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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 210, Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-47 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission Request for Additional Information (RAI) sent by NRC Letter 210, dated June 19, 2008 (Reference 1). The GEH response to RAI Number 9.4-47 S02 is addressed in Enclosure 1. The GEH response to RAI 9.4-47 S01 was submitted via Reference 2 in response to Reference 3. The original response was submitted via Reference 4 in response to Reference 5.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

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References:

1. MFN 08-531, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 210 Related to the ESBWR Design Certification Application,* June 19, 2008.
2. MFN 08-422, Response to Portion of NRC Request for Additional Information Letter No. 158 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-47 S01, April 25, 2008.
3. MFN 08-209, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 158 Related to the ESBWR Design Certification Application,* February 29, 2008.
4. MFN 07-592, Supplement 2, Response to Portion of NRC Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application - Heating, Ventilation, and Air Conditioning - RAI Number 9.4-47, November 23, 2007.
5. MFN 07-414, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 103 Related To ESBWR Design Certification Application*, July 23, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter 210 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-47 S02

cc:	AE Cubbage	USNRC (with enclosures)
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	eDRF	0000-0089-7032

Enclosure 1

MFN 08-733

Response to Portion of NRC Request for

Additional Information Letter No. 210

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.4-47 S02

For historical purposes, the original text of RAI 9.4-47 and RAI 9.4-47 S01 and the GEH response is included.

NRC RAI 9.4-47

DCD, Tier 2, Revision 3, Figure 9.4-9 shows that the reactor building clean air sub system exhaust air directly outdoors.

How is the release monitored for radiation? What assurance is there that this release is clean and does not have to be monitored? Are there barriers that separate the clean area from the contaminated areas of the reactor building other than air pressure differential?

GEH Response

The Clean Area HVAC Subsystem (CLAVS) which is described in DCD Tier 2 Subsection 9.4.6 and outlined in DCD Tier 2 Figure 9.4-9 serves the clean (non-radiological controlled) areas of the Reactor Building, and therefore its exhaust does not contain any contaminants during CLAVS operation. The CLAVS ventilation subsystem is a recirculation ventilation system kept at a slightly positive pressure with respect to the other building ventilation subsystems. There are walls and internal barriers within the reactor building, which keep the clean areas (served by CLAVS) separate from either of the potentially contaminated RB areas (served by CONAVS or REPAVS), which additionally are maintained at a slightly negative pressure. The building separation design and the pressure differential maintained ensure that any exhaust from this subsystem is clean.

DCD Impact

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

NRC RAI 9.4-47 S01

The response to 9.4-47 provided by GE did not address post accident releases from the reactor building. GDC 64 requires that means shall be provided for monitoring the reactor containment atmosphere, spaces containing components for recirculation of loss-of-accident fluids. Effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents. For the specific case of postulated accidents (i.e. LOCA), there can be migration of contaminations from the contaminated areas to clean areas. Although there are some barriers separating the clean areas from the contaminated areas, these barriers have not been identified on drawings or shown to be leak tight which leads the staff to believe that there can be some contamination in the clean areas.

How does the ESBWR comply with GDC 64 with respect to monitoring releases from the reactor building?

GEH Response

DCD, Tier 2, Revision 4, subsection 11.5.5.4, Implementation of General Design Criteria 64, ensures means are provided for monitoring the radiation levels in the reactor containment atmosphere, spaces containing components for the recirculation of loss-of-coolant accident fluids, effluent discharge paths and important process streams are monitored for radioactivity. The paths and areas monitored include the Reactor Building HVAC subsystems shown in DCD Tier 2 Figure 11.5-1, Location of Radiation Monitors:

- Reactor Building HVAC Exhaust RMS- the RMS monitors the gross radiation level in the exhaust duct of the RB ventilation system from the RB exhaust duct and the Refueling Area Air Exhaust duct.
- Plant RB/FB Stack RMS, and
- Containment Purge Exhaust RMS.

A common supply air duct distributes conditioned air to the potentially contaminated areas of the Reactor Building. Air is exhausted from the potentially contaminated areas of the Reactor Building (CONAVS) by the operating exhaust fan and discharged to the RB/FB vent stack.

