Idaho National Laboratory

RESEARCH REACTOR UTILIZATION I

An Overview of Current Projects / Utilization of the Advanced Test Reactor (ATR)

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Background

- Project Engineer Employed By Idaho National Laboratory (INL) at the Advanced Test Reactor (ATR) Since 1992

- Responsibilities Have Included Experiment Loop Design & Maintenance, Test Capsule Design and Fabrication, and Isotope Development and Management

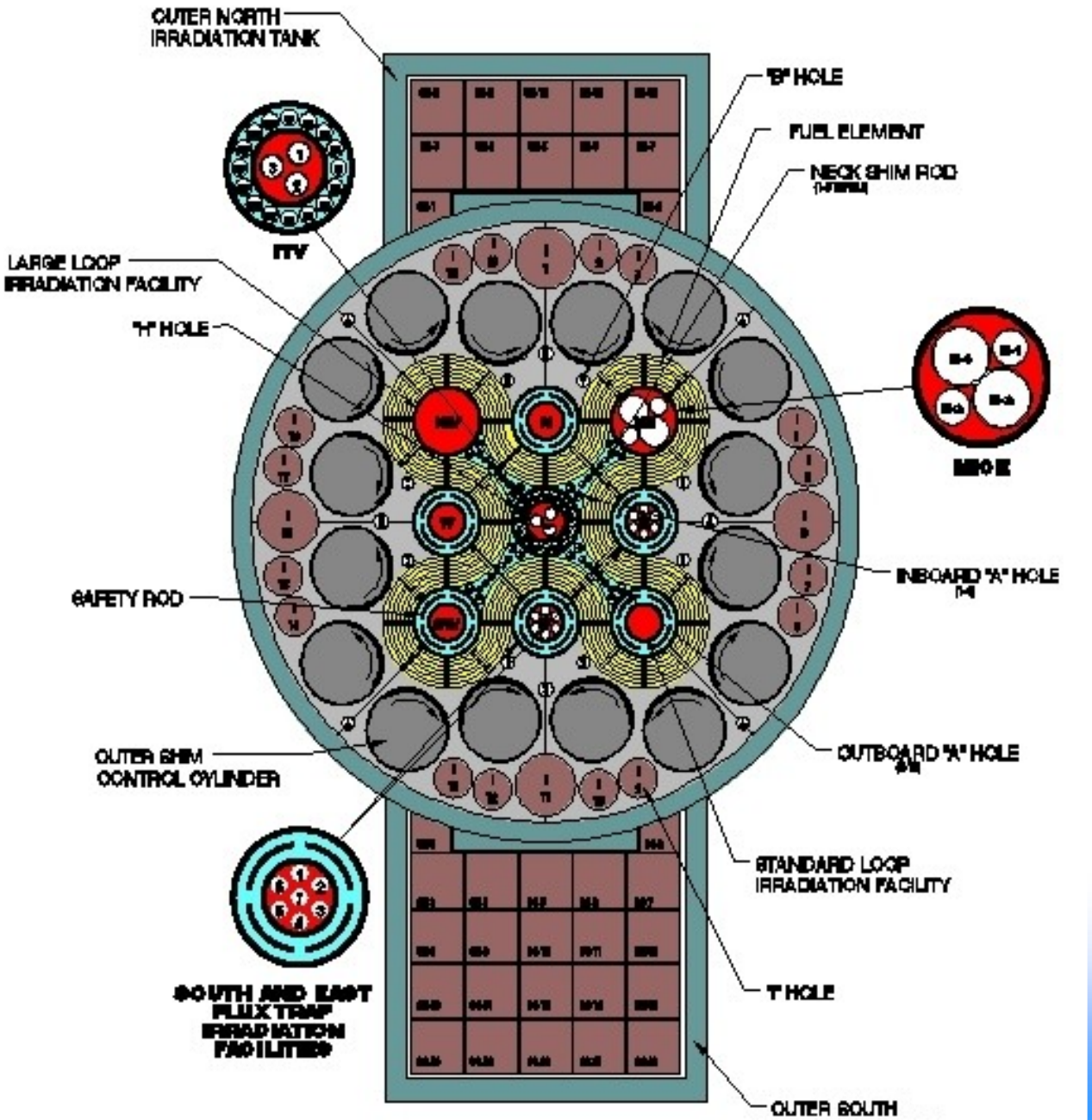
Outline

