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Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon the removal of Enclosure 1, the balance of this letter may be considered non-proprietary.

MFN 06-264

Docket No. 52-010

August 17, 2006

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

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-9, 6.2-13, 6.2-32, 6.2-33, 6.2-35 through 6.2-39, and 6.2-41 through 6.2-47**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

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 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 is contained in Enclosure 2.

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

D068

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

Enclosure:

1. MFN 06-264 - Response to Portion of NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-9, 6.2-13, 6.2-32, 6.2-33, 6.2-35 through 6.2-39, and 6.2-41 through 6.2-47 – GE Proprietary Information
2. MFN 06-264 - Response to Portion of NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-9, 6.2-13, 6.2-32, 6.2-33, 6.2-35 through 6.2-39, and 6.2-41 through 6.2-47 – Non Proprietary Version
3. Affidavit – George B. Stramback – dated August 17, 2006

Reference:

1. MFN 06-113, Letter from U. S. Nuclear Regulatory Commission to Mr. David H. Hinds, *Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application,* April 24, 2006

cc:	WD Beckner	USNRC (w/o enclosures)
	AE Cubbage	USNRC (with enclosures)
	LA Dudes	USNRC (w/o enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	eDRFs	0000-0056-6454 and 0000-0056-7613

ENCLOSURE 2

MFN 06-264

Response to Portion of NRC Request for

Additional Information Letter No. 18

Related to ESBWR Design Certification Application

Containment Design

RAI Numbers 6.2-9, 6.2-13, 6.2-32, 6.2-33,

6.2-35 through 6.2-39, and 6.2-41 through 6.2-47

Non Proprietary Version

NRC RAI 6.2-9

DCD Section 6.2.1.1.4 only addresses the drywell. Include a discussion for wetwell depressurization, if it can occur. Include a discussion of the events which could result in depressurization in the wetwell.

GE Response

There is no wetwell spray and therefore no rapid wetwell depressurization in an ESBWR. Suppression Pool Cooling and Cleanup System is the only system that can reduce the wetwell temperature. Heat removal capacity of suppression pool cooling system is limited and the effect on the wetwell temperature and pressure is gradual. The pressure difference between the drywell and the wetwell is limited to be less than or equal to the static head corresponding to the PCC vent line submergence in the suppression pool.

NRC RAI 6.2-13

Provide a synopsis of the piping break analyses performed and a justification for the selection of the design bases accident (break size and location) for each subcompartment. Include a discussion of the use of leak-before-break in limiting the pipe break area. Provide this information as part of the DCD Tier 2, Section 6.2.1.2.1, "Design Bases." This information is necessary to evaluate ESBWR subcomparment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

As explained in DCD Section 6.2.1.2.2, Reactor Shield Annulus (RSW) is the only subcompartment, in addition to DW and WW subcompartments, requiring assessment of pipe breaks. Four types of pipe break (main steam line, feedwater line, GDCS injection line and bottom drain line) have been assessed for the DW and WW compartments. Two types of pipe break (FWL and RWCU) have been assessed for the RSW. The break locations have been selected to maximize the mass and energy release into the subcompartment. These are usually the pipe segments on any flow path with the largest cross-section in the containment. Since double-end guillotine breaks were postulated for all pipe breaks, Leak-Before-Break was not used to limit the break area.

NRC RAI 6.2.32

DCD Figure 6.2-18 is called typical. In addition, there is a reference on the figure to a "sub model 2." This models does not appear to be in the DCD, provide it. For each applicable subcompartment, provide figure(s) of the model(s) and the results of the analyses.

GE Response

The required information will be included.

Also see response to RAI 6.2-47, which adds Table 6.2-12a to the DCD, response to RAI 6.2-31, which revises Table 6.2-11, and response to RAI 6.2-44, which revises Table 6.2-12.

DCD Figure 6.2-18 will be updated in the next issue as noted in the attached markup.

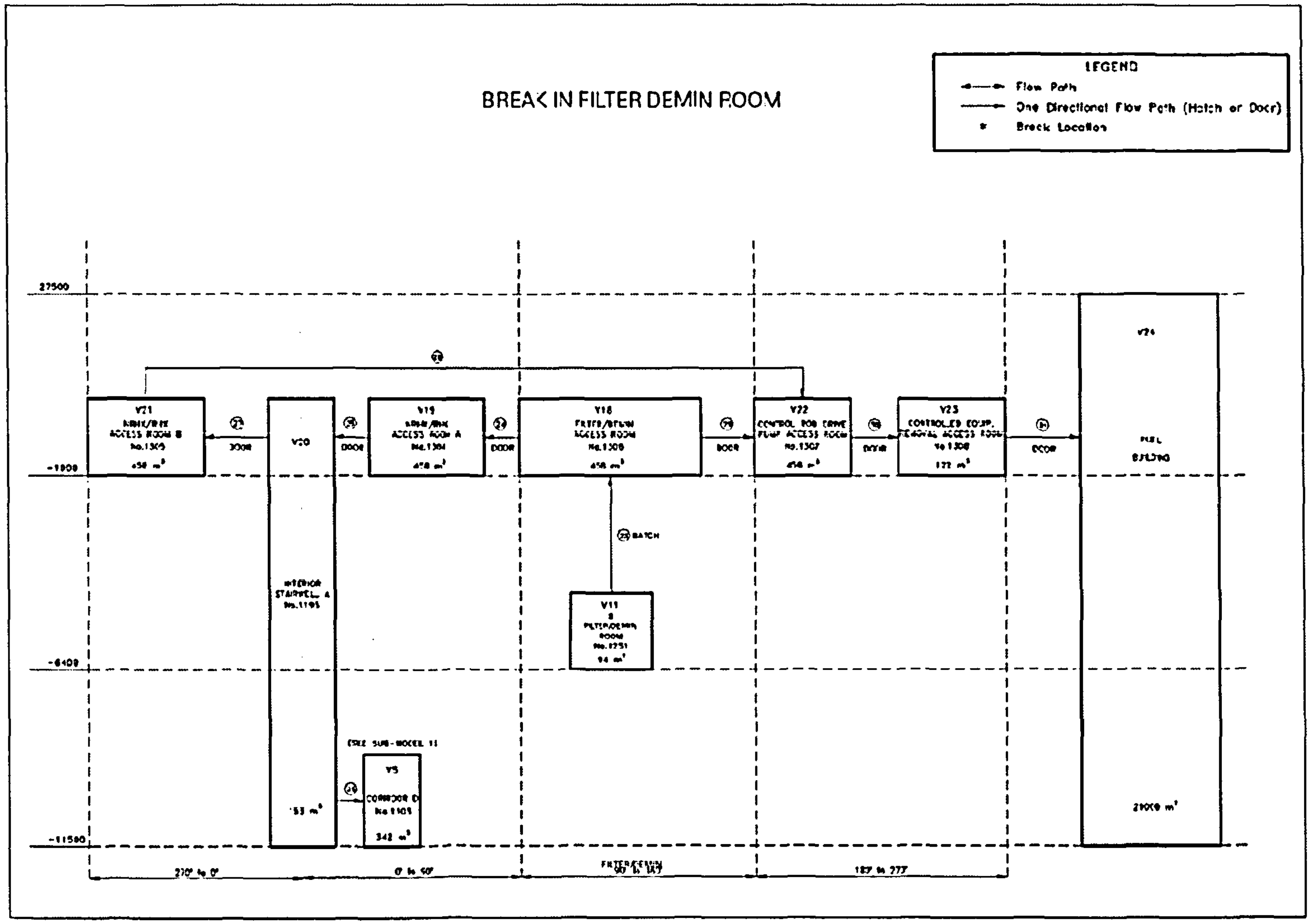

Figure 6.2-18 (continued). RWCU/SDC System Subcompartment Pressurization Analysis (Sub-Model 2)

NRC RAI 6.2.33

Besides the ones described in the DCD, are there other models for other compartments? If so, include them in the DCD.

