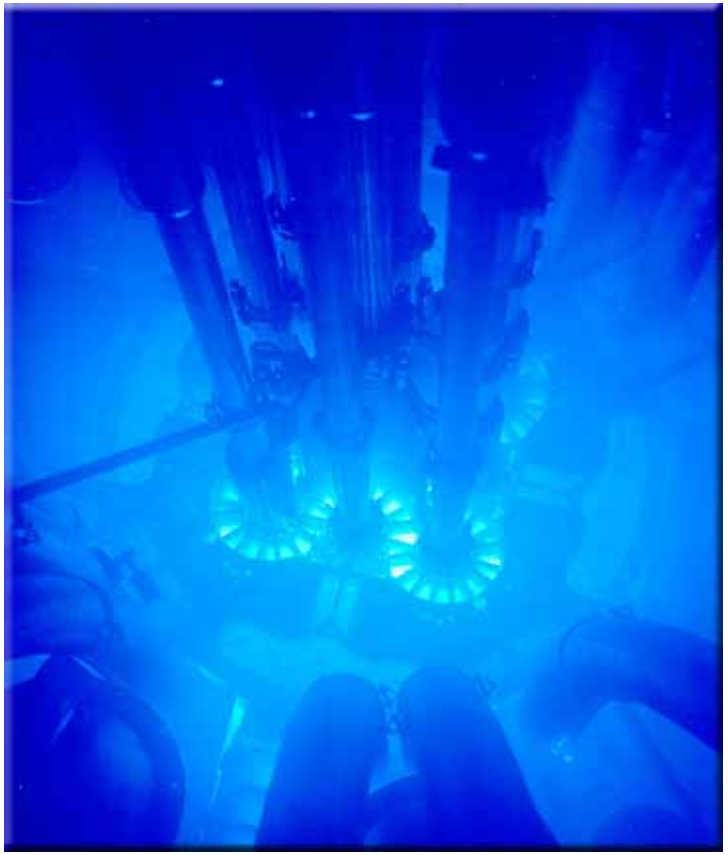
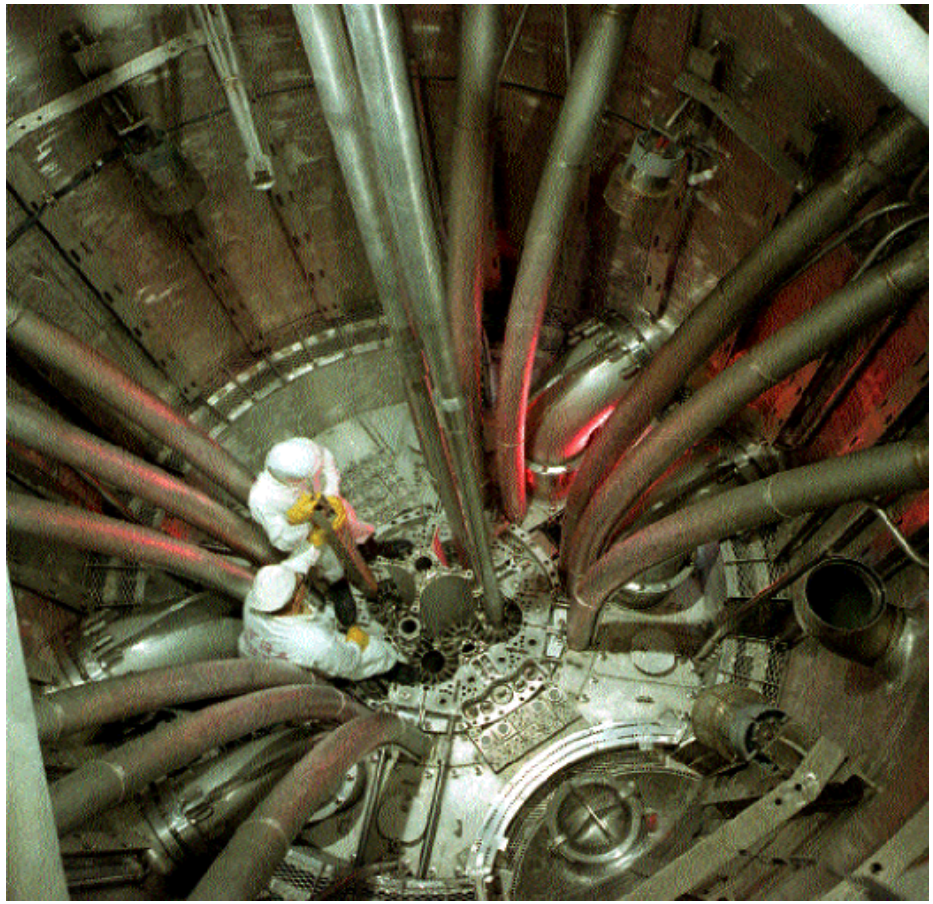
Agenda

