January 25, 2011

Mr. Mark McBurnett, Vice President
Regulatory Affairs
STP Nuclear Operating Company
P.O. Box 289
Wadsworth, TX 77483

SUBJECT: REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION REVISION 4 – FLOW-INDUCED VIBRATION PROGRAM

Dear Mr. McBurnett:

By letter dated September 20, 2007, STP Nuclear Operating Company (STPNOC) submitted to the U.S. Nuclear Regulatory Commission (NRC) a Combined License (COL) application to construct and operate two reactor units (Units 3 and 4) based on the U.S. Advanced Boiling Water Reactor (ABWR) Design Certification at the South Texas Project Nuclear Power Plant (STPNPP). The NRC Office of New Reactors (NRO) is reviewing the South Texas Project (STP) COL application that incorporates by reference the ABWR Design Control Document (DCD). As part of this review, the NRO Engineering Mechanics Branch 2 (EMB2) conducted an audit of the documentation supporting the STP COL application to develop the reactor internals comprehensive vibration assessment program in Chapter 3.9.2. The audit was conducted at the Westinghouse office in Windsor, Connecticut, from December 1 – 3, 2010. The NRC staff followed the guidance in NRO Office Instruction NRO-REG-108, "Regulatory Audits," in performing this audit. Enclosure 1 is the detailed results of the audit. Enclosure 2 is a list of the NRC and STPNOC team participating in the audit. Enclosure 3 is a draft of the RAIs prepared resulting from the audit.

Please contact Tom Tai at (301) 415-8484 or Tom.Tai@nrc.gov if you have any questions related to the audit.

Sincerely,

/RA/

Mark Tonacci, Chief
BWR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket Nos.: 52-012
52-013

cc: See next page

January 25, 2011

Mr. Mark McBurnett, Vice President
Regulatory Affairs
STP Nuclear Operating Company
P.O. Box 289
Wadsworth, TX 77483

SUBJECT: REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION REVISION 4 – FLOW-INDUCED VIBRATION PROGRAM

Dear Mr. McBurnett:

By letter dated September 20, 2007, STP Nuclear Operating Company (STPNOC) submitted to the U.S. Nuclear Regulatory Commission (NRC) a Combined License (COL) application to construct and operate two reactor units (Units 3 and 4) based on the U.S. Advanced Boiling Water Reactor (ABWR) Design Certification at the South Texas Project Nuclear Power Plant (STPNPP). The NRC Office of New Reactors (NRO) is reviewing the South Texas Project (STP) COL application that incorporates by reference the ABWR Design Control Document (DCD). As part of this review, the NRO Engineering Mechanics Branch 2 (EMB2) conducted an audit of the documentation supporting the STP COL application to develop the reactor internals comprehensive vibration assessment program in Chapter 3.9.2. The audit was conducted at the Westinghouse office in Windsor, Connecticut, from December 1 - 3, 2010. The NRC staff followed the guidance in NRO Office Instruction NRO-REG-108, "Regulatory Audits," in performing this audit. Enclosure 1 is the detailed results of the audit. Enclosure 2 is a list of the NRC and STPNOC team participating in the audit. Enclosure 3 is a draft of the RAIs prepared resulting from the audit.

Please contact Tom Tai at (301) 415-8484 or Tom.Tai@nrc.gov if you have any questions related to the audit.

Sincerely,
/RA/
Mark Tonacci, Chief
BWR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket Nos.: 52-012
52-013

cc: See next page

DISTRIBUTION:

PUBLIC	YWong, NRO	TTai, NRO
RidsNroDnrlNge2	RidsNroDeEmb2	BAbeywickrama, NRO
JDHerrity, NRO	SKirkwood, OGC	Gwunder, NRO
AHsia, NRO	RidsOgcMailCenter	RidsNroDnrl
	MTonacci, NRO	RidsRgnMailCenter

ADAMS ACCESSION NO. : ML110120674 **NRO-002**

OFFICE	PM:NRO/DNRL/BWR	LA:NRO/DNRL/BWR	NRO/DE/EMB2	BC:NRO/DE/EMB2	BC:NRO/DNRL/BWR
NAME	TTai	BAbeywickrama	YWong	JDixon-Herrity	MTonacci
DATE	1/13/11	1/13/11	1/13/11	1/14/11	1/25/11

