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
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 radiotoxicity and heat load of high-level waste sent to a geologic repository
AFCI / LWR: ATR Core Cross Section
AFCI / LWR: ATR Core Cross Section
AFCI: East Flux Trap Basket Design
AFCI:
Rodlet assembly axial dimensions for a metallic fuel pin
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