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To W from Girija ~~[illegible]~~ Shukla 1/12/06

Request for Additional Information
Crossflow and X-Beam Ultrasonic Flow Measurement Devices
Westinghouse/AMAG

1. "Crossflow System/Theory & Application," Slides from NRC Meeting with Westinghouse (W) and AMAG, October 3, 2005. (Proprietary) provided data from (b)(4) (b)(4) We calculated that the average C_0 was (b)(4) and the 2σ was (b)(4) percent.

   a. Are we correct in assuming that the crossflow instrument used in these tests was recalibrated to an average C_0 of one on the basis of the (b)(4) tests? If not, then are we correct in assuming that the C_0 was determined from the Alden-derived equation that fitted the two coefficients? Please provide the unrecalibrated AMAG flow rates for the (b)(4) tests.

   b. Please explain how the (b)(4) percent uncertainty is factored into overall AMAG uncertainty with respect to both testing and in plant installations.

   c. We would like to use these and other data to assess the straight line fit you used to obtain the two coefficients in your straight line equation but are unable to do so because you did not provide the unrecalibrated AMAG-indicated flow rates when tabulating the test-determined flow rates and Reynolds numbers. Please do so.

2. CENPD-397-P-A Rev. 01 on Page 5-11 stated that experimental data were obtained from the (b)(4) diameters resulted in a $C_f = C_0$ that was independent of distance from the elbow. This resulted in development of an equation to represent ΔC as a function of L/D. Coefficients in the equation were then stated to be established with data from Alden Research Laboratory using (b)(4) inch plastic pipe and no correction is stated to be necessary for (b)(4) (b)(4) The CENPD also states that the Alden Laboratory data provided the bases for assigning the Alden Laboratory weight tank uncertainty of (b)(4) percent to the correction factor. Please provide the data in a format similar to the data you provided for determination of the two straight line equation coefficients and provide a summary of how the data were applied.

(b)(4)

(b)(4)

3. The CENPD also makes a commitment on Page 5-11 regarding application of computational fluid dynamics (CFD) analyses and followup testing for pipe configurations other than an elbow. Please provide a list of the CFD analyses and followup testing that have been accomplished and summarize the findings of each analysis. In the case of followup testing, please provide the unrecalibrated AMAG-indicated flow rates

4. We have been provided with the figures "Verification of the Alden Calibration Curve at Higher Reynolds Number" in numerous references but we have not been supplied with the data illustrated on the figures and we cannot read the figure to sufficient accuracy to assess the data. Please provide the data for each point of Profile Correction Factor as a function of Re and of frictional velocity ratio.

5. Many of the comparisons, such as in Slides 13, 14,16, and 17 provided to us on October 6, 2005, in "CROSSFLOW Fully Developed Flow/Stable Flow," are in graphical form. Graphical comparisons are not sufficient when uncertainties of a fraction of a percent are

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involved. To be useful in justifying your uncertainty conclusions, we must either have sufficient data so that we can calculate uncertainties or you must provide them. And Slide 12 provides a comparison of two transducer orientations with [redacted] f the total data are assessed?

6. An uncertainty is introduced by the AMAG self-assessment that allows continued operation within an indicated band. How is this uncertainty factored into the overall AMAG uncertainty?

7. "Crossflow Standard and Nonstandard Installation," Slides from NRC Meeting with W/AMAG, October 6, 2005, Slide 10 provides a graph labeled "Delta between FPCF and 90E." Are we correct in believing this is for behavior downstream of [redacted]

8. The discussions regarding extrapolation from test to plant operation Re numbers do not adequately address the effect on flow that is not fully developed since the basis of the applicable equations is theoretical and for fully developed flow. Please address this. Include the contribution to uncertainty.

9. Please provide a table that lists every uncertainty associated with the feedwater flow rate determined by AMAG and provide either plant-specific uncertainties from one plant or typical uncertainties for each item for two conditions: (1) where distance from an upstream elbow is less than [redacted] and (2) greater than [redacted] This table should include entries for transducer replacement, bracket installation change in moving from the Alden tests to the plant, correction for distance from an upstream elbow, extrapolation of the Re from test to the plant conditions, and the effect when AMAG is operating at the limit permitted by the self-assessment process.

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Calvert Cliffs

1. Please provide a summary of the computational fluid dynamics (CFD) analyses and followup testing that have been accomplished and the findings of each analysis. In the case of followup testing, please provide the unrecalibrated AMAG-indicated flow rates for each of the installed instruments (Crossflow and/or X-Beam), the flow rates determined using tracer testing, and from the venturis obtained during followup testing.

2. Please provide a description of the tracer testing procedures to be used. Include a discussion of how the tracer testing is traceable to national standards, controls in place to assure the procedures are properly conducted, the accuracy of the tracer testing, and how the uncertainties associated with the tracer testing are factored into the overall uncertainty of the Crossflow system accuracy.

3. Please provide a desciption of any periodic testing to be performed that will verify the Crossflow systems remains calibrated over the range of operating conditions and changes in flow that may occur over time due to degradation of, modification to, and/or operational changes in the main feedwater system.

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Ft. Calhoun

1. Please provide the technical basis for determining the location for installing the Crossflow ultrasonic flow meters. If performed, include the computational fluid dynamic (CFD) analysis in your technical basis. Also, provide a discussion of any in situ testing that has been performed. In the case of in situ testing, please provide the unrecalibrated AMAG-indicated flow rates for each of the installed instruments (Crossflow and/or X-Beam), the flow rates from the in situ testing, and from the venturis obtained during in situ testing.

2. If being conducted, please provide a description of in situ testing procedures to be used. Include a discussion of how the in situ testing is traceable to national standards, controls in place to assure the procedures are properly conducted, the accuracy of the in situ testing, and how the uncertainties associated with the in situ testing are factored into the overall uncertainty of the Crossflow system accuracy.

3. Please provide a desciption of any periodic testing to be performed that will verify the Crossflow systems remains calibrated over the range of operating conditions and changes in flow that may occur over time due to degradation of, modification to, and/or operational changes in the main feedwater system.