ATR UTILIZATION: PROJECTS of INCREASING COMPLEXITY

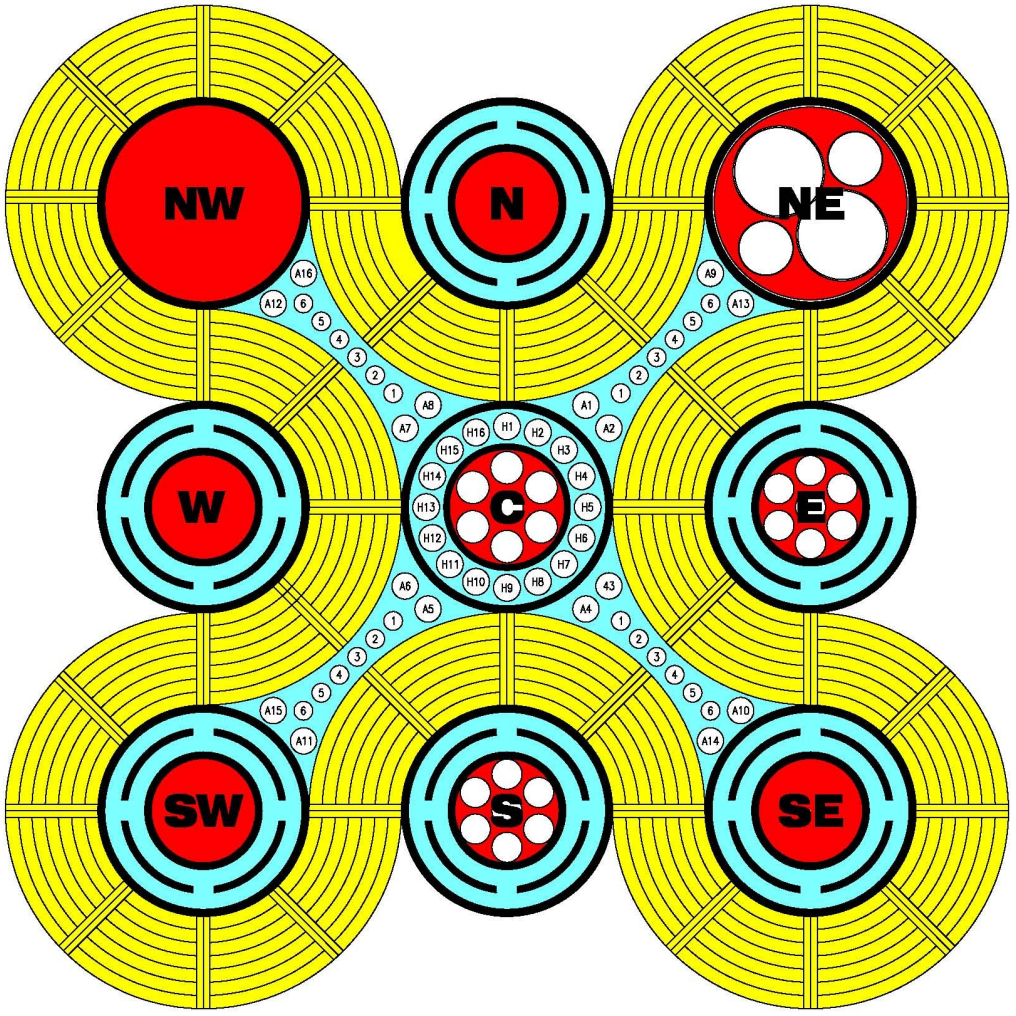
- Cobalt 60 Production
- Advanced Fuel Cycle Initiative / Light Water Reactor (AFCI/LWR) Project
- Advanced Graphite Capsule (AGC) Project

Cobalt 60 Production

Cobalt 60 Production: ATR Core Cross Section



Cobalt 60 Production: ATR Core Cross Section- 10 A's, 14 H's, 4 SB's



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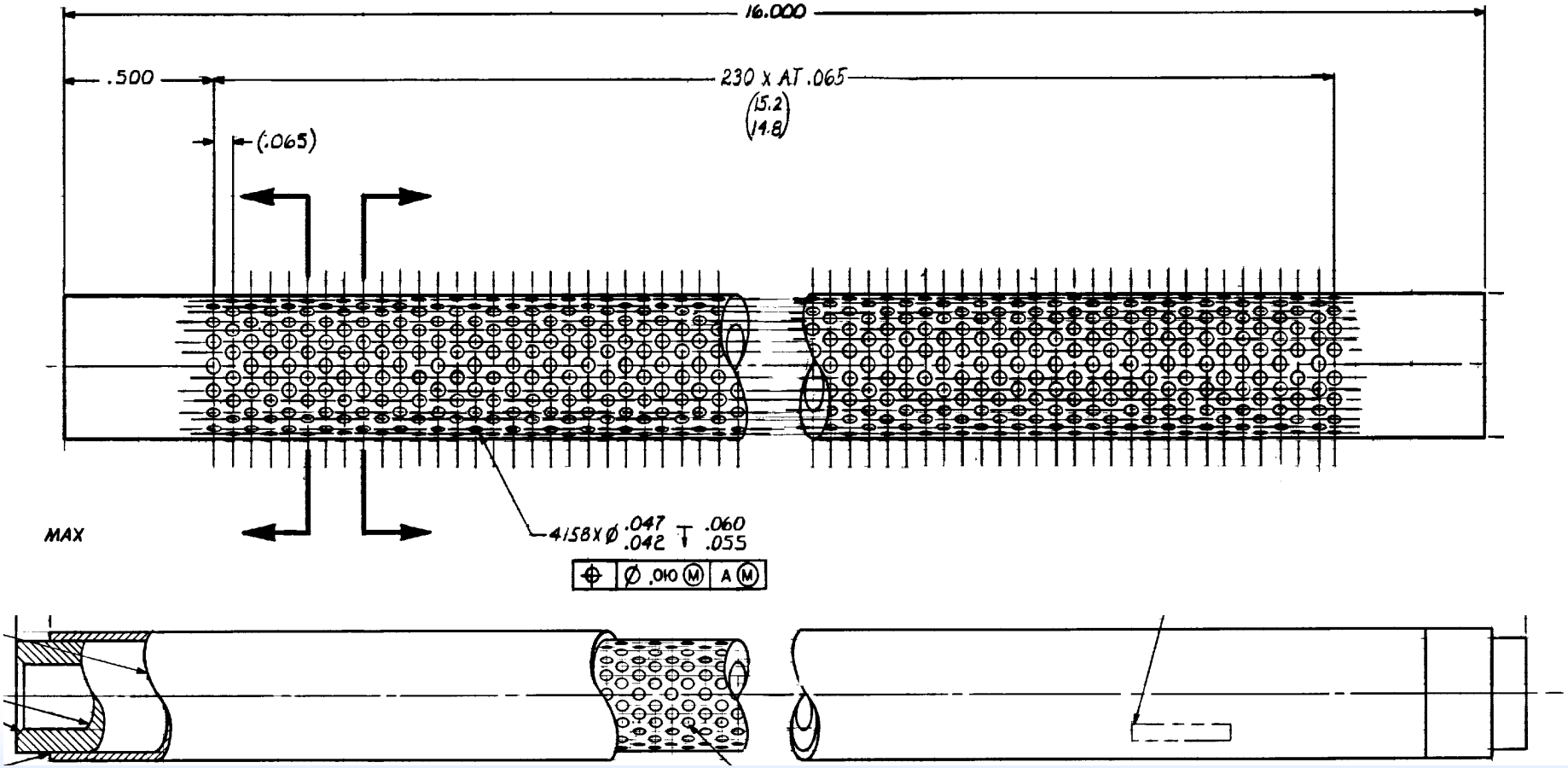
High Specific Activity (HSA) Cobalt Capsule



