

# **NRC Bulletin 2001-01**

## **NRC Meeting**

Robinson Nuclear Plant

October 24, 2001



**CP&L**  
Progress Energy

Enclosure 2

# Agenda

- Introduction
- Background
- Analytical Basis for Qualification
- Future Inspections
- Closing Remarks

# Introduction

# Background

Key Design Parameters	
NSSS Designer	Westinghouse
Head Fabricator	Combustion Engineering
Nozzle Material Supplier	Huntington
Number of Vessel Head Penetrations	69
Design Diametrical Nozzle Interference Fit	0.0 – 3.0 mils
Remaining EFPYs to Ocone 3	~3.0 EFPYs

# Background

- Qualified Examination of Vessel Head Penetrations (VHPs)
  - ▶ Completed April 2001 during Refueling Outage 20
  - ▶ Bare metal visual examination
    - ◆ VT-2 qualified inspectors
      - ▼ Inspectors briefed on Ocone leakage indicators
    - ◆ No evidence of VHP leakage

# Background

- Qualified Examination (continued)
  - ▶ Analyses provide high confidence of leakage path to vessel head surface
    - ◆ Finite element analyses provide analytical basis for leakage path
    - ◆ Records provide strong assurance of manufacture and assembly of Robinson VHPs in accordance with design

# Analytical Basis for Qualification

- Two Vendor-Performed Finite Element Analyses of Robinson VHPs
  - ▶ Structural Integrity Associates, Inc.
  - ▶ Dominion Engineering, Inc.

# Analytical Basis for Qualification

- Structural Integrity Associates Analysis Concluded
  - ▶ Leakage path to vessel head surface exists for interference fits through 3 mils
    - ◆ 3 mils interference fit is the largest interference fit allowed by design



# Analytical Basis for Qualification

- Dominion Engineering Analysis  
Concluded

- ▶ Leakage path to vessel head surface exists  
for interference fits through 2.75 mils
  - ◆ Based on the very low contact force near the  
surface over a short contact length, leakage  
would be likely for interference fits of greater  
than 2.75 through 3 mils

# Design Range of Interference Fits

Design Range of Nozzle Sizes	Design Range of Hole Sizes	Maximum Design Interference Fit
4.000	3.997	0.003
	3.998	0.002
	3.999	0.001
3.999	3.997	0.002
	3.998	0.001
	3.999	0.000

# Analytical Basis for Qualification

- Robinson VHPs Constructed in Accordance with Design Requirements
  - ▶ Manufacturing/Inspection records
    - ◆ Controlled under vendor/licensee quality assurance program & ASME Section III, 1965
      - ▼ Documentation of rejection/rework of dimensionally incorrect material
        - Example
      - ▼ Detailed documentation of lower vessel penetration non-conformances

# Analytical Basis for Qualification

- Robinson VHPs Constructed in Accordance with Design Requirements (continued)
  - ▶ Assembly process records
    - ◆ Instructions to minimize interference fit
      - ▼ Match housings to penetrations for assurance of least possible interference fit
    - ◆ Limitations of shrinkage method
      - ▼ Method could produce only ~ 4 mils shrinkage
      - ▼ Method designed to assure ~ 3 mils gap for assembly
    - ◆ Result – given instructions to match housings to penetrations to minimize interference, interference fits likely clustered at or below 2 mils

# Analytical Basis for Qualification

- Robinson VHPs Constructed in Accordance with Design Requirements (continued)
  - ▶ Comparison with similar reactor vessel heads
    - ◆ Evaluation of 3 similar vintage reactor vessel heads (230 VHPs)
      - ▼ No undersized holes
    - ◆ Two additional later vintage reactor vessel heads (156 VHPs) with dimensions of nozzles and holes
      - ▼ Interference fits of 3 mils or less

# Conclusion

- Qualified Examination of Vessel Head Penetrations was Performed
  - ▶ Visual examination (VT-2) with no identified leakage
  - ▶ Leakage path demonstrated through finite element analyses
  - ▶ Records support manufacture and assembly of Robinson VHPs in accordance with design

# Future Inspections

- Refueling Outage 21 (October 2002)
  - ▶ Qualified visual examination
  - ▶ Non-destructive examination

# Closing Remarks