OFFICIAL RECORD COPY

DETAILED AUDIT RESULTS FOR FLOW-INDUCED VIBRATION ANALYSES

December 1-3, 2010

1. Introduction

On September 20, 2007, STP Nuclear Operating Company (STPNOC) submitted to the U.S. Nuclear Regulatory Commission (NRC), a Combined License Application (COLA) Final Safety Analysis Report (FSAR) to construct and operate two additional units (Units 3 and 4) based on the U.S. Advanced Boiling Water Reactor (ABWR) Certified Design Control Documents (DCD) at the South Texas Project Nuclear Power Plant (STPNPP) site located in the County of Matagorda near Bay City, Texas.

The NRC staff is reviewing the South Texas Project (STP) Units 3 and 4 combined license (COL) application that incorporates by reference the design certification for the ABWR. However, in the area of dynamic testing and analyses under Chapter 3.9.2, STPNOC has advised the NRC that to address the issues associated with flow-induced vibration, STP Unit 3 will be the prototype plant and Unit 4 will be a non-prototype Category 1 plant. This is a change in the licensing position as described in the STP Units 3 and 4 Final Safety Analysis Report (FSAR). The Engineering Mechanics Branch 2 (EMB2) conducted audits of the analyses and testing supporting the reactor internals comprehensive vibration assessment program (CVAP) referenced in Chapter 3.9.2 of the STP FSAR. The first audit was conducted during August 23 to 25, 2010, and the audit report is Reference 1. The second audit was conducted at the Continuum Dynamics office in Ewing, New Jersey on October 18 and 19, 2010 and the audit report is Reference 2. The NRC staff conducted another audit from December 1 to 3, 2010, at Westinghouse in Windsor, Connecticut, as a follow-up to the October, 2010 audit in support of this review. The NRC staff followed the guidance in the Office of New Reactors' (NRO) Office Instruction NRO-REG-108, "Regulatory Audits," in performing this audit. Enclosure 2 is a list of the NRC staff and the STPNOC engineering team participating in the audit. Enclosure 3 is a draft of the RAIs prepared resulting from the audit.

2. Objectives and Approach

From December 1 to 3, 2010, the NRC staff conducted an audit of some of the documentation prepared by STPNOC's engineering team to support the STP CVAP.

In early 2010, STPNOC decided that STP Unit 3 reactor internals will be the ABWR prototype, and Unit 4 will be non-prototype, Category 1 in accordance with the guidance in Regulatory Guide 1.20. The proposed FSAR changes to reflect this new licensing position was provided in a letter to the NRC on May 19, 2010 (U7-C-STP-NRC-100114). This is a significant change in licensing position from Revision 3 of the FSAR which stated STP Units 3 and 4 reactor internals would both be non-prototype, Category I. The review and acceptance of the reactor internals CVAP report is part of the scope of Chapter 3.9.2 of the STP Units 3 and 4 COL FSAR.

The main objective of this audit was to provide the NRC staff an opportunity to review the approach, methodologies, and assumptions in the calculations that form the basis of the STP Units 3 and 4 CVAP. The proposed schedule to issue the CVAP for NRC's review and approval is January 31, 2010. It is the intent of STPNOC that the CVAP will be based on these calculations and the predictive analysis of the CVAP concerning these calculations will not involve additional detailed review, instead, the review will be confirmatory based on the findings and observations in the audits.

The purpose of this audit is to continue the audit of the results of the subscale model testing and the results of the acoustic analyses performed to support the CVAP. The audit team will also look at the non-dryer stress calculations, the dryer stress analysis models, the measurement, testing, and inspection plan and the dryer load definition using scale model test. These are proprietary calculations developed for the reactor internal components. Any significant findings during the audit will be documented in the audit report and Requests for Additional Information (RAI) may be issued for action.