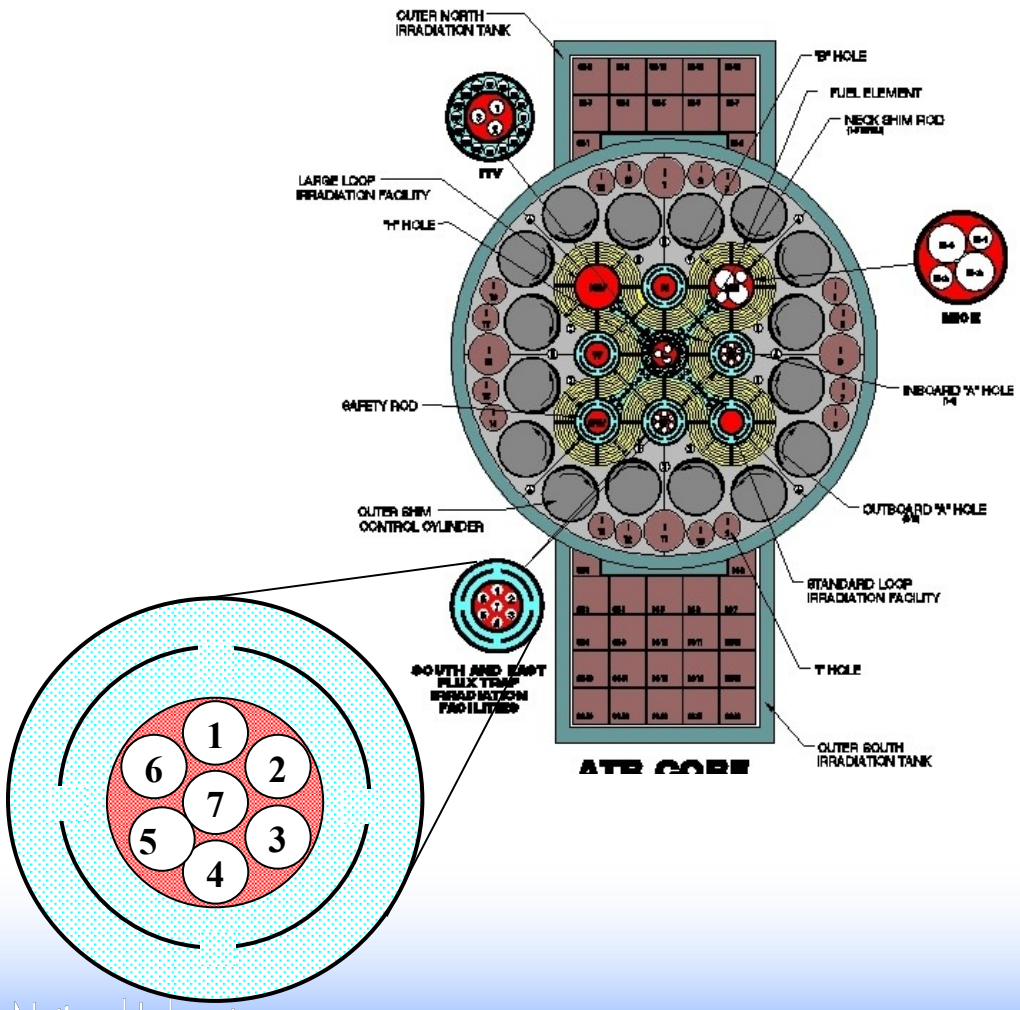
Advanced Fuel Cycle Project

AFCI / LWR - Mission

- **Fueled Test**

- **Transmute the long-lived transuranic actinide isotopes contained in spent nuclear fuel into shorter-lived fission products, thereby dramatically decreasing the volume of material requiring disposition and the long-term radiotoxity and heat load of high-level waste sent to a geologic repository**

