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Subject: **Response to NRC Request for Additional Information Letter No. 8 for the ESBWR Design Certification Application – Reactor Water Cleanup/Shutdown Cooling System – RAI Numbers 5.4-1 through 5.4-7, 6.5-1, 9.2-1, 9.2-2, 9.3-1, and 10.4-1**

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

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

Sincerely,

David H. Hinds
Manager, ESBWR

D068

Reference:

1. MFN 06-055, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 8 Related to ESBWR Design Certification Application,* February 1, 2006

Enclosure:

1. MFN 06-064 – GE Response to NRC Request for Additional Information Letter No. 8 for the ESBWR Design Certification Application – Reactor Water Cleanup/Shutdown Cooling System – RAI Numbers 5.4-1 through 5.4-7, 6.5-1, 9.2-1, 9.2-2, 9.3-1, and 10.4-1

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	0051-3120, 0050-7256, 0051-0611, 0050-8764, 0050-8743

ENCLOSURE 1

MFN 06-064

GE Response to NRC Request for Additional Information Letter No. 8 for the ESBWR Design Certification Application Reactor Water Cleanup/Shutdown Cooling System RAI Numbers 5.4-1 through 5.4-7, 6.5-1, 9.2-1, 9.2-2, 9.3-1, and 10.4-1

NRC RAI 5.4-1

Provide design requirements for the non-regenerative heat exchanger enabling it to maintain required temperature of the cleanup flow to the demineralizer when the regenerative heat exchanger cooling capacity is reduced as a result of partially bypassing a portion of the return flow to the main condenser or the radwaste system.

GE Response

The non-regenerative heat exchanger (NRHX), which is also designed to perform a shutdown cooling function, has a greater heat removal capacity that envelops the design requirement given in the above RAI.

The NRHX performance was evaluated in the cleanup mode with a reduced regenerative heat exchanger (RHX) capacity, by assuming 25% of its normal return flow bypassed to the main condenser. In this condition, to reduce the cleanup flow to the same temperature at the outlet of NRHX (or same demineralizer inlet temperature as with no return RHX flow bypassed), the estimated NRHX heat removal rate increased by 46% approximately from its heat transfer rate in the cleanup mode without RHX return flow bypassed. The NRHX is still found to have sufficient margin when compared with the shutdown cooling mode design heat removal rate.

NRC RAI 5.4-2

Provide design requirements for a system controlling the ability of the demineralizer to automatically maintain flow through its resin beds in the event the system flow has to be decreased in order to prevent loss of resin from the bed.

GE Response

The design description of flow control through demineralizer is given in DCD Subsection 7.4.3.2, under heading "Control Valves", last paragraph, first sentence as follows:

"The demineralizer bypass piping has an air-operated modulating flow control valve that will bypass the excess flow above the demineralizer capacity."

NRC RAI 5.4-3

Describe the resin transfer system and indicate the provisions taken to ensure that transfers are complete and that crud traps in transfer lines are eliminated.

GE Response

The details of the resin transfer system will be designed in the detail design phase. The following design description will be added in DCD Subsection 5.4.8.1.2 under the heading "Demineralizer".

"The resin transfer system is designed to prevent resin traps in sluice lines. Consideration is given in the design to avoid resins collecting in valves, low points or stagnant areas."

NRC RAI 5.4-4

Describe the design features of the RWCS that will control the release of radioactive effluents to the environment in accordance with GDC 60.

GE Response

The RWCU/SDC system design features to control the release of radioactive effluents to the environment in accordance with GDC 60, are as follows:

(1) Transfer contaminated liquid waste to the Liquid Waste Management System (LWMS).

Refer to DCD Subsection 5.4.8.1.2, 6th and 7th paragraphs under heading "Overboarding" for description of the transfer of high radiation effluent to LWMS.

(2) Flushing connections to decontaminate piping and equipment. Refer to DCD subsection 12.3.1.4.1 for description. The RWCU/SDC system P&ID 105E3981 Rev 0 sheets 2 and 3 show these connections.