3. Technical Review

During this audit, the NRC staff reviewed some of the documentation prepared by STPNOC's engineering team to support the STP CVAP. The documents were divided into the following four (4) categories:

A. Non-dryer vessel internal and lower plenum components stress calculations;
B. Dryer load definition using method discussed in the last meeting;
C. Dryer stress analysis models;
D. Measurement, test, and inspection plan.

The analyses completed under three of the four categories listed above were made available in the audit. The information provided under category D was in the form of a presentation followed by discussions. The following is a list of documents reviewed during the audit:

Document Nos.	Rev.	Document Title	Preparers
Non-dryer vessel internal and lower plenum components stress calculations			
SES-10-237	0	South Texas Plant 3/4 RG 1.20 Assessment Verification of CP and RIP DP Lines	Westinghouse
SES-10-238	0	South Texas Plant 3/4 RG 1.20 Assessment Verification of FW and LPCF Spargers	Westinghouse
SES-10-239	0	South Texas Plant 3/4 RG 1.20 Assessment Verification of Reactor Internal Pump Guide Rails	Westinghouse
SES-10-240	0	South Texas Plant 3/4 RG 1.20 Assessment Verification of Shroud Head Bolts and Lifting Rods	Westinghouse
SES-10-241	0	South Texas Plant 3/4 RG 1.20 Assessment Verification of Shroud Head and Steam Separators	Westinghouse
CN-SEE-II-10-22	0	Lower Guide Rods Stress Analysis	Westinghouse
LTR-RIDA-10-294	-	Recommended Damping Ratio, Peak-to-RMS Ratio, & Stress Concentration Factor Application for ABWR Reactor Internals Flow-Induced Vibration Analysis	Westinghouse
7B11-D001-3809-08	0	Structural Analysis Report – CR Guide Tube and CRD Housing	Toshiba
7B11-D001-3809-09	0	Structural Analysis Report – ICM Guide Tube and ICM Housing	Toshiba

Document Nos.	Rev.	Document Title	Preparers
Non-dryer vessel internal and lower plenum components stress calculations			
7B11-D001-3809-10	0	Structural Analysis Report – HPCF Sparger and Coupling	Toshiba
7B11-D001-3809-11	0	Structural Analysis Report – Shroud	Toshiba
Dryer stress analysis models			
CN-A&SA-10-37	0	South Texas Project Steam Dryer Finite Element Model	Westinghouse
CN-A&SA-10-45	0	South Texas Project Steam Dryer Harmonic Analysis	Westinghouse
CN-A&SA-10-48	0	STP Steam Dryer Modal Analysis Comparison to K6 Hammer Test Results	Westinghouse
Dryer load definition using the method discussed in the last meeting			
FAI/10-547	A	South Texas (STP) Unit 3 Supplemental Test Report for 4 Loop Acoustic Model-Data Evaluation	Fauske
C. D.I. Technical Note No. 10-21P	-	Loads Predicted on the Full Scale STP Dryer at 100% Power, Based on Pressure Transducer Measurements on a Subscale Model	CDI
Operating experience			
VCD-2010-000707	0	Inspection Experience of Steam Dryer for ABWR	Toshiba
K6-07-RM-R925X-01	-	K-6 Reactor Internals Inspection	TEPCO

Summary of non-dryer and lower plenum components stress analyses
*[*SES-10-237 to -241 and CN-SEE-II-10-22 all Rev. 0 for *vessel internal components, and 7B11-D001-3809-08 to -11 all Rev. 0 for lower plenum components]*:

There were a total of ten (10) stress analyses, six of which were for the non-dryer vessel internal components and prepared by Westinghouse, and the remaining four for the lower plenum components were prepared by Toshiba. The reference Letter LTR-RIDA-10-294 was included during the audit. Also, the stress analyses presented in Documents SES-10-240 and -241 for shroud head bolts and lifting rods and shroud head and steam separators, respectively, considered only load case #4 of pump pulsation, these reports will be updated later to include load cases #1 and #4'. In general, the staff found the stress analyses of good quality and the STPNOC team very supportive to staff's requests and responsive to feedback provided throughout the audit. A summary of the methodology of stress analyses of the non-dryer components is as follows:

For the turbulent buffeting load stress analysis, one-sigma root mean square (RMS) stress is calculated for each load case and then combined by square root of the sum of the squares

(SRSS) method to get the maximum stress. The RMS stress is then multiplied by a peak-to-RMS ratio to obtain the peak stress. The staff raised concerns regarding the basis for this peak-to-RMS ratio. The applicant stated that as described in Letter LTR-RIDA-10-294 for random vibrations, a peak-to-RMS ratio is used with the endurance limit obtained from ASME Section III, Appendix I, Fig. I-9.2.2 Curve C for austenitic stainless steels. However, since the ABWR DCD Section 3.9.2.1.1.3 specifies a different endurance limit, the peak-to-RMS ratio is calculated based on a ratio of these two endurance limits. This represents the 3-sigma value assuming a Gaussian distribution. Therefore, the maximum stress is multiplied by the new peak-to-RMS ratio to obtain peak stress, and also by a welding factor (based on the type of weld) for predicting the stress in the welds.

In the pump pulsation load stress analysis, harmonic analysis is carried out for each load case and then combined by SRSS method to get the maximum stress. The maximum stress is then multiplied by a welding factor (based on the type of weld) for predicting the stress in the welds.

The vortex shedding load is neglected in the stress calculation because the vortex frequencies are much smaller than the lowest frequencies of the components and lock-in cannot occur.

Stresses from turbulent buffeting and pump pulsation loads are combined using SRSS on the maximum stresses. The final maximum stress including the welding factor is then compared with the fatigue stress limit of 68.6 MPa (10 ksi) to obtain the stress ratio between calculated stress and allowed stress. In some cases (e.g., core plate and reactor internal pump differential pressure lines, and feedwater and low pressure core flooder spargers) the stress ratios for turbulent buffeting and pump pulsation loads were combined linearly, which yields a conservative value because the SRSS method results in a stress ratio lower than the linear summation. The results indicate that the calculated maximum stress ratio was relatively high (i.e., 0.95) for the lower guide rods and RIP DP lines, about 0.8-0.85 for control rod (CR) guide rods and control rod drive (CRD) housing and incore monitoring (ICM) guide tubes and housing, 0.72 for core plate differential pressure (DP) lines, 0.63 for shroud head and steam separators, 0.4-0.5 for shroud and shroud head bolts, and less than 0.2 for the rest of the components.

The applicant stated that the uncertainties of the modeling and stress calculations are small based on mesh convergence study, and conservatism used in enveloping the loading functions and in the stress combination.

Summary of dryer stress analyses models *[CN-A&SA-10-37, -45, and -48]*:

The calculated natural frequencies of the key dryer components agree well (within 10 percent) with actual ABWR plant hammer test, except the lowest mode of the outer hood which differs by 21 percent compared to the in-situ test results (64.7 Hz of modal analysis vs. 82 Hz of test results). During the audit, the staff and the applicant reexamined the actual ABWR plant hammer test results and found a frequency close to the analytical result of 64.7 Hz. The staff therefore raised concerns regarding the interpretation of the frequency spectra obtained from the hammer tests and requested the applicant to review the spectra of all other components of the dryer to ensure that no other resonance frequencies are overlooked.

Summary of dryer load definition using the method discussed in the last meeting *[FAI/10-547, C. D.I. Technical Note No. 10-21P, for load definition methodology, and VCD-2010-000707 and K6-07-RM-R925X-01 for inspection reports]:*

The scale model testing indicated that acoustic resonance in the SRV standpipes is expected to occur at certain power level, and that changing the design of standpipe of the Okano valves will not delay the onset of resonance sufficiently. The applicant is evaluating other design options such as enlarging the inlet diameter of the standpipes or using acoustic side branches to avoid acoustic resonances.

During the audit, the applicant presented sample pressure spectra measured on the subscale steam dryer, and suggested that these can be scaled up to the reactor size and operating conditions and used to estimate the design dynamic loading on the dryer. The staff noted that in CDI Technical Note # 10-21P, some of the pressure spectral peaks measured on the actual ABWR plant dryer were filtered out in the comparison of the ABWR measurements with the STP scale model test results. The amplitudes of two peaks near 20 and 40 Hz exceeded the SMT dryer. CDI explained that these peaks are likely generated by dryer vibration, and not pressure oscillations, and therefore they were filtered out from the pressure spectra. The staff requested the applicant to include these peaks in the best estimate design load of the dryer.