AFCI / LWR: ATR Core Cross Section



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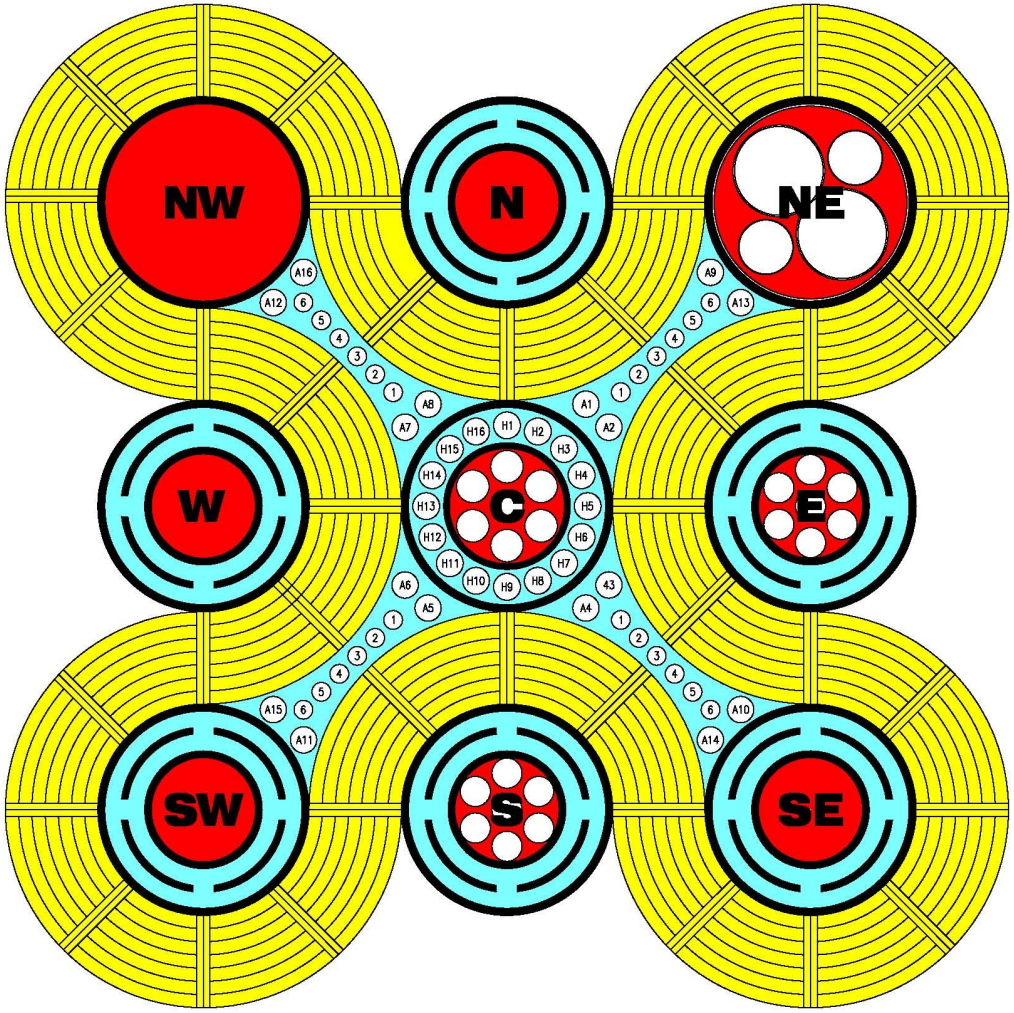
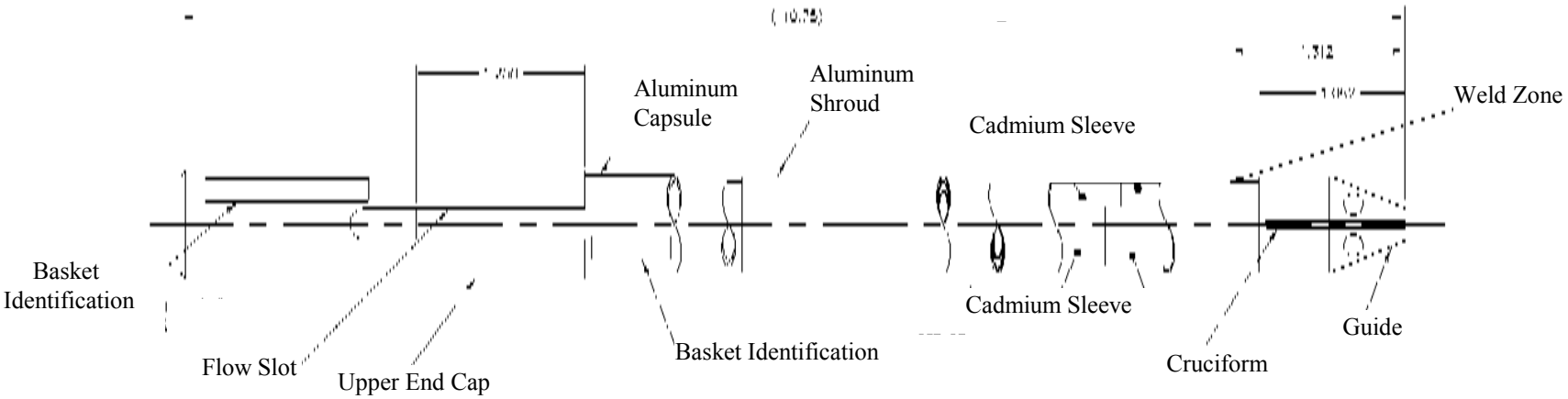
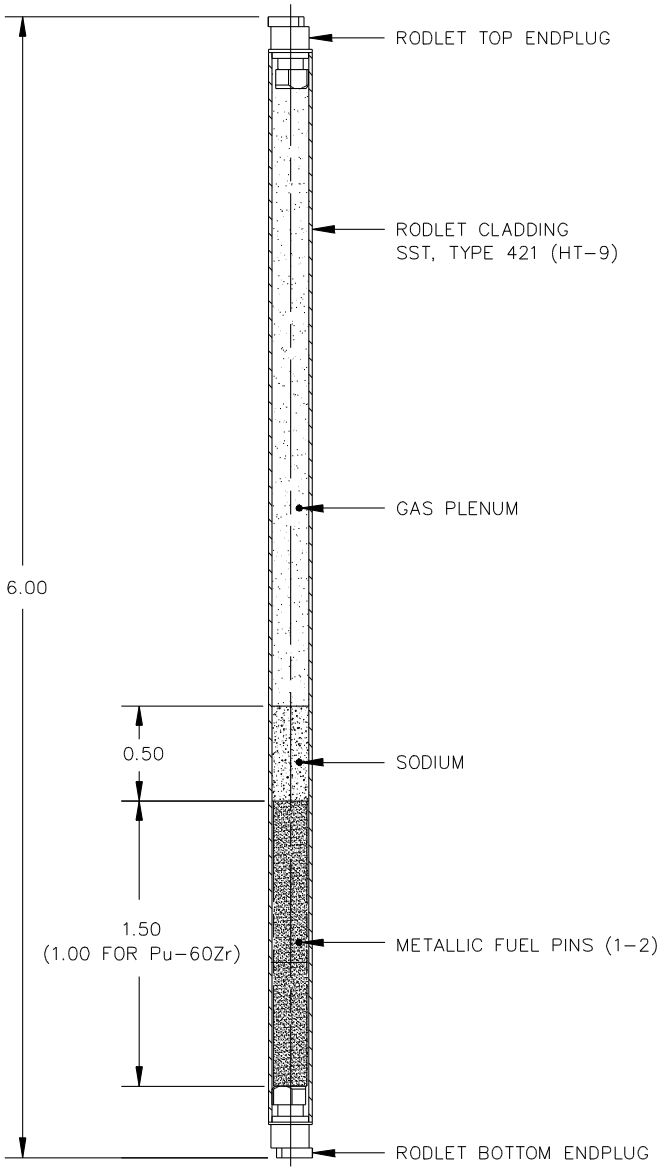
AFCI / LWR: ATR Core Cross Section



