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Subject: Response to Portion of NRC Request for Additional Information Letter No. 106 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-179

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI transmitted via the Reference 1 letter.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 07-479, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 106 Related to ESBWR Design Certification Application*, September 6, 2007

Enclosure:

1. MFN 08-215 - Response to Portion of NRC Request for Additional Information Letter No. 106 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-179

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	eDRF	0000-0079-9188

Enclosure 1

MFN 08-215

Response to Portion of NRC Request for Additional Information Letter No. 106 Related to ESBWR Design Certification Application

Containment Systems

RAI Number 6.2-179

NRC RAI 6.2-179:

The governing regulation for TMI Action Plan Item II.E.4.4, Containment Purging During Reactor Operation, is 10 CFR 50.34(f)(2)(xv), which states:

Provide a capability for containment purginglventing designed to minimize the purging time consistent with ALARA principles for occupational exposure. Provide and demonstrate high assurance that the purge system will reliably isolate under accident conditions. (II.E.4.4)

The DCD entry on this generic issue, in Table 1A-I, "TMI Action Plan Items," simply asserts that the ESBWR design complies with these requirements, without explanation or justification.

What follows is a discussion of the bases for the generic issue.

The first requirement of the regulation refers to a situation that generally does not occur in a plant with an inerted containment atmosphere, which is unwarranted or excessive containment purging. The NRC established this generic issue because it had found that some (non-inerted) plants were purging/venting their containments for sizable fractions of the plant's operating time, or even continuously. The NRC recognized that an open purge/vent line constitutes a sizable hole in the containment boundary, which is intrinsically a less safe condition than having all purge/vent valves closed, in case an accident occurred. One legitimate reason for purging while the reactor is operating is to reduce the concentration of airborne radioactive material in the containment atmosphere, which would reduce personnel occupational exposure for personnel who enter containment. The regulation, then, calls for minimizing purging time, consistent with ALARA principles for occupational exposure. However, personnel do not enter containments while they are inerted, so there is no need to purge for this reason. In general, plants with inerted containment will naturally minimize purge/vent time (except when inerting or de-inerting) because of the cost of the nitrogen gas needed to replace that which is expelled from containment. Also, as mentioned before, personnel exposure during containment entries is not a factor.

The second requirement of the regulation, to provide and demonstrate high assurance that the purge system will reliably isolate under accident conditions, is explained in more detail in NUREG-0737, item II.E.4.2, subpart (6) and Attachment 1. The staff had found that some purge/vent valves in operating plants, typically butterfly valves, were not capable of closing if a design bases (DB) loss of coolant accident (LOCA) occurred while the valves were open.

In a DB LOCA, containment pressure increases so rapidly that the containment atmosphere rushes out through open purge/vent valves before they can begin to close. Some valves were found to be incapable of closing against the aerodynamic forces induced by the rapidly moving gas; in fact, some valves would even be damaged by the transient so that they would be stuck open and incapable of closing again until repaired. The regulation, therefore, requires the applicant to demonstrate, by analysis and/or testing, that the purge/vent valves would be capable of closing under these conditions. An alternative to such demonstration is to assure that purge/vent valves will never be open while the plant is operating, by including a requirement in the Technical

Specifications (TS) that they must be locked or sealed closed in Modes 1 through 4, with no exception for even momentary opening of a purge/vent line while in Modes 1 through 4. The ESBWR TS SR 3.6.1.3.1 indicates that the ESBWR purge/vent valves will not be sealed closed.

Note that this issue extends beyond the 500 mm (20 in) purge valves covered by TS SR 3.6.1.3.1. Other systems which may purge/vent the containment, regardless of what they are called, must be included. Some or all of the valves in the containment inerting system, for example, will be opened to purge/vent the containment in Modes 1 through 4 and must also be demonstrated to reliably isolate under accident conditions.

Provide the following information:

A. *Provide a discussion in the DCD which presents arguments or justifications to demonstrate compliance with the requirement of 10 CFR 50.34(f)(2)(xv) to provide a capability for containment purging/venting designed to minimize the purging time consistent with ALARA principles for occupational exposure.*

B. *Provide and demonstrate in the DCD high assurance that the purge system will reliably isolate under accident conditions, or provide TS which require purge/vent valves to be sealed closed in Modes 1 through 4.*

C. *Identify in the DCD all purge/vent valves. This includes all containment isolation valves (CIVs) in lines that perform a purging or venting function - meaning transferring gas between the containment atmosphere and the outside atmosphere. This may include some or all of the CIVs in the containment inerting system, and perhaps others. All purge/vent valves are subject to the requirements of 10 CFR 50.34(f)(2)(xv).*

GEH Response:

DCD Tier 2, Chapter 16, Technical Specification (TS) Surveillance Requirement (SR) 3.6.1.3.1 will be revised to eliminate the specific sizes of the purge/vent valves, and DCD Tier 2, Chapter 16B, TS SR 3.6.1.3.1 Bases, will be revised to include the 25 mm, 350 mm, and 400 mm purge/vent valves as well as the 500 mm purge/vent valves. These other purge/vent valves exist within the same system as the 500 mm valves, and the system is described below. All other systems that penetrate containment and have direct contact with containment atmosphere do not have a purge/vent capability. These other systems are the Process Radiation Monitoring System and Containment Monitoring System.

