Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

October 18, 2010
U7-C-STP-NRC-100229

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
<u>Response to Request for Additional Information</u>

Attached are the responses and revised responses to NRC staff questions included in Request for Additional Information (RAI) letter number 363 related to Combined License Application (COLA) Part 2, Tier 2, Section 3.9.2. The attachments address the responses to the RAI questions listed below:

03.09.02-20	03.09.02-35
03.09.02-27	03.09.02-36
03.09.02-29	03.09.02-37
03.09.02-30	03.09.02-38
03.09.02-31	03.09.02-39
03.09.02-32	03.09.02-40
03.09.02-33	03.09.02-41
03.09.02-34	03.09.02-43

There are no commitments in this response.

Where there are COLA markups, they will be made at the first routine COLA update following NRC acceptance of the RAI response.

If you have any questions regarding these responses, please contact Scott Head at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

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NRO

STI 32765392

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 10/18/2010

Mark McBurnett
Vice President, Oversight & Regulatory Affairs
South Texas Project Units 3 & 4

jep

Attachments:

1. RAI 03.09.02-20
2. RAI 03.09.02-27
3. RAI 03.09.02-29
4. RAI 03.09.02-30
5. RAI 03.09.02-31
6. RAI 03.09.02-32
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13. RAI 03.09.02-39
14. RAI 03.09.02-40
15. RAI 03.09.02-41
16. RAI 03.09.02-43

cc: w/o attachment except*
(paper copy)

Director, Office of New Reactors
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011-8064

Kathy C. Perkins, RN, MBA
Assistant Commissioner
Division for Regulatory Services
Texas Department of State Health Services
P. O. Box 149347
Austin, Texas 78714-9347

Alice Hamilton Rogers, P.E.
Inspection Unit Manager
Texas Department of State Health Services
P. O. Box 149347
Austin, Texas 78714-9347

*Steven P. Frantz, Esquire
A. H. Gutterman, Esquire
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington D.C. 20004

*Tom Tai
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852

(electronic copy)

*George F. Wunder
*Tom Tai
Loren R. Plisco
U. S. Nuclear Regulatory Commission

Steve Winn
Joseph Kiwak
Eli Smith
Nuclear Innovation North America

Peter G. Nemeth
Crain, Caton & James, P.C.

Richard Peña
Kevin Pollo
L. D. Blaylock
CPS Energy

RAI 03.09.02-20

QUESTION:

The approach flow velocities used to estimate the forcing functions in Calculation Note CN-SEE-II-10-15, Revision 0, "STP 3 Flow Induced Vibration Analysis" are mean values based on the total flow rate and the flow area at the relevant component. Since CFD analysis is being performed, especially for the lower plenum, the applicant is requested to confirm that the CFD velocity values will be used, in calculating the loading functions, if they are larger than the estimated mean velocity values.

RESPONSE:

Because the available CFD analyses provide accurate and precise values of flow field information the CFD velocities will be incorporated into recalculation of the forcing function calculations.

This change, to use the CFD velocities in the recalculation of the forcing functions, will be reflected in a revision of Calculation Note CN-SEE-II-10-15, "STP 3 Flow Induced Vibration Analysis," which will be available for review by November 30, 2010.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-27

QUESTION:

In Toshiba Document Number 7B11-D001-3809-02, Revision 0, "Forcing Function Analysis Report for Lower Plenum," the forcing functions on the lower plenum components were determined for different elevations. The applicant is requested to elaborate on the methodology which will be used to correlate the forcing functions at different elevations.

RESPONSE:

For the control rod guide tube (CRGT)/control rod drive housing (CRDH), sub-regions are defined from the bottom elevation at 10 mm intervals, which is shorter than the distance between nodes in a finite element model (FEM) for stress analysis. For this case, the horizontal region is defined as a rectangle and the size of that region is based on the pitch distance of the CRGT/CRDHs. The representative flow velocity in a sub region is defined as the maximum cross flow velocity at that elevation. For the in-core monitor guide tube (ICGT)/in-core monitor housing (ICMH), the representative velocity is also defined as the maximum cross flow velocity, but the horizontal region is defined as an almost circular region of a size based on the diameter of the stub tube, because the computational fluid dynamics (CFD) model does not include the ICGT/ICMH. Using these representative flow velocities, fluid force power spectral densities (PSDs) are determined at each elevation. In the stress analysis, these forcing functions will be conservatively assumed to have no temporal phase differences (they are coincident) and act in the same direction.