AFCI: East Flux Trap Basket Design




RODLET TOP ENDPLUG
RODLET CLADDING
SST, TYPE 421 (HT-9)
GAS PLENUM
6.00
0.50
SODIUM
1.50
(1.00 FOR Pu-60Zr)
METALLIC FUEL PINS (1-2)
RODLET BOTTOM ENDPLUG

Advanced Graphite Capsule AGC

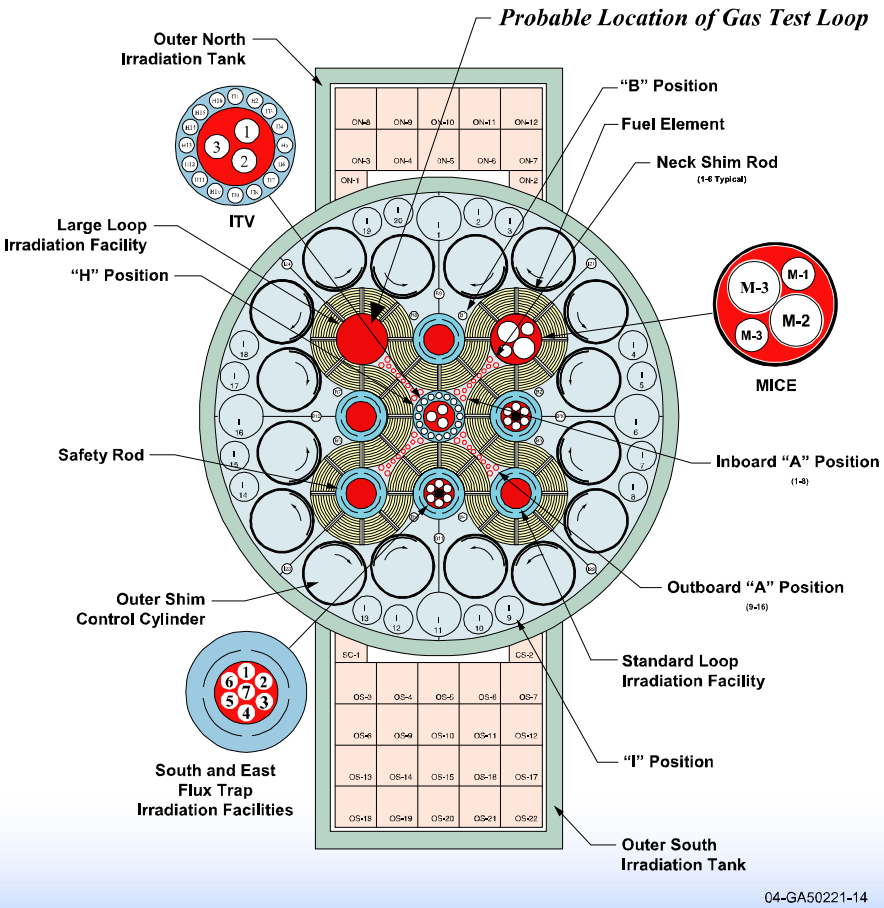
AGC: Mission

- **The graphite used for prior HTGRs in the U.S. (Fort St. Vrain-Grade H-451) is no longer in production and can no longer be fabricated to the prior specification.**

- **The general effect of neutron irradiation on graphite is well understood. However, models relating structure at the micro and macro structural level to irradiation behavior are not well developed.**