CONAVS also includes redundant Reactor Building HVAC Purge Exhaust Filter Units and exhaust fans. During radiological events, exhaust air from contaminated areas may be manually diverted through the Reactor Building HVAC Purge Exhaust Filter Units.

The Refueling and Pool Area Ventilation System (REPAVS) is a once-through ventilation system distributing conditioned air to the refueling area and across the pool surface. Exhaust air is ducted to the exhaust fans and exhausted to the outside atmosphere through the RB/FB vent stack.

The Clean Area Ventilation System (CLAVS) is a recirculating ventilation system that distributes conditioned air to and from the Reactor Building clean areas. Return air not directed back to the AHU is exhausted directly outdoors. A portion of the flow is directed to the battery rooms. Air is exhausted from the battery rooms by the battery room exhaust fans which discharge directly to the RB/FB vent stack.

GDC 64 is met due to the installation of the RB HVAC rad monitors, Fuel Handling Area HVAC rad monitors and Containment Purge HVAC rad monitors, all of which are safety-related.

The reactor building HVAC system (CONAVS, REPAVS and CLAVS) safety related boundary isolation dampers close on receipt of a high radiation signal or on a loss of AC power with or without the high radiation signal to isolate radioactive effluent discharges.

Contamination of reactor building clean areas (CLAVS) from contaminated areas will be minimal. By design, the building potentially contaminated areas (CONAVS and REPAVS) are separated from the clean area (CLAVS) of the Reactor Building. During normal operation and after post accident conditions when AC power is available, the CLAVS is maintained at a positive pressure relative to the CONAVS and REPAVS minimizing the possibility of contamination. The differential pressure, established during normal operation, between subsystems is not needed to maintain radiological areas from communicating with non-radiological areas during accident conditions. There are no flow paths, door louvers, etc. where air travels between ventilation subsystems (radiological and non-radiological areas). They are separated by the building compartmentalization. Also, direct leakage from the primary containment to the clean areas of the reactor building (CLAVS) is not credible with primary containment penetrations located in contaminated areas (not clean areas) and primary containment liner leakage through the concrete to CLAVS discounted due to the construction process. Therefore, potential contamination of CLAVS through communication with CONAVS or REPAVS is considered minimal.

If the CLAVS does become contaminated during normal operations, anticipated operational occurrences or postulated accidents, the effluent will be monitored and isolated, as required. A portion of the CLAVS flow, directed to the battery rooms, is exhausted by the battery room exhaust fans directly to the RB/FB vent stack. This effluent, representative of the radiation in the clean areas of the reactor building, will be monitored by the isokinetic probe for radiation. During system restoration following loss of power, a radiological assessment of the CLAVS area is made prior to restarting the ventilation subsystem by operating the system in recirc mode while exhausting the flow through the battery room to the stack monitoring system. Once the radiological assessment concludes that the exhaust flow is within regulatory limits, the CLAVS subsystem will be restored to normal operation. This will ensure GDC 64 requirements are met for the CLAVS in addition to CONAVS and REPAVS.

DCD Impact

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

NRC RAI 9.4-47 S02

At the time RAI 9.4-47 S01 was issued, post accident leakage from the reactor building (RB) was assumed to be 50% of the total volume of the reactor building on a mass basis per day. This leakage was not monitored, did not go through any HVAC system and was assumed to be through cracks, door seals and other unmonitored locations. The DCD Rev. 5 changes to the RB, (see RAI 6.2-167S01 on RB testing) have changed the assumptions. The staff's current understanding is that the leakage from the contaminated area of the reactor building is essentially isolated from the clean area of the reactor building and that this leakage is released directly to the environment from contaminated stairways

A. In response to 9.4-47 S01, GEH stated that the reactor building HVAC system (RBVS) (Reactor Building Contaminated Area HVAC Subsystem (CONAVS), Refueling and Pool Area HVAC Subsystem (REPAVS), and Reactor Building Clean Area HVAC Subsystem (CLAVS)) safety related boundary isolation dampers close on receipt of a high radiation signal..." DCD Rev. 5 states that the "RBVS performs no safety-related function except for automatic isolation of the reactor building boundary (CONAVS and REPAVS subsystems) during accidents." It appears that the CLAVS subsystem was intentionally left out. Does the CLAVS subsystem isolate upon high radiation signal? Is the clean area which CLAVS serves considered inside or outside of the reactor building boundary? Is the ESBWR being designed such that the CLAVS system can be operated if power is available post-accident for cooling and potentially for clean up operations in either a partial recirculation or once through ventilation mode.

