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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 263 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Numbers 9.1-18 S03 and 9.1-20 S03**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter 263, dated November 6, 2008, Reference 1. The GEH response to the subject NRC RAIs is addressed in Reference 1. Enclosure 2 contains the DCD markups associated with these responses.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 08-899, Letter from the U.S. Nuclear Regulatory Commission to Robert E. Brown, Request for Additional Information Letter No. 263, Related To ESBWR Design Certification Application, dated November 6, 2008

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 263 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Numbers 9.1-18 S03 and 9.1-20
2. Response to Portion of NRC Request for Additional Information Letter No. 263 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Numbers 9.1-18 S03 and 9.1-20 S03 - DCD Markups

cc:	AE Cubbage	USNRC (with enclosures)
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Enclosure 1

MFN 09-341

Response to Portion of NRC Request for

Additional Information Letter No. 263

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Numbers 9.1-18 S03 and 9.1-20 S03

NRC RAI 9.1-18 S03

Clarify whether the water level instrumentation for the Buffer Pool is safety-related or declare it so in the DCD.

In RAI 9.1-18 S02, the staff asked the applicant to specify the height of water above the top of active fuel (TAF) in the spent fuel pool that would be reached 72 hours after loss of cooling. In its response, the applicant made clear that there was adequate warning to operators on loss of cooling in the spent fuel pool. However, the responses to RAI 9.18, 9.1-9 and 9.1-49 do not address how the buffer pool non-safety-related water level instrumentation, as described in DCD Tier 2, Section 9.1.3.5, satisfies the requirements of GDC 63. The information provided in responses to RAIs 9,1-9 and 9.1-49 identify features that address the heat removal capability of the buffer required by GDC 61. But safety-related features to detect conditions that may result in loss of residual heat removal capability or excessive radiation levels, as required to 10 CFR 63 for fuel storage systems such as the buffer pool, are not addressed by these RAIs. (The buffer pool is described as a spent fuel storage area that may hold up to 154 spent fuel assemblies in DCD Tier 2, Section 9.1.2.7). Explain how GDC 63 is satisfied for the buffer pool, and designate appropriate equipment, such as the water level instrumentation, as safety-related. Information for the alarms for the buffer pool should be provided as was done for the spent fuel pool in the response to RAI9.1-18 S02.

GEH Response

The level instruments in the buffer pool will be upgraded to safety-related.

DCD Impact

The following DCD Sections will be modified as shown in the attached markups:

Tier 2, Table 3.2-1

Tier 2, Subsection 7.3.5

Tier 2, Subsection 7.5.5

Tier 2, Subsection 9.1.3

Tier 2, Table 9.1-3

NRC RAI 9.1-20 S03

Question summary: Provide performance requirements for coolant injection and heat removal functions assumed in the PRA

Full Text:

In RAI 9.1-20 S01, the staff requested that the applicant provide the basis for concluding that successful actuation of the assumed number of fuel pools and auxiliary pools cooling system (FAPCS) trains is adequate to satisfy success criterion for the respective coolant injection and heat removal functions. The applicant's response was inadequate, and in RAI 9.1-20 S02 asked the the PRA applicant to provide performance requirements for the FAPCS trains and to provide calculations that demonstrate these requirements are adequate. In its response dated December 14,2007, the applicant referenced calculations that show the assumed requirements were acceptable. However, the RAI response is not acceptable because the applicant failed to provide performance requirements as requested in the RAI. Please provide performance requirements assumed in your calculations that must be met by FACPS trains in order for them to satisfy the PRA success criteria for the respective coolant injection and heat removal functions.

GEH Response

The FAPCS heat exchanger performance will be added to Tier 1, Table 2.6.2-2, item 7.

DCD Impact

DCD Tier 1, Table 2.6.2-2 will be revised as noted in the attached markup.

