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MFN 06-127

Docket No. 52-010

June 16, 2006

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

Subject: **Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Design and Testing of Depressurization Valves, Vacuum Breakers and Critical Check Valves - RAI Numbers 3.9-1 and 3.9-2**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter. Correspondence and reports regarding the testing of depressurization valves and vacuum breakers are provided in response to RAI 3.9-1. Please note the following regarding these documents:

- GE Report GEFR-00879, "Depressurization Valve Development Test Program Final Report," October 1990 is being reformatted such that it can be submitted to the NRC and will be provided separately.
- MFN 155-94, "NRC Requests for Additional Information (RAIs) on the Simplified Boiling Water Reactor (SBWR) Design," 12/15/94 included some proprietary information. The proprietary portions are contained in Enclosure 4 and the non proprietary content is in Enclosure 3. The original affidavit (contained in Enclosure 4) applies to the proprietary content.

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 06-127 - Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application – Design and Testing of Depressurization Valves, Vacuum Breakers and Critical Check Valves - RAI Numbers 3.9-1 and 3.9-2
2. Reports/Correspondence Related to DPV Testing – non proprietary
3. Reports/Correspondence Related to VB Testing – non proprietary
4. Reports/Correspondence Related to VB Testing – Contains GE proprietary information

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)
eDRF 0000-0053-3505

ENCLOSURE 1

MFN 06-127

Partial Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application Design and Testing of Depressurization Valves, Vacuum Breakers and Critical Check Valves RAI Numbers 3.9-1 and 3.9-2

NRC RAI 3.9-1

During the pre-application phase of the ESBWR review, GE stated that full-size testing of the DPV and the VB were conducted to demonstrate the operation and reliability of these valves. However, the technical evaluation of the design and the testing programs for the DPV and VB were not part of the ESBWR pre-application review scope. Provide additional information regarding the design and testing of DPV and VB.

GE Response

The testing of the DPV and VB valves were conducted during the development of the SBWR in the 1990 time frame, and information was submitted during that time period for NRC review. The design of these valves remains the same for ESBWR except that the quantity of valves has increased to accommodate the larger plant size. The following is a listing of correspondence and reports from that time period:

DPV Testing – Enclosure 2

- MFN 136-95, "SBWR – Response to Request for Additional Information (RAI) Regarding the Simplified Boiling Water Reactor (SBWR) Design (Q900.102 – Q900.181," 7/28/95
- GE Report GEFR-00879, "Depressurization Valve Development Test Program Final Report," October 1990 – to be provided under separate cover

VB Testing – Enclosure 3

- MFN 065-94, "NRC Requests for Additional Information (RAI) on the Simplified Boiling Water Reactor (SBWR) Design," 5/2/94
- MFN 113-94, "Responses to the Referenced letters," 9/26/94
- MFN 155-94, "NRC Requests for Additional Information (RAIs) on the Simplified Boiling Water Reactor (SBWR) Design," 12/15/94 – non proprietary attachments
  - UTE I/EA Doc. No. 02-STS-0002-1, "SBWR Study Vacuum Breaker FMCA"
  - ED45833, "SBWR Vacuum Breaker Prototype Experimental Qualification General Test Procedure"
  - ED45834, "SBWR Vacuum Breaker Prototype Experimental Qualification FIAT CIEI Test Procedure"
  - ED45894, "SBWR Vacuum Breaker Prototype Experimental Qualification Thermal Ageing Procedure"
- MFN 021-95, "Request for Exemption of the SBWR Drywell to Wetwell Vacuum Breaker from Single Failure Criteria," 2/16/95
- MFN 018-95, "Approach to Achieve Closure of Items Related to the GE SBWR TAPD," 2/14/95
- MFN 216-95, "SBWR – Vacuum Breaker Single Failure Exemption," 11/7/95

- MFN 021-96, "Vacuum Breaker Test Program," 2/14/96
- MFN 035-96, "SBWR – Closure of the Vacuum Breaker Test Program," 3/12/96
- NEDO-32391, Revision A., "SBWR Test and Analysis program Description," September 1994

VB Testing – Enclosure 4 (Contains GE Proprietary Information)

MFN 155-94, "NRC Requests for Additional Information (RAIs) on the Simplified Boiling Water Reactor (SBWR) Design," 12/15/94
Proprietary Contents:

- "RAI Number 900.62"
- ED45841, "SBWR Vacuum Breaker Prototype Experimental Qualification General Test Notification Plan"
- ED45933, "SBWR Vacuum Breaker Prototype Experimental Qualification Campaign – Technical Note"
- Inspection Certificates
- QPLVBR00001, "Vacuum Breaker Valve Design Basis Accident Simulation Quality Plan"
- TCE.MII.G.1002, "Drywell to Wetwell Vacuum Breaker Dynamic Qualification Quality Control Plan"
- ED45913, "SBWR Vacuum Breaker Prototype Experimental Qualification General Test Report"
- ED45914, "SBWR Vacuum Breaker Prototype Experimental Qualification FIAT CIEI/COMPES Test Report"
- ED45921, "SBWR Vacuum Breaker Prototype Experimental Qualification HATU-ICO Test Report"
- ED45915, "SBWR Vacuum Breaker Prototype Experimental Qualification Ferioli E Gianotti Test Report"