NRC RAI 5.4-5

Describe the control features that will prevent inadvertent opening of the filter/demineralizer backwash valves during normal operation.

GE Response

Design features that prevent inadvertent opening of the filter/demineralizer backwash valve during normal operation are not described in the DCD. The following description of this design feature will be added in DCD subsection 5.4.8.1.2 under the heading "Demineralizer".

"Interlocks are provided to prevent inadvertent opening of the demineralizer resin addition and backflushing valves during normal operation."

NRC RAI 5.4-6

Clarify whether instrumentation is provided for measuring differential pressure across the demineralizers and across the resin strainers.

GE Response

Differential pressure measurement instrumentation is provided across the resin trap and the demineralizer. P&ID 105E3981 Rev 0 sheet 4 shows these instruments. The following additional bullet item will be added in DCD subsection 7.4.3.4:

- Differential pressure indication across the demineralizer and resin trap

NRC RAI 5.4-7

Provide the basis for designing the return line from the isolation valve, up to and including the connection to the feedwater line as Quality Group B.

GE Response

The portion of RWCU/SDC system return line from the isolation valve to the interface with the feedwater line is designed to Quality Group B in order to be consistent with the Quality Group of the feedwater line at the interface. Quality Group B for the portion of the feedwater line where the RWCU/SDC system return line interfaces, is as required by Regulatory Guide 1.26.

NRC RAI 6.5-1

Provide more information on how the requirements of GDC 42 and 43 are met.

GE Response

With respect to GD 42 and 43 in the DD subsection 6.5.4 discussion, the inspection and testing of the suppression pool is addressed in DBubsection 3.8.1.7 DBubsection 6.5.4 will be modified to reflect this in the next revision of the DI(Revision 02). A marked-up copy of this subsection is attached.

Leakage through the MSIVs is routed through the main steamline drain lines to the main condenser. These large volumes and surface areas are effective mechanisms to hold up and plate out the relatively low leakage flow. (See Section 15.4) The feedwater lines are large pipes that are flooded with water. The water acts as a seal to resist leakage and scrub any leakage that does occur.

The miscellaneous other penetrations that are based within the Reactor Building (e.g., RWCU/SDC, FAPCS, RCCWS, etc.) are protected from excess leakage by one of the following methods: (1) water inventories acting as seals to resist leakage and scrub entrained fission products, (2) redundant automatic isolation valves, or (3) closed loop piping systems qualified to maintain their pressure boundary function during the event.

6.5.2.4 Radwaste Building

The radwaste building is designed to contain any liquid releases by locating all high activity tanks in water-tight rooms designed to contain the maximum liquid release for that room. Airborne releases are routed by the Radwaste Building HVAC system through a HEPA filter to the Reactor Building plant stack. Under loss of power conditions, the Radwaste Building HVAC system is isolated providing hold up of potential releases. The Radwaste Building HVAC system performs no ESF/safety-related function.

6.5.2.5 Turbine Building

The turbine building contains two major process systems that remove fission products: the condensate filters and deep-bed demineralizers (with backwash tank), and the Offgas System with its charcoal adsorber beds. The activities in the filter/demineralizer system and in the Offgas System are relatively fixed, and in the event of breach of the system, would not result in a significant release of fission products to the environment. The condensate filter backwash receiving tank is located in a water-tight room which would contain any liquid release for treatment by the radwaste system. Airborne releases are routed via the Turbine Building HVAC system to the plant stack. The Turbine Building HVAC system performs no ESF/safety-related function.

6.5.3 Ice Condenser as a Fission Product Control System

The ESBWR does not use any kind of an ice condenser feature as a fission product control system.