GE Response

See Response to RAI 6.2-32 that describes sub-model 2. There are no other models.

No DCD changes will be made in response to this RAI.

NRC RAI 6.2.35

Provide the margin applied to the calculated differential pressures for use in the structural design of the subcompartment walls and equipment supports. Provide this information in DCD Tier 2, Section 6.2.3.2, "Design Description." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2

GE Response

For Short-Term Pressurization Response for postulated high energy line break (HELB) accidents outside the containment, a margin of 10% has been applied to the maximum pressures obtained by calculation.

See response to RAI 6.2-47.

DCD Subsection 6.2.3.3 will be revised in the next issue as noted in the attached markup.

Isolation Condenser (IC) System

The isolation condensers are located in the Reactor Building at the 27000 mm elevation. The IC steam supply line is connected directly to the reactor pressure vessel. The supply line leads to a steam distribution header, which feeds four pipes. Each pipe has a flow limiter to mitigate the consequences of an IC line break. The IC design basis break is a double-ended break in the piping after the steam header and flow restrictors. The IC/PCC pool is vented to atmosphere to remove steam generated in the IC pools by the condenser operation. In the event of an IC break, the steam/air mixture is expected to preferentially exhaust through hatches in the refueling floor (see Figure 1.2-9) and into the RB operating area with portions of the steam directed through the pool compartments to the stack, which is vented to the atmosphere. Because the vent path through the hatches leads to the refueling floor area, which is a large open space with no safety implications, this event was excluded from the pressurization analysis.

Main Steam (MS) Tunnel

The Reactor Building main steam tunnel is located between the primary containment vessel and the turbine building. The limiting break is a double-ended main steam line break. The main steam lines originate at the reactor pressure vessel and are routed through the steam tunnel to the turbine building. The steam/air mixture resulting from a main steam line break is directed to the turbine building through the steam tunnel. The pressure capability of the steam tunnel compartment is discussed in Subsection 3G.1.5.2.1.10. No blowout panels are required in the steam tunnel because the flow path between the steam tunnel and the turbine building is open. The main steam line break is excluded from pressurization analysis given the ability of the steam to blow down into the turbine building.

6.2.3.3 Design Evaluation

Fission Product Containment

There is sufficient water stored within the containment to cover the core during both the blowdown phase of a LOCA and during the long-term post-blowdown condition. Because of this continuous core cooling, fuel damage and fission product release is a very low probability event. If there is a release from the fuel, most fission products are readily trapped in water. Consequently, the large volume of water in the containment is expected to be an effective fission product scrubbing and retention mechanism. Also, because the containment is located entirely within the Reactor Building, multiple structural barriers exist between the containment and the environment. Therefore, fission product leakage from the RB is mitigated.

Compartment Pressurization Analysis

RWCU pipe breaks in the Reactor Building and outside the containment were postulated and analyzed. For compartment pressurization analyses, HELB accidents are postulated due to piping failures in the RWCU system where locations and size of breaks result in maximum pressure values. Calculated pressure responses have been considered in order to define the peak pressure, of the RB compartments, for structural design purposes. The calculated peak compartment pressures which include a 10% margin are listed in Table 6.2-12a out of which the maximum is 32.6 kPag which is below the RB compartment pressurization design requirements as discussed in Subsection 3G.1.5.2.1.11~~The calculated peak compartment pressure is 3.26 kPag~~

which is below the RB compartment pressurization design requirements as discussed in Subsection 3G.1.5.2.1.11.

Values of the mass and energy releases produced by each break are in accordance with ANSI/ANS-56.4. The break fluid enthalpy for energy release considerations is equal to the stagnation enthalpy of the fluid in the rupture pipe. The mass and energy blowdown from the postulated broken pipe terminates when system isolation valves are fully closed after receiving the pertinent isolation closure signal.

Subcompartment pressurization effects resulting from the postulated breaks of high-energy piping have been performed according to ANSI/ANS-56.10. In order to calculate the pressure response in the Reactor Building and outside the containment due to high-energy line break accidents, CONTAIN 2.0 code was used according to the nodalization schemes shown in Figure 6.2-18. The nodalization contains the rooms where breaks occur, and all interconnected rooms/regions through flow paths such as doors, hatches, etc. Flow path and blow out panel characteristics are given in Table 6.2-12 and Subcompartment Nodal Description are given in Table 6.2-12aFlow path and blow out panel characteristics are given in Table 6.2-12.

6.2.3.4 Tests and Inspections

Position status indication and alarms for doors, which are part of the RB envelope, are tested periodically. Leakage testing and inspection of all other architectural openings are also performed on a regular basis.

6.2.3.5 Instrumentation Requirements

Details of the initiating signals for isolation are given in Subsection 7.3.3.

Doors that form part of the RB boundary are fitted with position status indication and alarms.

6.2.4 Containment Isolation Function

The primary objective of the containment isolation function is to provide protection against releases of radioactive materials to the environment as a result of an accident. The objective is accomplished by isolation of lines or ducts that penetrate the containment vessel. Actuation of the containment isolation function is automatically initiated at specific limits defined for reactor plant operation. After the isolation function is initiated, it goes through to completion.

Relevant to the containment isolation function, this subsection addresses or references to other DCD locations that address the applicable requirements of General Design Criteria (GDC) 1, 2, 4, 16, 54, 55, 56, and 57 and Appendix K to 10 CFR Part 50 discussed in SRP 6.2.4 R2. Regulatory Guide 1.141 and ANS 56.2 are used as guidance documents for the design of containment isolation provisions for fluid systems. The plant meets the relevant requirements of

- GDC 1, 2, and 4 as they relate to safety-related systems being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed; systems being designed to withstand the effects of natural phenomena (e.g., earthquakes) without loss of capability to perform their safety functions; and systems being designed to accommodate postulated environmental conditions and protected against dynamic effects (e.g., missiles, pipe whip, and jet impingement), respectively.

NRC RAI 6.2-36

Provide a description of the computer program used to calculate the mass and energy release from a postulated pipe break. Discuss the conservatism of the blowdown model with respect to the pressure response of the subcompartment. If the computer code being used has not been previously reviewed by the staff, provide a comparison of the results to those predicted by an accepted code as justification of its acceptability. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

For Short-Term Pressurization Response for postulated high energy line break (HELB) accidents outside the containment, mass and energy blowdown input data for break cases have been taken to be the same as for the ABWR design, since its RWCU is similar to the ESBWR RWCU/SDC system. SAFER04V Computer Code was used for the mass and energy blowdown calculations for the ABWR. The mass and energy blowdown were calculated in accordance with the American National Standard for Subcompartment Pressure and Temperature Transient Analysis in Light Water Reactor - ANSI/ANS-56.4

The analysis using ABWR mass and energy release data for ESBWR is considered conservative for the following reasons:

(a) The break fluid specific enthalpy for energy release consideration is equal to the stagnation enthalpy of the fluid in the ruptured pipe. The specific stagnation enthalpy in the ESBWR is the same as in the ABWR.

(b) The ESBWR RWCU/SDC system design has air/nitrogen-operated containment isolation valves whose closing times are much shorter than the motor-operated containment isolation valves used in the ABWR RWCU system. This results in less total mass and energy release through the pipe breaks in the ESBWR RWCU/SDC system.

Additionally, a conservative ESBWR-RWCU model based on RELAP5/Mod3.3 Code has been developed to evaluate the mass and energy release for the five break locations. It has been found that ABWR mass and energy release data bound the ESBWR ones during the first seconds of the transient, which are the important ones for subcompartments pressurization, especially for break case 1, which is the break case that gives the maximum peak pressure value (32.6 kPa g).

A comparison of ABWR vs. ESBWR mass and energy release data for case 1 (bounding case) is provided in the attached figure.

No DCD changes will be made in response to this RAI.

