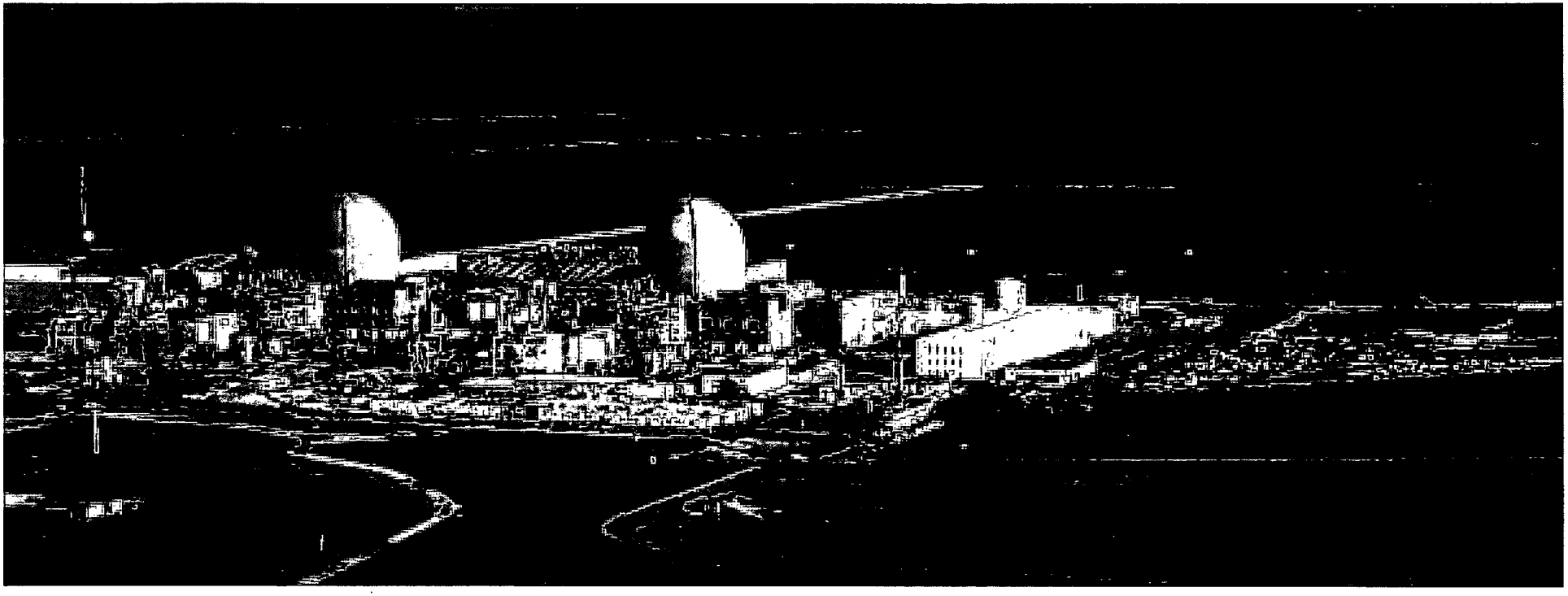
Caldon Ultrasonics



NRC Meeting at Alden Research Laboratory, Inc. Part 2

NON-PROPRIETARY

August 24, 2009

Agenda – Day 1

- Introductory Remarks 8:00 am – 8:15 am
- Tour of Lab with Special Emphasis Where Calibrations Tests are to be Run
- Description of the Analysis of the Uncertainties in the Lab Measurement (By ARL)
- History of LEFM and Their Applications to Power Plants
- The "Black Box"; How Chordal LEFMs work
- Calibrations Test in the Lab
- Laboratory Calibrations, Practice and Data
- Calibration Test for LaSalle Unit 2
- Witness Sample Data Collection – Preliminary Results (Lab)
- Questions and Answers Lab Tests
- Traceability and Uncertainties
- Summary of Completed Tests, Questions and Answers (Day 1)

