Enclosure 2

MFN 09-513

GEH Licensing Topical Report (LTR)
"ESBWR Steam Dryer Acoustic Load Definition,"
NEDO-33312, Revision 1 – Public Version

HITACHI

GE Hitachi Nuclear Energy

NEDO-33312
Revision 1
Class I
DRF 0000-0073-3923
July 2009

Licensing Topical Report

ESBWR STEAM DRYER ACOUSTIC LOAD DEFINITION

NON-PROPRIETARY INFORMATION NOTICE

This is a non-proprietary version of NEDE-33312P which has the proprietary information removed. Portions of the document that have been removed are indicated by open and closed double square bracket as shown here [[ ]].

IMPORTANT NOTICE REGARDING THE CONTENTS OF THIS REPORT

Please Read Carefully

The information contained in this document is furnished as reference to the NRC Staff for the purpose of obtaining NRC approval of the ESBWR Certification and implementation. The only undertakings of GE Hitachi Nuclear Energy (GEH) with respect to information in this document are contained in contracts between GEH and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other that for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Table of Contents

List of Tables

List of Figures

ABSTRACT

This document describes the GE Hitachi Nuclear Energy (GEH) approach used to develop the ESBWR flow induced vibration load (FIV) definition for the ESBWR steam dryer. There has been much development in FIV load modeling in the last several years, including techniques developed using measurements taken from several operating plants. Events in the industry including technical developments and regulatory interactions have dictated that GEH further develop the ESBWR Steam Dryer Load Definition approach. The current GEH approach to load definition is defined as the Plant Based Load Evaluation (PBLE) method.

Revision 1 of this report describes the ESBWR Steam Dryer Load Definitions with the PBLE method. The GEH approach to the ESBWR FIV load definition focuses on utilizing an ABWR-based steam dryer design, allowing the use of instrumented ABWR in-plant steam dryer test data to form the basis for the ESBWR load definition. This basic load definition will then be further improved through comparison with testing and operating experience gained from GEH Extended Power Uprates (EPUs) conducted on several operating plants.

The development of the FIV loads as described here are in accordance with Regulatory Guide 1.20 Revision 3. The FIV loads will be used in combination with other design loads in qualifying the steam dryer as described in Topical Report NEDE 33313P.

1.0 EXECUTIVE SUMMARY

This document describes the Flow Induced Vibration (FIV) loads for the ESWR steam dryer. The development of the FIV loads as described here are in accordance with Regulatory Guide 1.20 Revision 3. The FIV loads will be used in combination with other design loads in order to qualify the dryer as described in NEDE-33313P.

The FIV loads are unsteady differential pressure loads created by the unsteady flow adjacent to the dryer (hydrodynamic FIV loads) and from acoustic pressure waves present in the reactor dome and and steam lines that create unsteady differential pressure forces on dryer components (acoustic loads). The loads addressed here are associated with normal operation of the plant.

There is no purely analytical methodology for accurately predicting the FIV loads resulting from hydrodynamic and acoustic load sources in a complex system such as the Reactor Pressure Vessel (RPV) reactor dome and steam lines. Therefore, the approach used on the ESBWR includes the following:

[[

]]

2.0 ESBWR DRYER CONFIGURATION

2.1 Dryer and RPV Geometry

A key aspect in the development of the ESBWR FIV load definition is to incorporate the ABWR dryer geometry. By minimizing the geometrical differences between the ABWR and the ESBWR steam dryers, this approach will build on the successful operating experience of the ABWR steam dryer and will allow the ABWR steam dryer measurement data to be used in developing the FIV load definition for the ESBWR. The ESBWR and ABWR have the same RPV inside diameter (ID) and main steam line outlet nozzle configuration. Both plants have the venturi-flow restrictor as a component of the MSL nozzle. Figure 2.1-1 provides a comparison of the ABWR and ESBWR vessel in the steam dome region.

The six bank dryer used in the ESBWR will have similar vane height, skirt length, and water submergence as the ABWR steam dryer. The ESBWR steam flow rate will be approximately 15% higher than the ABWR. There is less neck down in the vessel head flange region of the ESBWR than in the ABWR. This will provide additional clearance allowing a larger dryer diameter and longer vane banks (more vanes) to be used in the ESBWR dryer steam.

[[

]] There is less vessel neck-down at the vessel flange; therefore, the plenum area between the dryer and vessel above the MSL nozzles is larger.

The vessel head for ABWR is hemispherical; the ESBWR uses a torispherical head, [[

]] The effect of these differences on the acoustic response will be evaluated as discussed in Sections 3.1 and 3.2 of this report.