Is there any monitor on the direct release of the CLAVS system to the environment? The staff understands that release from battery rooms could be monitored by an isokinetic probe at the stack. Does this probe tell what radiation is coming from the clean area of the building or does it measure a combined effect from other sources? The staff is also concerned that the air being exhausted from the battery room may not be representative of the air in the clean area as a whole and that because the flow rate is relatively small to the maximum CLAVS exhaust rate, it might not reflect the contamination accurately. Has GEH considered adding a monitor on the CLAVS system exhaust that would isolate the system on high radiation?

B. In the response to 9.4-47 S01, GEH stated that "there are no flow paths, door louvers, etc. where air travels between ventilation subsystems (radiological and non-radiological areas)". The staff's concern is not communication between ventilation systems. The ventilation systems are isolated. The staff's concern is communication between the contaminated area and the clean area. Doors are usually installed with a gap to allow pressure equalization and thermal expansion. Are all the access doors between the contaminated area and clean area sealed? In an April 10, 2008 meeting, GEH indicated that only the contaminated portion of the reactor building would be tested *and that the GOTHIC analysis took credit for migration and dispersion from gaps on doors and louvers between the contaminated and clean areas. How does GEH intend to demonstrate that the flow of contaminants from the contaminated area to the clean area is minimal? The RB test program for the contaminated area supplied as a response to RAI 6.2-167 S01 only establishes a maximum leakage rate. It does not preclude all of the leakage going to the clean area. If all of the leakage were to enter the clean area of the RB, what would be the impact on operator entry from contaminated effluent concentrating in the RB if there were minimal exhaust and exfiltration flow from the RB clean area such as the first 72 hours post-accident when power is not available?*

GEH Response

A. *Does the CLAVS subsystem isolate upon high radiation signal?*

No, the CLAVS subsystem is designed to only isolate upon loss of Instrument Air or loss of AC power.

Is the clean area which CLAVS serves considered inside or outside of the reactor building boundary?

The clean area, which the CLAVS serves, is considered outside the Reactor Building boundary based on the Accident analysis.

Is the ESBWR being designed such that the CLAVS system can be operated if power is available post-accident for cooling and potentially for clean up operations in either a partial recirculation or once through ventilation mode.

If power is available, following an accident when the CONAVS and/or REPAVS subsystems are isolated, the CLAVS subsystem can operate for cooling and battery room hydrogen removal (during battery recharge). The CLAVS subsystem operation would be in a recirculation or once thru mode of operation with a slightly positive pressure. With power available, the CLAVS will be in service and it will be maintained at a slightly positive with respect to the CONAVS area. This will preclude any CONAVS area contamination migration to the clean areas. Additionally, the potential leak paths for this leakage from the CONAVS area to the CLAVS area are virtually nonexistent by utilizing tightly sealed emergency stair tower doors. In addition, upon the isolation of the CONAVS subsystem, the CLAVS system can be switched from recirculation mode to "purge" mode by repositioning the "purge" and "return" dampers, which will allow the exhausted CLAVS atmosphere to be monitored by the RB/FB stack radiation monitoring system along with the Battery room exhaust.

Is there any monitor on the direct release of the CLAVS system to the environment?

Yes, the RB/FB vent stack radiation monitors monitor the CLAVS system exhaust whether the system is operated in once-through or recirculation mode. If the CLAVS area is in recirculation mode, the battery room exhaust (which is a representative sample of the CLAVS atmosphere) provides the monitoring flow to the stack radiation monitors.

Does this probe tell what radiation is coming from the clean area of the building or does it measure a combined effect from other sources?