- *Advanced Test Reactor (ATR) Description*
- *ATR Testing Capabilities*
  - *Static capsules*
  - *Instrumented lead experiments*
  - *Pressurized water loop experiments*
  - *New gas test loop*
- *Summary*



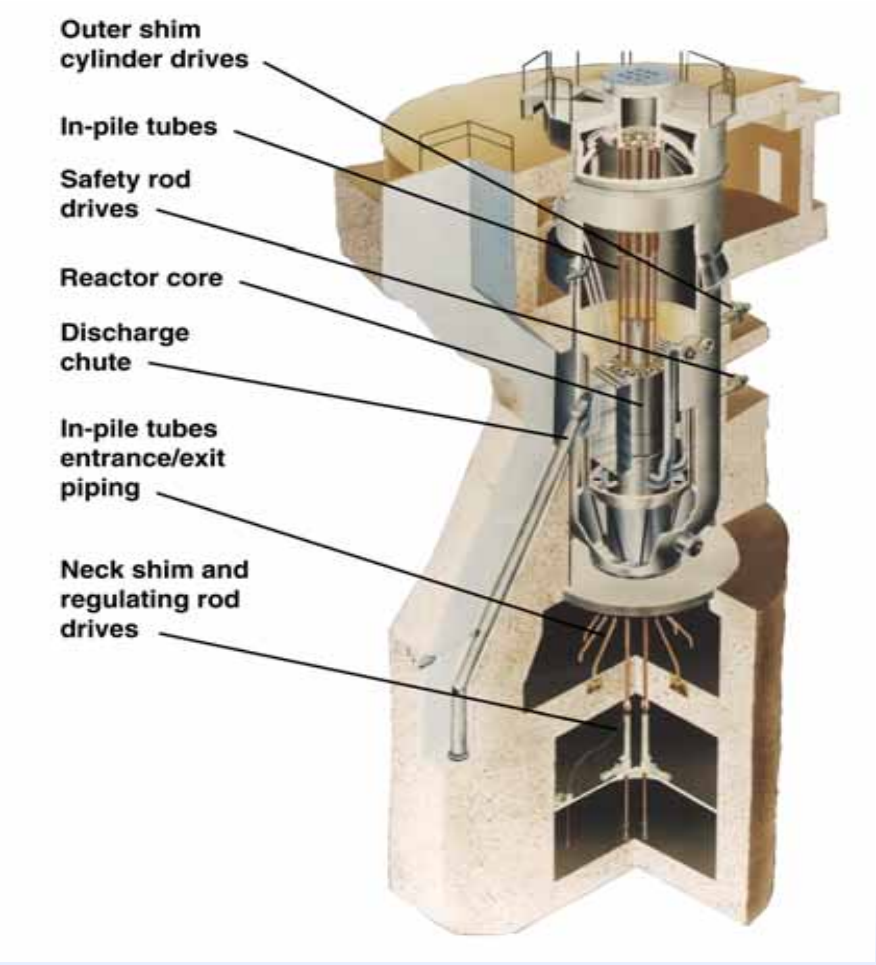
ATR Vessel & Internals

- *PWR Type:*
  - *Light-water cooled and moderated*
  - *Beryllium reflector*
- *Reactor Vessel:*
  - *Solid stainless steel*
  - *3.7 m diameter*
  - *10.7 m height*
- *Reactor Core:*
  - *1.2 m diameter*
  - *1.2 m height*
  - *40 curved aluminum plate fuel elements*



ATR Operations & Capabilities

- *Operating Conditions (inlet):*
  - *Coolant temperature = 52°C*
  - *Coolant pressure = 2.45 MPa*
- *Operating Cycles*
  - *Standard cycle is 6 to 8 weeks*
  - *Standard outage is 1 to 2 weeks*
  - *270 + operating days/year*
- *Test Capabilities:*
  - *5 In-Pile Tubes connected to individual pressurized water loops*
  - *Inert gas, temperature controlled experiments*
  - *Transient tests*
  - *Fast/thermal flux ratio tailoring*