The ABWR steam dryer, shown in Figure 2.1-2, was instrumented as part of the ABWR startup and power ascension test program. This instrumentation provides test data that can be used as a benchmark for the ESBWR FIV design loads. There have been no identified FIV problems with the in-service ABWR steam dryers. As shown in Figure 4.1-1, the ABWR steam dryer test data indicates that the amplitudes of acoustic loads in the ABWR dome are low.

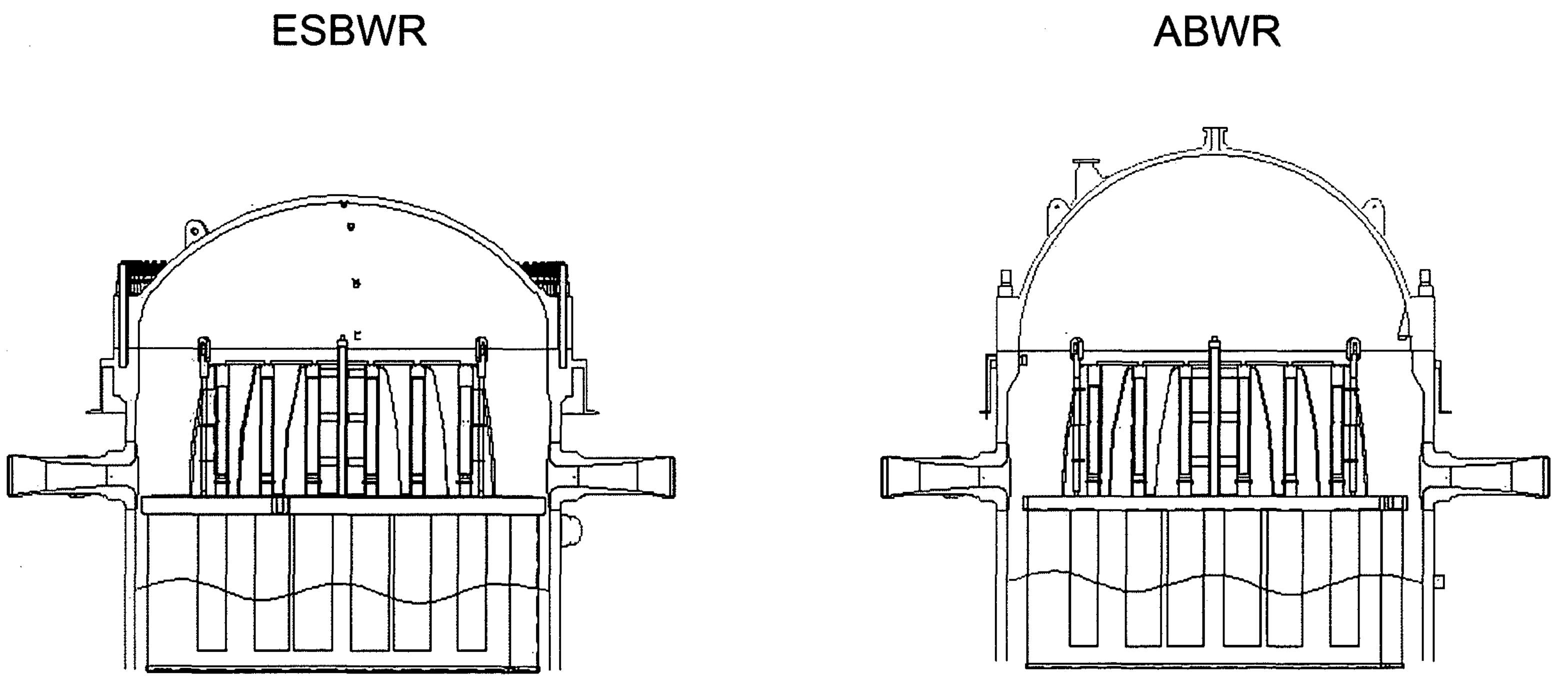

Figure 2.1-1. Comparison of Planned ESBWR and Typical ABWR Vessel Steam Regions

[[ ]]

Figure 2.1-2. [[ ]]
P: Pressure Transmitter
S: Strain Gage
A: Accelerometer

2.2 Comparative CFD Analysis

A comparison of the ABWR and ESBWR geometry and flow changes to the flow patterns and hydrodynamic loads on the steam dryer will be further evaluated with computational fluid dynamics (CFD). The steam dome, outlet nozzle and a portion of the downstream steam line of the ABWR and ESBWR will be modeled with CFD. The CFD study will [[