In its review the staff also noted that most of the pressure spectra measured on the scale model did not exemplify the spectral characteristics of the pressure fluctuations measured on the actual ABWR plant dryer, therefore, the scale model results are not acceptable to estimate the STP dryer design load at full power level. In response, STPNOC proposed an alternative approach to demonstrate that the steam dryer can be operated safely at the planned maximum power level. The approach includes the following:

1. Compile comprehensive operating experience on the ABWR dryers which are identical to the STP dryer.

2. Develop “best estimate” design load for the STP dryer based on actual ABWR plant results and scale model results from 15 pressure transducers, to design the STP dryer.

3. Provide the methodology that would be used to estimate the dryer dynamic load from pressure measurements on the dryer during the STP Unit 3 start-up test program.

4. During the STP Unit 3 start-up measurement program, validate the dryer dynamic loads at an approved power level (about 60 percent of current licensed thermal power (CLTP)) and, if needed, update the dryer load, stress margins and limit curves before further power increase.

Summary of measurement, test, and inspection plan:

The applicant presented the measurement, test and inspection plan in the scope of the CVAP for STP Unit 3. The criteria on selection of sensor locations, sensor types, and number of sensors of steam dryer and non-dryer components were presented. Six non-dryer components were selected based on results of predictive stress analysis and previous actual plant measurements. A total of 52 sensors including strain gage, accelerometers, displacement sensor, and pressure transducers are placed on the six non-dryer components. In addition, 15 pressure transducers, 4 accelerometers, and 5 strain gages are planned for the dryer measurement. The exact locations will be determined by the upcoming results of dryer stress analysis. The staff asked the applicant in evaluating these locations, if strain gages and accelerometers be located in high stress areas as well as areas with little or no stress gradients; whether additional sensors would be used to ensure that sufficient information will be obtained even when some sensors are damaged (redundancy); and if any sensors would be placed on the main steam lines (MSLs) to monitor possible SRV resonances. Both pre-operation tests and power operation tests will be performed with sufficient long duration of vibration cycles at various power levels. Inspection at the sensor locations and high stress areas such as welds will be conducted before and after the pre-operation tests using VT-1 inspection or remote video cameras, in accordance with the requirements of ASME Section XI, and guidelines of BWRVIP-139, "BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines" and BWRVIP-03, "BWR Vessel and Internals Project, Reactor Pressure Vessel and Internals Examination Guidelines" documents. The inspection scope includes cracking, wear, deformation, debris, looseness, damage, scratches, and evidence of movement or rotation.

Exit Meeting/Actions:

During the exit meeting, the staff provided the following observations:

a. During the presentation, there was no mention of the measurement on MSLs during initial startup test. STPNOC should address if there is any plan for MSL measurements in addition to the dryer measurements.

b. The measurement plan needs to address redundancy.

c. In the CVAP, clarify the use of a different stress limit, and the use of reduced peak-to-RMS ratio.

d. Include component figures in the CVAP report and calculations.

e. Operating experience should include design evolution to eliminate past failures.

Also, future deliverables, audit plan, and schedule were discussed. STPNOC advised that the remaining calculations: dryer load definition, dryer dynamic analysis, and the SMT results to confirm that resonance has been eliminated will be available by the week of January 10, 2011. An audit of these calculations is scheduled for January 25 and 26, 2011 (location to be determined later). STPNOC also advised that these calculations will be revised and approved prior to the submittal of the CVAP by the end of January 2011. In addition, all open items described in the calculations will be closed. Instead of issuing multiple revisions to the same calculation, STPNOC plans to prepare an assessment package for each calculation detailing what and how the NRC comments affect the calculation and the extent the changes are on the calculation.

