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MFN 06-012

Docket No. 52-010

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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Submittal of Licensing Topical Report, NEDE-33259P, "ESBWR Reactor Internals Flow Induced Vibration Program – Part 1," January 2006**

The subject Licensing Topical Report (LTR) is hereby submitted for NRC review and approval (Enclosure 1). Appendix 3L of the ESBWR Design Control Document (DCD) describes a process for evaluation of the ESBWR reactor internal components with respect to flow induced vibration (FIV). The initial assessment designated as Part 1 is provided in this report. The purpose of this report is to determine which components require a detailed evaluation.

Enclosure 1 contains GE proprietary information as defined by 10 CFR 2.390. GE customarily maintains this information in confidence and withholds it from public disclosure.

The affidavit contained in Enclosure 3 (and also incorporated in the report) identifies that the information contained in Enclosure 1 has been handled and classified as proprietary to GE. GE hereby requests that the information of Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. A non proprietary version of the LTR is provided in Enclosure 2 (NEDO-33259).

If you have any questions about the information provided here, please let me know.

T007

Sincerely,

David H. Hinds
Manager, ESBWR

Enclosures:

1. MFN 06-012 – NEDE-33259P, "ESBWR Reactor Internals Flow Induced Vibration Program – Part 1," January 2006 – GE Proprietary Information
2. MFN 06-012 – NEDO-33259, "ESBWR Reactor Internals Flow Induced Vibration Program – Part 1," January 2006 – Non Proprietary Version
3. Affidavit – George B. Stramback – dated January 12, 2006

cc:	WD Beckner	USNRC (w/o enclosures)
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	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GE San Jose (with enclosures)
	eDRF 0000-0049-6682	

ENCLOSURE 2

MFN 06-012

NEDO-33259, "ESBWR Reactor Internals Flow Induced Vibration Program – Part 1," January 2006

GE Energy
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3901 Castle Hayne Rd
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NEDO-33259
eDRF# 0000-0049-7170
Class I
January 2006

Licensing Topical Report

ESBWR
REACTOR INTERNALS FLOW INDUCED VIBRATION PROGRAM – PART 1

NON PROPRIETARY VERSION

This document is the non proprietary version of NEDE-33259P. Proprietary information that has been extracted is indicated by open and closed double brackets as shown here: [[.]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT
PLEASE READ CAREFULLY

Table of Contents

1. Introduction

In Appendix 3L of the ESBWR Design Control Document (DCD) a process is described for evaluation of the ESBWR reactor internal components with respect to flow induced vibration (FIV). The initial assessment designated as part 1, is provided in this report. The purpose of this report is to determine which components require a detailed evaluation as described by part 2 in reference 1. This report provides additional details, as to which components require additional work to evaluate and test FIV, and which components are considered acceptable, and require no additional work. The plant that will be used for comparison purposes that is closest to the ESBWR configuration is the Advance boiling Water Reactor (ABWR). Three ABWR plants are currently in operation in Japan and the first plant completed an FIV program that included analysis, testing and inspection as outline in regulatory guide 1.20. Since the steam dryer and the chimney partition assemblies FIV programs were discussed in reference 1, this report focuses on the following components:

Chimney Head/Steam Separator Assembly

Shroud/Chimney Assembly

Top Guide

Core Plate

Standby Liquid Control (SLC) piping

Control Rod Drive Housings (CRDH)

Control Rod Guide Tubes (CRGT)

In-Core Monitor Guide Tubes (ICMGT)

In-Core Monitor Housings (ICMH)

The remaining reactor internals components that are not specifically identified in the referenced document, or in this report are basically proven by past trouble-free BWR experience, and have designs and flow conditions that are similar to prior operating BWR plants e.g. the feedwater spargers and guide rods (guides chimney head and steam dryer in place during installation).