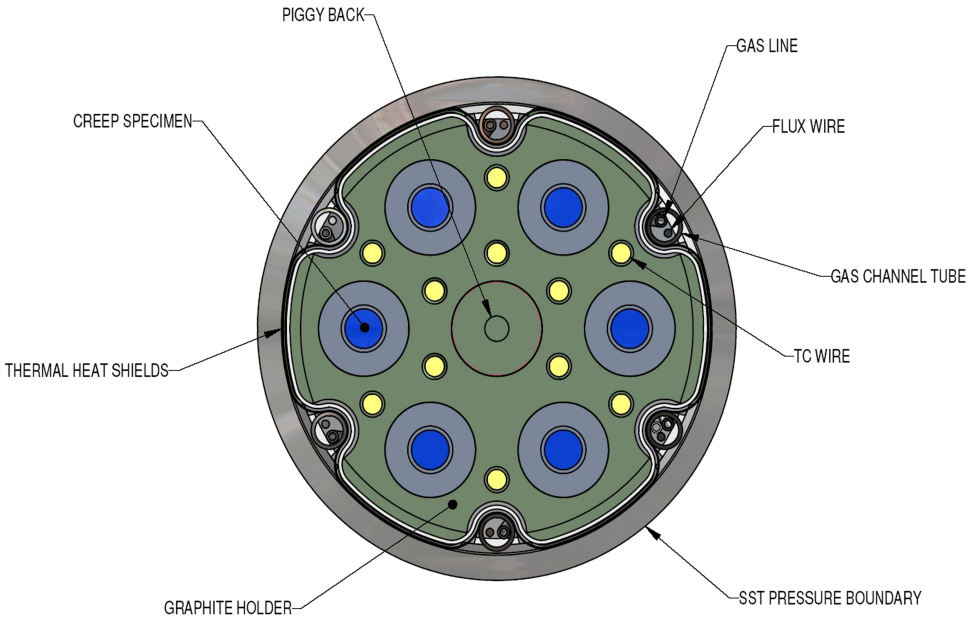
ATR Graphite Compressive Creep Capsule

- Location of capsule will be in the south flux trap.
- Other ATR experiment locations cannot support compressive creep capsule due to equipment limitations or insufficient fast flux levels.
- South lobe power is higher than the North lobe.
- Center flux trap taken by BEA.
- East flux trap taken by AFIC.

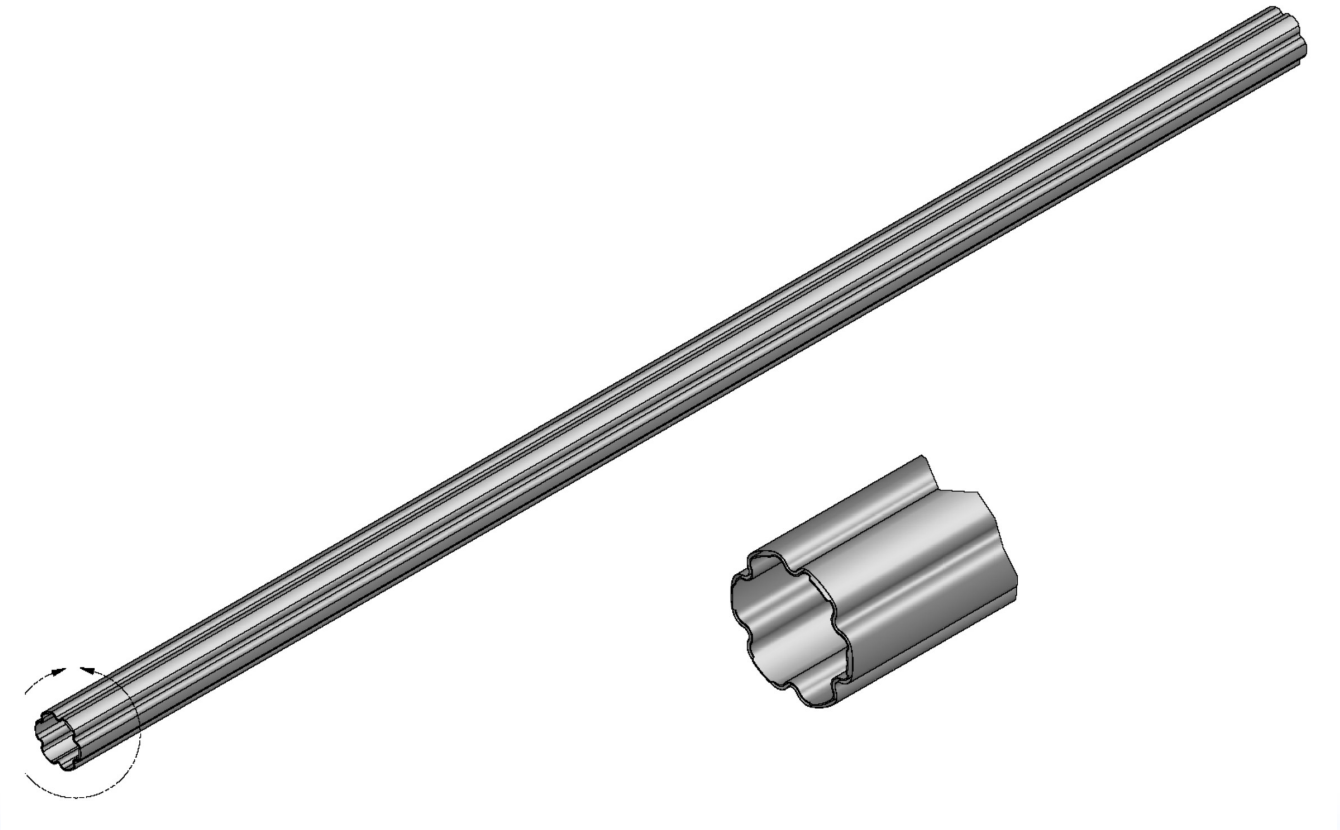


ATR Graphite Compressive Creep Capsule

- **Capsule Design Requirements**
  - **Capsule will employ variable He/Ar mixture sweep gas to actively control the desired temperature profile of 800°C.**
  - **A constant compressive load is applied mechanically to graphite samples by means of a pneumatic cylinders. Two loads will be applied 2 Ksi and 3 Ksi.**
  - **Verify stack integrity.**



