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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 100 –Auxiliary Systems– RAI Numbers 9.1-41 and 9.1-42**

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

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

Reference:

1. MFN 07-292, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 100 Related to the ESBWR Design Certification Application*, May 30, 2007.

Enclosure:

1. MFN 07-341 – Response to Portion of NRC Request for Additional Information Letter No. 100 – RAI Numbers 9.1-41 and 9.1-42.

cc:	AE Cubbage	USNRC (with enclosure)
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Enclosure 1

MFN 07-341

Response to Portion of NRC Request for Additional Information Letter No. 97 Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Numbers 9.1-41 and 9.1-42

NRC RAI 9.1-41

DCD Tier 2, Rev. 3, Section 9.1.3.3 states that safety-related level instrumentation is provided in the spent fuel pool and the isolation condenser/passive containment cooling system (IC/PCC) pools to detect a low water level that would indicate a loss of decay heat removal ability in accorfdance with GDC 63. Discuss how these instrumentations' accuracy is effected {sic, affected} during boiling conditions in the associated pools.

GHNEA Response

The level instruments in the IC/PCC pools are located in the expansion pool area - away from the heat load which is restricted to the heat exchanger subcompartments. Because the boil off occurs in these subcompartments, coolant flows from the expansion pool into these compartments. Therefore, the level instruments for these pools are not subjected to boiling conditions that could affect their accuracy.

Boiling of water in the spent fuel pool (SFP) may introduce some inaccuracy in level measurement. However, because boiling decreases the density of the water, the level instruments can only indicate a water level that is less than the actual level. Therefore, the instruments conservatively err on the side of safety. Setpoint methodology considers the inaccuracy in level measurement when determining the setpoints for the needed actions.

DCD Impact

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

NRC RAI 9.1-42

There are inconsistencies in DCD Tier 2, Rev. 3, Section 9.3.1 as to the classification of the make up portion of the fuel and auxiliary pool cooling system (FAPCS). DCD Tier 2, Rev. 3, Section 9.3.1 states that this portion of the system is safety-related but Chapter 19 states that it is RTNSS. If it is RTNSS, update DCD Tier 2, Rev. 3, Section 9.3.1. In addition, explicitly describe the RTNSS treatment of FAPCS in DCD Tier 2, Rev. 3, Section 9.3.1. Based on previous RAIs, the applicant has explicitly described RTNSS treatment of cooling water systems (I.e., plant service water) in Section 9.2 of Rev. 3 of the DCD.

GHNEA Response

The Chapter 19 discussion of the FAPCS is in agreement with Subsection 9.1.3 with the exception of the last sentence in Subsection 19A.3.1.2. GHNEA assumes this is the inconsistency to which this RAI refers.

The FAPCS interfaces with the Fire Protection System (i.e. the diesel-driven makeup pump system) in several locations. The FAPCS pipe is safety-related in some locations and RTNSS in others.

The interfaces used to provide emergency makeup from the Fire Protection System (FPS) to the spent fuel pool and the IC/PCC pools are safety-related.

There is another interface between the FAPCS and the FPS on the piping used for low pressure coolant injection. This piping is classified RTNSS. Subsection 19A.3.1.2 is to be modified to make this clarification. Subsection 9.1.3 is to be revised to better clarify what is RTNSS vs. safety-related.

DCD Impact

DCD Tier 2 is to be modified in Revision 4 as shown in the attached markup of Subsection 19A.1.1.2 and Subsection 9.1.3.2.

9.1.3 Fuel and Auxiliary Pools Cooling System

9.1.3.1 Design Bases

Safety Design Basis

Fuel and Auxiliary Pools Cooling System (FAPCS) is a Nonsafety-Related system, except for the containment isolation valves, the high-pressure interface with the Reactor Water Cleanup / Shutdown Cooling System, and emergency water supply flow paths.

Power Generation Design Basis

FAPCS provides continuous cooling and cleaning of the spent fuel storage pool during normal plant operation. It also provides occasional cooling and cleaning of various pools located inside the containment during normal plant operation and refueling outage.

9.1.3.2 System Description

System Description Summary

The FAPCS consists of two physically separated cooling and cleanup (C/C) trains, each with 100% capacity during normal operation. Each train contains a pump, a heat exchanger and a water treatment unit for cooling and cleanup of various cooling and storage pools except for the Isolation Condenser and Passive Containment Cooling System (IC/PCCS) pools (refer to Figure 9.1-1). A separate subsystem with its own pump, heat exchanger and water treatment unit is dedicated for cooling and cleaning of the IC/PCCS pools independent of the FAPCS C/C train operation during normal plant operation (refer to Figure 9.1-1).