There are no COLA or analysis report changes required as a result of this response.

RAI 03.09.02-29

QUESTION:

In Toshiba Document Number 7B11-D001-3809-02, Revision 0, "Forcing Function Analysis Report for Lower Plenum," the forcing functions on the lower plenum components were determined for different elevations. The applicant is requested to elaborate on how the worst case, which results in the highest dynamic stresses, will be determined. In other words, does the applicant plan to analyze all CRGTs to determine the one with the highest dynamic stresses, or a different approach will be pursued? This RAI applies equally to the analysis of all components of the CRDH, ICGT, ICMH.

RESPONSE:

STPNOC will analyze all components to determine the one with the highest dynamic stress. For example, all control rod guide tubes (CRGT) will be analyzed to determine the CRGT with the highest dynamic stress. This approach will also be taken for the control rod drive housings (CRDH), in-core monitor guide tubes (ICGT) and in-core monitor housings (ICMH). This information will be described in the stress analysis report.

There is no COLA change required as a result of this response.

RAI 03.09.02-30

QUESTION:

The acceptance criteria to avoid excessive flow-induced vibration of cylindrical structures in cross-flows are presented in Section 4.3 of document XGEN-2010-03, Revision 0, "FIV Evaluation of Option 1 Components for STP Unit 3." The second criterion to limit the stress amplitudes from vortex shedding loads is the ratio of f_l to f_s. The applicant is requested to elaborate on the physical meaning of this criterion, especially in view of its contradiction with the analysis given in the rest of the report.

RESPONSE:

The second criterion in Section 4.3 of XGEN-2010-03 contains a typo. "($f_l/f_s < 3$)" in the criterion sentence should be changed to "($f_l/f_s > 3$)". A frequency ratio (f_l/f_s) greater than 3 limits dynamic amplification to 20%. This change ensures consistency with the analysis given in the rest of the report, and removes the contradiction as noted in this RAI.

The document XGEN-2010-03 will be revised to incorporate this correction and will be available for review by November 30, 2010.

There are no COLA changes as a result of this response.

RAI 03.09.02-31

QUESTION:

In Section 6.4 of document XGEN-2010-03, Revision 0, "FIV Evaluation of Option 1 Components for STP Unit 3," it is concluded that the orificed fuel support can be excluded from the FIV test plan. This conclusion is based on extensive operating experience with this design. The applicant is requested to confirm that:

a) there are no design differences between the orificed fuel support planned for STP Unit 3 and those in currently operating plants

b) the flow conditions of the orificed fuel supports in currently operating plants envelope those of STP Unit 3.

RESPONSE:

The STP 3 fuel support castings will be similar to those used in the Reference Japanese ABWR except that the STP 3 plant will use the Debris Filter Integrated Fuel Supports (DFFS). The DFFS has essentially the same structural properties as those used at the Reference Japanese ABWR. The hydraulic characteristics (e.g. core plate differential pressure as a function of pump speed) of the DFFS for STP 3 are identical to those in the Reference Japanese ABWR. In light of the similarity in both the structural and hydraulic features between the Reference Japanese ABWR and STP 3 fuel supports, the FIV performance at STP 3 is expected to be similar to that at the Reference Japanese ABWR. Inspections of the DFFS performed after high flow tests and after one and three cycles of operation at an operating Japanese ABWR, which employed DFFS, showed no evidence of fatigue cracking. The test flow conditions bound those which would exist at STP 3. There were no abnormalities in the core plate differential pressure. Based on this operating experience using a similar design, no FIV issues are expected in the fuel support castings at STP 3.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-32

QUESTION:

Per Regulatory Guide 1.20, Subsection C.2.1(1), the applicant is expected to describe and justify all bias errors and random uncertainties for reactor internals, including components which may be affected by the flow-excited acoustic resonances and flow-induced vibrations. Please address uncertainties in all calculations (performed by Westinghouse, XGEN and Toshiba) or in the comprehensive vibration assessment program, including plan and approach to validate analytical results.