AGC: Heat Shield

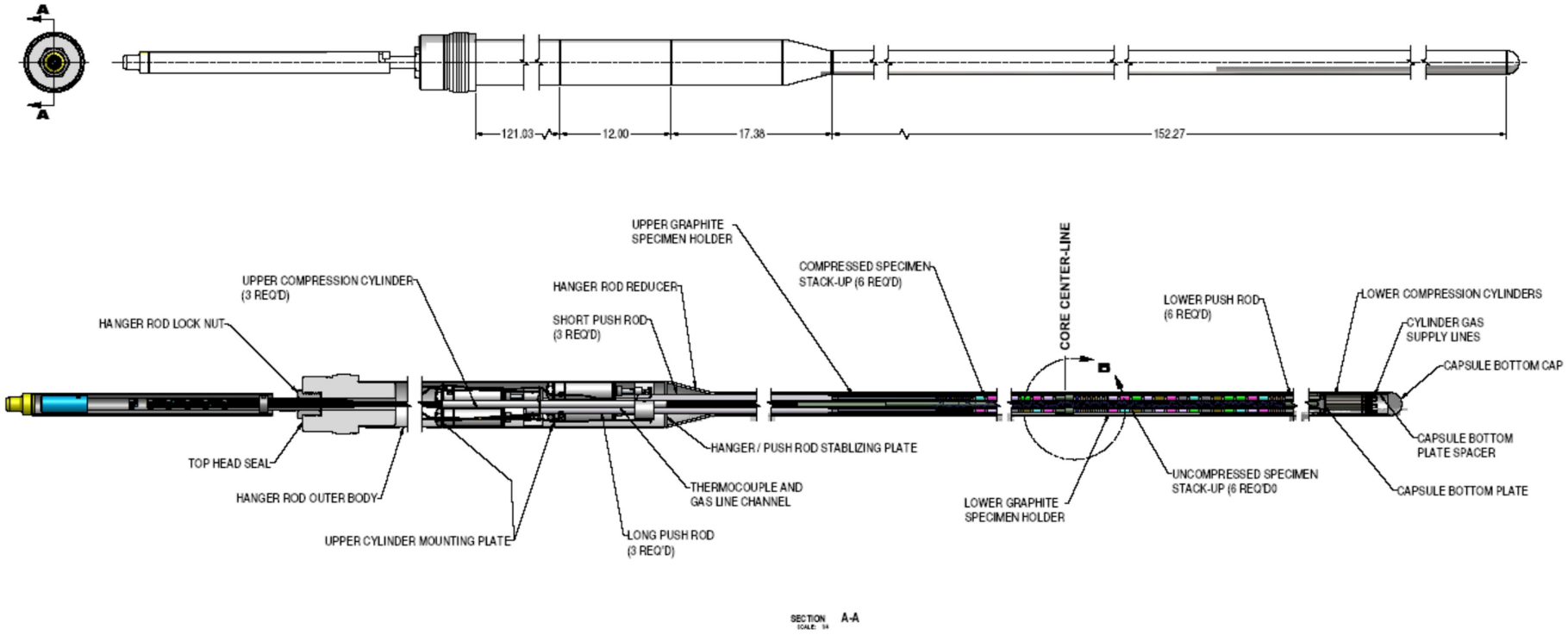


ATR Graphite Compressive Creep Capsule

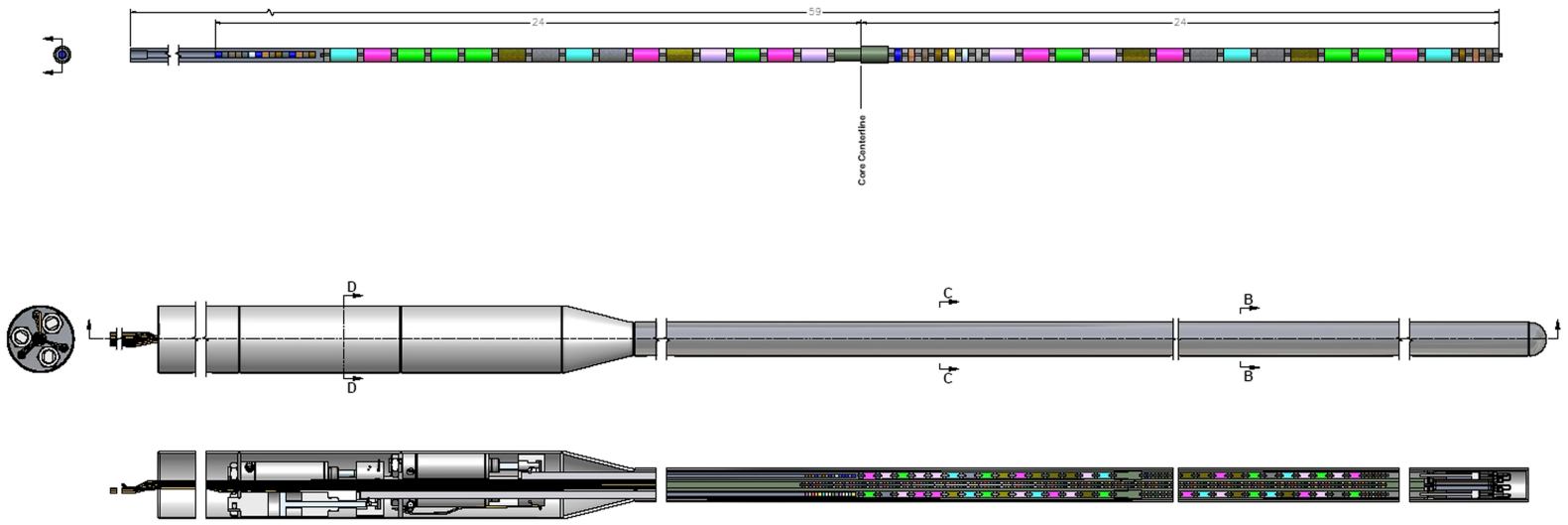
- Capsule Design (Continued)
  - The constant loads are controlled by periodic adjusting the pressure in the pneumatic cylinders.
  - Graphite samples 0.5 in. in diameter and 1 in. in length.
  - Multiple thermocouples can supply information for control of temperature and pneumatic cylinders.
  - Flux wires (Nb , Ni and Fe) and SiC thermal monitors will be used.