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NRC RAI 6.2.37

The CONTAIN 2.0 code is used for the RB subcompartment analyses. Discuss the conservatism of the model with respect to the pressure response of the subcompartment. Include a discussion of sensitivity studies to justify time steps, nodalization, and any other criteria used by GE to justify the final model used for licensing evaluations. How does GE's application compare with the SMSAB-02-04, "CONTAIN Code Qualification Report/User Guide for Auditing Subcompartment Analysis Calculations," September 2002 (ADAMS ML023220288)? Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR .

GE Response

The analytical tool selected and used to perform the resulting short-term response is CONTAIN 2.0 Code (NUREG/CR-6533) for Short-Term Pressurization Response for postulated high energy line break (HELB) accidents outside the containment.

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Compartments considered in the calculations are the rooms containing postulated RWCU/SDC system pipe breaks, and also those rooms/regions which connect to them (through doors, hatches, and so on). Owing to the geometry of the regions, each room-region was assigned to a node of the model. No simple or artificial divisions of rooms were considered to evaluate the sensitivity of the model to nodalization.

Modeling follows the recommendations given by SMSAB-02-04.

For the water entrainment, the suggestion regarding volumetric energy rates has been followed in order to avoid differential pressure overpredictions; dropout is activated since volumetric rates are less than 5 MW/m^3 (Section 4.2.1 of SMSAB-02-04).

Inertia terms are adequately determined for subcompartment analyses based on meaningful physical specification.

For critical flow, the default value of 1.0 has been used for the flow area reduction factor of the vena contracta.

The following paragraphs will be added in DCD, Tier 2, Section 6.2.3.3 at the end under the heading "Compartment pressurization analysis":

"The selected nodalization maximizes differential pressure. Owing to the geometry of the regions, each room-region was assigned to a node of the model. No simple or artificial divisions of rooms were considered to evaluate the sensitivity of the model to nodalization. A sensitivity study of pressure response was performed to select the time step.

Modeling follows the recommendations given by SMSAB-02-04 , "CONTAIN Code Qualification Report/User Guide for Auditing Subcompartment Analysis Calculations"."

NRC RAI 6.2.38

Provide the assumed initial operating conditions of the plant such as reactor power level and subcompartment pressure, temperature, and humidity. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

For Short-Term Pressurization Response for postulated high energy line break (HELB) accidents outside the containment, as required in the SRP 6.2.1.2 II.B.1, the maximum operating temperature, minimum operating pressure and minimum operating relative humidity were considered and used as initial conditions for each room. Table 6.2-12a added in response to RAI 6.2-47 provides the initial conditions in the subcompartments. Refer to DCD Table 3.8-10 for maximum operating temperatures in the reactor building.

No DCD changes will be made in response to this RAI.

NRC RAI 6.2-39

Provide a description of and justification of the subsonic and sonic flow models used in vent flow calculations. The degree of entrainment assumed for the vent mixture should also be discussed and justified. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

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See also the response to RAI 6.2-37.

NRC RAI 6.2-41

Demonstrate that the selected nodalization maximizes the differential pressures as a basis for establishing the design pressures for the structures and component supports. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

As additional information for Short-Term Pressurization Response for postulated high energy line break (HELB) accidents outside the containment see Response to RAI # 6.2-37.

No DCD changes will be made in response to this RAI.

NRC RAI 6.2-42

Provide graphs of the pressure responses of all subnodes within a subcompartment as functions of time to permit evaluations of the effect on structures and component supports. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2..

GE Response

The required information will be included.

Figures 6.2-19 through 6.2-27 will be added in revision 2 of the DCD.

DCD Subsection 6.2.3.2 will be revised in the next issue as noted in the attached markup.

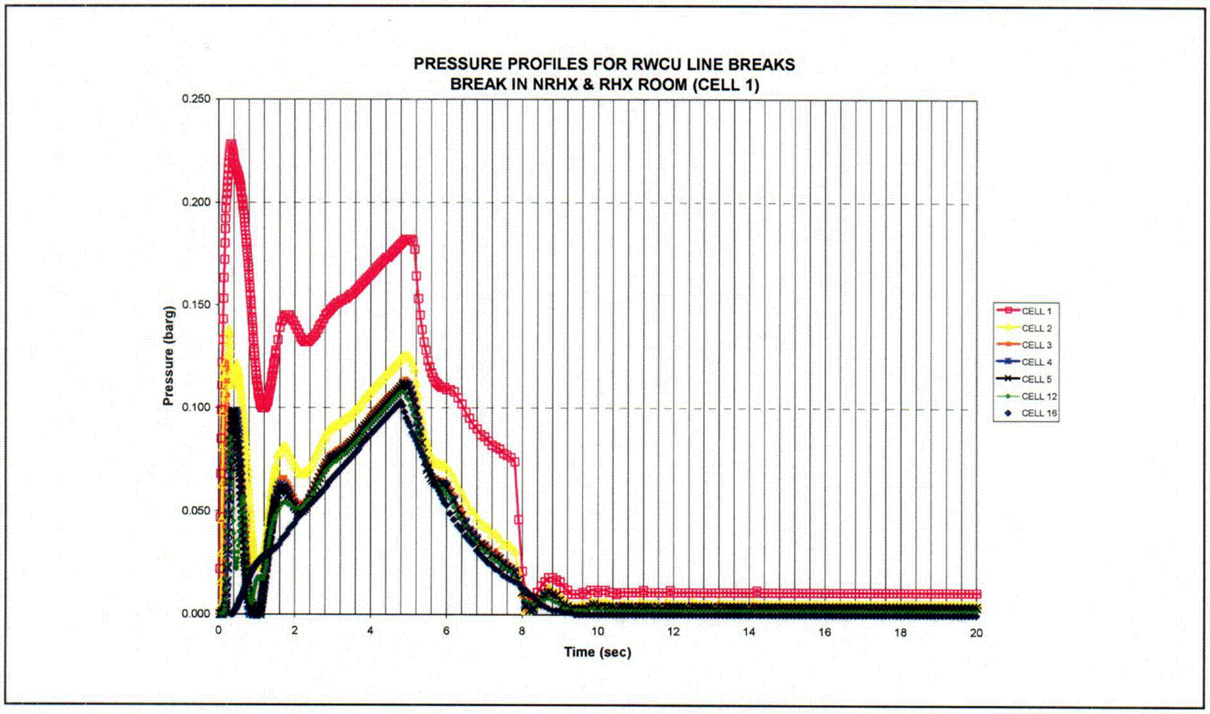

Figure 6.2-19 Pressure Histories due to Break Case 1 in Cell 1 (Sub-Model 1)