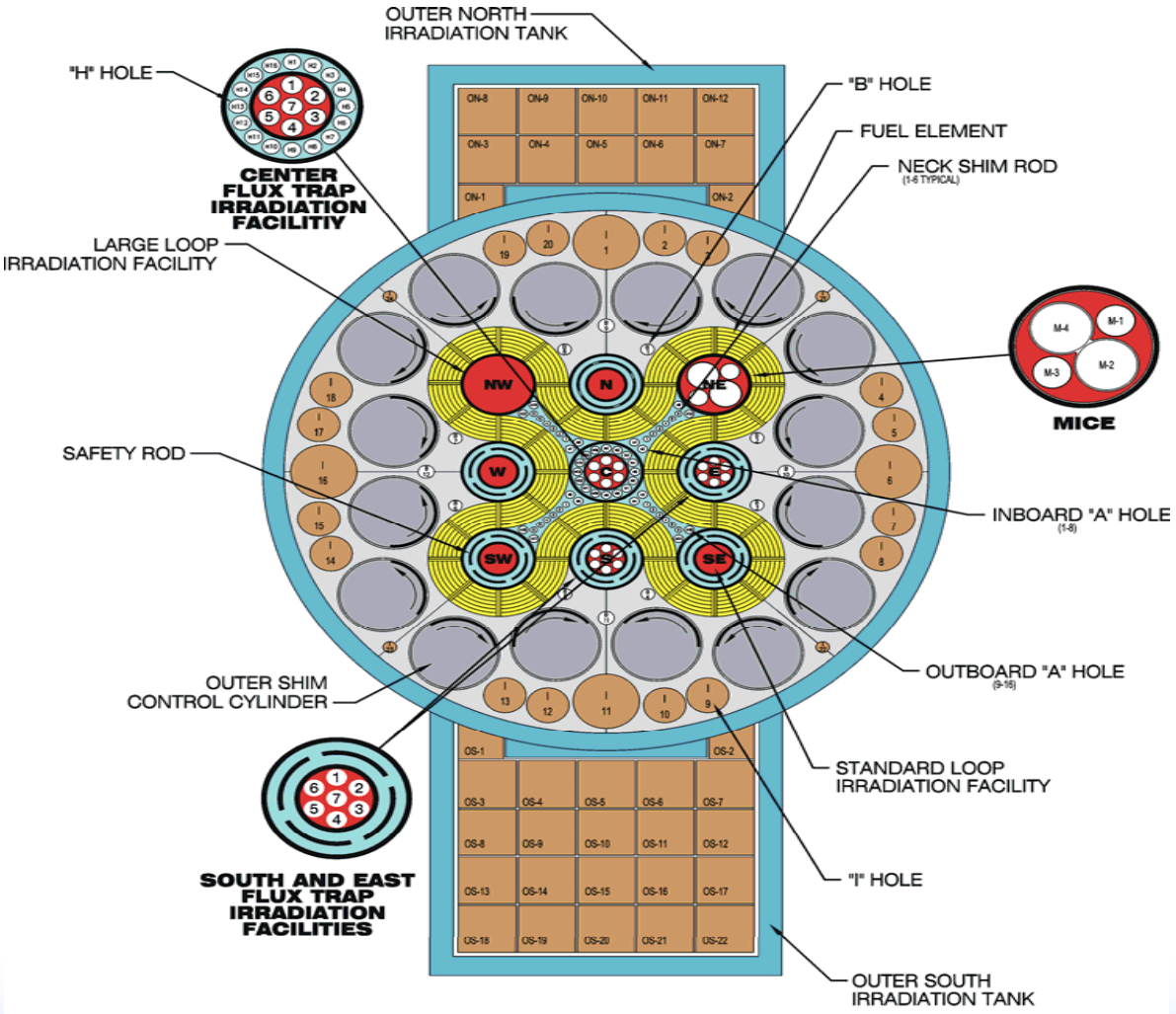
ATR Core Cross Section

Approximate Peak Values (Unperturbed)

- ***1 x 10^{15} n/cm^2-sec thermal***
- ***5 x 10^{14} n/cm^2-sec fast***
- ***250 MW total power***
- ***Power tilt capability***

77 Irradiation Positions:

- ***9 Flux traps***
- ***5 In-pile tubes***
- ***68 Reflector positions***
- ***Position diameters 12.7 mm to 12.7 cm***