This report includes:

a) A list showing the locations and types of FIV sensors used in the ABWR FIV test (Table 1)

b) A list of similarities and differences of the ESBWR component design configurations as compared to the ABWR design (Table 2)

c) An estimate of the ESBWR components natural frequencies based on the data from item b) above (Table 3)

d) Data from the prototype ABWR FIV test that includes the lowest predicted natural frequencies of components, the dominant response frequencies during the

FIV test, and the maximum zero-to-peak stress intensities calculated on the basis of strain gage measurements (Table 3)

e) Flow velocities in the ESBWR as compared to the ABWR (Table 3)

f) Assessments of the likelihood that FIV will not be an issue

2. Summary

Based on the evaluations performed in this report, the components that will be evaluated in greater depth and will be part of the ESBWR FIV prototype test program are the shroud/chimney assembly, the chimney head/steam separator assembly, and the SLC lines. These are in addition to the steam dryer and chimney partitions that have their own evaluation programs. For the remaining components, it has been concluded that no further evaluations are necessary since they are not susceptible to FIV. Due to the similarity of the ESBWR to the ABWR design, the ESBWR FIV program is considered to be non-prototype category II per reference 2. Under this program, limited analysis and measurements of selected components is necessary, and full inspection of the reactor internals of the first plant is required.

3. Discussion on ABWR Prototype FIV Test and Inspection Program

The prototype ABWR reactor internals preoperational test program was performed in Japan. Although the program was carried out under the jurisdiction of the Japanese Ministry of International Trade and Industry (MITI), it complied with the requirements of the U.S. Regulatory Commission (NRC) Regulatory Guide 1.20, Rev. 2 for a prototype design. Subsequent favorable operational experience has demonstrated structural adequacy of the ABWR reactor internals with respect to FIV. The program included analyses, measurements and inspections of reactor internals components deemed critical. Strain gages, accelerometers and linear variable differential transformer (LVDT) type relative displacement sensors were used for monitoring vibration levels. A total of 46 sensors of different types were used to obtain vibration data on 11 different reactor internals component structures. The sensor locations were determined based upon the analytically predicted mode shapes for each structure, or in some cases, based upon the locations of past adverse inservice vibration phenomena. A variety of steady state and transient conditions that could be expected to occur during the life of the plant were included in the program. Test data were evaluated for five different testing conditions. The maximum zero to peak stress intensities calculated on the basis measurements during the ABWR startup FIV test program are shown in Table 3.

The type of sensors, their locations and the basis for their locations are shown in Table 1.

4. General Discussion of Reactor Internal Component Evaluations

4.1. Comparison of the ESBWR reactor internals component design to the ABWR design (Table 2).

A dimensional comparison of the ESBWR and the ABWR component designs is shown in Table 2. Also, see figure 1 which shows the ABWR reactor pressure vessel with the reactor internals, and Figure 2 shows the same information for ESBWR. In general, the ABWR and ESBWR have the same components except that the ESBWR now includes a chimney which has been added to increase natural circulation flow. Also, the fundamental flow paths within the ESBWR reactor vessel are essentially the same, but the flow path is now extended by the chimney. In addition to the inclusion of the chimney, the other major difference in the ESBWR reactor internals components design, as compared to the ABWR design, is the standby liquid control piping (see Figure 3). Also, there are components that ESBWR does not have such as the high pressure core flooding (HPCF) coupling or low pressure flooding (LPFL) spargers. The other traditional BWR components have dimensional differences that are shown in Table 2.

4.2. Comparison of the estimated ESBWR FIV behavior to ABWR (Table 2)

Table 3 shows the lowest predicted natural frequencies, the dominant response frequencies, and the maximum zero-to-peak stress intensities calculated on the basis of strain gage measurements made during the ABWR prototype FIV test. The data was extracted from the ABWR prototype FIV test report. Calculations based on the test results showed a maximum calculated zero-to-peak stress intensity of [[ ]] MPa that occurred in an ICMH located directly in the flow exiting from between two shroud support legs. This stress intensity is much less than the [[ ]] MPa limit that was set on the basis of the lowest S_a–value shown in the design fatigue curve for austenitic stainless steel, Figure I-9.2.1 of the ASME Code, Section III.