4. <u>Conclusion</u>

The December 1-3, 2010, audit provided the NRC staff an opportunity to review the approach, methodologies, and assumptions in the calculations that form the basis of the STP Units 3 and 4 CVAP. The audit team reviewed the non-dryer stress calculations, the dryer stress analysis models, the measurement, testing, and inspection plan and the dryer load definition using scale model test results and inspection results for Japanese ABWR Plants. The staff found that in some documents sufficient information was not available for the staff to evaluate the adequacy of the analyses. The staff therefore, issued RAIs for the following subjects:

- Review of the hammer test results and revision of the dryer modal analysis report.
- Calculated stress for control rod guide tube is lower than the measured value.

- SMT results are not acceptable for dryer load definition, propose alternative methodology and include operating experience to support the methodology.
- Filtering of peaks from the actual plant pressure spectra.
- Toshiba sparger calculated stress is less than the measured value.
- Toshiba shroud stress analysis report has an open item.

The full description of the draft RAIs is listed in Enclosure 3.

5. Reference

1. NRC Audit Report, "REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION REVISION 3 – FLOW-INDUCED VIBRATION PROGRAM," October 6, 2010 (Adams Accession Number ML1025605351)

2. NRC Audit Report, "REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION REVISION 3 – FLOW-INDUCEDVIBRATION PROGRAM," November 23, 2010 (Adams Accession Number ML1030704880)

Enclosure 3
List of Requests for Additional Information

RAI 1:

Table 5.4 of FIV Stress Analysis Report of the Control Rod Guide Tube and Control Rod Drive Housing (7B11-D001-3809-08) shows that two predicted strains in load case 4' are less than the actual ABWR plant measurement results (ratio of predicted strain/measurement strain of 0.85 and 0.73). Though a safety factor of 1.38 (1/0.73) is applied in the analysis to compensate the difference, the report neither explains why the analysis underestimated the results nor provides any evidence that this factor is not larger for other locations within the reactor. Please explain the difference and provide evidence that the safety factor is not exceeded for other CR Guide Tube and CRD Housing.

RAI 2:

Tables 5.11 and 5.13 of FIV Stress Analysis Report of the High Pressure Core Flood Sparger and Coupling (7B11-D001-3809-10) shows that several predicted strains under turbulent buffeting and pump pulsation loads are less than the actual ABWR plant measurement results (ratio of predicted strain/measurement strain of 0.28, 0.35, and 0.74). Please provide the explanation why the analysis underestimated the results. Also provide explanation why there is no safety factor applied in the analysis to compensate the difference.

RAI 3:

An open item in Section 2.2 of the FIV Stress Analysis Report of the Shroud (7B11-D001-3809-11) states that the calculation is based on the load definitions in the CN SEE-II-10-15, Rev. 0. During the audit, the applicant stated that the load definitions of the shroud have been updated. Please provide the impact or the results based on the new load on the fatigue usage of the shroud.

RAI 4:

In Calculation Note CN-A&SA-10-48, the STP steam dryer modal analysis is compared with the actual plant hammer test results. In general, the calculated natural frequencies of the key dryer components agree well (within 10 percent) with the K6 hammer test, except the lowest mode of the outer hood which differs by 21 percent compared to the in-situ test results (64.7 Hz of modal analysis vs. 82 Hz of actual ABWR plant results). During the audit, the applicant re-examined the frequency spectra obtained from the hammer tests of the existing dryer and found a frequency close to the analytical result of 64.7 Hz. Therefore, STP is requested to:

(a) review the frequency spectra obtained from the hammer tests of all other components of the dryer to ensure that no other resonance frequencies are overlooked from the hammer tests of the actual ABWR plant dryer.

(b) update the STP modal analysis report CN-A&SA-10-38.

<u>RAI 5</u>:

During the audit, STP presented sample pressure spectra measured on the subscale steam dryer. STP suggested that these pressure measurements can be scaled up to the full scale reactor size and operating conditions and then used to estimate the design dynamic loading on the dryer. After reviewing these sample pressure spectra, the NRC staff concluded that most of the pressure spectra measured on the subscale dryer do not exemplify the spectral characteristics of the pressure fluctuations measured on the actual ABWR plant dryer. Therefore, the staff advised STP that the use of pressure measurements from the subscale tests to estimate the STP dryer design load at full power level cannot be approved by the staff. STP was further advised to propose an alternative approach to demonstrate that the steam dryer can be operated safely at the planned maximum power level. In response, STP suggested the following alternative approach:

1. Comprehensive industrial experiences on ABWR dryers will be collected and submitted to NRC for review. The industrial experiences will be compiled for the ABWR reactors in Japan because these reactors are "identical" to the STP dryer and have been in operation for several years at conditions similar to those of the STP dryer.

