History of Fuels and Materials Experimentation in EBR-II

2nd International Symposium on Materials Test Reactors

September 28-October 1, 2009

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What was EBR-II?

- 62.5 MWth, 20 MWe liquid- sodium fast reactor
- Reached criticality in 1964 and ran for 30 years
- 4 major missions: demonstration of closed fuel cycle (1964-1969), steady state fuels and materials test reactor (1970 to 1978), operational test reactor (1979 to 1986), and Integral Fast Reactor demonstration (1982 to 1994)

Initial Fuels and Materials in EBR-II

- High smear density, uranium based metal fuels
- Cladding/ducts and all structural materials 304 and 304L stainless steel
- Variety of other materials, including antimony/beryllium source rods, graphite shield blocks, and copper bus bar on aux pump
- Little was known how these material would perform at high neutron dose in liquid sodium

Multiple Fuels and Materials Behavior Surprises

- Irradiation induced swelling and creep in stainless steel discovered in late 1960's
- The implications to continued operation of EBR-II and the design of future reactors were significant
- Metal fuel could achieve only limited burnup and preferred orientation of vendor manufactured fuel caused reactivity concerns

The need developed to irradiate ceramic fast reactor fuels

- While issues associated with swelling and creep of stainless steel were being understood a host of new experiments were being planned for EBR-II

EBR-II organization created to accommodate experimenters

- ESRG, Experiment Safety Review Group
- PSRG, Plant Safety Review Group
- RSRG, Reactor Safety Review Group
- Experiment Coordination Group
- Guide for EBR-II Experimenters
- Experiment Design and Manufacturing
- Physics Support Group
- Post-irradiation Examination Organization

Many Novel Irradiation Vehicles Created

- Pressurized tubes, springs, and beams fit in hex duct geometry were all used to study swelling and creep
- High risk fuel tests were all doubly encapsulated
- Various orifice configurations were used to adjust temperature
- Instrumented tests with TC's were used
- Special assemblies were built to filter particle loss for run-beyond cladding breach experiments
- Most fueled experiments were xenon tagged for failure indentification

Devices were developed to measure temperature and neutron fluence

- SiC, Vapor Deposition, and TED (thermal expansion difference) temperature monitors were all developed with some success
- Flux wire capsules were eventually used as standard additions to many experiments

Post–irradiation Examination Equipment Development

- Initially the available equipment for destructive and non-destructive examination was crude
- The hot-cell organization kept pace with the demands of the experimenters often without deserved recognition
- They developed and installed laser gas puncture capability, gamma scanning, contact profilometry, neutron radiography, metallography, and sectioning capability for electron optics examiination

The Future

- Much of what was presented has been improved and is being used today.
- It is particularly gratifying to see a new generation of bright engineers and scientists carry this work forward
- There is no question that we are in the midst of a resurgence of nuclear energy world-wide
- Best of good fortune to all of you