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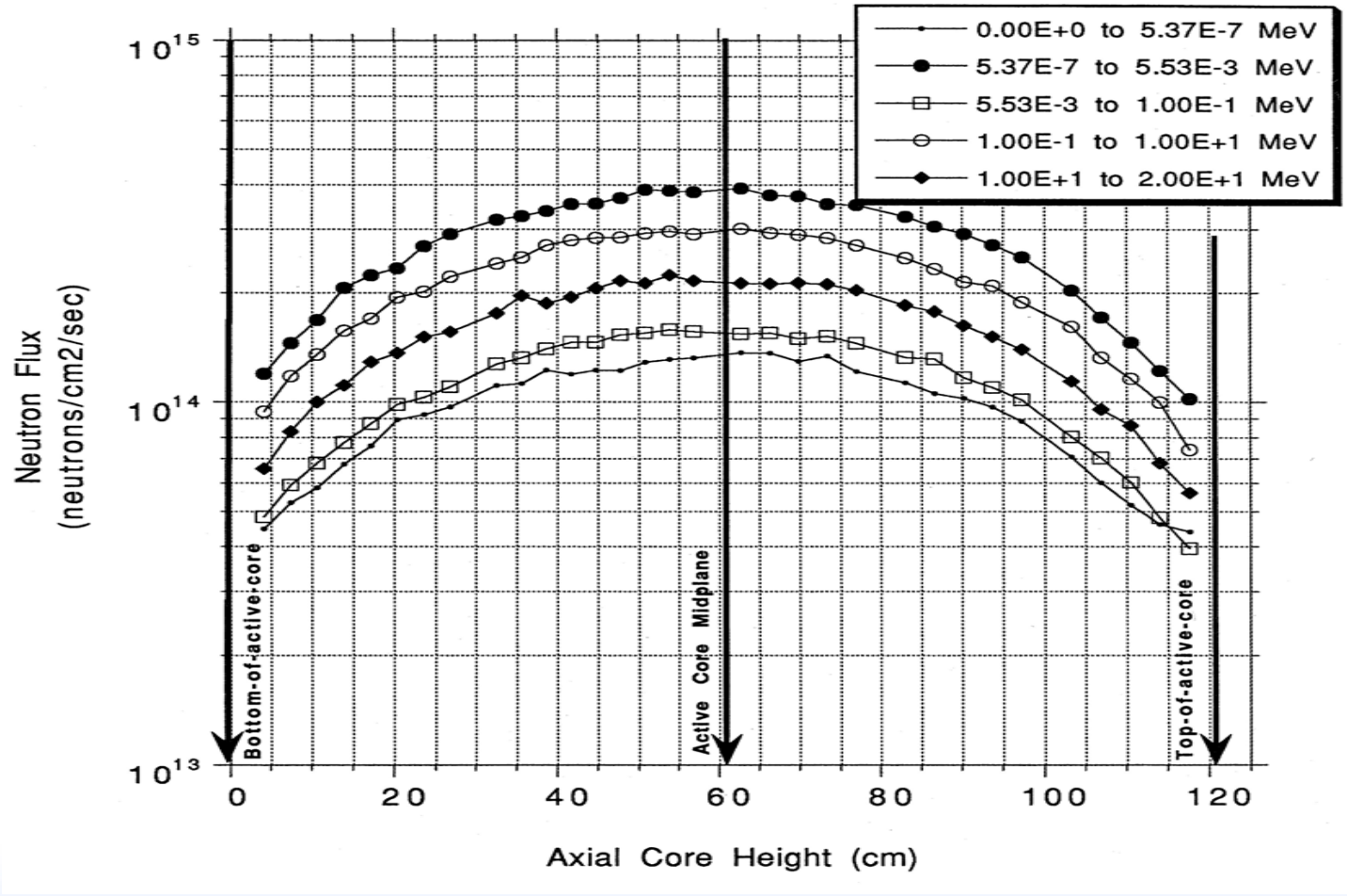
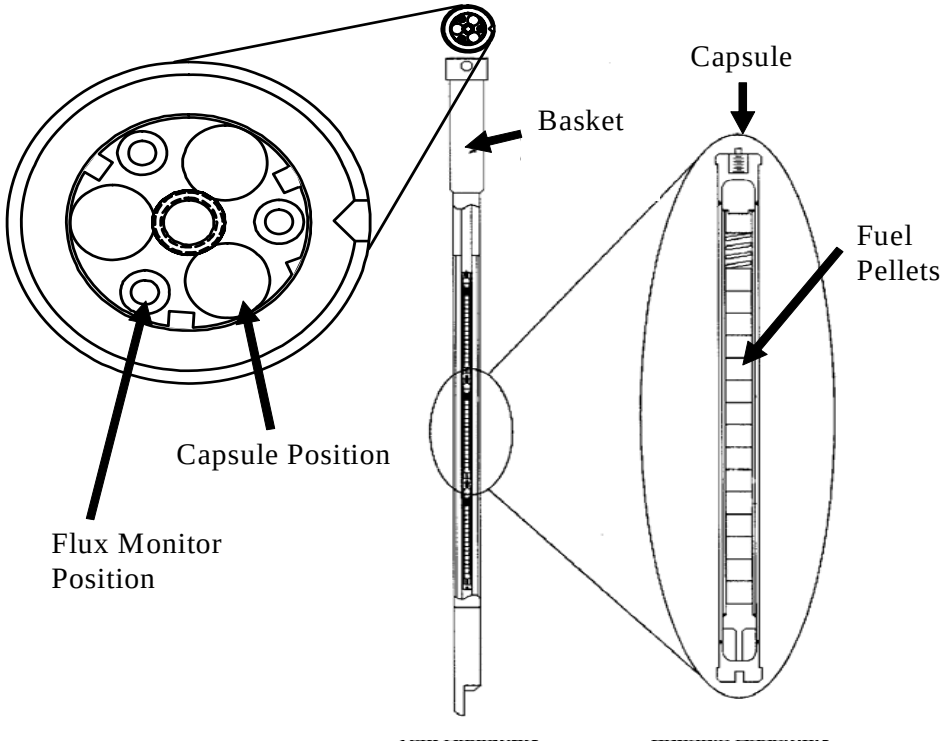
Typical Axial (Vertical) Flux Profile