The RB/FB isokinetic sample probe samples the process flow within the RB/FB stack. The sample flow to the monitoring system is adjusted accordingly based on the measured process flow to maintain isokinetic sampling. The RB/FB stack receives a combined process input from the reactor building contaminated areas, fuel building, battery room, and the clean areas (CLAVS) of the reactor building. The monitoring system is designed to maintain near isokinetic sample conditions capable of spanning the expected process flow range.

The staff is also concerned that the air being exhausted from the battery room may not be representative of the air in the clean area as a whole and that because the flow rate is relatively small to the maximum CLAVS exhaust rate, it might not reflect the contamination accurately. Has GEH considered adding a monitor on the CLAVS system exhaust that would isolate the system on high radiation?

The addition of a monitor has been considered but it is not needed because the stack radiation monitors will process any potential leakage into the CLAVS area if the system is being operated in once-through or recirculation mode. As a result, additional monitors in the CLAVS area will be performing the same job as the stack radiation monitors. The explanation of how the CLAVS area functions as well as monitoring of potential leakage is provided above. The CLAVS area is equipped with safety-related isolation dampers. The air, which exhausts the building from the CLAVS subsystem (via the battery room exhaust and the CLAVS return/exhaust fans), is representative of the air in the clean area system. The reason being that if the CLAVS system is in full recirculation, then that atmosphere is mixed in the AHU and then delivered, albeit cooled, to the battery room, where it is then drawn out via the battery room exhaust fans and discharged to the stack. If the CLAVS system is in full exhaust mode, the whole volume is discharged to the stack. In both instances, it is a mixed representative sample of the clean area of the RB.

B.

Are all the access doors between the contaminated area and clean area sealed?

The only means of communication between the contaminated (CONAVS and REPAVS subsystems) and clean (CLAVS) subsystems is via the emergency exit doors at the clean area that connect to the contaminated stairwell. These doors are normally closed and sealed tightly. Openings through the RB boundary, such as personnel and equipment doors, are closed during normal operation and after a DBA by interlocks. These doors are equipped with position indicators and alarms that are monitored in the control room. There are no flow paths, door louvers, etc. where air travels between ventilation subsystems (radiological and non-radiological areas).

How does GEH intend to demonstrate that the flow of contaminants from the contaminated area to the clean area is minimal?

The testing of the CONAVS area (300 cfm acceptance criteria) will ensure that the leakage amount remains less than the most limiting leakage assumed in the dose analysis. Testing does not determine if contaminates leak from the CONAVS area to the CLAVS area or REPAVS areas or outside the building. All areas outside the CONAVS area are conservatively considered “outside environment”.

The RB test program for the contaminated area supplied as a response to RAI 6.2-167 S01 only establishes a maximum leakage rate. It does not preclude all of the leakage going to the clean area. If all of the leakage were to enter the clean area of the RB, what would be the impact on operator entry from contaminated effluent concentrating in the RB if there were minimal exhaust and exfiltration flow from the RB clean area such as the first 72 hours post-accident when power is not available?

There are no credited operator actions taken in the CLAVS areas of the reactor building. However, the electrical equipment areas and remote shutdown panels have been listed as access and egress areas to address TMI Action item II.B.2. The dose rates for those areas are listed in Tier 2 DCD, Revision 5, Table 12.3-14 and are well less than the GDC 19 limit of 5 rem.

There are no actions required in the passive design prior to 72 hours, which provides the basis for the dose analysis. For actions in the reactor building not specifically described in the design basis including actions taken prior to 72 hours, the emergency preparedness program (TMI Action I.C.1) used in coordination with symptomatic emergency operating procedures will address post-accident reactor building re-entry. While assumptions used in the calculation of the radiation mission doses in Table 12.3-14 do not assume a lower exfiltration rate or discharge directly to the CLAVS area, emergency preparedness procedures will ensure radiation dose to operators, who enter the reactor building post accident, is controlled below EPA Protective Action Guidelines as required by 10CFR50.47(b)(11). The intent of this position has been reflected in DCD Tier 2, Revision 5, Subsection 6.2.3.

DCD Impact

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