A. The containment purging/venting is performed using the Containment Inerting System (CIS). A description of the system is provided in DCD Tier 2, Chapter 6, Subsection 6.2.5.2. The CIS is used to establish and maintain an inert atmosphere within the containment during all plant operating modes except during plant shutdown for refueling or maintenance and during limited periods of time to permit access for inspection and maintenance during reactor low power operation. The system is designed to permit de-inerting the containment for safe operator access and minimizing personnel exposure. DCD Tier 2, Chapter 16, Technical

Specification (TS) 3.6.1.8 sets out the conditions for inerting and de-inerting containment (See response to RAI 16.2-110 S02, MFN 07-025 Supplement 2).

The DCD will be revised to describe the CIS function in relation to minimizing personnel exposure.

B. As discussed in the response to RAI 3.9-178 and the associated DCD Tier 2 markup (MFN 08-131), valves that perform an active safety-related function will be functionally qualified to perform their required functions, using QME-1-2007 as guidance. A qualification specification (i.e., purchase specification) consistent with Appendices QV-I and QV-A of QME-1 will be prepared for the containment purge valves to ensure the operating conditions and safety functions for which the valves are to be qualified are communicated to the manufacturer or qualification facility. In addition, as discussed in the response to RAI 3.9-193 and the associated DCD markup of Tier 2, Revision 4, Section 3.9.6.8 (MFN 08-131), active safety-related valves, including the containment purge valves, will be pre-operationally tested to verify they are set up properly to perform their required functions. Finally, the containment purge valves will be periodically tested as shown in DCD Tier 2, Revision 4, Table 3.9-8, as part of the Inservice Testing (IST) program. This testing includes periodic valve exercise testing (including stroke time measurement), verification of fail-safe performance, local leakage rate testing and remote position indicator tests.

C. As described in response "A" above, containment purging/venting is performed using the Containment Inerting System. A complete list of Containment Isolation Valves for this system can be found in the DCD Tier 2, Tables 6.2-36, 6.2-37 and 6.2-38.

DCD Impact:

DCD Tier 2, Subsection 6.2.5.1.1; DCD Tier 2, Chapter 16, Technical Specification Surveillance Requirement (TS SR) 3.6.1.3.1; and DCD Tier 2, Chapter 16B, Bases for SR 3.6.1.3.1 will be revised as shown in the attached markup.

6.2.5.1.1 Containment Purging Under Accident Conditions

In accordance with 10 CFR 50.34(2)(xv), (NUREG-0933 Item II.E.4.4), the capability for containment purging/venting is designed to minimize the purging time consistent with As Low As Reasonably Achievable (ALARA) principles for occupational exposure. The piping, valves and controls in the Containment Inerting System can be used to control containment pressure (that is, purge the containment), and can reliably be isolated under accident conditions.

The CIS is used to establish and maintain an inert atmosphere within the containment during all plant operating modes except during plant shutdown for refueling or maintenance and during limited periods of time to permit access for inspection and maintenance during reactor low power operation. The system is designed to permit de-inerting the containment for safe operator access and minimizing personnel exposure.

6.2.5.2 Containment Inerting System

The objective of the Containment Inerting System is to preclude combustion of hydrogen and prevent damage to essential equipment and structures by providing an inerted containment environment. This is the method of combustible gas control for the ESBWR, as required by 10 CFR 50.44.

6.2.5.2.1 Design Bases

Safety (10 CFR 50.2) Design Bases

The Containment Inerting System (CIS) does not perform any safety-related function. Therefore, the CIS has no safety design bases other than provision for safety-related containment penetrations and isolation valves, as described in Subsection 6.2.4.

Power Generation Design Bases

- The CIS is designed to establish an inert atmosphere (i.e., less than 4% oxygen by volume) throughout the containment in less than 4 hours and less than 2% oxygen by volume in the next 8 hours following an outage.
- The CIS is designed to maintain the containment oxygen concentration below the maximum permissible limit (3%) during normal, abnormal, and accident conditions to assure an inert atmosphere.
- The CIS is designed to maintain a positive pressure in the primary containment during normal, abnormal, and accident conditions to prevent air (oxygen) in-leakage into the inerted spaces from the Reactor Building. The CIS nitrogen gas makeup supply line is designed for the normal daily operating capacity to maintain approximately 4.8 kPaG (0.7 psig) positive pressure within the containment. The system has the capability to replenish containment atmosphere leakage at a design value of 0.5% per day based on containment operating pressure.
- The inerting auxiliary steam vaporizer is sized to provide at least 2.5 times the containment (wetwell and drywell) free volume of nitrogen within the allotted 4 hours. The temperature of the injected nitrogen is within the range of 10°C (50°F) to 65°C (150°F).
- The CIS is designed to permit de-inerting the containment for safe operator access without breathing apparatus in less than 12 hours.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.1.3.1	- NOTE - Not required to be met when the ~~500 mm~~ containment purge valves are open for inerting, de-inerting, pressure control, ALARA or air quality considerations for personnel entry, or Surveillances that require the valves to be open.	
	Verify each ~~500 mm~~ containment purge valve is closed.	31 days

BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.1.3.1

This SR requires periodic verification that each 25 mm, 350 mm, 400 mm, and 500 mm containment purge valve is closed. This SR ensures that the primary containment purge valves are closed as required or, if open, open for an allowable reason. If a purge valve is open in violation of this SR, the valve is inoperable.

This SR is modified by a Note that permits the 25 mm, 350 mm, 400 mm, and 500 mm containment purge valves to be opened for inerting, de-inerting, pressure control, ALARA or air quality considerations for personnel entry, or Surveillances that require the valves to be open.

The 31 day Frequency is based on engineering judgment and has been shown to be acceptable through operating experience. The 31 day Frequency is acceptable because containment purge valve status is available to operations personnel.