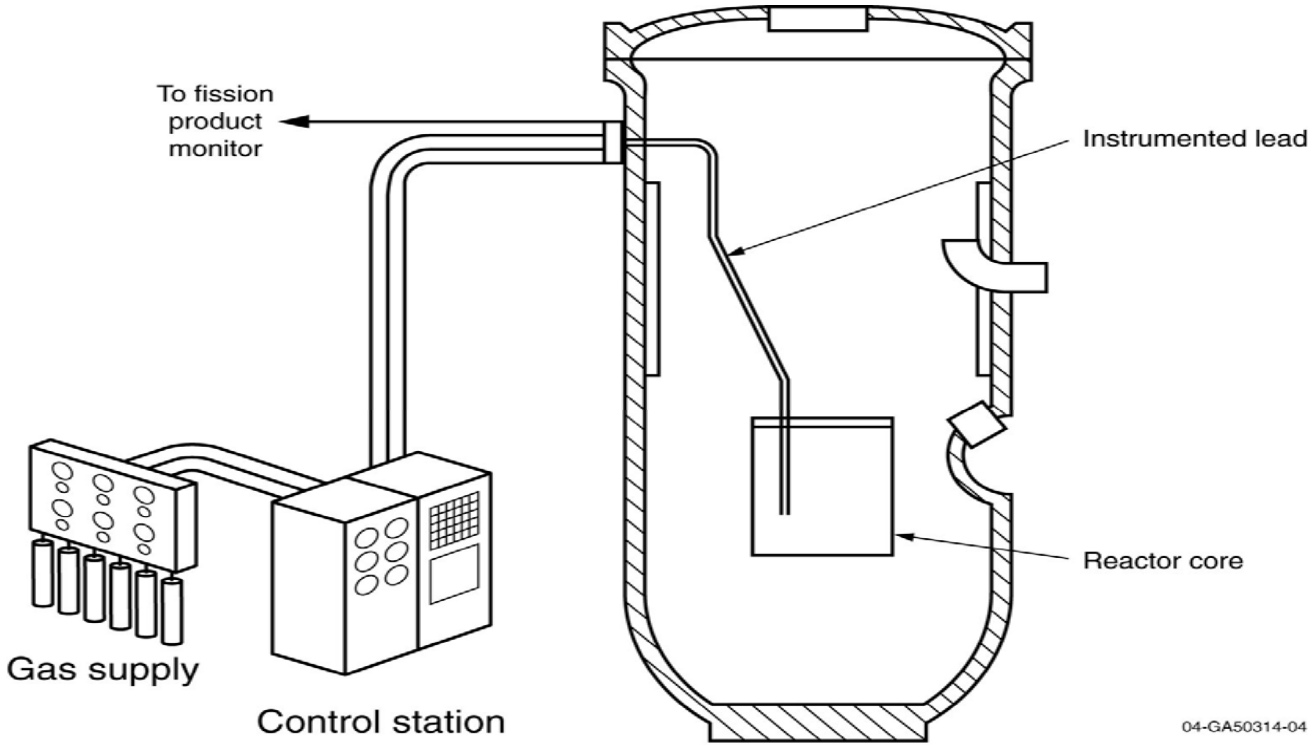
Static Capsules

- *Many are non-instrumented (e.g, radioisotopes)*
- *Can include passive instrumentation (flux wires, melt wires)*
- *Performed in reflector positions or flux traps*
- *Utilized for isotopes, structural materials, or fuel*
- *Lengths up to 1.2 m & diameters up to 12.7 cm*
- *Usually the least expensive testing technique*
- *Six month lead time*