The primary design function of FAPCS is to cool and clean pools located in the containment, Reactor Building and Fuel Building (refer to Table 9.1-1) during normal pant operation. FAPCS provides flow paths for filling and makeup of these pools during normal plant operation and during post accident conditions, as necessary.

FAPCS is also designed to provide the following accident recovery functions in addition to the Spent Fuel Pool cooling function:

- Suppression pool cooling (SPC);
- Drywell spray;
- Low pressure coolant injection (LPCI) of suppression pool water into the RPV; and
- Alternate Shutdown Cooling.

In addition to its accident recovery function, suppression pool cooling (SPC) mode is also designed to automatically initiate during normal operation in response to a high temperature signal from the suppression pool.

Redundancy and physical separation will be provided in accordance with SECY 03-087 for active components in lines dedicated to LPCI and SPC modes.

During normal plant operation, at least one FAPCS C/C train is available for continuous operation to cool and clean the water of the Spent Fuel Pool, while the other train can be placed in standby or other mode for cooling the Gravity Driven Cooling System (GDCS) pools and suppression pool. If necessary during refueling outage, both trains may be used to provide maximum cooling capacity for cooling the Spent Fuel Pool. The water treatment units can be bypassed when necessary, and will be bypassed automatically on a high temperature signal downstream of the heat exchangers.

Each FAPCS C/C train has sufficient flow and cooling capacity to maintain Spent Fuel Pool bulk water temperature below 48.9°C (120°F) under normal Spent Fuel Pool heat load conditions. During the maximum Spent Fuel Pool heat load conditions of a full core off-load plus irradiated fuel in the Spent Fuel Pool resulting from 20 years of plant operations, both FAPCS C/C trains are needed to maintain the bulk temperature below 60°C (140°F).

During a loss of the FAPCS cooling trains, the cooling to the Spent Fuel Pool and IC/PCCS pools is accomplished by allowing the water to heat and boil. Sufficient pool capacity exists for pool boiling to continue for at least 72 hours post-accident, at which point emergency makeup water can be provided through safety-related connections to the Fire Protection System (FPS) or another onsite or offsite water source.

All operating modes (refer to Table 9.1-2) are manually initiated and controlled from the Main Control Room (MCR), except the SPC mode, which is initiated either manually, or automatically on high suppression pool water temperature signal. Instruments are provided for indication of operating conditions to aid the operator during the initiation and control of system operation. Provisions are provided to prevent inadvertent draining of the pools during FAPCS operation by including anti-siphon holes on all FAPCS piping that is normally submerged.

The FAPCS is designed to provide for the collection, monitoring, and drainage of pool liner leaks from the spent fuel pools, auxiliary pools, and IC/PCCS pools (refer to Table 9.1-1) to the Liquid Waste Management System.

Containment isolation valves are provided on the lines that penetrate the primary containment. Containment isolation valves are powered from independent safety-related sources. Air-operated valves with containment isolation function are designed to close upon loss of its electric power or air supply, except for containment isolation valves on the suppression pool supply and return lines, which fail as-is.

The containment isolation valves are automatically closed upon receipt of a containment isolation signal from the Leakage Detection and Isolation System (LD&IS). The containment isolation valves needed to perform an accident recovery function described above, will require a manual operator action to override the isolation signal.

The FAPCS is a Nonsafety-Related system with the exception of piping and components required for:

- Containment isolation;
- Refilling of the IC/PCCS pools and the Spent Fuel Pool with emergency water supplies from the Fire Protection System or another onsite or offsite source.
- The high-pressure interface with the Reactor Water Cleanup/Shutdown Cooling system used for low pressure coolant injection.

The piping and components needed for the following functions are classified as RTNSS:

- Suppression pool cooling
- Low pressure coolant injection

The FAPCS piping and components that are required to support safety-related and/or accident recovery function have Quality Group B or C and Seismic I classification (Table 9.1-3). A Seismic I classification is required for all safety-related functions listed above. A Seismic II classification is sufficient for the remaining Nonsafety-Related piping and components that support accident recovery functions. This classification satisfies the requirements of SRP 9.1.3 Section I.1.

Detailed System Description

The FAPCS is provided with two cooling and cleanup (C/C) trains with 100% capacity during normal operation. Each FAPCS train is physically separated and has one pump, one heat exchanger and one water treatment unit consisting of a prefilter and a demineralizer.