Agenda – Day 2

- Purpose and Scope of ER-157 and ER-80
- Summary of Changes to ER-157 Rev. 8
- Coherent Noise Treatment
- Transducer Placement Treatment
- Responses to Recent RAIs
- Reprise of Calibration Results to Date
- Configuration of LEFMs for New Plants
- LEFM Follow Up
- Questions and Answers, Meeting Wrap Up

Revision 8, ER-157P

Changes are described in ER-685

•

•

Trade Secret and Confidential Commercial Information

- Supplements Appendix F, ER-80, by reference to ER-486 in describing the sensitivity of chordal systems to upstream hydraulic configuration
- Updates hardware description, LEFM CheckPlus system
- Clarifies the performance of an LEFM CheckPlus system with a component out of service
- Makes the main body of ER-157 non proprietary by eliminating the breakdown of uncertainties for Check and CheckPlus systems. Only the bottom lines are included. Appendix A is referenced for details

Revision 8, ER-157P

Appendix A (Uncertainty analysis)

- Incorporates, weighting factors for CheckPlus in the algorithm discussion (previously only the Check weighting factors were included), subsequent discussion of error contributors includes both Check and CheckPlus.
- Corrects several editorial and typographical errors
- ASME 19.1 remains the methodology reference, but references to ISO standard used in Europe and a NIST technical note are added for completeness.
- Includes a more straightforward derivation of sensitivity coefficients for the volumetric flow determination
- Includes a comprehensive listing of sensitivity coefficients for all independent inputs to the LEFM and cross references these contributors to the detailed uncertainty accounting in Table A-1 (Equation (32))
-
-
-
-

Revision 8, ER-157P

Appendix B

- Changed to reflect the (small) changes in "bottom line" uncertainties and sample rate in Appendix A
- Made non proprietary

Treatment of Coherent Noise

Treatment of Coherent Noise

Transducer (Re)placement Uncertainty

Trade Secret and Confidential Commercial Information

Transducer (Re)placement

Transducer (Re)placement

Trade Secret and Confidential Commercial Information

Responses to Recent RAIs

Derivation and meaning of "systematic" and "random" temperature errors for combination with mass flow uncertainties

- The appropriate combination of errors is given in Appendix A of ER-157

  $P = Q\,\rho\,(h_s - h_{fw})$

  $\partial P/P = \partial Q/Q + \partial\rho/\rho + \partial\, h_s/(h_s - h_{fw}) + \partial\, h_{fw}/(h_s - h_{fw})$

- The uncertainties in Q, ρ, and h_{fw} are the responsibility of the LEFM

- Almost all of the uncertainties in ρ, and h_{fw} are systematically related to some of the uncertainties in Q

  $\partial P/P \approx \{\partial Q/Q_{uncorr}^2 + [\partial Q/Q_{corr} + \partial\rho/\rho + \partial\, h_{fw}/(h_s - h_{fw})]^2 + [\partial\, h_s/(h_s - h_{fw})]^2\}^{1/2}$

- But the thermal power uncertainty analyses used some licensees assume:

  $\partial P/P \approx \{[\partial Q/Q + \partial\rho/\rho_{corr} + +\partial\, h_{fw\,corr}/(h_s - h_{fw})]^2 + \partial\rho/\rho_{uncorr}^2 + [\partial\, h_{fw\,uncorr}/(h_s - h_{fw})]^2 + [\partial\, h_s/(h_s - h_{fw})]^2\}^{1/2}$

- The "correlated" and "uncorrelated" values of temperature are selected such that

  $[\partial Q/Q + \partial\rho/\rho_{corr} + +\partial\, h_{fw\,corr}/(h_s - h_{fw})]^2 + \partial\rho/\rho_{uncorr}^2 + [\partial\, h_{fw\,uncorr}/(h_s - h_{fw})]^2 = \partial Q/Q_{uncorr}^2 + [\partial Q/Q_{corr} + \partial\rho/\rho + \partial\, h_{fw}/(h_s - h_{fw})]^2$

Responses to Recent RAIs

- Effect of local fluid velocity vectors on LEFM pressure instrument
- Effect of downstream hydraulic geometry on LEFM flow measurement