NRC RAI 3.9-2

DCD Sections 3.9.3.5.2 and Section 3.9.6.1 address issues related to check valves (CVs) but do not include adequate information to provide confidence that the CVs will be designed, manufactured, qualified, installed and periodically tested to perform their applicable safety functions. The design and testing issues for certain critical CVs, especially in passive plant designs, may need to be addressed during the design certification phase. Provide additional information regarding design conditions for each critical CV (such as flow, differential pressure, system pressure, flow temperature and ambient conditions), and prototypical or qualification testing of each size, type and model of CV under a range of differential pressure and flow conditions up to the design conditions to ensure the adequacy of CVs under design and required operating conditions. Your response should include the following information:

1. *What is the design ΔP to hold these valves in close position, and what is the expected ΔP across the valve during operation.*
2. *What is the design ΔP to break open these valves and what is the minimum ΔP expected or available to break open these valves.*
3. *What is the design flow or flow velocity required to lift the disc in stable full-open position and what is the minimum flow rate expected or available when these valves are called upon to perform their intended safety function.*
4. *Describe qualification requirements and provide acceptance criteria for these requirements for testing each size, type, and model under required or expected operating conditions up to design-basis conditions.*
5. *Provide an estimate of the reliability for these check valves based on study, test data and/or any relevant operating experiences.*
6. *Due to design limitations or reasons of impracticality for certain old vintage plants, the ASME OM Code allows test intervals to be extended up to refueling outage. However, ESBWR has a long lead time to design the plant and should have sufficient time to include provisions or necessary design features to accommodate the quarterly test. GE is proposing a refueling outage test frequency for these valves, but no justification is provided as to why ESBWR can not be designed to accommodate the quarterly test.*
7. *Describe the non-intrusive techniques and acceptance criteria used to assess the degradation and performance of these valves.*
8. *Describe the test parameters and acceptance criteria for successful completion of the preservice and inservice testing of these valves to demonstrate continuing design-basis capability of these valves.*

This information should be provided for the GDCS CV, the only critical CV that has been identified so far. We will request similar information for any additional critical CVs we identify. Detailed guidance on the functional design, qualification and inservice testing of CVs can be found in SRP 3.9.6, Draft 3, April 1996.

GE Response

The following are responses to items listed in the RAI related to the GDCS biased open check valves in the injection lines and the equalizing lines:

1-3. The system available flows and ΔP across the check valves during a design basis accident (DBA) are functions of reactor pressure, drywell pressure, and GDCS pool height. Typical available system flows for an injection line during such an event range from 3.32 to 1.69 m/sec. The available static head to open the check valves from the GDCS pools is approximately 135 kPa. The available ΔP to hold the check valves closed is a function of reactor pressure, which varies as it is being depressurized by the automatic depressurization system during a DBA. Reactor pressure during such an event ranges from approximately 7000 kPa down to approximately 200 kPa. During normal reactor operation, there is zero differential pressure across the check valve, since the downstream squib valve isolates the biased open check valve from reactor pressure. GDCS biased open check valve design will be bounded by system available flows and pressures.

4. Type: Check Valve – Tilting Disc (Biased Open)
Size: 6 inch
Model: Determined by COL Applicant

The check valve is a Seismic Category 1, designed per ASME Section III, Class 1. The following industrial codes and standards are used.

Code or Standard Number	Year	Title
Institute of Electrical and Electronic Engineers (IEEE)		
323-2003	2003	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
344-2004	2004	Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations
American Society of Mechanical Engineers (ASME)		
BPVC Sec II	2004	Boiler & Pressure Vessel Code (BPVC) Section II - Materials
BPVC Sec III	2004	BPVC Section III, Rules for Construction of Nuclear Power Plant Components Division 1: NB and NCA
BPVC Sec V	2004	BPVC Section V: Nondestructive Examination

5. Component reliability data is provided in Section 5 of NEDO-33201 Revision 1, which has been previously supplied to NRC.

Tilting disc check valves are used through the nuclear power generating industry, and hinge pin wear has been identified as major failure mode. The GDCS check valve will see light duty (quarterly surveillance testing) during normal operation and such concern is minimized.

6. The GDCS check valve will be remotely tested quarterly by exercising and position indication test. Leak test will be conducted during refueling outages. Revision to DCD Tier 2, Table 3.9-8, In-Service Testing, will be updated with the following changes:

F003	8	GDCS biased open check valve (g1)	1	C	A	~~S~~ L S, P	R0 3 mo
F007	4	GDCS based open check valve (g1)	1	C	A	~~S, P~~L S, P	R0 3 mo

7. During normal reactor operations, the valve will be actuated remotely through the use of a non-intrusive magnetically coupled torque-motor. The disc will be made to travel its full range of motion from closed to fully open and back to its biased open position. During refueling outages, the valve will be made to close through a reverse flow supplied downstream of the valve using a test line connection. Leakage will not exceed the expected leakage characterized for normal surveillance testing conditions.

8. In the pre-service testing the valve will be required to meet the component design data to be provided by the COL applicant as per response # 1. Testing will involve forward flow and reverse flow testing. The start of disc movement to full disc lift will be required at designated forward flows. Leakage will not exceed the characterized allowable leakage at reverse flow. For in-service testing, see response # 7.