6.5.4 Suppression Pool as a Fission Product Cleanup System

The ESBWR design incorporates isolation condensers, passive containment cooling condensers, and a suppression pool to condense steam under transients, accidents or unplanned reactor isolation conditions. In the event of an accident condition involving the direct release of fission products from the reactor core to either the reactor vessel or, the release of fission products directly to the drywell airspace, fission products blown into the suppression pool are entrained as they pass through water. This is effective in removing particulate and elemental forms of fission products. The ESBWR suppression pool is designed and complies with GDCs 41, 42, and 43 and provides water submergence and relief valve discharge quenchers similar to existing Mark III containments. Suppression pool compliance with GDCs 42 and 43 is addressed in Subsection

3.8.1.7. The design of the ESBWR quenchers are similar (X-quenchers) to a Mark III design and the submergence depth of the downcomers and quenchers are also similar to the Mark III design. Consequently, a decontamination factor of 10 is assumed for any particulate species or elemental iodine species that traverses the pool based upon Standard Review Plan 6.5.5.

6.5.5 COL Information

None.

6.5.6 References

None.

NRC RAI 9.2-1

Clarify if the Makeup Water System meets the requirements of GDC 2 and RG 1.29, Positions C-1 and C-2 and explain how each of these requirements are met. It is not clear from the application whether the non-safety related portions of the system, which upon their failure during a natural phenomena can adversely impact systems, structures and components important to safety, will be designed to ensure their integrity under the effects of natural phenomena.

GE Response:

The MWS meets GDC 2, as it relates to meeting the guidance of Regulatory Guide (RG) 1.29. The applicable sections of RG 1.29 include Position C.1 for safety-related portions and Position C.2 for non safety-related portions.

DCD Subsection 9.2.3.1 will be updated to reflect this response.

NRC RAI 9.2-2

Identify under what Seismic Design Categories and Quality Groups is the Makeup Water System classified, including the classification for the containment isolation portion of the system.

GE Response:

The only containment penetration in the Makeup Water System (MWS) is for a line providing water to the drywell during an outage. This line contains a check valve inside containment. The isolation valve outside containment is locked closed during normal operation. These containment isolation portions are Seismic Category I, Quality Group B. Piping either inside containment or the reactor building is Seismic Category II, Quality Group D. Other portions of the MWS are Nonseismic. The MWS function to provide makeup water to the ICS/PCC pools is accomplished through a connection to the FAPCS outside containment.

DCD Section 9.2.3.1 will be updated in DCD Chapter 9 Revision 2 to refer to Table 3.2-1. The MWS section of Table 3.2-1 will be updated to clarify these classifications.

9.2.2.3 Safety Evaluation

The RCCWS has no safety-related function. Failure of the system does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant.

There is no interface with the Class 1E electrical system.

9.2.2.4 Testing and Inspection Requirements

All major components are tested and inspected as separate components prior to installation and as an integrated system after installation to ensure design performance. Additional testing details of RCCWS are described in Subsection 14.2.8.1.24.

Provision is made for periodic inspection of major components to ensure the continued capability and integrity of the system. Indicators are provided for vital parameters required for testing and inspection. Provisions for grab sampling of RCCWS cooling water are provided for chemical and radiological analyses.

9.2.2.5 Instrumentation Requirements

The RCCWS is operated and monitored from the Main Control Room (MCR). Major system parameters (loop flow rate, heat exchanger outlet temperature and pressure) are indicated in the MCR. Low pump discharge header pressure, high or low head tank level, and excessive makeup valve opening time are alarmed/annunciated in the MCR.

Local temperature, pressure and level indicators provide additional component performance information.

The RCCWS heat exchanger isolation valves open automatically upon start of the corresponding PSWS flow. Failure of a RCCWS pump automatically starts the standby pump. Failure of one of the electrical buses automatically starts the standby pump(s) in the unaffected train.

9.2.3 Makeup Water System

9.2.3.1 Design Bases

Safety (10 CR 50.2) Design Bases

The Makeup Water System (MWS) is a nonsafety-related system, and has no safety design basis other than provision for safety-related containment penetrations and isolation valves. The MWS meets GDC 2, as it relates to meeting the guidance of Regulatory Guide (RG) 1.29. The applicable sections of RG 1.29 include Position C.1 for safety-related portions and Position C.2 for nonsafety-related portions. The seismic and quality group classifications are identified in Table 3.2-1. As discussed below, if available, the MWS can be used to provide makeup water to the Isolation Condenser / Passive Containment Cooling (IC/PCC) pools following an anticipated operational occurrence (AOO). However, this MWS function is not assumed or modeled in any safety analysis.

