Westinghouse/Expert Panel/Industry/NRC Meeting on H*

October 1-2, 2008

Westinghouse Waltz Mill

Agenda (October 1, 2008)

Introduction/Safety/Housekeeping	HL
Project/NRC Communications	GB/MM
Frequency	
Protocol/Methods	
H* Overview	HL
Options A and B revisited	
Option D defined	
Review prior status/resolution/recommendations	W/EP
CTE revisited	
Update EP Review of H*	EP/W
Model Benchmark Analysis results	
Applicability/Conservatism of Superpositioning Approach	
Option D probabilistic analysis	
Leakage Analysis	
NRC Concerns/Feedback	NRC
Clarification of Option B comments	
Thoughts on Option D	
CTE	
Comments on Test Specification	
Peer Review	W/EP/NRC
Format	
NRC Participation/Attendance	
Schedule	Industry/NRC/W
Completion of Lead Plant (Model F) Report	
Reports for Other Model SGs	
NRC Review	

Agenda (October 2, 2008)

Review NRC Comments on Test Specification

Observe Tests

- Test Setup, Instrumentation, Data Acquisition
- Hydraulic Expansion Process
- Pullout Test

Discussion/Summary/Actions

Notes:

Breakfast will be provided in the meeting room both days.

Lunch in the WM cafeteria 10/1/08 and 10/2/08(if necessary)

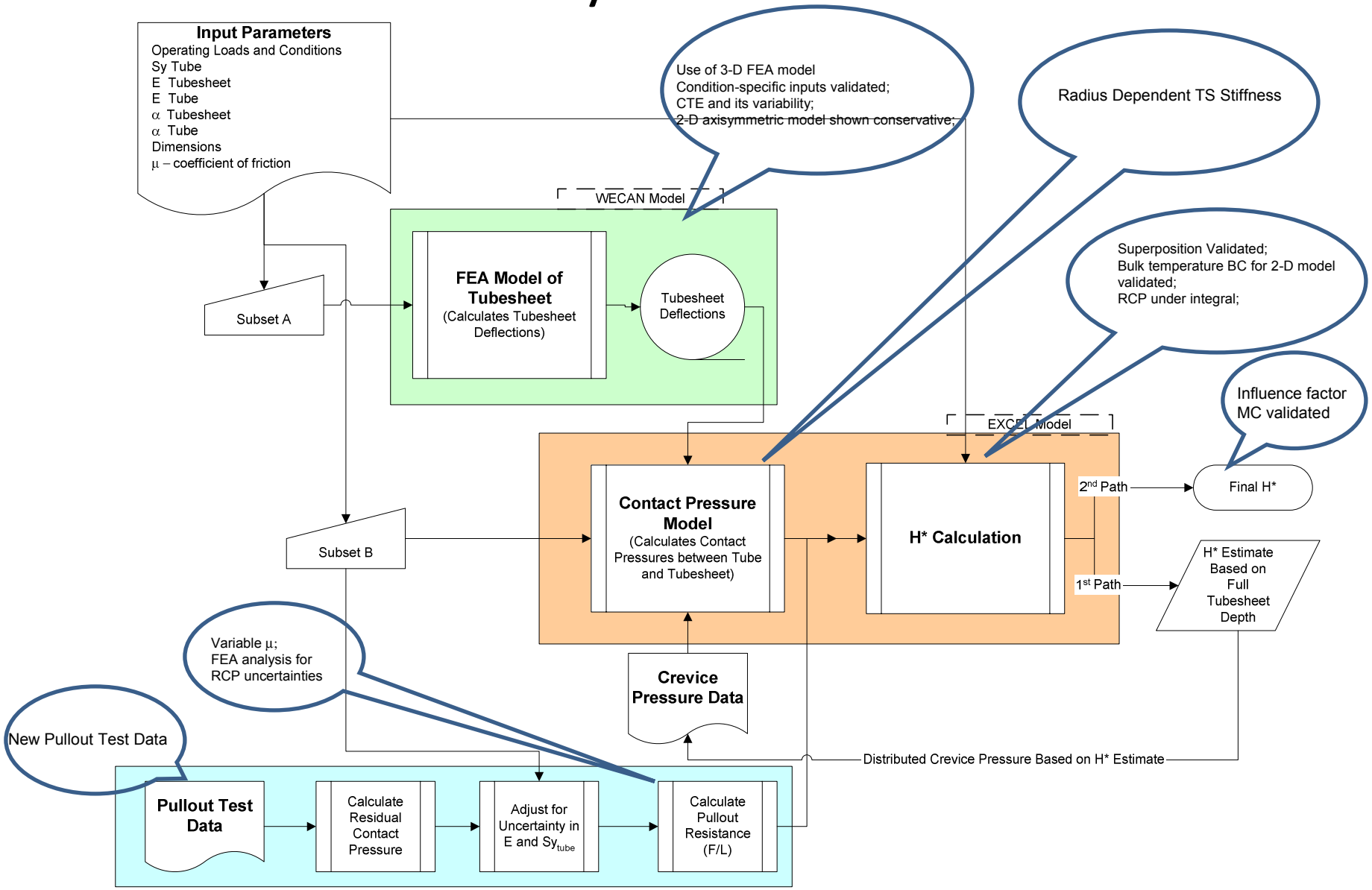
Overview of H*-2008

- H* Approach/Methods
- Principal Issues
  - Expert Panel Participation
- Structural Models
- Probabilistic Approach
- Leakage Analysis
- Residual Contact Pressure
- Schedule Overview