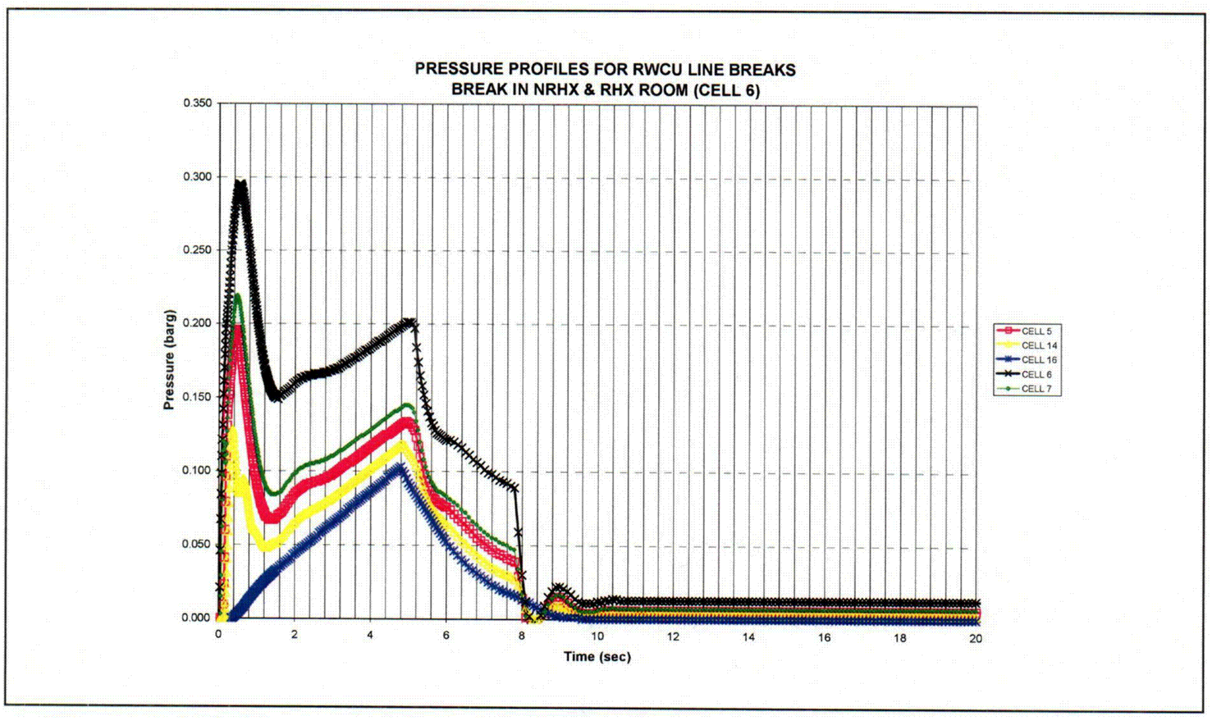

Figure 6.2-20 Pressure Histories due to Break Case 1 in Cell 6 (Sub-Model 1)

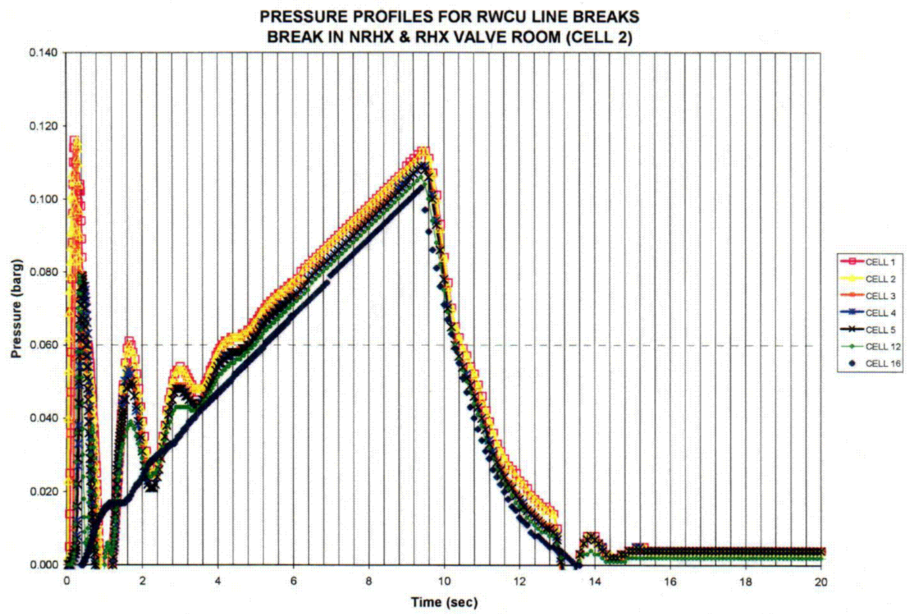

Figure 6.2-21 Pressure Histories due to Break Case 2 in Cell 2 (Sub-Model 1)

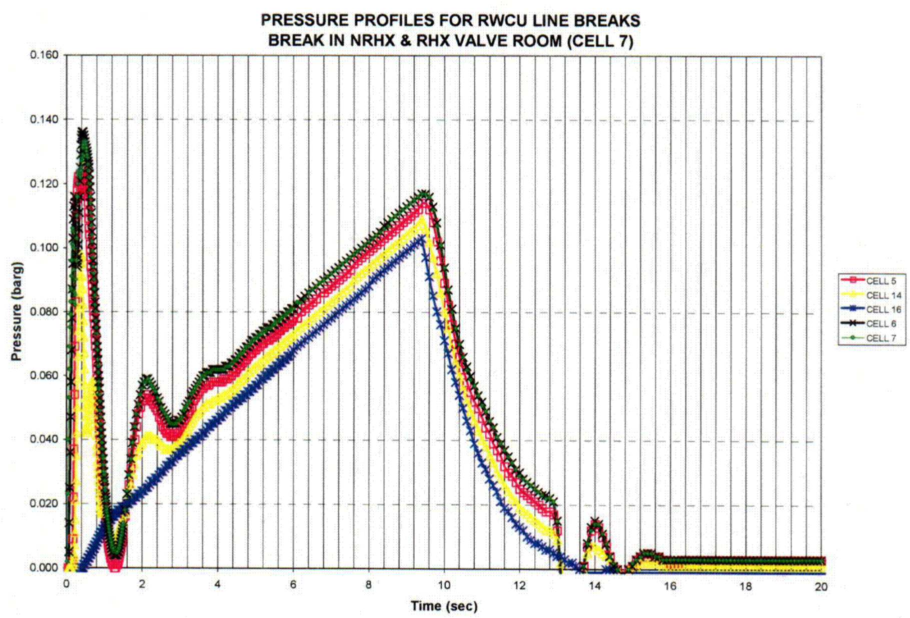

Figure 6.2-22 Pressure Histories due to Break Case 2 in Cell 7 (Sub-Model 1)

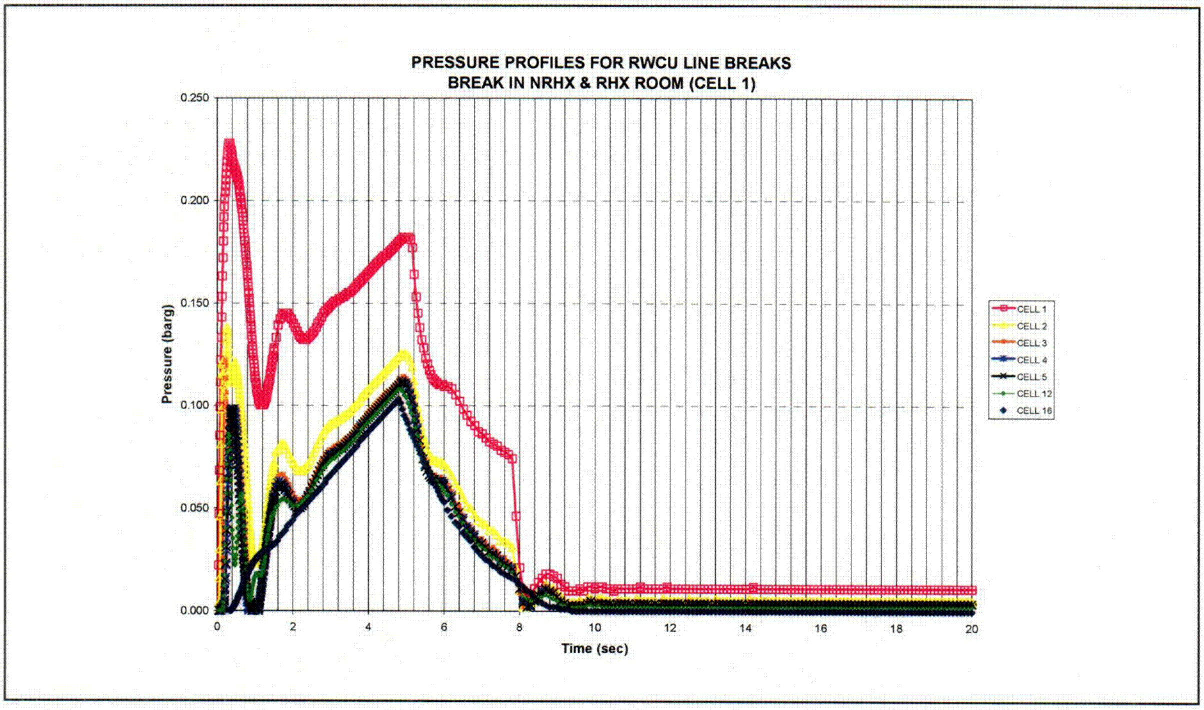

Figure 6.2-23 Pressure Histories due to Break Case 3 in Cell 1 (Sub-Model 1)