Table 3.2-1

Classification Summary

Principal Components[1]	Safety Design.[2]	Location[3]	Quality Group[4]	QA Req.[5]	Seismic Category[6]	Notes
P STATION AUXILIARY SYSTEMS						
P10 Makeup Water System (MWS)						
1. Piping and valves (including supports) forming part of the containment boundary	Q	CV, RB	B	B	I	
2. Piping and valves inside containment or inside the Reactor Building	N	CV, RB	D	E	II	
3. Other mechanical and electrical modules	N	OO, RW, RB, CB, SF	D	E	NS	
P21 Reactor Component Cooling Water System (RCCWS)	N	TB, RB	D	E	NS	
P22 Turbine Component Cooling Water System (TCCWS)	N	TB	D	E	NS	
P25 Chilled Water System (CWS)						
1. Piping and valves (including supports) forming part of the containment boundary	Q	CV, RB	B	B	I	
2. Piping and valves inside containment	N	CV	D	E	II	
3. Other mechanical and electrical modules	N	TB, RB, CB, FB, EB, RW	D	E	NS	
P30 Condensate Storage and Transfer System (CS&TS)						
1. Mechanical modules, including piping, valves, and condensate storage tank	N	OO, RB, RW, TB	D	E	NS	

NRC RAI 9.3-1

Clarify whether the means for storing and handling hydrogen comply with EPRI Report NP-5283-SR-A "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations."

GE Response

GE has clarified section 9.3.9 in revision 1 to indicate that the Hydrogen Water Chemistry (HWC) system is an option for the COL applicant, or later the COL holder, if the plant shows a need for HWC. The HWC system is not offered in the ESBWR standard plant design. Section 9.3.9.3, revision 1, states that any HWC installation would have to meet EPRI NP 5283-SR-A guidance with respect to storage and handling of hydrogen. The section goes on to state that the COL applicant can tie into the bulk hydrogen storage described in Chapter 10.

In the standard plant design, bulk hydrogen is used only for the main generator and described in section 10.2.2.2. The storage and handling of bulk hydrogen meets the referenced EPRI guideline. It states:

"Specifically, the bulk hydrogen system piping and components are located to reduce risk from their failures. The bulk hydrogen storage is located outside the Turbine Building at a distance great enough to ensure no structural damage will result from a hydrogen detonation. The hydrogen lines are provided with a pressure reducing station that limits the maximum flow to less than 100 standard cubic meters per minute before entering the Turbine Building. Equipment and controls are designed to be accessible and remain functional after a bulk hydrogen storage detonation. The design features and/or administrative controls shall be provided to ensure that the hydrogen supply is isolated when normal building ventilation is lost.

The arrangement of buildings at the facility and location of building doors and the bulk hydrogen storage tanks are designed to ensure that damage to buildings containing safety-related equipment due to detonation or combustion of hydrogen is unlikely."

NRC RAI 10.4-1

Clarify whether the Condensate Purification System complies with EPRI NP-49-47-SR "BWR Hydrogen Water Chemistry Guidelines," (1987 Revision, October 1988).

GE Response

The HWC system is not offered in the ESBWR standard plant design. Per Subsection 9.3.9.1 and Reference 9.3-1, provisions (space and shielding in the turbine building) have been made to install the HWC system as a COL option. The HWCS will utilize the

guidelines in EPRI report "BWR Hydrogen Water Chemistry Guidelines, (Reference 9.3-1) if the COL option is exercised to include HWC in the unit specific design.

The Condensate Purification System will be modified, as required, to comply with the subject EPRI chemistry guidelines, if and when it ever becomes necessary to install HWC.