The table also compares flow velocities that might induce vibrations due to vortex shedding from cylindrical components. The flow velocities were determined by using the geometry of the flow areas and coolant flow rates of [[ ]] m^3/s for the ABWR and [[ ]] m^3/s for the ESBWR. When calculating the flow velocities in the ESBWR RPV bottom head, it was conservatively assumed that the maximum flow velocity is that of the flow exiting from the annulus between the vessel and the shroud in the shroud support area. The assumption is based on the annulus having the smallest flow area. The maximum flow velocity in the ABWR bottom head occurs between the shroud support legs. These maximum flow velocities were used to calculate the vortex shedding frequencies shown in the table.

Table 3 also shows the calculated natural frequencies of the ESBWR components. These calculations were made using the natural frequencies reported for the ABWR and then calculating the ESBWR natural frequency using classical formulas based on the component geometry differences.

5. Specific Reactor Internal component Evaluations

5.1. Chimney Head/Steam Separator assembly

The ESBWR Chimney Head and Steam Separator assembly differs from earlier BWR designs in that the Chimney Head geometry is now flat as compared to the domed shape on the traditional Shroud Head. Note that the ESBWR is called a chimney head /steam separator assembly as compared to prior BWR product lines that have called it the shroud head/steam separator assembly since the chimney is an additional component in ESBWR to which the head now attaches.

Additionally, the steam separator standpipes are longer which will result in a lower natural frequency. Due to this change, the chimney head/steam separator assembly is selected for further evaluation. During the next evaluation phase, restraints in the separator/standpipe "forest" will be designed to increase the natural frequency and to minimize vibration responses to flow conditions. Vibration instrumentation will be provided for the ESBWR prototype FIV test to confirm the adequacy of the design.

5.2. Shroud/Chimney Assembly

As shown in Figures 1 and 2, there are differences between the major components forming the ABWR core circulation path as compared to the ESBWR design. For ABWR, the major core structure components starting from the bottom attachment to the reactor pressure vessel (RPV) are the shroud support, shroud, top guide assembly, and the shroud head /steam separator assembly. These components form a complete assembly that is a freestanding structure, which has a full circumferential support between the RPV and the shroud. Also, there are bolted connections between the shroud and top guide assembly, and between the top guide assembly and shroud head/steam separator assembly.

In comparison to the ABWR, the ESBWR design has shroud support brackets (12), shroud, top guide, chimney, and chimney head/steam separator assembly. This assembly is also a freestanding structure; however, there are also eight lateral restraints at the top of the chimney structure that transmit loads through the RPV. Also, the support of the shroud involves the use of 12 support brackets that provide a load path from the shroud to the RPV. For the ESBWR, there are bolted connections at the shroud to top guide, top guide to chimney, and chimney to chimney head.

In reviewing the shroud as an individual component using the data from table 2, the calculated natural frequency of the shroud is lower than that of the ABWR. Additionally, the flow velocity in the annulus between the RPV and the shroud for the ESBWR is higher because of a narrower annulus width. The ABWR shroud was instrumented with strain gages during the ABWR prototype FIV test. The movement of the shroud was measured with displacement sensors located on the OD of the top guide. Similar measurements will be performed on the ESBWR shroud.

The ESBWR chimney is a new component that has a structure which is similar to the shroud. The flow velocity of the water in the annulus between the chimney and the RPV is approximately the same as that in the annulus between the shroud and the RPV for the ABWR. The design goal is to minimize FIV. Since the chimney is a new component, it has been selected for further evaluation, and will be instrumented for the FIV prototype test.

As an assembly, the core plate, top guide, and the chimney head plate provide rigid lateral structures that help to minimize vibration to the shroud and chimney. The analysis to be performed in the next phase will include the effect of these components to accurately determine the vibration characteristics of the shroud and chimney assembly.