A manifold of four motor operated valves is attached to each end of the FAPCS C/C trains [refer to Figure 9.1-1]. These manifolds are used to connect the FAPCS C/C train with one of the two pairs of suction and discharge piping loops to establish the desired flow path during FAPCS operation. One loop is used for the fuel pools and auxiliary pools, and the other loop for the GDCS pools and suppression pool and for injecting water to drywell spray sparger and reactor vessel via RWCU/SDC and feedwater pipes.

The use of manifolds with proper valve alignment and separate suction-discharge piping loops 1) allows operating of one train independent of the other train to permit on-line maintenance or dual mode operation using separate trains if necessary, 2) prevents inadvertent draining of the pool and mixing of contaminated water in the Spent Fuel Pool with cleaner water in other pools.

Each water treatment unit is equipped with a prefilter, a demineralizer and a post strainer. A bypass line is provided to permit bypass of the water treatment unit, when necessary. The prefilter and demineralizers of the water treatment units are located in shielding cells so that radiation exposure of plant personnel is within acceptable limits.

Proper physical separation is provided between the active components of the two redundant trains to assure operation of one train in the event of failure of the other train.

A reactor makeup water discharge line is provided for injecting suppression pool water or water from the Fire Protection System to the reactor vessel via Reactor Water Cleanup/Shutdown Cooling System (RWCU/SDC) Loop B and Feedwater Loop A discharge pipes. This injection line shall be provided with two pairs of isolation valves such that the flow path branches to include two parallel air-operated gate valves and two parallel testable check valves in series (refer to Figure 9.1-1). This line is safety-related up to the second pair of isolation valve upstream of the RWCU/SDC interface. These isolation valves fail as-is, are normally closed, and prevented from opening by a high reactor pressure signal from the Nuclear Boiler System to protect the low pressure portion of FAPCS piping and components. Redundant valves are contained in separate fire zones for improved reliability.

A drywell spray discharge line and a ring header with spray nozzles mounted on the header are provided for spraying water inside the drywell to reduce the drywell pressure 72 hours following a LOCA to assist in post accident recovery. In order to prevent excessive negative pressure the

19A.1.1.1 *Core Cooling*

The safety function is to provide an adequate inventory of water to ensure that the fuel remains cooled and covered, with stable and improving conditions, beyond 72 hours. This function is met by the safety-related Isolation Condenser System (ICS) for scenarios with the RCS intact, and by the safety-related Gravity-Driven Cooling System (GDCS) injection function for scenarios with the RCS open to containment. As long as decay heat removal is ensured as described below, the GDCS provides a sustainable closed-loop method to keep the core covered.

There are no RTNSS systems associated with this safety function.

19A.1.1.2 *Decay Heat Removal*

The safety function is to remove reactor decay heat from the core, containment, and spent fuel pool. The passive systems that provide this function for the core and containment are the safety-related ICS and the safety-related Passive Containment Cooling System (PCCS). Theses systems are capable of removing decay heat for at least 72 hours without the need for active systems or operator actions. After 72 hours, makeup water is needed to replenish the boil-off from the upper containment pools. The ESBWR design includes permanently installed piping in the Fuel and Auxiliary Pools Cooling System (FAPCS) that connects directly to a diesel-driven makeup pump system. This connection enables the upper containment pools and spent fuel pools to be filled with water from the Fire Protection System (FPS), which provides on-site makeup water to extend the cooling period from 72 hours to 7 days. The dedicated FPS equipment for providing makeup water and the flow paths to the pools are classified as nonsafety-related. The spent fuel pool is normally cooled by FAPCS. However, on a complete loss of FAPCS cooling under the condition of maximum heat load, a sufficient quantity of water is available in the spent fuel pool to allow boiling for 72 hours and still provide minimum fuel coverage in the pool. A dedicated external connection to the FAPCS line allows for manual hook-up of external water sources, if needed, at 7 days for either upper containment pool replenishment and for spent fuel pool makeup. These functions are manually actuated from the yard area and can be performed without any support systems.

The following components are within the scope of RTNSS with the exception those components described as safety-related in Tier 2 Subsection 9.1.3: the diesel-driven makeup pump system, FAPCS piping connecting to the diesel-driven makeup pump system, the external connection.

19A.1.1.3 *Control Room Habitability*

Safety-related portions of the Control Room Habitability Area Ventilation System maintain control room habitability. This function is operated on safety-related battery power for the first 72 hours following an event. For longer term operation, the system can be powered by a small, portable AC power generator that is kept on the plant site.

This generator is included within the scope of RTNSS.

19A.1.1.4 *Post-Accident Monitoring*

Operator actions are not required for successful operation of safety-related systems for the first 72 hours following an event. Beyond that, operator actions are necessary to support continued