REVISED 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.:	**230-8201**
SRP Section:	**11.02 – Liquid Waste Management System**
Application Section:	**11.2**
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Question No. 11.02-6

During the overall review and evaluation of section 11.2 the staff had concerns on what basis the applicant used to ensure the application design controls radioactive releases to the environment (GDC 60). Additionally, concerns pertaining to the requirements of 10 CFR Part 50.34a relating to the availability of equipment of sufficient design and related information to demonstrate that the objectives necessary for controlling releases of radioactive effluents to the environment have been met. Finally, the staff review of this design application raised concerns relating to 10 CFR Part 20.1406 implementation of design features to minimize contamination. The staff raised the following items of concern related to this application:

1. DCD section 11.2.1.3, the application states: “The design options for operator initiation and termination of the process operations and the selection of treatment components to achieve treatment objectives and effluent specifications to meet the set of regulations...” Staff would like to have the overall details explained dealing with the actions the operators will take to maintain dose limits within the prescribed bounds of the regulations.

2. Concerning GDC 60, and control of radioactive materials to the environment. In DCD section 11.2.1.4, the applicant states that, “The COL applicant is to provide the piping and instrumentation diagrams (P&IDs),” as COL item 11.2(4). The Staff would like to see P&IDs in the DCD that would clarify (Design Specifications) these items utilized to understand how the radwaste system is designed to control the releases of radioactive material to the environment.

3. DCD section 11.2.2.1.1 states, the applicant describes waste input streams. In the description of the waste input streams, the applicant uses the term “including but not limited to,” to describe some of the waste pathways. Staff is requesting that the applicant provide all systems that correspond to any of the waste streams discussed by the applicant. Current DCD text supports that there are potentially more pathways for each waste stream that are not described.

4. DCD section 11.2.2.1.2 of the applicant includes a statement that describes: “In the event that a small amount of fluid is accumulated in the drain pipe and triggers the level detection instrumentation, an alarm is initiated in the radwaste control room for timely operator actions.” Staff is seeking details for the actions that an operator would take once these indications are received.

Please address these items and provide a markup for the proposed DCD changes.

Response – (Rev. 1)

1. The LWMS is designed with redundant trains for treatment of liquid waste. The operator can initiate treatment using one of two trains. As presented in DCD, Tier 2, Figure 11.2-1, some components, primarily the floor drain pumps, equipment drain pumps, and monitor tank pumps are equipped with cross-ties at the suction side to provide transfer capability between tanks. The pumps can also route liquid waste for treatment to either LWMS train, which consists of R/O and ion exchanger modules. The treated effluent in the monitor tanks can also be recycled for treatment in the event that the release exceeds a predetermined radiological setpoint. These design features add flexibility to treatment operation and are operator initiated. However the internal components inside each module are arranged in series in order to maintain dose limits within the prescribed bounds of the regulations. DCD Subsections 11.2.1.3 and 11.2.2.2 will be revised to add the information above.

2. A P&ID showing the subsystem for the release of processed liquid is provided in Attachment 1.

3. The detailed waste inputs shown in DCD Tier 2, Figure 11.2-1 (sheet 1 & 2) will be added into DCD Subsection 11.2.2.1.1. The expression “including but not limited to” will be deleted for clarity.

4. When the tank leakage alarm is annunciated, a plant operator is dispatched to investigate the cause of the alarm for determination of mitigation actions. The mitigation actions may include termination of liquid waste collection, transferring tank contents, identifying leakage area, decontaminate the contaminated area, and/or performing maintenance and repair as required, in accordance with the program and procedures to be developed by COL applicant per COL 11.2(2), (9) and (10)).

   DCD Subsection 11.2.2.1.2 will be revised to provide clarify for development of the COL items.

Impact on DCD

DCD Tier 2 Subsections 11.2.2.1.1 and 11.2.2.1.2 will be revised as indicated in the attached markup.

DCD Tier 2 Subsections 11.2.1.3 and 11.2.2.2 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.

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For a more detailed discussion of the drainage systems, refer to Subsection 9.3.3.