H* Approach/Methods

- Approach and Methods are consistent with 2007 submittal of record with refinements, benchmarking and validation.
  - Flow chart (next slide) is still applicable
  - Significant refinement is use of 3-D FEA analysis for TS displacements and structural model benchmarking
  - H* relies on differential thermal expansion, pressure loading and residual contact pressure
  - Probabilistic evaluation based on industry guidelines criteria (95/50 whole bundle) at SIPC loads
  - Leakage model is Darcy formulation and existing leak test data
  - Inputs have been refined (CTE, μ, RCP uncertainties)
  - Residual Contact Pressure (RCP) has been refined
- The final report is expected to justify TS radius-dependent values of H*

H* Analysis Flow Chart



Principal Issues/Resolutions

- Variability of coefficient of thermal expansion has been resolved
  - Multiple tests of A600TT, SA508 and strain hardened A600TT
- Option D – Probabilistic approach/criteria defined
  - Whole bundle analysis at 95/50 for SIPC loads utilizing 3-D FEA TS displacements
  - Benchmark with 1*SLB loading whole bundle analysis at 99%
  - Comparison with 2-D worst case single tube analysis
- Residual contact pressure to be established by pullout tests
  - Variability of RCP determined analytically using FEA model

Structural Models

- 2-D Axisymmetric model compared to 3-D FEA (ANSYS) models
  - 3-D FEA model shows 2-D axisymmetric model to be highly conservative
    - Limiting location/direction for H* can be identified
- Superpositioning approach validated by FEA analysis
  - Static (bulk) temperature input validated by FEA conduction study
- Radius dependent tubesheet stiffness (previously, beta factor) approach developed and applied
- Condition-specific (NOP, SLB, FLB) inputs validated and applied

Comparison of Probabilistic Approaches

- Option D (Proposed Approach)
  - Whole bundle analysis at 95/50 for SIPC loads (3ΔPnop, 1.4ΔPslb) utilizing 3-D FEA TS displacements
  - Benchmark with 1*SLB loading whole bundle analysis at 99%
  - Comparison with 2-D worst case single tube analysis
- Option B
  - 2-D whole bundle analysis at 99/50 based on 1xDPslb loading
  - NRC requested demonstration of conservatism relative to whole bundle analysis at 95/50 based on SIPC loading (3ΔPnop, 1.4ΔPslb)
- Option A
  - Combined H*/P*
  - Approx outer 40% of bundle shown to meet 95/50 based on SIPC loading (3ΔPnop, 1.4ΔPslb)
  - Inner Approx 60% of bundle prevented from ejection by outer 40% of bundle.
- RCP and coefficient of friction treated as variable inputs
- Variables interaction study

Leakage Analysis

- Approach is essentially the same as IARC
- Use of Darcy formulation leakage factor uncertainty based on prior leak test data
- Leak rate factor methodology under review by Expert Panel
  - EP will perform independent verification

Residual Contact Pressure (RCP)

- Pullout tests will determine mean RCP
  - Conservative value of RCP will be chosen based on test data
- Variability of RCP determined analytically
  - FEA (ANSYS) elastic-plastic model
  - E_{TS}, E_{tube}, Sy_{tube}, TS hole dia., tube OD (mean t), tube strain hardening
  - MC combination to determine variability distribution of RCP
- RCP treated as a variable input

NRC Feedback Requested

- Clarification of comment on Option B (probabilistic analysis based on 1*SLB loading, whole bundle, 99/50)
- Comments on pull-out test procedure
- Agreement that CTE variability has been established
- Response on Option D

Westinghouse H* Activities/Schedule

- March through September 2008
  - Expert Panel reviews
    - Detailed to provide background for peer review
  - Validation of input parameter variability
  - Benchmarking of models
  - CTE test
  - Pullout test preparation
  - Leakage analysis
  - H* "lite"
- October through December 2008
  - Complete Pullout Tests
  - Final H* analysis (Model F SG reference)
  - Formal Peer Review
  - Draft Final Report
- January through mid-February 2009
  - Final report (bounding report for Model F SGs)
- February through May 2009
  - Final bounding reports for Models D5, 44F and 51F
  - Resolve technical comments