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.:	**235-8275**
SRP Section:	**12.03 – 12.04 Radiation Protection Design Features**
Application Section:	**12.03 – 12.04**
Date of RAI Issue:	**10/07/2015**

Question No. 12.03-30

10 CFR 50.34(f)(2)(vii) requires and NUREG-0737 II.B.2, notes that vital areas which require access by operators aiding, mitigating or recovering from the accident, need to be identified.

In FSAR Sections 12.3.1.8 and 12.3.1.9, the applicant indicates that the main control room and technical support center require continuous access and that the post-accident sampling system, remote shutdown room and remote control console room, class 1E switchgear room, I&C equipment room, and access areas outside the CS and SC pump rooms require limited access and that accessing and performing vital actions in these areas will not result in a dose exceeding 5 rem. The FSAR also indicates that the safety injection system, containment spray system, shutdown cooling system, and CVCS system were considered for post-accident access but do not constitute vital areas.

In addition, FSAR Section 12.4.1.2 indicates that vital areas are based on performing vital functions following a LOCA. However, it is unclear if other accidents were considered and if vital areas or dose rates could be different for other design basis accidents.

1. Please update the FSAR to explain why the safety injection system, containment spray system, shutdown cooling system, and CVCS system do not constitute vital areas.

2. Please indicate why the emergency diesel generators and diesel generator oil delivery area is not considered a vital area.

3. The FSAR indicates that manual action may be required in the areas outside the CS and SC pump rooms and that is why these areas are considered vital areas. It is unclear what manual actions could be performed outside of these rooms. Please update the FSAR to specify what vital post-accident actions are performed outside these rooms (for example, what equipment is located at that location and what actions may be required at the equipment).

4. Please update FSAR Section 12.4.1.2 to indicate if other design basis accidents (other than a LOCA) were considered in identifying vital areas and determining dose rates for vital area access.

Response

1. The Safety Injection System (SIS) is designed to provide core cooling in the event of a design basis accident (DBA), such as a loss-of-coolant (LOCA) accident. The SIS provides very important safety functions in the event of an accident through the injection of borated water to provide core cooling water inventory and reactivity control. The SIS provides these functions for a range of postulated accidents including a LOCA, a steam generator tube rupture (SGTR), a steam line break (SLB), and a control elements assembly (CEA) ejection. The post-accident safety functions of the SIS are described in Section 6.3.

   In the unlikely event of a LOCA or other accident resulting in a significant breach in the reactor coolant pressure boundary (RCPB), a safety injection actuation signal (SIAS) is initiated, which automatically opens the valves on the SI lines and automatically initiates operation of the SI pumps. Therefore, there is no operator action needed for the post-accident short-term mode. For the long-term mode of post-accident conditions, manual initiation is required from the operator. Remote instrumentation and controls for the SIS are provided in the remote shutdown room (RSR) and the main control room (MCR). Therefore, the plant areas within containment and just outside containment in the auxiliary building where SIS components are located are not required to be directly accessed by operators in the event of an accident and are therefore not considered vital areas.

   The Containment Spray System (CSS) is a safety-related system designed to reduce containment pressure and temperature from a main steam line break (MSLB) or a LOCA accident and to remove fission products from the containment atmosphere following a DBA. Similar to the SIS, the CSS is an automatically actuated engineered safety feature (ESF) system. The CSS spray flow of borated water from the top of containment is provided by the CS pumps which are automatically initiated upon the receipt of a SIAS or a containment spay actuation signal (CSAS) following the automatic opening of the containment spray header isolation valves initiated by the same signal. Following the automatic initiation of system operation, the operator monitors the containment pressure and terminates the CSS operation when it is no longer needed. The operator can manually restart the CSS operation if the containment pressure does not stabilize. The post-accident safety functions of the CSS are described in Subsection 6.5.2.

   Remote instrumentation and controls for the CSS are provided in the remote shutdown room (RSR) and the main control room (MCR). Therefore, the plant areas within containment and just outside containment in the auxiliary building where CSS components are located are not required to be directly accessed by operators in the event of an accident and are therefore not considered vital areas (with the exception of the valve area outside of the pump rooms as described in Item 3 below).

The Shutdown Cooling System (SCS) is a safety-related system which can also be used during accident conditions. The SC pumps are designed to be interchangeable with the CS pumps; therefore, when used in the containment spray configuration, the SC pumps are capable of being automatically started by a SIAS or CSAS. Additionally, the SCS is used in conjunction with the atmospheric dump valves (ADVs) and the auxiliary feedwater system to provide long-term cooling of the reactor coolant system (RCS) following a small break LOCA. The post-accident safety functions of the SCS are described in Subsection 5.4.7.

The SCS post-accident long-term cooling function is manually controlled from the MCR after the RCS fluid level has stabilized and the RCS pressure and temperature have been reduced to shutdown cooling entry conditions. The safety functions provided by the SC pumps in providing the function of the CS pumps are automatically initiated when the SCS/CSS interconnection is configured. Remote instrumentation and controls for the SCS components are provided in the remote shutdown room (RSR) and the main control room (MCR). Therefore, the plant areas within containment and just outside containment in the auxiliary building where SCS components are located are not required to be directly accessed by operators in the event of an accident and are therefore not considered vital areas (with the exception of the valve area outside of the pump rooms as described in Item 3 below).