2. A "best estimate" design load for the STP dryer will be developed from compilation of the results obtained from:
- pressure transducers on the subscale dryer
- pressure transducers on the existing ABWR dryer
- strain gages on the existing ABWR dryer
- accelerometers on the existing ABWR dryer.

3. The "best estimate" design load will be used to design the dryer, but the dryer will be instrumented with pressure transducers, strain gages and accelerometers to monitor the alternating stresses during the start-up measuring program.

4. During the start-up measurement program, the reactor load will not be increased beyond an approved power level (around 60% CLTP) until pressure measurements on the actual dryer are obtained and used to update the dryer load, stress margins and limit curves. Further power increases would proceed only if the updated stress margins allow.

5. STP will provide a comprehensive report explaining the methodology which will be used to estimate the dynamic dryer load from pressure measurements on the dryer during the start-up test program. The report will include validation tests together with expected bias errors and uncertainties. The subscale model test (SMT) will be used to validate the methodology of load definition.

6. STP will also submit a comprehensive report documenting the FE dynamic model of the dryer and the method which will be used to estimate the minimum alternating stress ratio of the dryer at CLTP operating conditions. The report will include expected bias errors and uncertainties. In this report, the best estimate design load will be used to estimate the stress level of the dryer.

In order to confirm mutual understanding of the new approach being pursued by STP, the applicant is requested to:

(a) confirm that the above detailed approach will be followed, or update the NRC staff if any deviations from this approach are expected.

(b) submit comprehensive reports on: the industrial experiences of ABWRs; determination of the best estimate dryer load; validation of the procedure of load definition from pressure measurements on the dryer during start up tests; and FE stress analysis of the dryer based on the best estimate design load.

RAI 6:

The pressure spectra measured on the subscale dryer are compared with corresponding spectra obtained from the existing ABWR in CDI Technical Note # 10-21P, "Loads predicted on the full scale STP dryer at 100 percent power, based on pressure transducer measurements on a subscale model" dated November 2010. The staff determined that some of the spectral peaks measured on the existing ABWR dryer were filtered out in this comparison. In particular, two peaks near 20 and 40 Hz were removed from the existing ABWR spectra at location P3. The amplitudes of these peaks exceed the SMT dryer pressure which will be used to calculate the best estimate design load of the dryer. CDI explained that these peaks are likely generated by dryer vibration, and not pressure oscillations, and therefore they were filtered out from the pressure spectra. The staff finds this explanation unconvincing and therefore, STP is requested to include these peaks in the best estimate design load of the dryer.

DECEMBER 1 - 3, 2010, AUDIT PARTICIPANTS

Name	Organization
Brad Maurer	Westinghouse
Jianfeng Yang	Westinghouse
Subhash Chandra	Westinghouse
Nirmal Jain	Westinghouse
Robert Quinn	Westinghouse
Leslie Wellstein	Westinghouse
Jeff Bibby	Westinghouse
Karen Fujikawa	Westinghouse
Berndt Gustaffsson	Westinghouse – Sweden
Markus Stinlbom	Westinghouse – Sweden
John E. Price	STPNOC – Licensing
Tom Daly	STPNOC Engineering
Kasuke Ono	STPNOC
Aaron Heinrich	STPNOC
Ken Uchida	Toshiba
Keiji Matsunaga	Toshiba
Kevin Ramsden	FAI
Dale Wuokko	TANE – Licensing
Milton Teshe	CDI
Alan Bilanin	CDI
Tom Tai	NRC
Yuken Wong	NRC
Samir Ziada	McMaster University/Argonne
Omesh Chopra	Argonne National Laboratory
David Ma	Argonne National Laboratory