Enclosure 2

MFN 09-341

Response to Portion of NRC Request for

Additional Information Letter No. 263

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Numbers 9.1-18 S03 and 9.1-20 S03

DCD Markups

process parameters or at operator request. The SSLC/ESF includes the I&C implementing the following functions:

- The non-MSIV isolation functions of the LD&IS;~~,~~
- ~~t~~The ADS functions of the NBS for SRV and DPV control;~~,~~
- ~~t~~The ECCS, and decay heat removal – safe, stable ~~functions of the GDCS and SLC system, the ECCS and~~ shutdown ~~cooling~~ and reactor pressure control functions of the ICS;~~, and~~
- ~~t~~The control room isolation function of the CRHS.~~ The SSLC/ESF architecture is presented Reference 7.3-1 and Reference 7.3-5.~~
- Logic for the detection of a CRD system control rod separation event and transmits the rod separation signal to the RC&IS (described in Subsections 4.6.1 and 7.7.2.2.7).

The SSLC/ESF system also provides safety-related display information for system performance monitoring and accident monitoring (described in Subsection 7.5.1), and pool monitoring (described in Subsection 7.5.5) with the exception of SPTM, which is collected by RTIF.

7.3.5.2.1 General SSLC/ESF Arrangement

The SSLC/ESF resides in four independent and separated instrumentation divisions. The SSLC/ESF integrates the control logic of the safety-related systems in each division into firmware or microprocessor-based, software-controlled, processing modules located in divisional cabinets in the safety-related equipment rooms of the CB. The SSLC/ESF runs without interruption in all modes of plant operation to support required safety functions.

The SSLC/ESF consists of the non-MSIV isolation functions of the LD&IS, the ECCS functions, and the isolation function of the CRHS. The ESF/ECCS part includes the functions of SRV and DPV initiation, GDCS initiation, SLC initiation, and the core cooling and shutdown cooling logic functions of the ICS. There are separate multiplexing networks for RTIF and SSLC/ESF functions within each division. Figure 7.3-4 shows a functional block diagram of the SSLC/ESF portion of the system. The RPS function is discussed in Subsection 7.2.1, with the RPS functional block diagram shown in Figure 7.2-1. The ATWS/SLC mitigation function is discussed in Subsection 7.8.1.1.

Most SSLC/ESF input data are process variables multiplexed by the Q-DCIS in four physically and electrically isolated redundant instrumentation divisions (Subsection 7.1.3). Each of the four independent and separated Q-DCIS channels feeds separate and independent ~~trains of~~ SSLC/ESF equipment in the same division.

7.3.5.2.2 Signal Logic Processing

Signals that must meet time response constraints and signals from system logic that are proximal to the SSLC/ESF cabinets are directly connected to the divisional cabinets in the safety-related equipment rooms in the CB. These signals are derived from sensors that are redundant in the four divisions (for each sensed variable).

All input data are processed within the RMU function of the Q-DCIS. The sensor data are transmitted through the DCIS network to the SSLC/ESF Digital Trip Module (DTM) function

The FAPCS provides the Spent Fuel pool ~~is provided~~ with safety-related instruments that monitor water level. Each instrument generates a high and low water level signal when the water level reading increases above or decreases below its setpoint. Anti-siphoning holes are provided in all submerged portions of FAPCS discharge lines at the elevation of normal water level to prevent significant draining of the pool in the event of a pipe break. These level instruments are safety-related to ensure proper level is maintained.

The skimmer surge tanks are used for receiving overflow water from the spent fuel pool, and as a pump suction source during the spent fuel pool-cooling mode of operation. These tanks are provided with instruments that monitor their water level. The instruments generate high-high, high, low, or low-low water level signals when the water level reading increases above or decreases below its setpoint. The high and low level signals are used for the opening and closing of the Condensate Storage and Transfer System valve for make up water to skimmer surge tanks. The high-high and low-low signals initiate high and low water level alarms in the MCR. Additionally, the low level signal is used for tripping the FAPCS pump operating in the spent fuel pool-cooling mode. The high level setpoint is established to avoid overflow of skimmer surge tank water. The low water level setpoint is established to prevent inadvertent draining of the tank water below the minimum safe level.

The level instruments for the spent fuel pool are classified as safety-related components because they provide necessary information to the operator for performing the safety-related function of refilling the spent fuel pool following an accident.