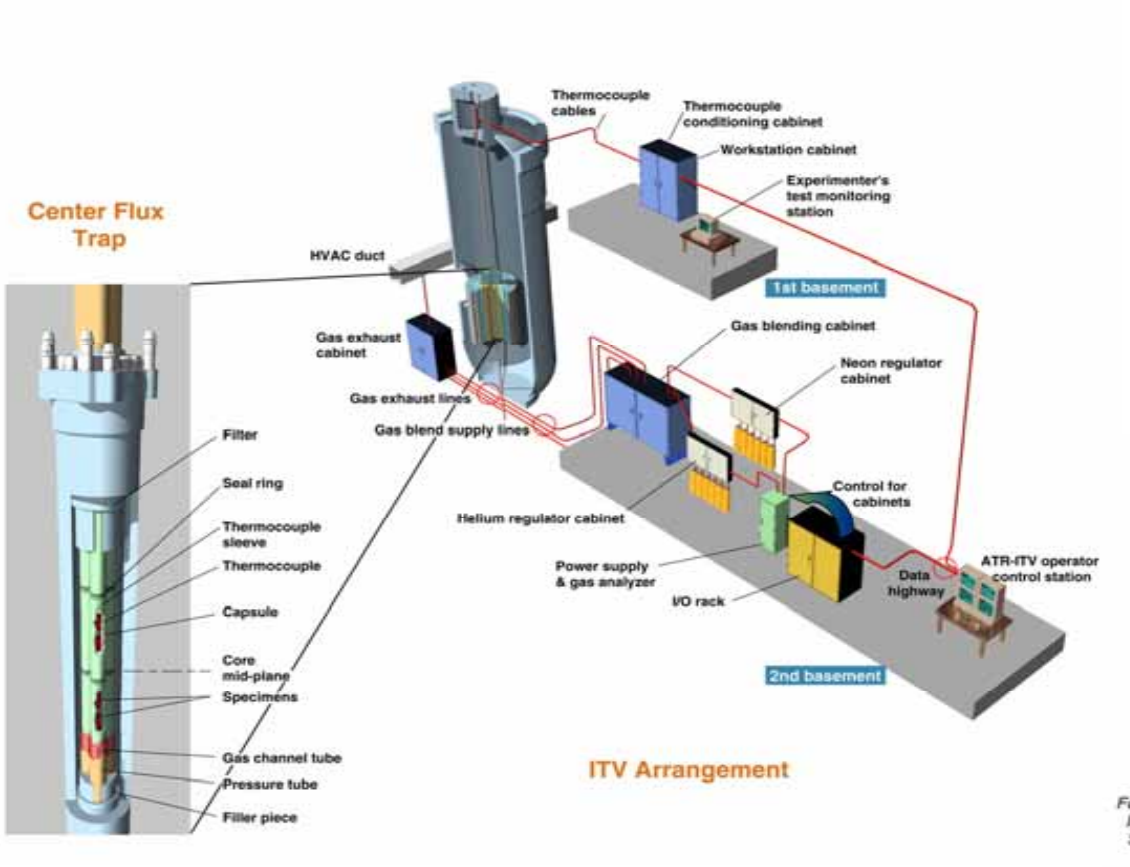
Instrumented Lead Experiments

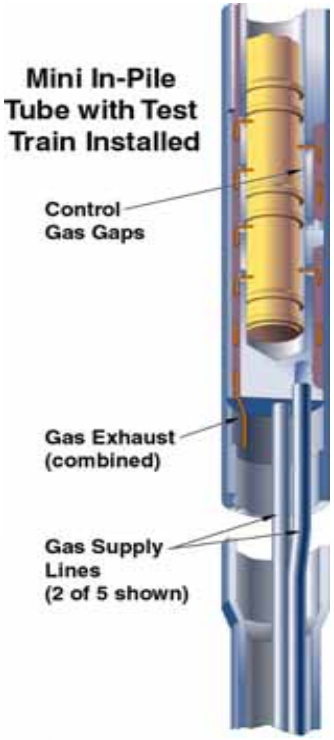
- ***On-line instrument (typically temperature) measurements***
- ***With or without active temperature control***
  - ***Range: 250 to 1000 +/- 5 °C***
- ***Utilized in reflector positions or flux traps***
- ***Structural materials, cladding, fuel***
- ***One year lead time for new test design and installation***