RESPONSE:

The effects of individual biases and uncertainties will be evaluated for each of the calculations involved in the prediction of the structural responses and stresses. The following areas will be covered:

1. The principal operating parameters that define the three Analysis Cases,
2. The forcing function correlations and selection of local velocities for evaluating the forcing functions,
3. Grid size and boundary conditions for the computational fluid dynamics (CFD) modeling of the lower plenum flow distributions,
4. Structural analysis assumptions including boundary conditions, and
5. Damping, pump phasing and wavelength uncertainties in the pump pulsation analysis.

The above effects will be addressed in the individual calculations, either quantitatively where possible, or qualitatively if necessary.

In addition, a plan will be developed and included in the comprehensive vibration assessment program (CVAP) report that covers:

1. Measurement biases and uncertainties associated with the CVAP instrumentation and data acquisition system,
2. Scaling from calculation points to measurement points on the structures,
3. The end-to-end combination of individual biases and uncertainties on responses and the method for combining the biases and uncertainties.

An additional section dealing with uncertainties will be incorporated in the stress analysis reports.

There are no COLA changes required as a result of this response.

RAI 03.09.02-33

QUESTION:

In Section 3.2 of SES 10-161, Rev. 0, "RG 1.20 Assessment for Natural Frequencies & Mode Shapes for CP DP lines & RIP DP lines," the report states that the translation degrees of freedom (DOFs) perpendicular to the pipes are assumed to be fixed. However there is a gap between the pipe and support for the CP DP line and for the RIP DP line. Please provide more details to justify the assumption in fixing the translational DOFs perpendicular to the pipe. If the CP DP lines and RIP DP lines are installed in a preloaded condition for preventing FIV motions as described by the applicant during the audit of August 23 - 25, 2010, please provide details of the preload conditions and installation procedure.

RESPONSE:

Documentation for support offsets will be provided. The support offsets create contact between the pipes and (intermediate) supports. The support offsets eliminate the possibility for pipe translations perpendicular to the pipe relative to their supports.

The calculation will be revised and will be available for review by November 30, 2010.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-34

QUESTION:

The assumption in Section 3.2 of "RG 1.20 Assessment of Natural Frequencies & Mode Shapes for FW and LPCF spargers" (SES 10-162, Rev. 0) states that the boundary conditions of the pin and the stop are modeled such that there is no vertical and radial movement. Please provide more details to justify these boundary conditions.

RESPONSE:

The design is performed in such a manner that the spargers can move tangentially, which accommodates movements relative to the reactor pressure vessel. This is achieved by using a pin in two rectangular holes at each end of the spargers. Because the end brackets (containing the rectangular holes) can rotate around the pins, the rotation around vertical axes at the ends is free. The spargers are pre-tensioned, giving radial forces between the pin and the holes. This eliminates vertical and radial movements. Consequently, the modeling of boundary conditions is realistic.

The calculation note will be revised and will justify the boundary conditions. The revised calculation note will be available for review by November 30, 2010.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-35

QUESTION:

In section 3.2 of calculation SES 10-164, Rev. 0, "Assessment of Natural Frequencies & Mode Shapes for Guide Rods," the boundary conditions described in the second assumption do not consider a gap between the bracket hole and the guide rod although there is a gap at the top and at the bottom. Please justify this boundary condition.

RESPONSE:

The upper bracket (Lower Guide Rod Bracket) does have a gap, however, this connection is fixed by the attachment of the lower stud, which rigidly connects the bracket to the guide rod, and restricts all degrees of freedom. The lower bracket (Top Guide Bracket) also has a gap, however, this bracket does not serve as a support when the deformations are small. Therefore, the simulations with forcing functions will be performed without considering support from the Top Guide bracket.

The calculation will be revised to include a modal analysis without any support at the lower bracket in the modal analysis report. The report will be available for review by November 30, 2010.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-36

QUESTION:

Section 3.2 of SES 10-165, Rev. 0, "Assessment of Natural Frequencies & Mode Shapes of Shroud Head and Steam Separators" states that some nodes of the shroud head are fixed horizontally to prevent rigid body motion. Please explain the basis and selection of these nodes.

