PMSTPCOL PEmails

From: Tai, Tom
Sent: Monday, August 08, 2011 9:54 AM
To: Wu, Cheng-Ih
Cc: STPCOL; Dixon-Herrity, Jennifer; Wunder, George
Subject: FW: Write-up for Proposed ACSTIC2 Actions
Attachments: ACSTIC2 Audit - Supporting Info for Proposed Actions.pdf

John,

Attached for your use is additional information on the validation of ACSTIC2 from NINA/WEC. This is a draft and if you are satisfied that it meets your expectation to close out RAI 03.09.01-1 and 03.09.02-21, please let me know and I'll advise NINA to submit formally in a letter. Otherwise, please be ready to provide feedback on Wednesday (8/10) if possible.

Thanks

Tom Tai
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From: Price, John E [mailto:jeprice@STPEGS.COM]
Sent: Monday, August 08, 2011 9:49 AM
To: Tai, Tom
Subject: Write-up for Proposed ACSTIC2 Actions

Tom,

The attached file is a draft of information in support of the two actions regarding the applicability of ACSTIC2 to the ABWR. Please pass along to John Wu and we can discuss in our Wednesday's phone call.

John E. Price
Licensing Engineer - STP Units 3 & 4
972.754.8221 (cell)

Hearing Identifier: SouthTexas34Public_EX
Email Number: 3024

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From: Tai, Tom

Created By: Tom.Tai@nrc.gov

Recipients:
"STPCOL" <STP.COL@nrc.gov>
Tracking Status: None
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Proposed Approach to Address NRC ACSTIC2 Audit Question
Regarding ABWR Applicability

The U.S.NRC has noted that the ACSTIC2 program has been used primarily in PWR applications and received most of its verification and validation (V&V) in that environment. The NRC has therefore requested additional verification and validation for ACSTIC2 in a BWR environment. This memo proposes an effort to provide such V&V.

1. STP-3 modeling and analysis: The analysis described in WCAP-17287-P considers only the regions where water is the dominant medium, that is, the fluid below the normal water level. In some parts of this region, some vapor will exist. However, it was decided to proceed with the analysis using properties (density and sound speed) of pure water rather than perform a two phase flow-induced vibration analysis with two phase properties that would be difficult to predict. Because of its higher density and sound speed, assuming water to be the working fluid will yield higher acoustic loads than a less stiff, less dense fluid like steam or a steam-water mixture. Since higher loads mean greater conservatism, this approach was adopted.

2. Boundary conditions: The STP-3 ACSTIC2 model uses a boundary condition at the steam-water interface that requires the pressure fluctuation to be zero. This is a commonly used boundary condition in acoustics and is valid as long as the acoustical fluid interfaces with a large volume of similar fluid. It is also valid for smaller volumes if the fluid in the volume is less stiff and/or less dense than the fluid in the analysis region. To demonstrate the validity of this boundary condition, Westinghouse will provide the results of a simple analytical solution that demonstrates its validity.

3. The STP-3 ACSTIC2 model employs pump forcing function models that essentially act as a body force in a pump flow path momentum equation. In the past, these forcing functions have been determined by test. In the case of STP-3, no independent tests are available to determine these forcing functions. Instead, the plant test data taken from the Reference Japanese ABWR (RJ-ABWR) were used to infer these forcing functions for the first and second rotational speeds and the first vane passing frequency. The second vane-passing frequency was not considered because the RJ-ABWR data showed its amplitude to be insignificant. The approach used unit forcing functions magnitudes in the analysis and compared analysis and test results at the transducer location to determine actual forcing function magnitudes. For this purpose, RJ-ABWR plant test pressure transducer P7 data were used because it is located in the water region and typically has some of the largest

measured pressure amplitudes. This is in keeping with the desire to perform a conservative analysis.

4. Comparisons with RJ-ABWR test data: The relevant RJ-ABWR test data are the pressure amplitude and frequency data from pressure transducers P1 to P7. It has already been mentioned that the amplitude data from P7 was used to determine the pump forcing function magnitudes. Obviously, a comparison of analysis amplitude results with test data would agree at this location. Comparison at the other P1 to P6 locations is problematic, however. First, only two of the pressure transducers are located in the water region. The others are in the steam space above the water level and are consequently not in the analysis model. Secondly, the nature of the ten pumps in the RJ-ABWR plant is that they will operate at slightly different rotational speeds. This means that their pulsations will sometimes reinforce each other and sometimes will interfere with each other. This random phasing behavior will influence what the transducers measure at any point in time as pressure amplitudes. Since there is no way of determining relative pump phases at any moment, there is no way to adjust the analysis to properly represent these phases, making comparisons of calculations and transducer amplitude data difficult.

   The ACSTIC2 results are used in the structural analysis of the reactor internals components. The structural response of these components is dependent primarily on the frequency and amplitude of the ACSTIC2 results. Thus, it is necessary that the fluid behavior of the system as modeled by the ACSTIC2 code appropriately predict the pressure response of the ABWR plant. Since STP-3 is essentially identical to the RJ-ABWR plant, the test data obtained from RJ-ABWR is used to assure that the ACSTIC2 predictions are representative of an ABWR plant. Thus, the two important characteristics of the analysis model are that 1) the predicted pressure amplitudes are representative of the pressure amplitudes measured at RJ-ABWR, and 2) the acoustic modal response is the same as the measured frequency response in the RJ-ABWR plant. As noted in item 3, the magnitude of the pump pulsation pressure is developed using RJ-ABWR data from transducer P7 as input to establish a conservative value. The frequency behavior of the ACSTIC2 results is a consequence of the ACSTIC2 model, and thus it is important that these results exhibit the same modal response as that measured at RJ-ABWR. Therefore, Westinghouse will perform a comparison of the ACSTIC2 acoustic modal response calculations with the pressure frequencies measured at RJ-ABWR. Much of the RJ-ABWR data indicates pressure peaks at frequencies around 20 and 40 Hz. The objective will be to demonstrate that the ACSTIC2 model compares well with the frequency response measured at RJ-ABWR.

Summary of Proposed Actions

- A zero pressure boundary condition is assumed at the steam-water interface. WEC will provide a simple analytical solution (calculation) to demonstrate the validity of the zero pressure boundary condition for a BWR system.

- Westinghouse will perform a comparison of the ACSTIC2 acoustic modal frequency calculations with the pressure frequencies measured at RJ-ABWR. This comparison will demonstrate that the ACSTIC2 model compares well with the measured data.