RIC 2002

Session W1

Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles

Industry Experience: Management of RV Head Penetration PWSCC at Oconee Nuclear Station

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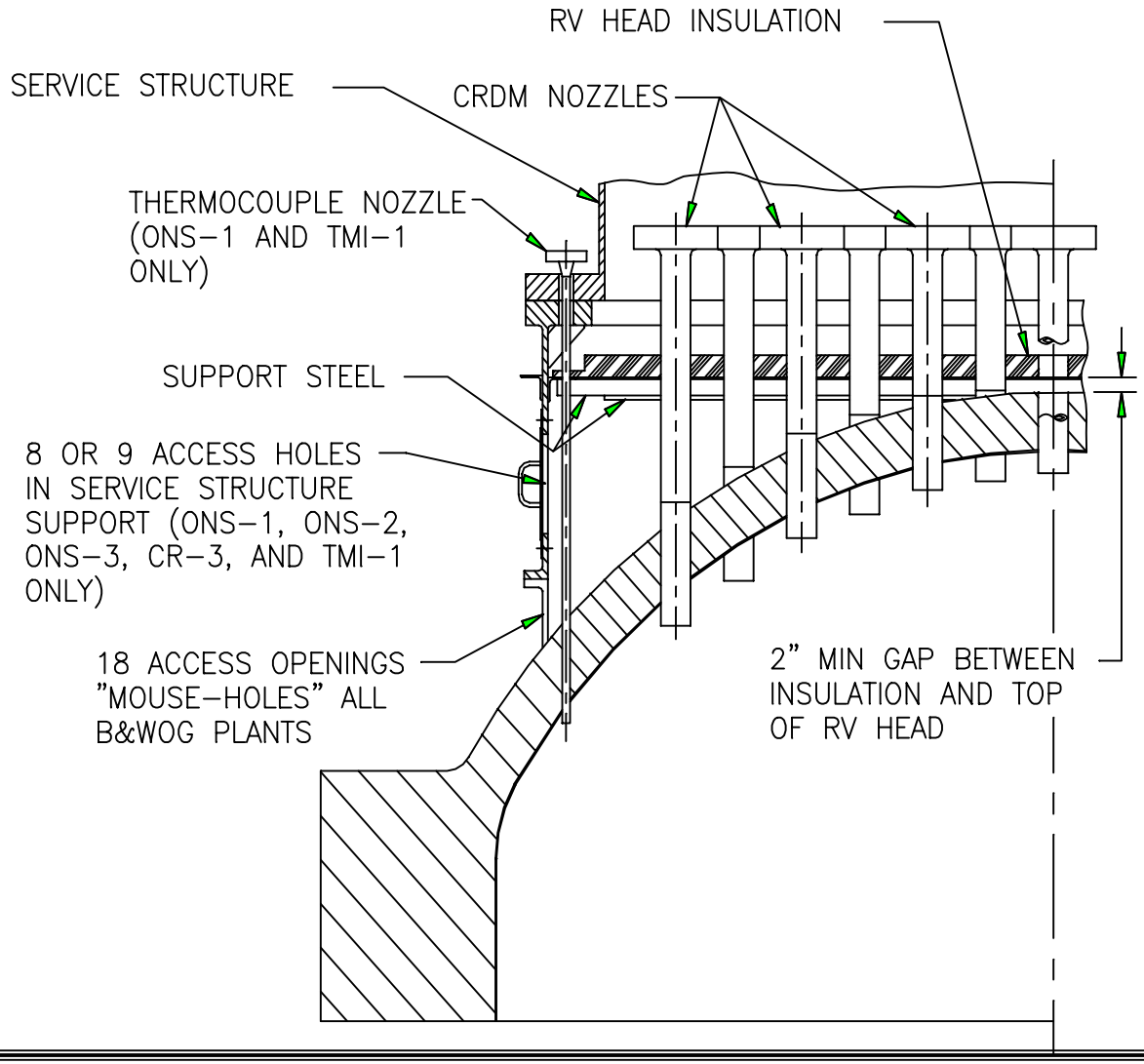
Configuration of RV Head Insulation and Location of Inspection Ports



Impact to Oconee Nuclear Station

- Loss of Unit Reliability
  - Leakage events must be repaired
  - 75 days of lost generation in repairs alone
- Radiation Exposure
  - ~ 413 rem of unplanned personnel radiation exposure
  - Workforce and staffing challenges
- RPV Head Replacement
  - Spring 2003 Oconee Unit 3
  - Fall 2003 Oconee Unit 1
  - Spring 2004 Oconee Unit 2

Evolution of Top of the RPV Head Bare Metal Visual Inspections

- Amount of boric acid crystals around penetrations can be very small and in some cases < ½ cubic inch
  - Leakage may appear as “popcorn” pushed up around the nozzle, or as a “string” coming from the annulus, or as flow
- All boric acid deposits should be cleaned from head each outage
- Perform additional NDE inspections of nozzles that may be masked by boron or other deposits

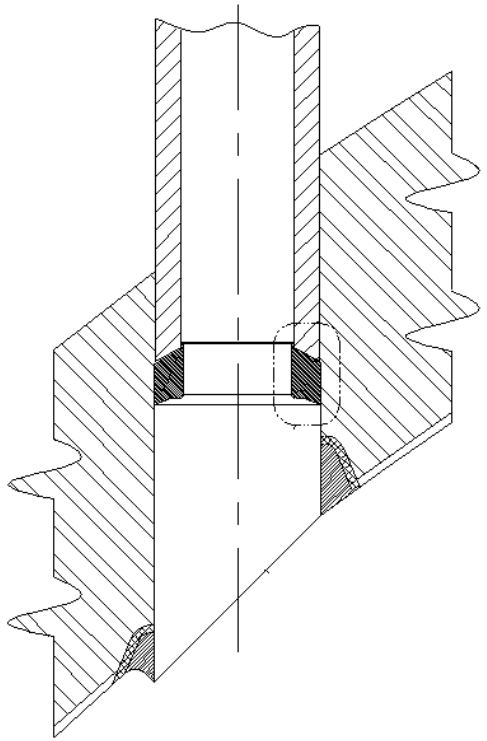
Oconee Unit 3, March 2001, RV Head After Cleaning

Evolution of Ultrasonic Inspection Techniques

- Techniques for detection and sizing of ID flaws is now well developed
- Developed blade probe capability to search for OD circumferential indications
- Improved analysis techniques and delivery systems to increase detectability of OD nozzle cracks

Evolution of Repair Techniques

- Repairs during ONS-1 RFO and ONS-3 Maintenance Outage accomplished by manual excavation and welding
- The “ID Temper Bead” repair technique
  - First demonstrated for ONS-2 repairs



Evolution of Repair Techniques

- The “ID Ambient Temper Bead” was developed in time for the ONS-3 Fall 2001 refueling outage
- ASME Relief Requests were needed for all repair methods

Lessons Learned

- PWSCC in CRDMs is a real problem
- Significant progress has been made in a short period of time
- Alloy 600 material is very flaw tolerant and even when cracks develop the material maintains significant structural capacity

Lessons Learned

- Management of PWSCC in the RPV closure head penetrations is a long term undertaking
- Less dose intensive methods for performing the inspections must be developed and the capabilities demonstrated

Lessons Learned

- Clear and frequent communication with NRC Staff is imperative
- Better automated repair methods must be developed and demonstrated
- Develop management plans for other Alloy 600 locations in contact with primary water