Buffer Pool

The FAPCS provides the buffer pool with safety-related instruments that monitor water level. Each instrument generates low water level signals when the water level reading decreases below its setpoint. Each low-level signal initiates an alarm in the MCR.

The level instruments for the buffer pool are classified as safety-related components because they provide necessary information to the operator for refilling the buffer pool following an accident.

7.5.5.1 System Design Bases

See Subsection 9.1.3.1.

7.5.5.2 System Description

See Subsection 9.1.3.2.

7.5.5.3 Safety Evaluation

This subsection addresses Pool Monitoring Instrumentations conformance to regulatory requirements, guidelines, and industry standards.

~~See Subsection 9.1.3.3.~~

7.5.5.3.1 Code of Federal Regulations

10 CFR 50.55a(a)(1), Quality Standards Important to Safety:

7.5.5.2 System Description

See Subsection 9.1.3.2.

7.5.5.3 Safety Evaluation

This subsection addresses Pool Monitoring Instrumentations conformance to regulatory requirements, guidelines, and industry standards.

~~See Subsection 9.1.3.3.~~

7.5.5.3.1 Code of Federal Regulations

10 CFR 50.55a(a)(1), Quality Standards Important to Safety:

- Conformance: The safety-related Pool Monitoring instrumentation design complies with these standards.

10 CFR 50.55a(h), Protection and Safety Systems compliance with IEEE Std. 603:

- Conformance: The safety-related Pool Monitoring instrumentation design conforms to IEEE Std. 603. Conformance information is found in Subsection 7.1.6.6.1 through 7.1.6.6.1.27. Additional information concerning how the Pool Monitoring conforms to IEEE Std. 603 is discussed below.
  - Section 4.2 (Safety-related Functions): Safety-related functions of the Pool Monitoring instrumentation are described in Subsection 7.5.5. The design bases for the instrumentation is included with the system that uses the signal from the sensor as shown below.
    - GDCS pools (Subsection 7.3.1.2.1),
    - IC/PCCS Expansion Pools (Subsection 5.4.6.1),
    - Spent Fuel Pool (Subsection 7.5.1.1), and
    - Buffer Pool (Subsection 7.5.1.1).
  - Section 4.3 (Permissive Conditions for Operating Bypasses): Permissive conditions for operating bypasses are not applicable for the Pool Monitoring instrumentation design.
  - Section 4.6 (Spatially Dependent Variables): Spatial dependency of monitored variables is not applicable to Pool Monitoring instrumentation design.
  - Section 5.2 (Completion of Protective Actions): The Pool Monitoring instrumentation does not provide any trip or isolation functions.
  - Section 5.7 (Capability for Test and Calibration): See Subsection 9.1.3.4.
  - Section 6.2 and 7.2 (Manual Control): Manual Control is not applicable beyond that discussed in Subsection 7.1.6.6.1.18.
  - Section 6.4 (Derivation of System Inputs): Derivation of System Inputs for Pool Monitoring instrumentation is not applicable beyond that discussed in Subsection 7.1.6.6.1.20.

Drywell Spray Mode - This mode may be initiated following an accident for accident recovery. During this mode of operation, FAPCS draws water from the suppression pool, cools and then spays the cooled water to drywell air space to reduce the containment pressure.

9.1.3.3 Safety Evaluation

The FAPCS is a nonsafety-related system except for the portions of the system that establish flow paths necessary for

- The interface with safety-related RWCU/SDC piping;
- The supply of post-accident makeup water to the Spent Fuel Pool and IC/PCCS pools following an accident; and
- The system's containment isolation function. (Subsection 6.2.4.3.2)

The SFP is designed to dissipate the maximum fuel decay heat through heat up and boiling of the pool water. The most conservative heat load for the SFP occurs when the pool contains spent fuel from 20 years of operation plus one full core offload. The pool water performs the safety-related heat removal function stipulated in GDC 44. Upon loss of power, the Fuel Building HVAC isolates the fuel building as described in Subsection 9.4.2.5. Steam generated by boiling of the SFP is released to the atmosphere through a relief panel in the Fuel Building. Water inventory in the SFP is adequate to keep the fuel covered through 72 hours, thereby avoiding heat up of the fuel and the potential for fission product release. Engineered safety feature atmosphere cleanup systems and associated guidance described in RG 1.52 are not credited by the FAPCS in the ESBWR design as indicated in Subsection 15.4.1.4.1. The Fuel Building does not house any safety-related equipment, subject to flooding, as stated in Subsection 3.4.1.4.3. Sufficient reserve capacity is maintained onsite to extend the safe shutdown state from 72 hours through 7 days ensuring compliance with GDC 61. Post 72-hour inventory makeup is provided via safety-related connections to the Fire Protection System and to offsite water sources.