5.3. Top Guide Assembly

During the prototype ABWR FIV test, the movement of the top guide was measured together with the shroud. The highest zero-to-peak stress intensity calculated on the basis of these measurements was [[ ]] MPa. Since the ESBWR top guide is of a similar design, only the displacement sensors discussed in Section 5.2 will be applied.

5.4. Core Plate Assembly

The ESBWR core plate assembly is of a similar design as that of the ABWR and BWR/6. It is a stiff structure that has no record of any FIV issues. There was no instrumentation applied in the prototype ABWR FIV test. Based on previous BWR operating experience, no instrumentation will be applied for the ESBWR FIV test.

5.5. Standby Liquid Control (SLC) Lines

The SLC line is a new ESBWR component that is located in the down-coming flow region in the annulus between the RPV and the chimney. The design is shown in Figure 3. Since the configuration of the SLC line has a new geometry and location within the RPV, this component is selected for further detailed analysis and will be included in the prototype FIV test and inspection program. During the analytical evaluation, the design of the supports will be established such that it can accommodate the differential thermal expansion between the RPV and the shroud, and at the same time have enough rigidity to avoid FIV related issues. For the design of this line, the lowest natural frequency of the line between its supports will be at least a factor of 3 above the calculated vortex shedding frequency.

5.6. Control Rod Drive Housings (CRDH), Control Rod Guide Tubes (CRGT), In-Core Monitor Housings (ICMH) and In-Core Monitor Guide Tubes (ICMGT)

From Table 3 it can be seen that the calculated natural frequencies of the CRGTs, ICMHs and ICMGTs of the ESBWR are higher than those reported for the ABWR. That is because the CRGTs, ICMHs and ICMGTs of the ESBWR have shorter lengths (they have the same diameters, wall thicknesses, and mass per unit length). The increase in natural frequency effectively moves it away from the dominant response frequency as recorded by the ABWR test, and the values are high enough that FIV is not a concern. Also, these components are exposed to lower flow velocities, and the corresponding vortex shedding frequencies are approximately a factor of [[ ]] less than those in the ABWR. In comparing the calculated natural frequencies to the vortex shedding frequency, the component natural frequencies are in all cases an order of magnitude above or more than the vortex shedding frequency which confirms why FIV will not be a concern. These results are consistent with BWR operating plant experience where no FIV problems have ever been found in the lower region of the reactor vessel.

Since the ABWR flow induced vibration test did not reveal any significant vibration of the CRGTs, ICMHs, and ICMGTs and had peak stress intensities that were well below the ASME Code limits, it is reasonable to expect that these ESBWR components will have no FIV issues. It is therefore concluded that the CRGTs, ICMHs and ICMGTs can be excluded from the ESBWR prototype FIV test program and no instrumentation will be installed.

Based on previous BWR/5 experience, the CRDHs were not included in the ABWR FIV test program. Since the CRDHs are rigid structures that are welded to the RPV bottom head, and with an estimated [[ ]] times higher natural frequencies due to shorter lengths and lower flow velocity in the bottom head, there will be no FIV issues with the ESBWR CRDHs. The CRDHs will not be instrumented during the prototype FIV test.

6. References

1. GE Letter MFN 05-116, DCD Appendix 3L "Reactor Internal Flow Induced Vibration Program"
2. Regulatory Guide 1.20, Comprehensive Vibration Assessment Program for Reactor Internals during Preoperation and Initial Startup Testing, Revision 2

TABLE 1: ABWR Prototype FIV Test sensor Types, Locations, and Location Basis

Equipment Item	Location on Equipment	Sensor Type	Basis for Location
Steam Dryer Support Ring	[[		
Steam Dryer Skirt			
Steam Dryer Skirt			
Steam Dryer Skirt			
Steam Dryer Skirt			
Steam Dryer Hood			
Steam Dryer Drain Channel			
HPCF Sparger			
HPCF Coupling			
HPCF Coupling Thermal Ring			
CRD Guide Tube			
ICM Housing			
Shroud			]]

