Fast Reactor Materials Issues & Their Implications for Design

Professor R. G. Ballinger

Department of Nuclear Science & Engineering
Department of Materials Science and Engineering

Massachusetts Institute of Technology
Extension of LWR Conditions to FR Conditions

- **Key Differences**
  - Flux Distribution
    - (Energy)
  - Total Dose
    - LWR/Thermal~ 50 dpa max, FR > 100 dpa
  - Temperature
    - 300°C (>300 for SCW) LWR/Thermal, FR > 500°C
  - Fuel Type
    - UO$_2$ (MOX), UC/UCO LWR/Thermal, UC, UN, (Cermet, Cer-Cer, etc) FR
  - Exposure (Burnup)
  - Cladding Type
    - Zr Alloy LWR, SS, Fe-Based, Ceramic (SiC/SiC), etc. FR
    - Dose
  - Operating Environment
    - LWR/Thermal-Water, He, SCW, FR SC-CO$_2$, He,
Design Implications

• Flux Distribution
  – Radiation Damage
    » Temperature, Energy Distribution
• Total Dose
  – Radiation Effects
    » Swelling, He Embrittlement, Creep
• Temperature
  – Creep, Creep-Fatigue, Microstructural Stability
• Fuel Type
  – Fast Reactor “legacy” Data
  – Swelling, FGR
• Cladding Type
  – Fluence
• Operating Environment
  – Corrosion
  – Stability (Microstructural)