The FAPCS piping and components that provide the flow paths for the post-accident makeup water supply are designed to meet the requirements contained in Table 9.1-3, Item 3. No active valves are required to operate for establishing post-accident makeup water supply flow paths.

The Reactor Building and the Fuel Building provide adequate protection against natural phenomena for the safety-related components of the FAPCS as required by GDC 2 and GDC 4.

Safety-related level instrumentation is provided in the spent fuel pool, buffer pool, and IC/PCCS pools to detect a low water level that would indicate a loss of decay heat removal ability in accordance with GDC 63.

9.1.3.4 Testing and Inspection Requirements

The FAPCS is designed to permit surveillance test and in-service inspection of its safety-related components and components required to perform the post-accident recovery functions, in accordance with GDC 45 and ASME Section XI. The FAPCS is designed to permit leak rate testing of its components required to perform containment isolation function in accordance with 10 CFR 50 Appendix J.

9.1.3.5 Instrumentation and Control

System Instrumentation

Water Levels - The skimmer surge tank level is monitored by a level transmitter mounted on a local panel. The skimmer surge tank level is displayed in the MCR. In addition to level indication, this signal is used to initiate low and high water-level alarms and to operate the Condensate Storage and Transfer System makeup water control valve for the skimmer surge tank.

The IC/PCCS pool has four ~~local panel-mounted,~~ safety-related level sensors ~~transmitters~~ in ~~both~~ each inner expansion pool~~s~~. All sensor ~~transmitter~~ signals are indicated on the safety-related displays and sent through the gateways for nonsafety-related display and alarms. All signals are validated and used to control the valve in the makeup water supply line to the IC/PCCS pool. A low level signal from these sensors ~~transmitters~~ is sent to the Isolation Condenser System to open the pool cross-connect valves ~~connections~~ to the equipment storage pool. Each expansion pool also contains four nonsafety-related level sensors ~~transmitters~~ that provide a backup to the safety-related sensors~~transmitters~~.

The Spent Fuel Pool and buffer pool each have ~~has~~ two wide-range safety-related level transmitters that transmit signals to the MCR. These signals are used for water level indication and to initiate high/low-level alarms. At a minimum, alarm set points are included at the top of the active fuel, an adequate shielding level (3.05 m [10 ft]above TAF), and an elevation just below normal water level to give operators advanced notice of a loss of inventory but with sufficient margin to allow for 72 hours of pool boiling.

The SFP and IC/PCCS pools contain backup nonsafety-related ~~resistive type~~ level indicators that can be operated using portable onsite power supplies to indicate when the pools have been replenished to their normal water level.

All other pools (upper transfer pool, lower fuel transfer pool, cask pool, ~~buffer pool,~~ reactor well, dryer and separator storage pool) have local, nonsafety-related, panel-mounted level sensors ~~transmitters~~ to provide signals for high/low-level alarms in the MCR.

Level instruments for the suppression pool and GDCS pools are provided by other systems.

Water Temperatures – Water temperatures are monitored in the Fuel and Auxiliary pools (listed in Table 9.1-1) with temperature transmitters that send signals to the MCR for water temperature indication and high-temperature alarms. In the IC/PCCS pool, each condenser subcompartment also has temperature transmitters that send signals to the MCR for water temperature indication and high-temperature alarms. The upstream and downstream piping of the two heat exchangers in the cooling/cleanup trains have temperature transmitters that send signals to the MCR.

