ACR-700 Reactor Physics Methods

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Current ACR Physics Toolset

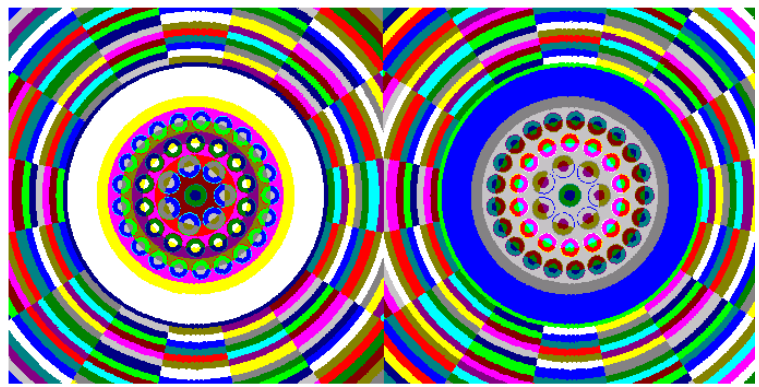
- WIMS
  - 2-D transport, lattice cell calculations
  - multi-group cross sections generated for ACR-700
- DRAGON
  - 3-D transport, incremental cross sections to represent reactivity devices between fuel channels
- RFSP
  - 2-group diffusion theory for whole reactor calculation
  - time-dependent refueling, xenon-transients, kinetics with thermal hydraulics iteration
- MCNP
  - theoretically rigorous treatment for detailed assessments of modeling accuracy

Assessment of Toolset

- Key ACR physics phenomena
  - tighter coupling between adjacent lattice cells
  - heterogeneity between adjacent cells
  - leakage
- Our assessment to date
  - toolset is adequate for most applications
  - enhancement desired for certain heterogeneous configurations

Enhancements to Physics Codes

- **WIMS 3.0**
  - improved resonance treatment
  - more detailed geometrical representation
  - multi-cell capability



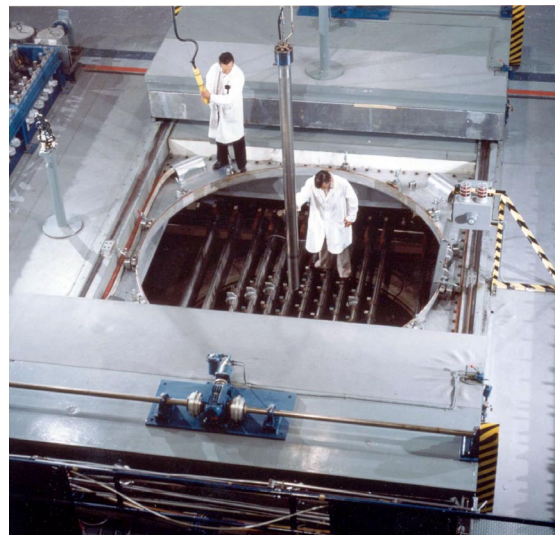
- **RFSP**
  - micro-depletion model for isotopic evolution calculations (burnup reflecting local parameters and history)
  - specific enhancements being assessed and under development to address heterogeneity between adjacent cells

ACR Physics Analysis Approach

- Will use WIMS 3.0
- Enhancements to RFSP
  - as they become available
- Modeling uncertainties assessed through specific detailed MCNP analysis
  - bundle powers/channel powers in steady state
  - reactivity, powers during LOCA

Qualification of Physics Toolset

- ACR-700 specific experiments in ZED-2
- Past experiments in other critical facilities
- NRU irradiations
- MCNP for “filling in the gaps”
- Independent assessments to confirm the adequacy of both modeling, and the toolset qualification



Conclusions

- Current toolset, including MCNP, is adequate for core physics design
  - MCNP analysis for situations having significant spatial heterogeneity (such as checkerboard voiding)
- Physics toolset is being enhanced to capture heterogeneity between adjacent cells
- Physics toolset qualification based on
  - extensive measurements in ZED-2
  - past measurements in other critical facilities
  - NRU irradiations
  - benchmarks against MCNP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