Anticipated ACR Fuel Channel R&D Program

D. Wren, Manager
ACR R&D Program

Meeting with the USNRC and CNSC

2002 December

AECL TECHNOLOGIES INC.

ACR Fuel Channel Design

- The ACR fuel channel design is an evolutionary extension of the current CANDU fuel channel design to address
  - ACR operating conditions
  - ACR core design requirements

Anticipated ACR Fuel Channel R&D Program

- The ACR fuel channel R&D program consists of activities required to confirm the anticipated design performance of the fuel channel
  - Extension of databases to ACR operating conditions
  - Qualification of new components

Pressure Tube Properties

- Tests will be conducted to extend the measurements on delayed hydride cracking velocity to confirm the performance of Zr-2.5%Nb material at ACR operating temperatures and projected end-of-life hydrogen concentrations
- Tests will use existing pressure tube material and coupons from prototype ACR pressure tubes

Leak Rate

- The leak rate from pre-existing cracks in prototype ACR pressure tube sections will be measured to provide data to support leak-before-break assessments for the pressure tube

Corrosion and Hydrogen Uptake

- AECL has an ongoing program to investigate corrosion rates of Zr-2.5%Nb pressure tube coupons in the Halden reactor at 325°C
- A new test series has started in the Halden reactor to measure the corrosion rate and hydrogen uptake in coupons from prototype ACR pressure tubes at ACR conditions
  - Confirm the benefits of chemistry optimization

Corrosion continued

- Tests will be conducted using prototype ACR pressure tubes to measure hydrogen uptake at the pressure tube/end-fitting rolled joints
  - the CTL-1 loop has been upgraded to operate at ACR temperatures
  - Tests sections will be installed with ACR prototype pressure tubes

Corrosion continued

- The corrosion tests in the Halden reactor and the CTL-1 loop will be supported by autoclave studies
  - Isotope effect of heavy vs light water hydrogen uptake rates

Deformation

- A test series will be conducted in the OSIRIS reactor to measure the deformation rates of ACR pressure tube material at ACR operating temperatures
  - Creep capsules have been manufactured from prototype ACR pressure tube material
- Coupons of prototype ACR pressure tube material will be irradiated in the NRU reactor to confirm
  - Predicted anisotropy effects
  - Thermal creep component of deformation rate

Rolled Joints

- AECL has had considerable experience in creating dissimilar metal rolled joints
- Tests are in progress to confirm the design of the calandria tube to end-shield rolled joint
- Tests will be conducted to confirm the design of the pressure tube to end-fitting rolled joint using prototype ACR pressure tube material
- When the designs are finalized the joint manufacturing process will be fully qualified

Calandria Tube

- The process for manufacturing the thicker ACR calandria tube will be qualified
- The calandria tube failure strength will be measured using a burst test facility to confirm the ability of the calandria tube to withstand spontaneous pressure tube rupture

Channel Closure

- The ACR includes a modified design for the fuel channel closure
- The design of this closure will be fully qualified in a test program

Safety Studies

- The ACR fuel channel is functionally equivalent to the current CANDU fuel channel and will experience the same type of transients during postulated accident sequences
- A series of test programs is planned to extend the existing database to include the behaviour of prototype ACR fuel channel materials

Anticipated Safety Tests

- Fuel channel heat transfer under LOCA and LOCA + LOECI conditions
- Fuel channel failure under flow blockage conditions (molten fuel moderator interaction)
- Fuel channel deformation and collapse for severe core damage event sequences

Fuel Channel R&D Summary

- A comprehensive program on R&D is planned to confirm the ACR fuel channel design
  - Extend the range of the predictive tools for pressure tube aging mechanisms to ACR conditions.
  - Qualify the design of new ACR components.
  - Extend the database of safety performance under transient conditions.


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