]]

3.0 ACOUSTIC FINITE ELEMENT MODELING OF THE RPV AND STEAM-LINES

3.1 RPV Steam Dome Acoustic Finite Element Model

[[

]]

3.2 Coupled RPV Steam Dome and Main Steam Lines Acoustic Finite Element Model

[[

]]

4.0 FIV LOAD DEFINITION BASED ON DATA FROM PLANT INSTRUMENTATION

4.1 FIV Loads Developed from Data from Multiple Plants

[[

]]

Figure 4.1-1 includes comparison of instrumented steam dryer data for [[

]]

Table 4.1-1 provides a comparison of geometry and flow parameters for the ESBWR, the ABWR at full power and the BWRs at extended power uprate conditions.

Figure 4.1-1 includes design PBLE load projections based on test data from both [[

]] The design loads have been factored by [[ ]] to reflect the bias and uncertainty of the PBLE loads developed from dryer pressure sensors as described in Reference (4).

More information on the PBLE pressure loads on other areas of the dryer is included in Reference (3). [[

]]

Figure 4.1-1 also includes the PSD curves for the measured differential pressure for the ABWR dryer at 100% power. [[

]]

A comparison of the RMS values of the design loads and test data shown in Figure 4.1-1 is included in Table 4.1-2. The design loads RMS values are approximately 50% higher than the factored measured ABWR data.

The structural assessment for each set includes a +/-10% frequency variation to provide a range of applied load frequencies. [[

]] A frequency dependent bias and uncertainty evaluation will be included in the structural evaluation for areas of the dryer with the highest alternating stress.

[[

]] This methodology will identify the acoustic load frequencies and associated dryer structural response modes that are most affected by FIV loads. [[

]]

Table 4.1-1 Comparison of Geometry and Flow Parameters

[[					
			]]		

Table 4.1-2 RMS Comparison of Loads and Test Data

	[[			
				]]

[[ ]]

Figure 4.1-1. PSD Comparison of Loads and Test Data

5.0 FIV LOAD MITIGATION

5.1 FIV Load Mitigation Through Design

As described in Section 3, [[

]]

5.2 (Deleted)

Figure 5.2-1. (Deleted)

Figure 5.2-2. (Deleted)

REFERENCES

[1] Regulatory Guide 1.20, "Comprehensive Vibration Assessment Program For Reactor Internals During Preoperational And Initial Startup Testing," March 2007.

[2] NEDE 33313P, "ESBWR Steam Dryer Structural Evaluation", November 2007

[3] GE Hitachi Nuclear Energy, "ESBWR Steam Dryer – Plant Based Load Evaluation Methodology," NEDC-33408P, Class III (Proprietary), February 2008, and NEDO-33408, Class I (Non-proprietary), February 2008.

[4] GE Hitachi Nuclear Energy, "ESBWR Steam Dryer - Plant Based Load Evaluation Methodology Supplement 1," NEDC-33408P, Supplement 1, Class III (Proprietary), October 2008, and NEDO-33408, Supplement 1, Class I (Non-Proprietary), October 2008.

MFN 09-513

Enclosure 3

Affidavit

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, David H. Hinds, state as follows:

(1) I am the Manager, New Units Engineering, GE Hitachi Nuclear Energy ("GEH"), have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of GEH letter MFN 09-513, Mr. Richard E. Kingston to U.S. Nuclear Regulatory Commission, entitled *Transmittal of GEH Licensing Topical Report (LTR) "ESBWR Steam Dryer Acoustic Load Definition," NEDE-33312P, Revision 1, July 2009,* dated August 3, 2009. The GEH proprietary information in Enclosure 1, which is entitled *GEH Licensing Topical Report (LTR) "ESBWR Steam Dryer Acoustic Load Definition," NEDE-33312P, Revision 1 – Proprietary Version* is delineated by a [[dotted underline inside double square brackets.{3}]]. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination. A non-proprietary version of this information is provided in Enclosure 2, *GEH Licensing Topical Report (LTR) "ESBWR Steam Dryer Acoustic Load Definition," NEDO-33312, Revision 1 – Public Version.*

(3) In making this application for withholding of proprietary information of which it is the owner, GEH relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a., and (4)b, above.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it identifies detailed GEH ESBWR design information. GEH utilized prior design information and experience from its fleet with significant resource allocation in developing the system over several years at a substantial cost.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GEH asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 3rd day of August, 2009.

David H. Hinds
GE-Hitachi Nuclear Energy Americas LLC