RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: **538-8720**

SRP Section: **11.03 – Gaseous Waste Management System**

Application Section: **11.3**

Date of RAI Issue: **02/06/2017**

Question No. 11.03-12

The applicant commits to the stipulations in NFPA 804, which are the "Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants." NFPA 804, section 8.4.9.4 states that "Fixed water spray systems shall be provided for charcoal adsorber beds containing more than 100 lb (45.4 kg) of charcoal." Currently the staff found that the DCD section 11.3.2 only contains only a description on the use of an isolated delay bed with Nitrogen for fire suppression. The staff is seeking information on compliance with NFPA 804, and if the applicant has planned use for a fix water spray system for the charcoal delay beds. Please describe in the DCD how the design complies with NFPA 804 and provide the details of the fixed water spray systems for the charcoal adsorber beds that contain more than 100 lbs of charcoal. The staff expects DCD markups as a result of this RAI.

Response

The Gaseous Radwaste System (GRS) is designed to prevent the formation of an explosive mixture by monitoring and controlling the concentration of hydrogen and oxygen. Hydrogen and oxygen concentrations are continuously maintained below the lower flammability limit. Dual instruments are provided to continuously monitor the concentrations. Nitrogen gas is injected to dilute the oxygen concentration if required. The charcoal delay beds are located inside a shielded cubicle, which also acts as a fire barrier; and there is no additional combustible material that could cause fire or the spread of fire. These design features help to preclude the occurrence of a fire condition and satisfy the requirements of 10 CFR 50, GDC 3, Fire Protection.

In accordance with NFPA 804, KHNP performed a fire hazard analysis and concluded that the design of the GRS charcoal delay beds have sufficient design features that a fire condition is unlikely to occur. Hence a fixed water spray system for charcoal delay beds is not required to be provided for GRS.

DCD section 9.5A.3.6.4 will be revised to provide the information above.

Impact on DCD

DCD Tier 2, Section 9.5A.3.6.4 will be revised as indicated in the attached markup.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

RAI 235-8275 - Question 12.03-46

Fire Protection Adequacy Evaluation

The fire area is enclosed with 3-hour-rated concrete walls except for the exterior walls. Penetrations and openings are sealed for fire confinement. HVAC ductwork passing into the barrier is equipped with a fire damper.

A fire in this area is detected by smoke and temperature detectors and is extinguished manually using water hose or portable extinguishers in accordance with NFPA 72, 14, and 10. The fire area has an automatic wet pipe sprinkler system in accordance with NFPA 13 and regulatory guidance. Based on the expected fire hazards in this area, the 3-hour-rated boundaries of this area provide sufficient containment of any unsuppressed fire that can be expected. On this basis, there is adequate fire protection provided for this fire area.

This fire area is served by the CPB HVAC system. Any HVAC ductwork passing into the area is provided with automatically closing fire dampers at the fire area boundaries. Smoke migration into the area is mitigated by sealed penetrations and openings of the fire area boundaries. After the fire, smoke is removed from the fire area by the exhaust ACU.

Fire Protection System Integrity

Inadvertent actuation of the automatic wet pipe sprinklers installed in this area would not affect the capability to safely shut down the plant since there is no safety-related equipment in this area.

Safe Shutdown Analysis

The design basis fire would occur if all combustibles in this fire area burned, but the design basis fire would not affect the ability to safely shut down the plant since this fire area is completely separated from the adjacent fire areas by 3-hour-rated fire barriers and equipment located in this fire area is non-safety related.

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Radioactive Release Analysis

~~This fire area is not a radiological area. The piping systems in the fire area do not contain fluids with radiological content. Therefore, a radioactive release due to a fire in this area is not expected.~~

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This fire area is a radiological area, due to the charcoal delay beds and spent resin long-term storage tank containing radiological material. But the spent resin is stored in the spent resin long-term storage tank in the wet condition, which is composed of spent resin and water. These spent resin tanks are located at the enclosed, controlled-access storage area. Also, there is no ignition source in the spent resin long-term storage tank room. Thus it can be credited the radioactive materials contained in the spent resin are not released to the environment since the possibility of fire occurrence is eliminated by the fire hazard analysis.