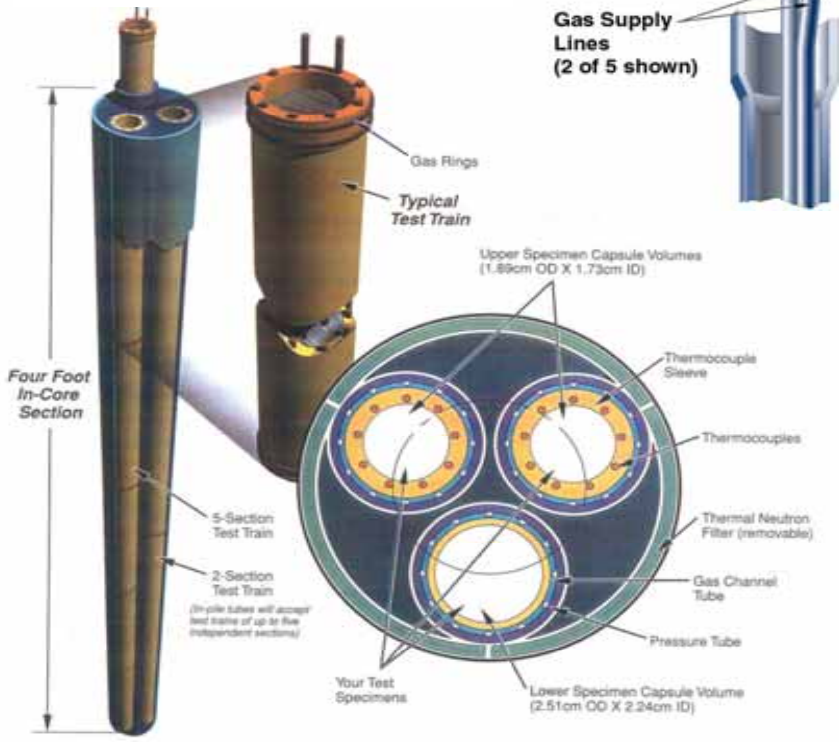


Cross section of ATR vessel

Irradiation Test Vehicle







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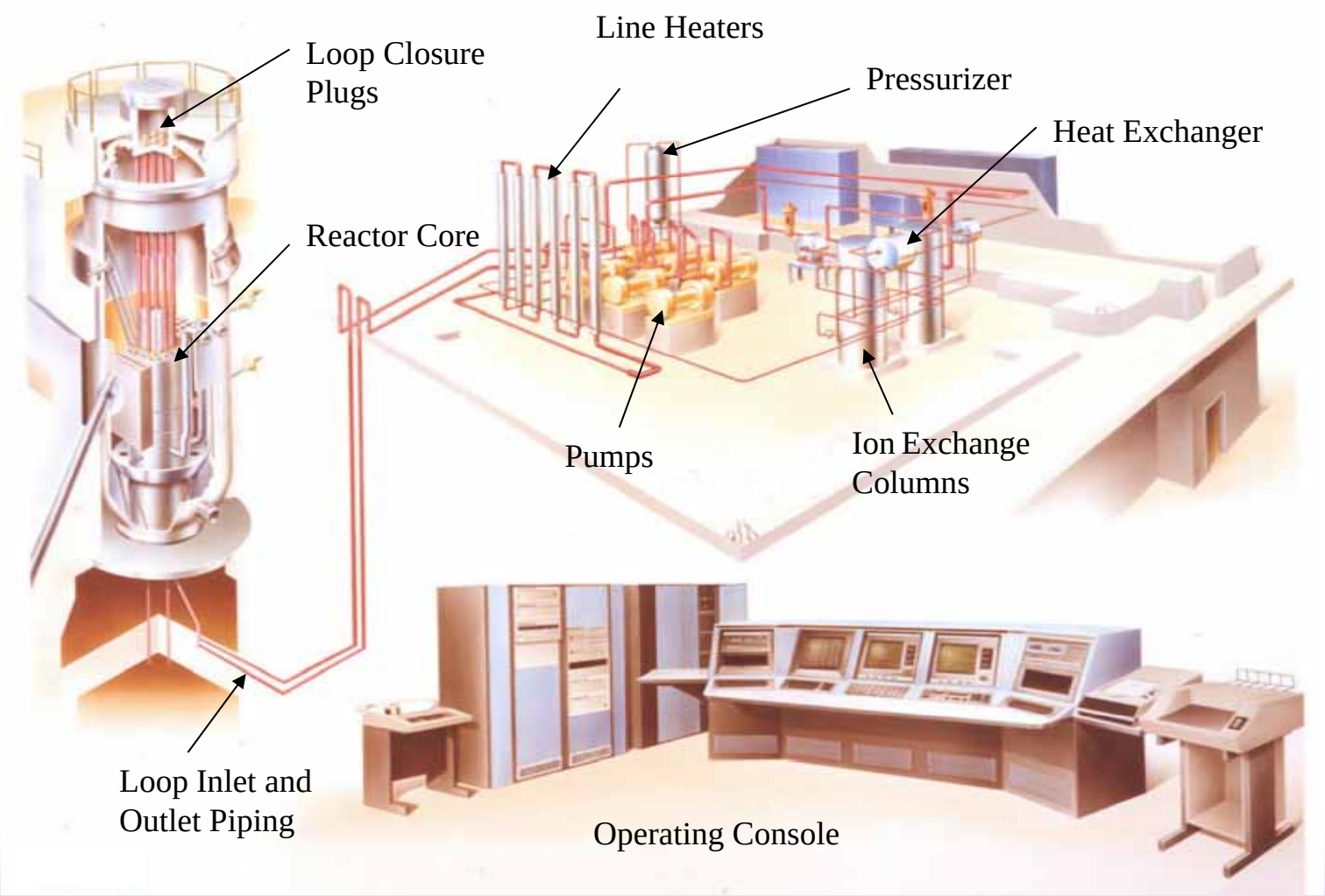
Pressurized Water Loop Experiments

- *Five flux trap positions currently have in-pile tubes connected to pressurized water loops*
- *Past operations had all nine flux traps connected to pressurized water loops*
- *Each loop has its own temperature, pressure, flow rate & chemistry control systems*
- *Structural materials, cladding, fuel*
- *Flux tailoring and transient testing capabilities*
- *Up to two year lead time for new test programs*