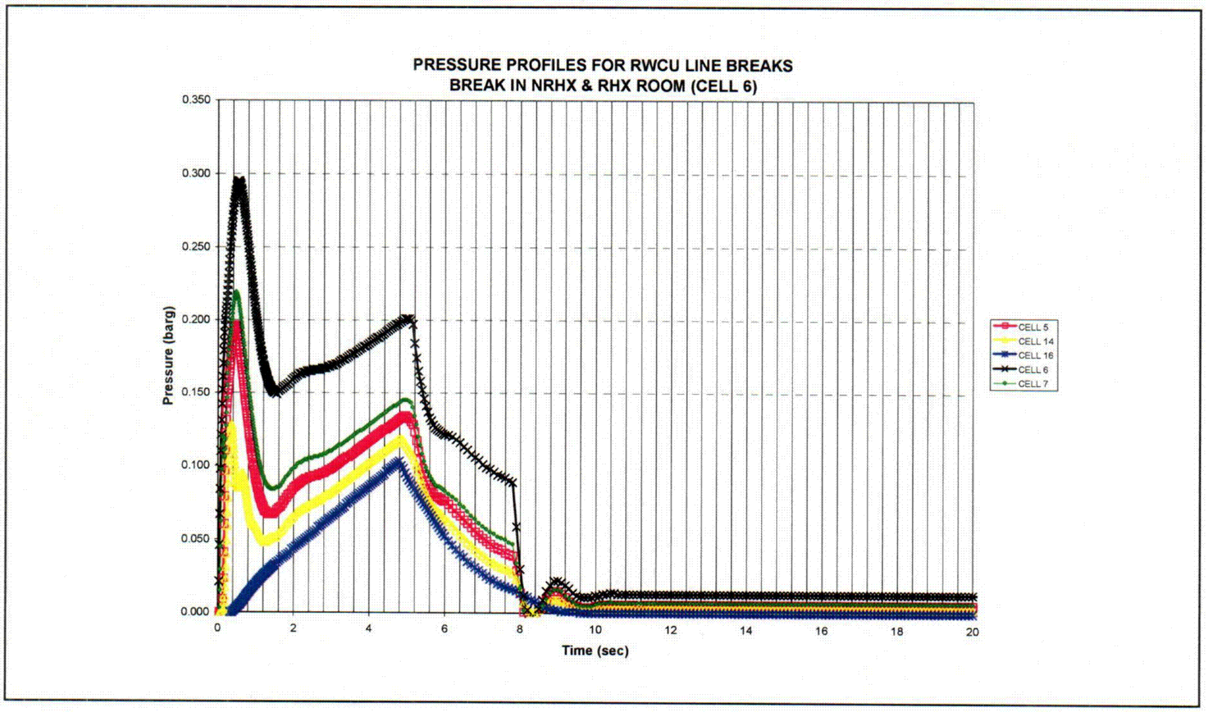

Figure 6.2-24 Pressure Histories due to Break Case 3 in Cell 6 (Sub-Model 1)

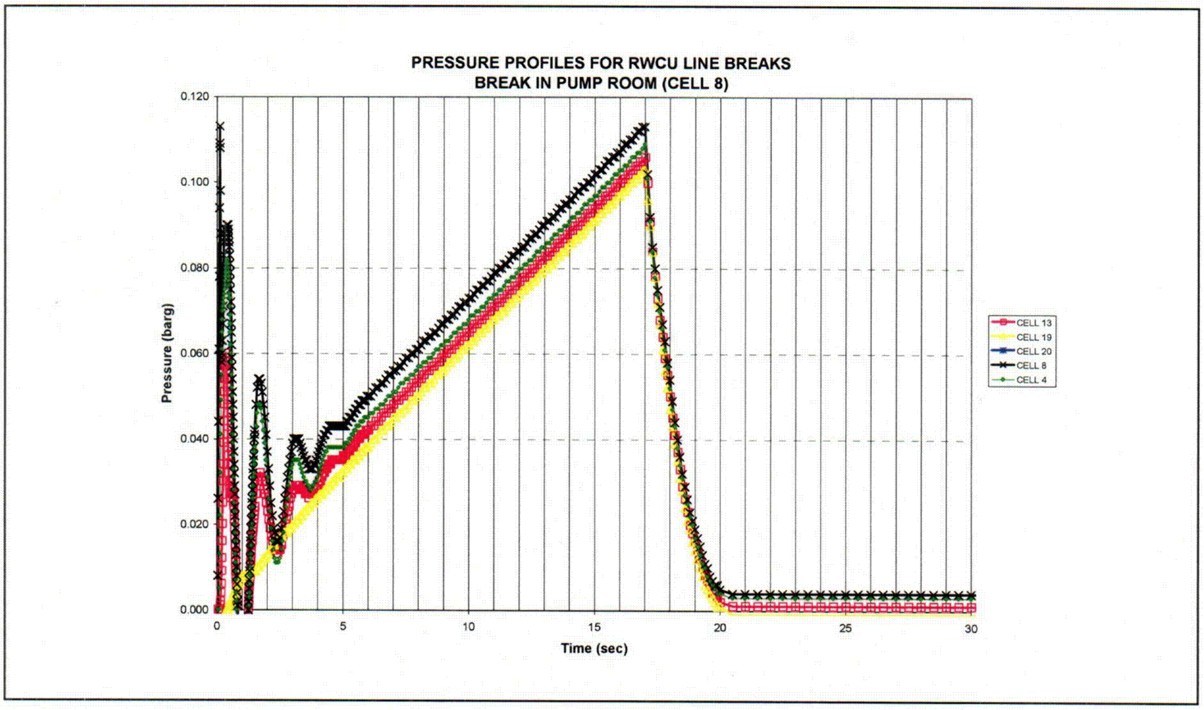

Figure 6.2-25 Pressure Histories due to Break Case 4 in Cell 8 (Sub-Model 1)

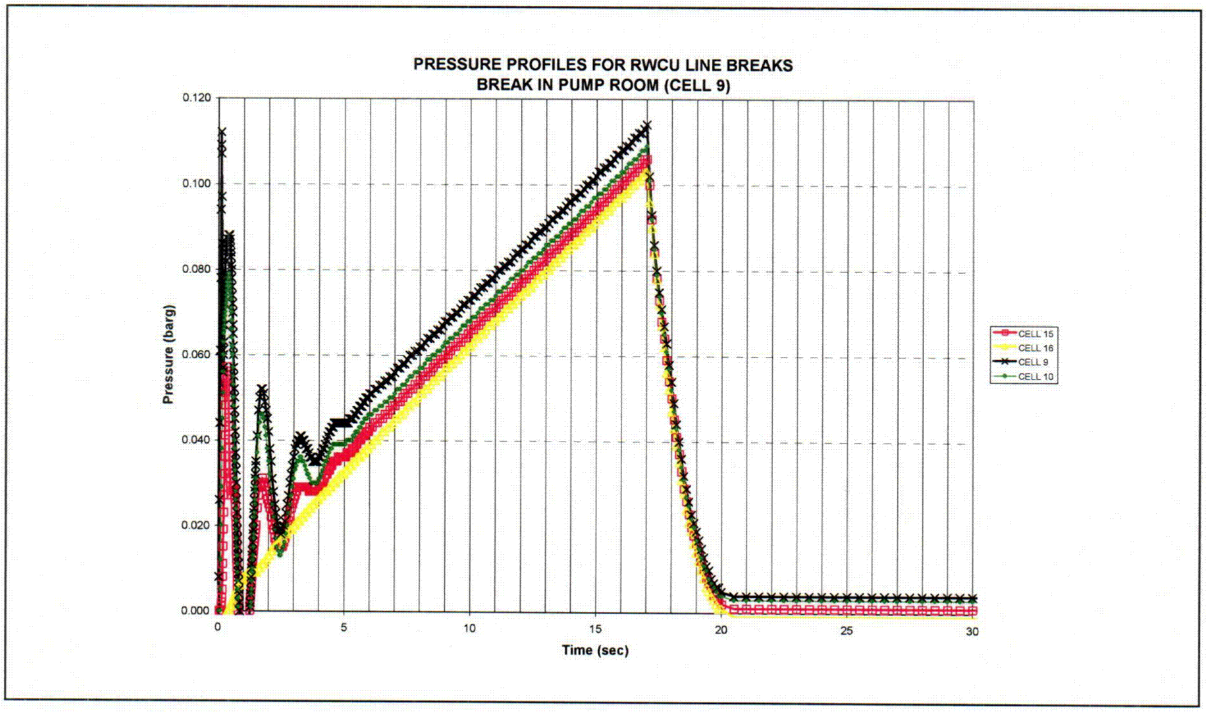

Figure 6.2-26 Pressure Histories due to Break Case 4 in Cell 9 (Sub-Model 1)