RESPONSE:

Every node at the lower edge is fixed in vertical direction. To prevent rigid body motion, four nodes of those at the lower edge, placed in 0°, 90°, 180°, and 270° in the cylindrical coordinate system, are also fixed in circumferential direction. The purpose of the modeling of the shroud head was to obtain appropriate boundary conditions for performing a modal analysis of the steam separator. If all nodes at the lower edge are fixed horizontally, then the lowest natural frequency only increases about 0.1 Hz.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-37

QUESTION:

Appendix 1 of SES 10-165, Rev. 0, "Assessment of Natural Frequencies & Mode Shapes of Shroud Head and Steam Separators" states that the fluid contains less water at the top of the separator than in the bottom. In the analysis the fluid density is conservatively assumed the same along the whole separator. Please explain and justify the conservatism of this assumption.

RESPONSE:

The report includes a modal analysis performed to conservatively estimate natural frequencies and mode shapes. Fluid density is lower at the top of the separator than at the bottom. The analysis conservatively assumes the fluid density to be the same along the whole separator, which results in higher hydrodynamic mass and lower natural frequencies. The detailed stress analysis will account for density variation.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-38

QUESTION:

The shroud head structure in Calculation SES-10-165, Revision 0, is a complex model, and there is no K-6 data to compare and validate. Please advise if there is any measurement plan and what parameters are being considered.

RESPONSE:

The need to instrument the shroud and steam separator will be determined in-part on the results of the final (as-built) stress verifications.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-39

QUESTION:

The introduction section of XGEN-2010-03, Revision 0 states that these are reactor internal structures other than the steam dryer that can either be excluded from the FIV plan based on experience and scoping evaluation or detailed stress analyses, or they can be included in the test plan. The results concluded that none of these components need to be included in the FIV stress analysis and test program. Please advise if there is any plan to validate this conclusion.

RESPONSE:

Operating experience for ABWR plants was used to classify the STP 3 reactor internals into different categories for the purpose of analysis. For components (Category 1) with the lowest flow induced vibration (FIV) susceptibility (e.g. core plate, top guide etc.) based on operating plant experience, the analysis compared the natural frequency of the structure to the vortex shedding and vane passing frequencies to confirm the FIV margin. For components judged to have higher FIV susceptibility (Categories 2 and 3), forcing functions were developed and detailed stress analysis was performed.

XGEN-2010-03 addressed Category 1 components and concluded that there was significant margin between the structural natural frequency and the vortex shedding and vane passing frequencies. The analysis concluded that FIV potential is insignificant for these components. This is confirmed by the operating experience for the Reference Japanese ABWR and an operating Japanese ABWR which have similar Category 1 component design and flow conditions as for STP 3 plant. Further validation is not planned or necessary for these components.

There are no COLA or report changes required as a result of this response.

RAI 03.09.02-40

QUESTION:

Section 5.3 of 7B11-D001-3809-03, Revision 0, "Modal Analysis of CR Guide Tube and CRD Housing" states that the two lateral translational DOFs are fixed at the top of the guide tube at core plate level. However, the report does not specify the gap size at the top end. Please provide the gap size and justification for fixing the two translational DOFs.

RESPONSE:

The gap is 0.1 mm between the outside diameter of the control rod guide tube and the hole of the core plate support. Therefore, the calculation assumed there is no transitional motion because of this small gap.

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-41

QUESTION:

In Table 5.1 of Calculation 7B11-D001-3809-05, Revision 0, "Modal Analysis of HPCF Sparger and Coupling", the water weights at 160 degree Celsius and at 289 degree Celsius are significantly different. Please explain the difference.

RESPONSE:

For the 160°C temperature condition, zero percent power is assumed, and the environmental liquid condition is water only. For the 289°C temperature condition, 100 percent power is assumed, and the environmental liquid condition is a mixed fluid of water and steam inside the top guide.

Temperature (°C)		Inside of Top Guide	Outside of Top Guide
160	Inside of Pipe	Water	Water
	Outside of Pipe	Water	Water
289	Inside of Pipe	Water	Water
	Outside of Pipe	Water and Steam	Water

No COLA revision is required as a result of this RAI response.

RAI 03.09.02-43

QUESTION:

Please explain in more detail the reason for ignoring the mode shapes of the 7th and 8th modes of the control rod guide tube and control rod drive housing in Calculation 7B11-D001-3809-03, Revision 0.

RESPONSE:

The 7^{th} mode is axial expansion and contraction movement, and the 8^{th} mode is torsional. Additional clarification will be included in the final calculation which will be available for review by November 30, 2010.

No COLA revision is required as a result of this RAI response.