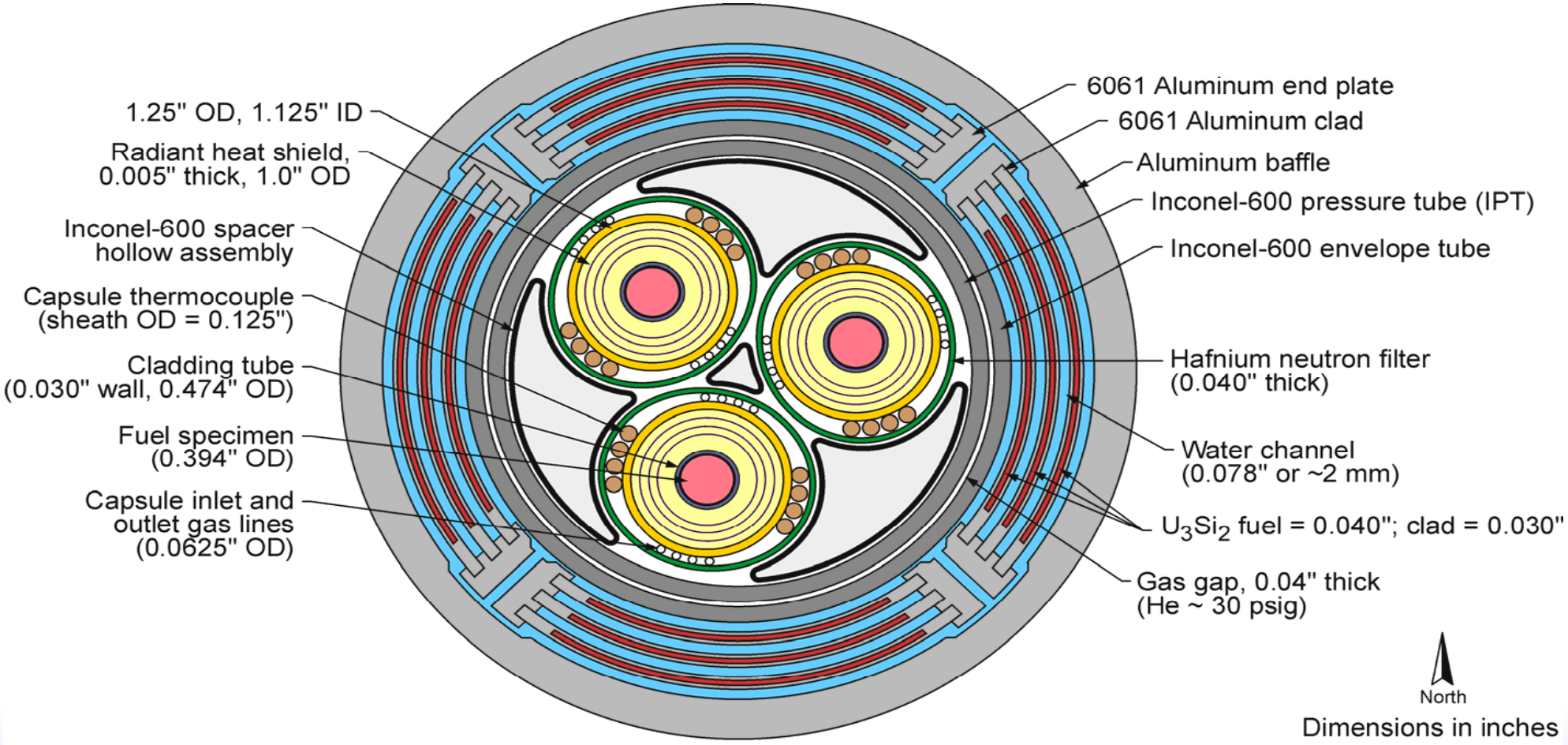
Typical ATR Pressurized Water Loop Layout



Proposed ATR Gas Test Loop

- *New facility currently in conceptual design phase*
- *Installation in large flux trap*
  - *Maximize experiment volume available*
  - *Three mini in-pile tubes (similar but larger than ITV)*
  - *Maximize neutron flux rates (including fast neutron flux due to proximity to ATR driver fuel)*
- *Additional booster fuel inside of facility to enhance the fast neutron flux rate even more*
- *Heat transfer methods*
  - *Main method - high flow helium convection cooling*
  - *Fine temperature control - conduction/radiation through very low flow inert gas mixture*

Gas Test Loop Concept



Summary

- *Unique and versatile capabilities*
  - *Numerous high flux and large test volumes*
  - *Constant axial flux profile*
  - *Power/flux tilt across reactor core*
  - *Simultaneous tests in different testing environments*
- *Expected to operate for many more years*
- *New capabilities being added*
  - *Reactivated pressurized water test loop*
  - *New hydraulic rabbit system*
- *ATR facility utilization supports participation from other government, commercial, and international users*