Flow and Pressure - Panel-mounted pressure transmitters for the pump suction and discharge pressure are provided locally. A pump trip signal is generated on low suction pressure to provide for pump protection. The pressure transmitters send signals to pressure indicators in the MCR. An orifice type flow element is located on the downstream side of each pump discharge check valve. A local panel-mounted flow transmitter sends the signals from these transmitters to flow indicators in the MCR.

Table 9.1-3 Safety Classification, Quality Group and Seismic Category (Continued)			
8. Piping inside containment between inboard containment isolation valves and their termination points inside containment for: GDCS pool suction line GDCS pool return line	N	D	II
9. IC/PCCS Pool C/C subsystem piping	N	D	II
10. Auxiliary pools skimmer lines and auxiliary pools return lines between the isolation valves and terminating points, and all piping and components associated with pool liner leak detection	N	D	NS
11. Instrument Sensing lines for the following parameters: IC/PCCS pool water level Spent Fuel Pool water level Buffer pool water level	3	C	I
12. Electrical Module and cables with safety-related function (containment isolation, LPCI isolation)	3	NA	I
13. Electrical Module and cables with nonsafety-related function	N	NA	II
14. Control and Instrumentation required for safety-related functions.	Q	NA	I
15. Control and Instrumentation required for nonsafety-related functions	N	NA	II

Table 3.2-1

Classification Summary

Principal Components[1]	Safety Class.[2]	Location[3]	Quality Group[4]	Quality~~A~~ ~~Req.~~Class[5]	Seismic Category[6]	Notes
all components in the cooling and cleanup trains.						
6. Suppression pool suction line inside containment between inboard manual valve and its termination point (including suction strainers)	N	CV	C	S~~E~~	I	(5) b, (5) c, (5) i – for RTNSS equipment
7. Piping and valves inside containment between inboard containment isolation valves and their termination points inside containment for: – Suppression pool return line – Drywell spray discharge line	N	CV	C	S~~E~~	I	(5) b, (5) c, (5) i – for RTNSS equipment
8. Piping and valves inside containment between inboard containment isolation valves and their termination points inside containment for: – GDCS pool suction line – GDCS pool return line	N	CV	D	S~~E~~	II	(5) c
9. IC/PCCS pools active cooling and cleanup subsystem piping, and components.	N	RB	D	S~~E~~	II	(5) c
10. Auxiliary pools skimmer lines, and auxiliary pool return lines between isolation valves and terminus points.	N	RB	D	N~~E~~	NS	
11. Instrument sensing lines for the following parameters – IC/PCCS pool water level – Spent fuel pool level – Buffer pool level	3	RB, FB	C	Q~~B~~	I	

Table 2.6.2-2

ITAAC For The Fuel and Auxiliary Pools Cooling Cleanup System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. The containment isolation portions of the FAPCS are addressed in Tier 1, Subsection 2.15.1.(Deleted)	See Tier 1 Subsection 2.15.1.	See Tier 1 Subsection 2.15.1
7a. The FAPCS performs the following nonsafety-related suppression pool cooling functions.: a. Suppression pool cooling mode	i. Perform a test to confirm the flow path and minimum flowrate between the FAPCS to and the suppression pools.	i. Test report(s) document exist and conclude that the cooling flow path is demonstrated and confirmed by operation of the function. The flow rate is ≥ 545.1454 m^3/hr (1998.422000 gal/min).
	ii. Perform a type test to confirm the heat transfer capacity of the FAPCS heat exchanger.	ii. Report(s) exist and conclude that the design heat removal capacity of a single FAPCS train is ≥ 9.6 MW under the following conditions: • Primary and secondary side flow rate of 545.1 m^3/hr (2400 gpm) • Process inlet temperature of 48.9ºC (120ºF) • Cooling water inlet temperature of 35ºC (95ºF)
7b. The FAPCS performs the nonsafety-related Llow-pressure coolant injection modefunctions.	Perform a test to confirm the flow path and minimum flowrate from the FAPCS to the RWCU/SDC system.	Test Rreport(s) document exist and conclude that the injection flow path is demonstrated and confirmed by operation of the function. The flowrate is ≥340 m^3/hr (1500 gal/pmmin) at a differential pressure of 1.03 MPa (150 psi).