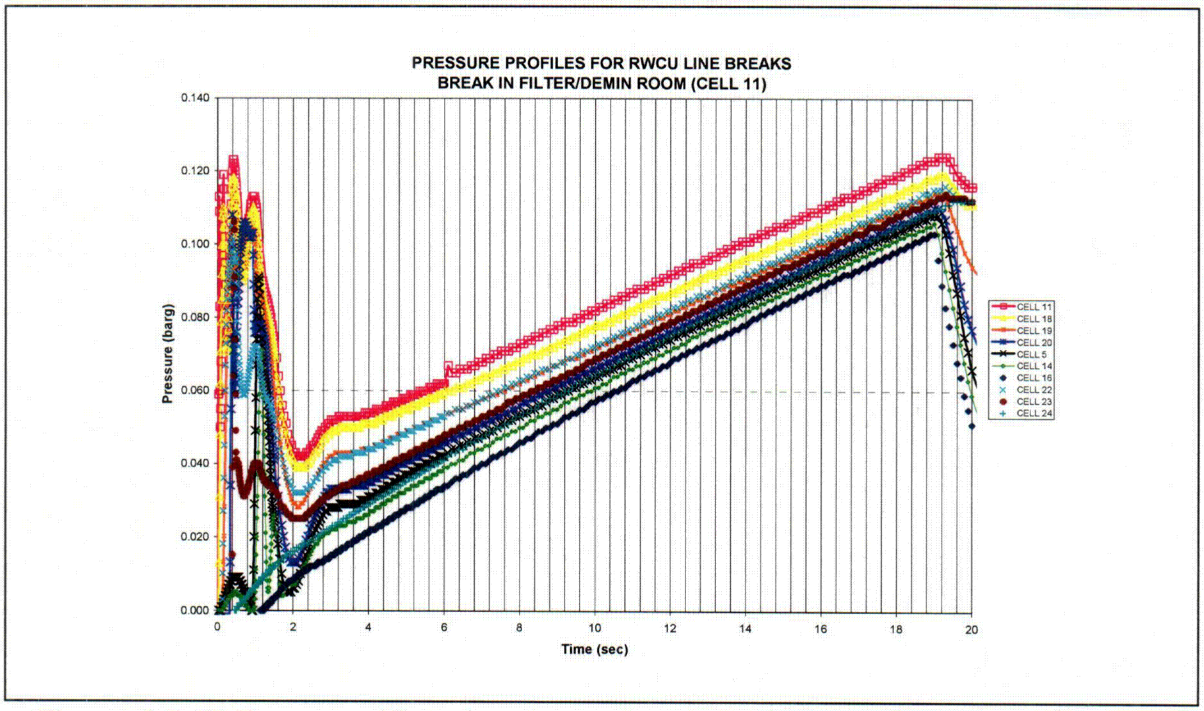

Figure 6.2-27 Pressure Histories due to Break Case 5 in Cell 11 (Sub-Model 2)

conjunction with worst-case single active component failure is considered. Blowout panels between compartments provide flow paths to relieve pressure.

- The RB is capable of periodic testing to assure that the leakage rates assumed in the radiological analyses are met.

6.2.3.2 Design Description

The Reactor Building is a reinforced concrete structure that forms an envelope completely surrounding the containment (except the basemat). The boundary of the clean areas and the Reactor Building are shown in Figure 6.2-17.

During normal operation, the Reactor Building potentially contaminated areas are maintained at a slightly negative pressure relative to adjoining areas by the Contaminated Area HVAC Sub-system (CONAVS) portion of the Reactor Building HVAC system (Section 9.4.6). This assures that any leakage from these areas is collected and treated before release. Airflow is from clean to potentially contaminated areas. Reactor Building effluents are monitored for radioactivity by stack radiation monitors. If the radioactivity level rises above set levels, the discharge can be routed through CONAVS purge system for treatment before further release.

Penetrations through the RB envelope are designed to minimize leakage. All piping and electrical penetrations are sealed for leakage. Access to the Reactor Building is through interlocked doors. The Reactor Building HVAC system is designed and tested for isolation under accident conditions.

High-energy pipe breaks (HELB) in any of the Reactor Building compartments do not require the building to be isolated. These breaks are detected and the broken pipe is isolated by the closure of system isolation valves (Subsection 7.3.3). There is no significant release of radioactivity postulated from these types of accidents because reactor fuel is not damaged.

The following paragraphs are brief descriptions of the major compartments in the ESBWR design.

Reactor Water Cleanup (RWCU) Equipment and Valve Rooms

The two independent RWCU divisions are located in the 0–90° and 270-0° quadrants of the Reactor Building. The RWCU equipment (pumps, heat exchangers, and filter/demineralizers) is located on floor elevations -11500 mm and -6400 mm with separate rooms for equipment and valves. The RWCU piping originates at the reactor pressure vessel. High energy piping leads to the RWCU divisions through a dedicated, enclosed, pipe chase. The steam/air mixture resulting from a high energy line break in any RWCU compartment is directed through adjoining compartments and pipe chase to the Reactor Building operating floor. Figure 6.2-18 shows the model of the Reactor Building compartments with the interconnecting flow paths for a typical analysis. The design basis break for the RWCU system compartment network is a double-ended break. The selected break cases are identified in Table 6.2-11. Figure 6.2-19 through 6.2-27 provide the pressure profiles due to all postulated RWCU/SDC system break cases for each individual room/region. The envelope profile represents the calculated maximum pressure response values for the given room/region due to all postulated RWCU/SDC system pipe breaks. No margin is included in these pressure profiles. Tables 6.2-12b provide the mass and energy release data for the break cases analyzed.

NRC RAI 6.2-43

Provide the mass and energy release data for the postulated pipe breaks in tabular form, with time in seconds, mass release rate in kg/sec, enthalpy of mass released in kJ/kg, and energy release rate in W/sec. A minimum of 20 data points should be used from time zero to the time of peak pressure. The mass and energy release data should be given for at least the first three seconds. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

The required information will be included.

DCD Subsection 6.2.3.2 will be revised in the next issue as noted in markup attached to RAI 6.2-42.

Table 6.2-12b below will be added in the DCD Revision 2 which is the same as provided in the ABWR DCD.