11.2.2.1 Liquid Waste Processing System Operation

11.2.2.1.1 Waste Input Streams

Sources of radioactive liquid wastes include the following:

a. Floor drain wastes, ~~including but not limited to~~ such as the reactor containment and auxiliary building floor drains and compound building drains via each building sump

b. Equipment wastes, ~~including but not limited to~~ such as the auxiliary building equipment drains via the auxiliary building equipment drain sump

c. Chemical wastes, ~~including but not limited to~~ such as the radiochemistry laboratory, fuel handling area, and equipment decontamination drains via the auxiliary building chemical waste drain sump and compound building chemical drain sump

d. Detergent wastes, ~~including but not limited to~~ such as the wastes from the personnel decontamination station and detergent-type decontamination solutions, which occur in the unlikely event of high radioactivity surpassing the effectiveness of the detergent waste filter

e. All of the potentially radioactive waste streams, such as the auxiliary steam condensate receiver tank drains and condensate polishing area sump drains are monitored for radiological contamination. Contaminated drains from these sources are routed to the LWMS for processing prior to discharge to the environment

11.2.2.1.2 Waste Collection and Storage

The LWMS is not designed for abnormal or accident plant conditions, but the LWMS has the capacity to hold up the liquid wastes generated during normal conditions and AOOs.

The floor drain tanks, equipment drain tanks, and chemical waste tanks are housed in separate cubicles with individual leak detection instruments and sloped and epoxy coated floors to facilitate drainage and cleaning. In the event that a small amount of fluid is accumulated in the drain pipe and triggers the level detection instrument, an alarm is initiated in the radwaste control room for timely operator actions. This design approach meets the requirements of RG 4.21 (Reference 8).

When the tank leakage alarm is annunciated, a plant operator is dispatched to investigate the cause of the alarm for determination of mitigation actions. The mitigation actions are in accordance with the program and procedures to be developed by COL applicant per (COL 11.2(2), (9) and (10)).

11.2.2.1.3 Waste Processing

The LWMS is designed to operate with a tank-to-tank manual batch operation according to the plant condition. Therefore, the LWMS is designed with the high degree of flexibility illustrated on the process flow diagrams.

Floor drain and equipment waste are routed to the R/O package for processing. The chemical waste is also processed by the R/O package and discharged to the monitor tanks. Downstream of the chemical waste pumps, there is a provision to connect to a mobile chemical waste treatment system that processes boric acid concentrates, if required.

The liquid waste processing system has two R/O packages. Each R/O package has four modules: pre-treatment, R/O, demineralizer, and concentrate feed.

The liquid wastes collected in the floor drain tanks, equipment waste tanks, and chemical waste tanks are first passed through a pre-treatment module in which oily and suspended solids are removed to maintain optimal performance of the R/O module. The suspended solids include the corrosion (e.g., sodium and iron) and activation products (e.g., cobalt and strontium), SG cruds, and other particulate from the floor drains. The passed water is routed to the R/O module for the removal of soluble species, which includes the ionic activation products (e.g., cesium and technetium). The activation products can be in particulate or ionic form, depending on pH and other fluid chemistry species (such as carbonates, hydroxides, and nitrates) in the liquid waste. Between the pretreatment and the R/O units, most of the radionuclides are removed from the R/O permeate. Current advances in treatment technologies and industry experience demonstrate the effectiveness of these treatment units and provide reasonable assurance that the 10 CFR 20, Appendix B (Reference 3) release limits are met. To further enhance the permeate quality, the R/O permeate from the R/O module is processed by the demineralizer module for final polishing and then transferred to the monitor tank for sampling, analysis, and release.

compound building, which provides shielding and temporary containment of leakage and drainage through the use of cubicles with epoxy coating, leak detection instruments, and operator actions. The design provides options for operator initiation and termination of the process operations and the selection of treatment components to achieve treatment objectives and effluent specifications to meet the set of regulations, including 10 CFR 20, Appendix B (Reference 3) and 10 CFR 50, Appendix I (Reference 4) efficiently. Due to equipment redundancy, the components can be divided into separate trains that can operate in series, or parallel, based on the contamination levels and treatment needs. ~~The design also provides recycle capability in the event that additional processing is required to meet the release specifications.~~ Details of the system and component descriptions and operations are provided in Subsection 11.2.2.

Insert A (next page)

Detergent wastes from personnel decontamination showers and detergent-type decontamination solutions drainage are unlikely to have high radioactivity. The detergent waste is collected, filtered, and released through a monitored pathway. In the unlikely event that the radionuclide concentration is above a setpoint, the detergent waste is diverted to the chemical waste tank (CWT) for additional processing.