~~For the charcoal delay bed rooms of the GWMS(Gaseous Waste Management System), it is not realistic to assume the fire damage of the charcoal due to exposed fire outside the charcoal delay bed rooms. There is no combustible material inside the charcoal delay bed rooms except for the charcoal in the delay beds. As shown in Figure 9.5A-21, there is no large opening to allow propagation of fire from outside the room into these rooms. The access openings to the charcoal delay bed rooms for maintenance are normally closed by removable slabs, which do not allow propagation of fire. Thus, the possibility of exposure to direct flame by a postulated fire outside of the charcoal delay bed rooms is eliminated in the fire hazard analysis.~~

For the charcoal delay bed rooms of the GRS(Gaseous Radwaste System), it is not realistic to assume the fire damage of the charcoal. The GRS is designed to prevent the formation of an explosive mixture by monitoring and controlling the concentration of hydrogen and oxygen. Hydrogen and oxygen concentrations are maintained below the lower flammability limit. Dual instruments are provided to continuously monitor the concentrations. Nitrogen gas is injected to dilute the oxygen concentration if required. Also, there is no additional combustible material that could cause fire or the spread of fire inside the charcoal delay bed rooms except for the charcoal in the delay beds. This design feature helps to preclude the occurrence of a fire condition in the system.

In case of fire outside the charcoal delay rooms, there is no large opening to allow propagation of fire from outside the room into these rooms as shown in Figure 9.5A-21. The access openings to the charcoal delay bed rooms for maintenance are normally closed by removable slabs, which do not allow propagation of fire. Thus, the possibility of exposure to direct flame by a postulated fire outside of the charcoal delay bed rooms is eliminated in the fire hazard analysis.

The fixed water spray system for charcoal delay beds which is described in NFPA 804, section 8.4.9.4 is not required to be provided for GRS because the fire damage of the charcoal is unlikely to occur by its own system design features and layout.

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Question No. 11.03-13

1. The GWMS continuously releases to the ventilation system and to the environment through the charcoal filter banks. Valve number 008, in Figure 11.3-1, is the main gaseous effluent automatic termination valve that is connected to a gaseous radiation monitor that includes a high alarm set point reading to automatically close isolation Valve number 008 when it exceeds the radiation monitor high alarm setting. Therefore, if the gaseous radiation monitor reading exceeds the calculated set point of the gaseous radiation monitor, the GWMS continuous gaseous effluent release would be terminated due to Valve number 008 closing. Explain the consequences from a radiation protection perspective if the isolation valve did not close. Would the discharge limits of 10 CFR Part 20, Appendix B and 10 CFR 50, Appendix I be exceeded? How would the gaseous effluent discharge be terminated? Is there another isolation valve that could be operated remotely or locally to isolate the system? Please clarify and describe the capabilities of the system to be isolated in the DCD.

2. Valve number 008 also should automatically close on a low flow signal from the ventilation flow meter. Again, what if the valve did not close automatically when the flow meter indicated a reading below the flow meter low flow signal alarm set point? How would the gaseous discharge, if any, be terminated? Please clarify and describe in the DCD.

3. The function of the PERMSS is to generate alarm indications and, in some cases, control functions to limit the release or divert the release of the radioactivity. In Figure 11.3-1, there is a full flow bypass line around the discharge Valve number 008 with a manual, normally closed, manual valve number V-1015. Because this is a manual valve, if that valve is open, the discharge flow cannot be isolated. When is this valve opened? When, during normal or abnormal operations, should that valve V-1015 be open? Please clarify and describe in the DCD.

Please provide details to address these 3 items and provide a mark-up for the proposed DCD changes.