Table 6.2-12b – Mass and Energy Release Rate

TIME (sec)	MASS FLOW (kg/sec)	ENTHALPY (kJ/kg)	ENERGY (W)
Break Case 1- RWCU/SDC System Break in NRHX Room.			
0	782.6	1224.41	9.58E+08
5.14	782.6	1224.41	9.58E+08
5.14	617.2	1224.41	7.55E+08
7.83	617.2	1224.41	7.55E+08
7.83	337.7	976.69	3.29E+08
42.7	337.7	976.69	3.29E+08
42.7	337.7	888.76	3.0E+08
53.61	337.7	888.76	3.0E+08
53.61	225.9	1224.41	2.77E+08
64.05	225.9	1224.41	2.77E+08
76	0	1224.41	0.0
Break Case 2- RWCU/SDC System Break in NRHX Valve Room.			
0	503.1	1058.10	5.32E+08
12.97	503.1	1058.10	5.32E+08
12.97	204.4	815.03	1.67E+08
60.29	204.4	815.03	1.67E+08

Table 6.2-12b – Mass and Energy Release Rate

TIME (sec)	MASS FLOW (kg/sec)	ENTHALPY (kJ/kg)	ENERGY (W)
60.29	92.6	1224.41	1.13E+08
64.05	92.6	1224.41	1.13E+08
76	0.0	1224.41	0
Break Case 3- RWCU/SDC System Break in RHX Room			
0	782.6	1224.41	9.58E+08
5.14	782.6	1224.41	9.58E+08
5.14	617.2	1224.41	7.56E+08
7.83	617.2	1224.41	7.56E+08
7.83	337.7	976.69	3.3E+08
42.7	337.7	976.69	3.3E+08
42.7	337.7	888.76	3E+08
53.61	337.7	888.76	3E+08
53.61	225.9	1224.41	2.77E+08
64.05	225.9	1224.41	2.77E+08
76	0	1224.41	0
Break Case 4- RWCU/SDC System Break in RWCU/SDC Pump Rooms.			
0	223.6	1224.41	2.74E+08
17.02	223.6	1224.41	2.74E+08
17.02	111.8	1224.41	1.37E+08
34.69	111.8	1224.41	1.37E+08
34.69	111.8	1224.41	1.37E+08
36.77	111.8	1224.41	1.37E+08
36.77	391.3	1224.41	4.79E+08
49.73	391.3	1224.41	4.79E+08
49.73	68.5	1224.41	8.39E+07
64.05	68.5	1224.41	8.39E+07
76	0	1224.41	0.00E+00
Break Case 5- RWCU/SDC System Break in Filter/Demineralizer Room			
0	503.1	1167.42	5.87E+08
9.9	503.1	1167.42	5.87E+08
30.55	503.1	1167.42	5.87E+08
30.55	180.3	1065.54	1.92E+08
64.05	180.3	1065.54	1.92E+08
64.05	180.3	1065.54	1.92E+08

Table 6.2-12b – Mass and Energy Release Rate

TIME (sec)	MASS FLOW (kg/sec)	ENTHALPY (kJ/kg)	ENERGY (W)
76	111.8	968.31	1.08E+08
136.42	111.8	968.31	1.08E+08
136.42	0	0	0

NRC RAI 6.2-44

For all vent flow paths, provide the flow conditions (subsonic or sonic) up to the time of peak pressure. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

The required information will be included.

DCD Table 6.2-12 will be revised in the next issue as noted in the attached markup.

Table 6.2-12

Subcompartment Vent Path Designation

FIGURE	FLOW PATH NO.	CELL FROM	CELL TO	TYPE	FLOW PATH		LOSS COEFFICIENTS				FLOW CONDITION	FLOW DIRECTION	BLOW-OUT PRESSURE (Pa g)	COMMENTS
					LENGTH (m)	AREA (m^2)	t	FORWARD DIRECTION	REVERSE DIRECTION	ANALYSIS LOSS COEFFICIENT				
6.2-18	1	1	2	DOOR	2.0	4.0	0.24	1.56	1.61	0.79	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	2	2	3	DOOR	1.0	4.0	0.97	1.51	1.24	0.69	Subsonic	FORWARD	1.034E4	–
6.2-18	3	2	3	DOOR	1,0	4.0	0.97	1.52	1.26	0.7	Subsonic	FORWARD	1.034E4	–
6.2-18	4	3	4	DOOR	0.7	4.0	1.13	1.25	1.24	0.62	Subsonic	FORWARD	1.034E4	–
6.2-18	5	3	5	DOOR	0.5	4.0	1.19	1.31	1.32	0.66	Subsonic	FORWARD	1.034E4	–
6.2-18	6	6	7	DOOR	2.0	4.0	0.24	1.56	1.61	0.79	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	7	7	5	DOOR	1.0	4.0	0.97	1.52	1.26	0.7	Subsonic	FORWARD	1.034E4	–
6.2-18	8	7	5	DOOR	1.0	4.0	0.97	1.51	1.24	0.69	Subsonic	FORWARD	1.034E4	–
6.2-18	9	8	4	DOOR	2.0	4.0	0.24	1.43	1.47	0.72	Subsonic	FORWARD	1.034E4	–
6.2-18	10	9	10	DOOR	2.0	4.0	0.24	1.49	1.48	0.74	Subsonic	FORWARD	1.034E4	–
6.2-18	11	10	5	DOOR	0.7	4.0	1.13	1.25	1.24	0.62	Subsonic	FORWARD	1.034E4	–
6.2-18	12	10	4	DOOR	0.5	4.0	1.19	1.24	1.24	0.62	Subsonic	FORWARD	1.034E4	–
6.2-18	13	11	10	DELETED										
6.2-18	14	12	16	OPEN SPACE	1.0	5.0	0.97	0.90	0.47	0.34	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	15	13	16	OPEN SPACE	1.0	5.0	0.97	0.90	0.47	0.34	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	16	14	16	OPEN SPACE	1.0	5.0	0.97	0.93	0.48	0.35	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	17	15	16	OPEN SPACE	1.0	5.0	0.97	0.93	0.48	0.35	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	18	3	12	OPEN SPACE	1.0	5.0	0.97	0.47	0.90	0.34	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	19	5	14	OPEN SPACE	1.0	5.0	0.97	0.48	0.93	0.35	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	20	10	15	OPEN SPACE	1.0	5.0	0.97	0.48	0.93	0.35	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	21	4	13	OPEN SPACE	1.0	5.0	0.97	0.47	0.90	0.34	Subsonic	NO BLOW-OUT PANEL		two-way path
6.2-18	22	16	17	BLOW-OUT PANEL	1.0	16.0	0.97	2.46	2.44	1.23	Subsonic	FORWARD	1.034E4	Assumed blow-out to atmosphere
6.2-18	23	11	18	HATCH	1.0	11.56	1.16	2.09	1.41	0.87	Subsonic	FORWARD	1.034E4	–
6.2-18	24	18	19	DOOR	0.6	4.0	1.16	1.97	1.97	0.98	Subsonic	FORWARD	1.034E4	–
6.2-18	25	19	20	DOOR	0.3	4.0	1.25	2.07	2.07	1.04	Subsonic	FORWARD	1.034E4	–
6.2-18	26	20	5	DOOR	2.0	4.0	0.24	1.22	0.82	0.51	Subsonic	FORWARD	1.034E4	–

Table 6.2-12

Subcompartment Vent Path Designation

FIGURE	FLOW PATH NO.	CELL FROM	CELL TO	TYPE	FLOW PATH		LOSS COEFFICIENTS				FLOW CONDITION	FLOW DIRECTION	BLOW-OUT PRESSURE (Pa g)	COMMENTS
					LENGTH (m)	AREA (m^2)	t	FORWARD DIRECTION	REVERSE DIRECTION	ANALYSIS LOSS COEFFICIENT				
6.2-18	27	20	21	DOOR	0.3	4.0	1.25	2.07	2.07	1.04	Subsonic	FORWARD	1.034E4	–
6.2-18	28	21	22	DOOR	0.6	4.0	1.16	1.97	1.97	0.98	Subsonic	FORWARD	1.034E4	–
6.2-18	29	18	22	DOOR	0.3	4.0	1.25	2.07	2.07	1.04	Subsonic	FORWARD	1.034E4	–
6.2-18	30	22	23	DOOR	2.0	4.0	0.24	1.49	1.63	0.78	Subsonic	FORWARD	1.034E4	–
6.2-18	31	23	24	DOOR	2.0	4.0	0.24	1.59	1.48	0.77	Subsonic	FORWARD	1.034E4	–

<u>NRC RAI 6.2-45</u>

Provide a detailed description of the method used to determine vent loss coefficients. Provide a tabulation of the vent paths for each subcompartment and the loss coefficients. Provide this information as part of DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

<u>GE Response</u>

The forward and reverse flow loss coefficients were calculated in accordance with Section IV Diagram 4-11 of handbook -E Idel'chick Handbook of Hydraulic Resistance, Coefficients of Local Resistance and Friction, 1960. The calculated forward and reverse flow loss coefficients were averaged and used as a single value input in CONTAIN, since the CONTAIN code allows for only one flow loss coefficient value. The loss coefficients are tabulated in DCD Table 6.2-12. Analysis Loss Coefficient (for CONTAIN) is K-Idel'Chick/2.