Equipment Item	Location on Equipment	Sensor Type	Basis for Location
Top Guide	[[		
Top Guide			
Vessel Dome Region			
Vessel Annulus			
Vessel Annulus			]]

TABLE 2: Comparison of ESBWR Reactor Internals Component Design to ABWR (All dimensions are in mm)

Feature	ABWR	ESBWR	Difference
RPV			
Nominal ID	[[		
Minimum ID			
Shroud			
Upper shell OD			
Lower shell OD			
Wall thickness upper shell			
Wall thickness lower shell			
Total height			
Height upper shell			
Upper flange OD			
Upper flange ID			
Upper flange height			
Upper flange width			
Lower flange OD			
Lower flange ID			
Lower flange height			
Lower flange width			
Core plate support OD			
Core plate support ID			
Core plate support height			
Core plate support width			
Annulus RPV/Shroud			
Upper width			
Lower width			]]
Feature	**ABWR**	**ESBWR**	**Difference**
Top Guide Assembly			
Overall OD	[[		]]

Overall thickness	[[		
Core Plate Assembly			
Core plate OD			
Core plate rim ID			
Core plate rim height			
Core plate thickness			
Overall height			
Beam thickness			
Beam height			
Chimney head and separators			
Overall height			
Shroud head OD			
Height cylindrical portion			
Shroud head height			
Number of separators			
Separator height			
Separator OD			
Standpipe OD			
Standpipe maximum height			
Separator pitch			
Overall diameter of separators			
Distance lower guide ring from the bottom			
Distance upper guide ring from the bottom			
Thickness of dome or plate			
Total height of plate and beams			
OD of upper and lower rings			
Thickness of upper and lower guide rings			
Width of upper and lower guide rings			]]

Feature	ABWR	ESBWR	Difference
ESBWR Chimney (ABWR Top Guide Shell)			
Shell OD	[[		
Shell ID			
Shell thickness			
Total height			
Upper flange OD			
Upper flange ID			
Upper flange width			
Lower flange OD			
Lower flange ID			
Lower flange cross section			
Lower flange height at OD			
Lower flange height at ID			
Chimney Partition			
Upper flange OD			
Upper flange ID			
Lower flange OD			
Lower flange ID			
Upper and lower flange width			
Upper and lower flange thickness			
Partition thickness			
Partition height			
Partition pitch			
Total height partition			
CRD Housing			
OD			
Wall thickness			
Length inside reactor (Max. length at center location including stub tube)			
Control Rod Guide Tube			
OD			
Wall thickness			
Length			]]

Feature	ABWR	ESBWR	Difference
Feedwater Sparger			
OD	[[		
Wall thickness			
Length			
ICM Housing (incl. guide tube and stub tube)			
OD			
Wall thickness			
Length inside reactor (incl. guide tube and stub tube)			
ICM Guide Tube			
OD			
Wall thickness			
Length			
Guide Rod			
OD			
Wall thickness			
Total length upper and lower guide rod			
Standby Liquid control Lines			
-Upper vertical portion			
OD			
Wall thickness			
Approximate length			
- Header			
OD			
Wall thickness			
Approximate length			
- Lower vertical portion			
OD			
Wall thickness			
Approximate length			]]

	ABWR		ESBWR		ABWR			ESBWR
Component	Lowest analytically predicted natural frequency (Hz)	Flow velocity m/sec	Natural frequency based on ABWR calculations (Hz)	Flow velocity m/sec	Dominant response during flow test (Hz)	Maximum zero to peak stress intensity calculated on the basis of strain gage measurements during flow test. Limit is 68.9 MPa (7.0 kg/mm^2)	Calculated vortex Shedding Frequency (Hz)	Calculated vortex Shedding Frequency (Hz)
Shroud	[[							
Chimney								
Top Guide								
Control Rod Guide Tube								
In-core Housings								
In-core Guide Tubes								
CRD Housings								]]