Response

1. Since the GRS (Gaseous Radwaste System) is based on continuous operation, the isolation is not normally used. Gaseous effluents from the GRS is mixed with the GRS cubicle ventilation flow and then filtered by normal exhaust ACU to the environment. In the event of high radiation with the valve 008 not closed completely, another isolation valve in the GRS package can be closed remotely at the radwaste control room when the isolation valve 008 fails to close completely. The vendor for GRS package is required to provide this isolation valve in the effluent discharge line. It is noted that the normal GRS cubicle exhaust is routed to the CPB ventilation system and is treated by the normal ventilation ACU; or diverted to the emergency exhaust ACU in the condition of high radiation. A radiation monitor located at GRS and HVAC system continue to detect the flow that contains radionuclides. In addition, the two manual valves (valves 1013 and 1014) located at both sides of the valve 008 also can be closed for limiting the release of discharge flow. Therefore, gaseous effluent to environment is monitored and controoled at all time during the system operation at various points.

   DCD section 11.3.1.4 will be revised to provide the information above.

2. Valve 008 is also closed automatically on a low flow signal from the ventilation flow meter. As described in the response for item 1, remotely controlled isolation valves in the GRS package and the two valves located at both sides of the valve 008 can be closed to terminate the gaseous discharge when the valve 008 does not close completely.

3. As described in the response for item 1, the normal GRS cubicle exhaust is routed to the CPB ventilation system and is treated by the normal ventilation ACU; or diverted to the emergency exhaust ACU in the condition of high radiation. The PERMSS has the function of generating an alarm and indication to divert the release of radioactivity to environment including isolation of discharge flow from GRS.

   The full flow bypass line around the discharge valve 008 is provided to maintain the continuous GRS process flow. When the main discharge line is isolated due to fail position or maintenance of valve 008, valve 1015 is opened for vent flow until valve 008 is repaired.

   DCD section 11.3.1.4 will be revised to provide the information above.

Impact on DCD

DCD Tier 2, Section 11.3.1.4 will be revised as indicated in the attached markup.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

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The GRS uses equipment that is commonly used in the nuclear power industry, whose performance is proven and documented. The equipment is sized to process waste gases using design basis source term and design conditions that bound normal operation including AOOs. The equipment is also housed in the compound building with sufficient shielding. Charcoal guard beds reduce the concentration of radioactive iodine in the effluent stream. Noble gases are delayed in the charcoal beds to facilitate decay prior to release.

GRS equipment is designed, located, and shielded to conform with the guidance of NRC RG 8.8 (Reference 11), thus maintaining occupational doses ALARA.

The GRS includes radiation monitoring to continuously measure the radioactivity in the effluent stream prior to release into the environment to conform with the requirements of GDC 60 (Reference 13) and 64 (Reference 15). Additional and redundant radiation monitors are provided in the building ventilation system to verify the radiation level. Upon detection of radiation levels above the setpoint, the monitor activates an alarm and sends signals to close the GRS discharge valves. Hence, the GRS design precludes the unmonitored and uncontrolled releases of radioactivity to the environment to meet the requirements of IE Bulletin 80-10 (Reference 19).

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The GRS is designed with at least two isolation valves between the clean and contaminated systems to minimize the potential for contamination of clean systems. This feature meets the requirements of 10 CFR 20.1406 (Reference 23) and RG 4.21 (Reference 18).

11.3.1.5 Radioactive Source Terms in GRS

As shown in Figure 11.3-1, the input sources to the GRS are the vent gases from the reactor drain tank (RDT), volume control tank (VCT), equipment drain tank (EDT), and gas stripper. The radioactive sources for each component of the GRS are calculated using the radioactive concentrations of the inflows to the GRS from the CVCS components shown in Table 11.1-8, which are determined based on the reactor coolant radionuclide concentrations provided in Table 11.1-2.

The mixed specific activities of sources to the GRS are then calculated by weighting each source contribution corresponding to its partial flow fractions. Activity buildup on the

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The GRS package includes another isolation valve in the effluent discharge line. This isolation valve can be closed remotely at the radwaste control room when the GRS discharge valve fails to close. The two manual valves located at both sides of the GRS discharge valve also can be closed for limiting the release of discharge flow if the GRS discharge valve does not close tight.
The full flow bypass line around the GRS discharge valve is provided to maintain the continuous GRS process flow. When the main discharge line is isolated due to fail position or maintenance of the GRS discharge valve, the valve located at the bypass line is opened for vent flow until the GRS discharge valve is fixed.