See attachment to RAI 6.2-44 for the revised Table 6.2-12.

NRC RAI 6.2-46

Provide, in electronic format, the CONTAIN 2.0 models for the limiting case for each reactor building subcomparment model to allow the staff to perform independent studies.

GE Response

Attached is the CONTAIN 2.0 model general input file for all breaks.

No DCD changes will be made in response to this RAI.

NRC RAI 6.2-47

Provide tabularized subcompartment volumes and vent paths to allow the staff to perform independent analyses. See for example, Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition) Rev. 3 (ADAMS ML011340072, ML011340108, and ML011340116), Section 6.2.1.2.

GE Response

DCD Table 6.2-12 provides the subcompartment vent path information in accordance with Table 6-13 of Regulatory Guide (RG) 1.70 Rev 3.

Table 6.2-12a below will be added in DCD Rev 2. It provides the following parameters required by Table 6-14 of RG 1.70 Rev 3.

a. "Cell Number" in Table 6.2-12a corresponds to "Volume No" in Table 6-14 of RG 1.70 Rev 3.
b. "Description" in Table 6-2.12a corresponds to "Description" in Table 6-14 of RG 1.70 Rev 3.
c. "Volume" in Table 6.2-12a corresponds to product of "Height" and "Cross Sectional Area" in Table 6-14 of RG 1.70 Rev 3.
d. "Postulated Break" in Table 6.2-12a corresponds to "Break Loc. Vol. No." and "Break Line" in Table 6-14 of RG 1.70 Rev 3.
e. "Initial Conditions" in Table 6.2-12a corresponds to "Initial Conditions" in Table 6-14 of RG 1.70 Rev 3.
f. "Calculated Peak Pressure" in Table 6.2-12a corresponds to "Calc. Peak Press Diff" required in Table 6-14 of RG 1.70 Rev 3.

The remaining required parameters in Table 6-14 of RG 1.70 Rev 3 are given as follows:

g. "Break Type" required in Table 6-14 of RG 1.70 Rev 3 is described in DCD Section 6.2.3.2 under heading "Reactor Water Cleanup (RWCU) Equipment and Valve Rooms" in the second to last sentence as "double-ended break".
h. "Design Peak Pressure" required in Table 6-14 of RG 1.70 Rev 3 is given in DCD Section 6.2.3.3 under the heading "Compartment Pressurization Analysis" in the last sentence of the first paragraph, which refers to DCD Section 3G.1.5.2.1.11, and which gives a value of 34.5 kPag.
i. "Design Margin" required in Table 6-14 of RG 1.70 Rev 3 is currently not given in the DCD. This will be included in the DCD as per response to RAI # 6.2-35.

Table 6.2-12a below will be added to the DCD Revision 2.

DCD Subsection 6.2.3.3 will be revised in the next issue as noted in the markup provided for RAI 6.2-35.

Table 6.2-12a Subcompartment Nodal Description

Figure	Cell Number	Postulated Break (See Table 6.2-11 for Break Case Description)	Description	Room No.	Net Volume (m^3)	Calculated Peak Pressure (kPa g)	Initial Conditions		
							Pressure (Pa a)	Temperature (°C)	Relative Humidity (%)
6.2-18	1	CASE 1 CASE 3	RWCU /Shutdown Cooling Heat Exchanger Room A	1151	348	25.2	1.013e5	43	0
6.2-18	2	CASE 2	RWCU /Shutdown Cooling Valve Room A	1150	271	15.3	1.013e5	43	0
6.2-18	3	NO	Corridor A El. -11500 mm	1100	334	13.5	1.013e5	43	0
6.2-18	4	NO	Corridor B El. -11500 mm	1101	472	12.4	1.013e5	43	0
6.2-18	5	NO	Corridor D El. -11500 mm	1103	342	21.7	1.013e5	43	0
6.2-18	6	CASE 1 CASE 3	RWCU /Shutdown Cooling Heat Exchanger Room B	1161	353	32.6	1.013e5	43	0
6.2-18	7	CASE 2	RWCU /Shutdown Cooling Valve Room B	1160	271	24.2	1.013e5	43	0
6.2-18	8	CASE 4	RWCU /Shutdown Cooling Pump Room A	1152	151	12.5	1.013e5	43	0
6.2-18	9	CASE 4	RWCU /Shutdown Cooling Pump Room B	1162	151	12.6	1.013e5	43	0
6.2-18	10	NO	Corridor C El. -11500 mm	1102	519	12.4	1.013e5	43	0
6.2-18	11	CASE 5	RWCU /Shutdown Cooling Filter/Demin. Vault A1	1251	152	13.7	1.013e5	43	0
6.2-18	12	NO	Non-Divisional Commodity Chase A	1293	565	12	1.013e5	43	0
6.2-18	13	NO	Non-Divisional Commodity Chase B	1294	565	11.9	1.013e5	43	0
6.2-18	14	NO	Non-Divisional Commodity Chase D	1296	565	14.2	1.013e5	43	0
6.2-18	15	NO	Non-Divisional Commodity Chase C	1295	565	12	1.013e5	43	0

Table 6.2-12a Subcompartment Nodal Description

Figure	Cell Number	Postulated Break (See Table 6.2-11 for Break Case Description)	Description	Room No.	Net Volume (m^3)	Calculated Peak Pressure (kPa g)	Initial Conditions		
							Pressure (Pa a)	Temperature (°C)	Relative Humidity (%)
6.2-18	16	NO	UPPER PLENUM	—	26163	11.4	1.013e5	43	0
6.2-18	17	NO	Atmosphere	—	1.0E8	—	1.013e5	40	0
6.2-18	18	NO	Filter/Demin Access Room	1306	458	13.2	1.013e5	43	0
6.2-18	19	NO	RWCU /Shutdown Cooling Heat Exchanger Access Room A	1304	458	12.6	1.013e5	43	0
6.2-18	20	NO	Interior Stairwell A	1195	153	12.2	1.013e5	43	0
6.2-18	21	NO	RWCU /Shutdown Cooling Heat Exchanger Access Room B	1305	458	12.2	1.013e5	43	0
6.2-18	22	NO	Control Rod Drive Pump Access Room	1307	458	12.9	1.013e5	43	0
6.2-18	23	NO	Controlled Equipment Removal Access Room	1308	122	12.6	1.013e5	43	0
6.2-18	24	NO	FUEL BUILDING	—	29000	12.4	1.013e5	43	0

Pages 34 – 72 are proprietary and have been extracted

ENCLOSURE 3

MFN 06-264

Affidavit

General Electric Company

AFFIDAVIT

I, George B. Stramback, state as follows:

(1) I am Manager, Regulatory Services, General Electric Company ("GE"), 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 GE letter MFN 06-264, David H. Hinds to USNRC, *Response to Portion of NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-9, 6.2-13, 6.2-32, 6.2-33, 6.2-35 through 6.2-39, and 6.2-41 through 6.2-47,* dated August 17, 2006. The proprietary information in Enclosure 1, *Response to Portion of NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-9, 6.2-13, 6.2-32, 6.2-33, 6.2-35 through 6.2-39, and 6.2-41 through 6.2-47 – GE Proprietary Information,* is delineated by a double underline 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 containment design and modeling information developed by GE over a period of several years at a cost of over one 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.

(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 17th day of August 2006.

George B. Stramback
General Electric Company