H*: Where Are We Now?

W/EP/NRC – Meeting on H*

November 19, 2008

Technical Issues

- Coefficient of Thermal Expansion
- Applicability of Axisymmetric Model
- Probabilistic Criteria and Approach
- Application of 3D FEA Model
- Residual Contact Pressure
- Leakage (k as a function of Pcontact)
- Divider Plate
- Incremental slippage; monitoring
- Peer Review

Coefficient of Thermal Expansion

- Issue is resolved
- All tests/re-tests are complete
- Analysis shows narrow uncertainty bands for both SA508 and A600
- Need to update report
  - Include results of strain hardened material retests
  - Ignore PMIC SA508 air and vacuum data for temp. decrease due to material change during prior 700C exposure
  - Address PMIC SA508 vacuum data for temp. increase

Applicability of ALSP (2D) Model (Application of 3D FEA Model)

- Resolved; 2D ALSP model replaced by 3D FEA model
  - ALSP shown to be conservative by benchmarking analyses
  - ALSP superpositioning approach validated for individual operating conditions
  - Boundary conditions (bulk temperature vs. surface temperature with conduction) validated; surface BCs correct for 3D FEA
- ANL modeling differences; adequacy of sub-model challenged

Probabilistic Criteria and Approach

- Criteria are settled
  - 95% probability, 50% confidence for whole bundle
  - Open NRC question if NOP should include whole plant complement of tubes (>22000 for Model F); response not mandatory
- Approach is settled
  - 3D FEA analysis basis
  - Influence Factor MC including RCP, coefficient of friction
  - Short-cut approach based on SRSS of individual parameter variability and probability factor for 5626 tubes shows acceptable H* values
- Leakage analysis at 95/50 based on leakage test variability and loss coefficient sensitivity study (if needed)

Leakage Analysis

- Open issue with NRC staff
- Darcy formulation
- Little, if any, variation of k with Pc
- All DBA's that include leakage are considered
- DBA/NOP leakage factors for each plant
  - Trade off leakage factor against inspection depth
  - Address an increased leakage factor by adjusting the dose equivalent iodine as discussed in DG-1074

Residual Contact Pressure

- Mean value of RCP is an open issue
  - Pullout test program on hold after 6 pullout tests for data analysis and diagnostics
  - Restart imminent using new test collars that more closely simulate field conditions
- Variability analysis is complete

Incremental Slippage

- Open Issue
  - In-service monitoring?
- Lower priority than basic H* justification
- Proposed solutions to be reviewed by EP

Peer Review

- Scheduled: January 20&21, 2009
  - Based on draft of technical sections of report
  - Rescheduled to respond to issues from meeting with ANL
- Protocol
  - EP as peer review team
  - Utility observation/participation
  - Download to NRC after peer review
- EP issues report

Westinghouse Status on RAIs

RAI No.	Description	0% Progress 100%	Comments
1 & 2	Contact pressure between the tube and tubesheet		1.TOE not used 2.Tests with long specimens in progress
3	Allowed degree of tube slippage at pullout loads		Tests in progress; concurrence to use 0.25" slip values
4 & 5	Dimensions and yield strength of test specimens		Tests in progress; RAIs overtaken by events
6 to 9	Pullout test data base adequacy for uncertainties		6.Using analysis (100% complete) 7.Using analysis (100% complete) 8.Repeating pull tests 9.Mean value of RCP from pull tests; variability analytically
10	Thermal expansion coefficient values and variability		Report complete; updating for strain hardened; Report in progress
11	Statistical performance standard for H* adequacy		3DFEA and 95/50 whole bundle; Monte Carlos based on influence factors; Need to do MC, but SRSS approach OK
12	Propagate input uncertainties to H* uncertainties		Monte Carlo based on influence factors; need to do MC, but SRSS approach OK
13	Accuracy of 2-D FE tubesheet model		3-D FE analyses is reference basis; SLB vs NOP concerns
14	Error in the unit load FE analyses for SLB		Overtaken by events? Using 3D FEA Analysis
15	Input random vs. systematic uncertainties		1 TS, many tubes; Approach Established; need to do MC
16	Incremental slippage under N Op and monitoring		
17	Need to assess accident leakage for FL break		Included in structural and leakage section
18	Conservatism of "limiting median crevice pressure approach"		Adopted distributed crevice pressure; new scope(ANL)
19	Beta factor adjustment to crevice pressure (tubesheet stiffness)		FE analyses 100% complete; presented at ANL and 9/08 meeting
20	Consider assumptions on divider plate condition		DP not attached to TS shown to be worst case
21	Contact Pressure/Leakage-Tube Hole Ovalization		Need NRC question; new scope (ANL meeting); tube follows hole
22	CTE After Radial Strain Hardening		Need NRC question; See #10

H* and Leakage Inspection Depths

- Leakage Inspection Depth
  - 6-10 inches assuming k = constant
    - All DBA included
    - All H* plants included
  - Leakage uncertainty included (95% values)
  - Loss coefficient uncertainty (factor 1-2 based on contact pressure predictions)
- H*
  - Mean min = 3.3 inches (based on leakage database, not structural considerations)
  - 95/50 : Approximately 6 inches (depends on SG model)