TABLE 3: Comparison of Estimated ESBWR FIV Behavior to ABWR

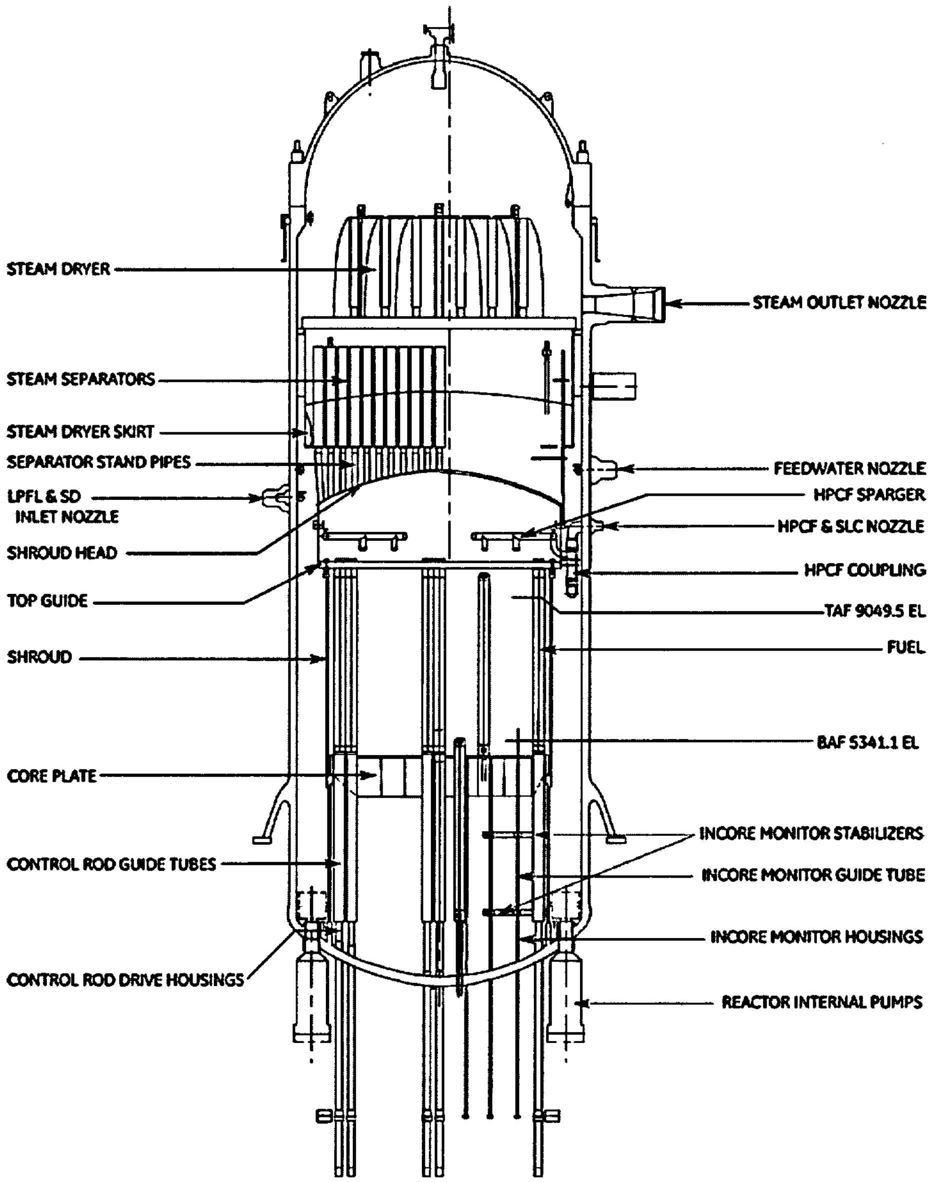

Figure 1: ABWR RPV ASSEMBLY

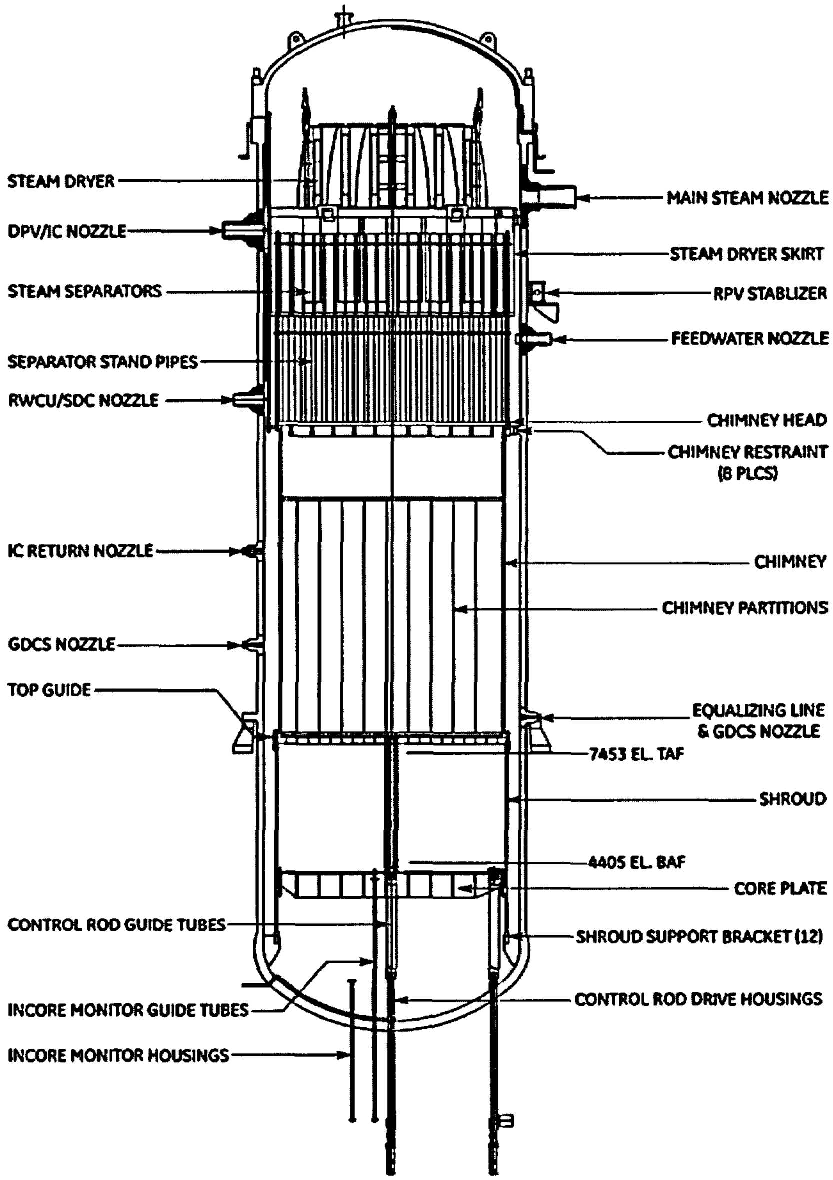

FIGURE 2: ESBWR REACTOR ASSEMBLY

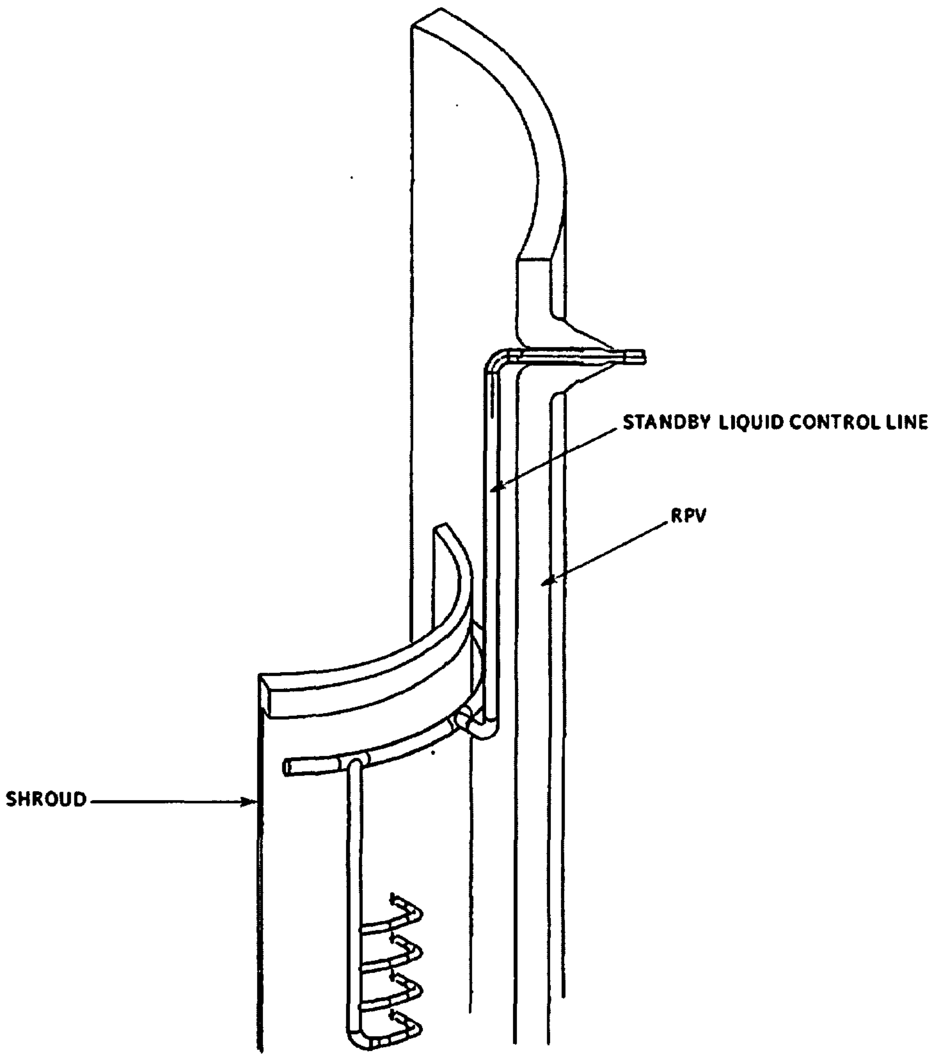

FIGURE 3: ESBWR STANDBY LIQUID CONTROL INJECTION PIPING/HEADERS AND NOZZLES

ENCLOSURE 3

MFN 06-012

Affidavit

General Electric Company

AFFIDAVIT

I, George B. Stramback, state as follows:

(1) I am Manager, Regulatory Services, General Electric Company ("GE") and 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 the GE proprietary report, NEDE-33259P, *ESBWR Reactor Internals Flow Induced Vibration Program – Part 1*, January 2006. GE proprietary information is identified by a dark red font with double underlines inside double square brackets. 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.

(3) In making this application for withholding of proprietary information of which it is the owner, GE 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 2.790(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 General Electric's competitors without license from General Electric 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 General Electric customer-funded development plans and programs, resulting in potential products to General Electric;

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 GE, 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 GE, 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. Access to such documents within GE 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 GE 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 contains detailed ESBWR and ABWR design information and dimensional information derived from GE proprietary detail design drawings, including ABWR plant test results, developed by GE over a period of more than ten years at a cost of several million dollars. This information, 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.

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

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE'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 GE.

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.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE 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 GE 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 GE 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 12th day of January 2006

George B. Stramback

George B. Stramback
General Electric Company