Depending on site-specific requirements, the COL applicant is to determine whether contaminated laundry is sent to an offsite facility for cleaning or for disposal (COL 11.2(3)).

Tanks are equipped with high-level and high-high level alarms that alert operators of high liquid levels in order to minimize the potential for overflow. If an operator action is not taken, the overflow over the high-high level can be directed to the other storage tank through the cross-connections.

11.2.1.4 Radioactive Source Terms in LWMS

Radioactive sources in the radwaste systems include fission and activation radionuclides produced in the core and the reactor coolant. The radioactive source terms in each LWMS component are determined using the DIJESTER Computer Code (Reference 20).

The DIJESTER Code (Reference 20) determines radionuclide inventories and concentrations by solving the differential equations of flow through the component, taking into account the flow rate, liquid source concentrations, decontamination factors, process time, equipment volume, and decay constant.

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A

The operator can initiate treatment using one of two trains. Some components, primarily the floor drain pumps, equipment drain pumps, and monitor tank pumps are equipped with cross-ties on the suction side to provide transfer capability between tanks, as shown on Figure 11.2-1. The pumps can also route liquid waste for treatment to either LWMS train, which consists of R/O and ion exchanger modules.

The treated effluent in the monitor tanks can also be recycled for treatment in the event that the release exceeds a predetermined radiological setpoint. These design features add flexibility to the treatment operation and are operator initiated. However the internal components inside each module are arranged in series in order to maintain dose limits within the prescribed bounds of the regulations.

The chemicals are then mixed with the tank contents using the recirculation/mixing mode, followed by sampling and further chemical addition, if necessary. This process is repeated until the tank contents meet the required fluid pH for discharge.

11.2.2.2 Monitoring and Discharge

LWMS monitor tanks collect liquid processed through the R/O package. Following the sample analysis as described in Subsection 11.2.2.1.4, the operator determines where the contents of the monitor tank are to be transferred. If the water quality and radionuclide concentrations of the contents in the monitor tank meet the water specifications for the holdup tank, and the plant load following operation is not affected by the recycle operation, the contents of the monitor tank are transferred to the holdup tanks for plant reuse. If the water is not recycled and it is determined to be acceptable for offsite release, the contents of the monitor tank are discharged to the offsite release point.

The LWMS is designed to control the release of the treated effluent. The effluent is stored in the monitor tank and is sampled and analyzed to confirm that the release nuclide concentrations are within the limits of 10 CFR 20, Appendix B, Table 2 (Reference 3), prior to release. The LWMS is designed with recycle capability for further treatment for any batch that exceeds the release specifications (Table 11.2-1 for normal operation). The release is also continuously monitored by dual in-line radiation monitors (RE-183 and RE-184) during release. Any portion of the flow that exceeds the predetermined setpoint will trigger alarms in the MCR and the radwaste control room for operator actions, simultaneously turn off the monitor tank pump, and close the effluent discharge valve that is under supervisory control. The design and setpoints of the radiation monitors are described in Section 11.5. The LWMS is designed with no release bypass.

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11.2.2.3 Component Description

The LWMS components are determined for the radioactive safety classification in accordance with the guidance provided in NRC RG 1.143 (Reference 1). The component safety classification is summarized in Table 11.2-6. Accordingly, the LWMS is classified as RW-IIa, based on the highest safety classification for the components within the system boundary. The LWMS components are housed within the compound building, which has been determined to be RW-IIa.

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A

The effluent from the detergent waste tank is transferred to either the monitor tank pump discharge line or the chemical waste tank based on the sample result.
If the fluid has minimal radioactivity, the flow for discharge is simultaneously transferred to the environment via the detergent waste filter, to the monitor tank pump discharge line. If the fluid has significant radioactivity beyond the effluent concentration limits of 10 CFR 20, Appendix B, the contents are transferred to the chemical waste tank for further processing. The release from the detergent waste tank is also continuously monitored by RE-183 and RE-184 during release. When the release exceeds the predetermined setpoint it will trigger alarms, the discharge valve is closed automatically and the operator turns off the detergent waste pump and diverts the flow to the chemical waste tank manually.

B

An annual report that specifies the quantity of each principal radionuclide released to unrestricted areas as liquid effluents to conform with 10 CFR 50.36a (Referenece 19) is described in Subsection 11.5.1.2.k.