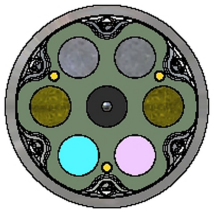
ATR Graphite Compressive Creep Capsule

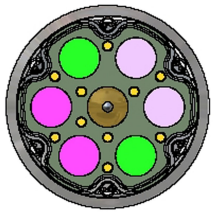
Capsule layout

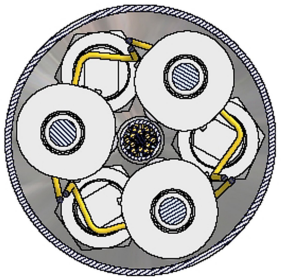


ATR Graphite Compressive Creep Capsule



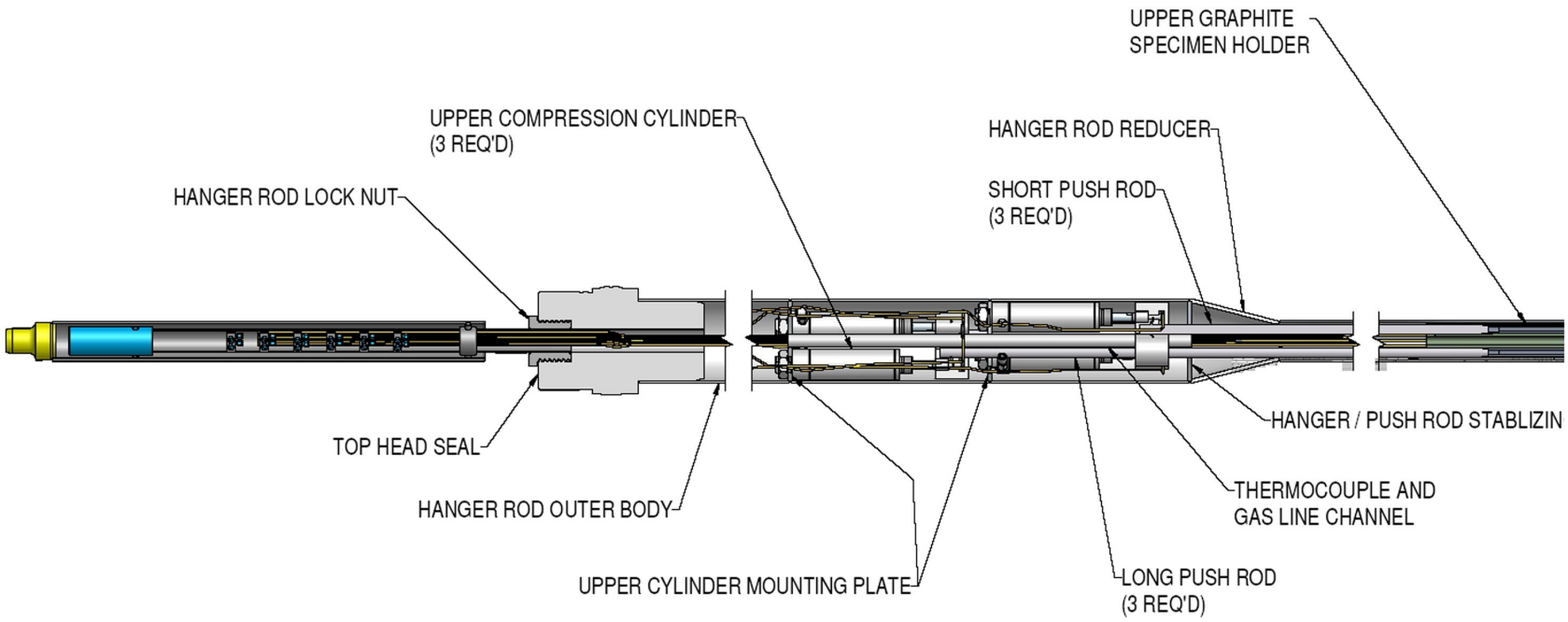






ATR Graphite Compressive Creep Capsule

Upper capsule section view



AGC: Core Model