As reported in Subsection 9.3.4.2.9.4, the Chemical and Volume Control System (CVCS) is not required to perform any accident mitigation or safe shutdown function. Therefore, the plant areas and cubicles in which the CVCS components are located are not required to be accessed by operators in the event of an accident and are therefore not considered vital areas.

Subsection 12.3.1.8 will be updated to explain why the areas in which these systems are located are not considered vital areas.

2. The Class 1E onsite power system, as described in Subsection 8.3.1.1.2.4, consists of four separate trains, each of which has one emergency diesel generator (EDG). The onsite power system is designed such that two of the trains together are sufficient to meet the emergency load requirements for a safe shutdown during a loss of onsite power (LOOP) accident concurrent with a LOCA accident.

   The EDGs are automatically started through the initiation of an engineered safety feature actuation signal (ESFAS): safety injection actuation signal (SIAS), auxiliary feedwater actuation signal (AFAS), or a containment spray actuation signal (CSAS). The EDGs are also automatically started through the initiation of a two-out-of-four loss of voltage or degraded voltage signal from the Class 1E 4.16 kV bus to which the EDG is connected. In addition to automatic actuation, emergency manual actuation can be initiated through operator actions by the emergency start and stop push buttons in the MCR and RSR. These initiation methods are described for the EDGs in Subsection 8.3.1.1.3.1. As the initiation for the EDGs is automatic during accident conditions and can be further controlled remotely from the MCR and RSR, direct access to the generators during an accident is not required and the EDG area is not considered a vital area.

The emergency diesel engine fuel oil system (EDGEFOS) consists of a diesel fuel oil day tank for each EDG and four diesel fuel storage structures, each containing one diesel fuel oil storage tank. Two of the diesel fuel storage structures are located in the auxiliary building (AB) and the other two are located in the EDG building.

Once started, the EDGs will run off the fuel in their respective fuel oil day tank, which each contains a 60 minute supply of fuel. The day tanks have level instrumentation, which send a signal for automatic filling from the fuel oil storage tanks upon low level indication. Therefore, no operator action is needed to keep a steady supply of fuel oil to the EDGs during design basis accident conditions concurrent with LOOP conditions.

As described in DCD Subsection 9.5.4, each diesel fuel oil storage tank is designed for a 7-day supply to its associated EDG without relying on the associated fuel oil day tank inventory. With this fuel supply, the EDGEFOS provides the required storage capacity and continuous supply of fuel oil to the four EDGs to safely shut down the plant and maintain a safe shutdown condition following a design basis accident concurrent with a LOOP.

3. As described in Subsection 12.3.1.8 and 12.3.1.9, the areas outside of the CS and SC pump rooms are considered vital areas requiring operator access during accident conditions. The mission dose to operators performing required post-accident tasks in these areas is shown in Table 12.4-8. As indicated in this table, these areas outside of the CS/SC pump rooms require infrequent access following a LOCA accident.

   The operations which may be required to be performed in this area during post-accident conditions are the manual opening of the valve that would allow, interconnection between the shutdown cooling line and the containment spray line which allows the SC pump to perform the CS pump's function. There is also manual operation required to route the in-containment refueling water storage tank (IRWST) water to the shutdown cooling line and the shutdown cooling pump. These are not the normal operating positions for these valves as these functions are provided by the SCS as back-up to the ESF functions of the CSS.

   DCD Subsection 12.3.1.9 will be updated to describe the vital post-accident functions which may be performed outside of the CS/SC pump rooms.

4. The accident analysis detailed in DCD Chapter 15 considers various design basis accidents (DBAs) for radiological consequences for the APR1400. The Chapter 12 analyses for post-accident source terms and dose assessment also consider a range of DBAs, but mainly focus on the LOCA as it is considered the bounding accident for radiation exposures as described in DCD Subsection 12.4.1.2. The methodology and criteria, including the analyses models, for the Chapter 15 and Chapter 12 accident analyses and dose assessment are performed in accordance with the requirements of NUREG-0800 and RG 1.183.

   Therefore, the accidents considered for the identification of vital areas requiring post-accident access for operator action do consider a range of DBAs. DCD Subsection 12.4.1.2 will be updated to indicate that other design basis accidents (in addition to a

LOCA) were considered in identifying vital areas and determining dose rates for vital area access.

Impact on DCD

DCD Subsections 12.3.1.8, 12.3.1.9, and 12.4.1.2 will be updated as indicated in Attachment.

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 Environment Report.

a. Safety injection system

b. Containment spray system

c. Shutdown cooling system

d. Chemical and volume control system

The safety injection system, containment spray system, and shutdown cooling system are all safety-related systems with ESF functions, which are required during design basis accident conditions in order to achieve safe shutdown and mitigate the accident. However, these functions which are required during accident conditions can be monitored and controlled remotely from the MCR and RSR. Therefore, the plant areas housing these system components (with the exception of the area outside of the CS/SC pumps) do not directly require operator access and are therefore not considered vital areas.

The zone limits are summarized for the design basis loss-of-coolant accident (LOCA) in Table 12.3-3. Post-accident radiation zone maps are shown in Figures 12.3-20 through 12.3-51.

12.3.1.9 Vital Area Access

The following descriptions detail the post-accident access routes to the vital areas listed in Subsection 12.3.1.8. Vital area access routes are illustrated by arrows in Figures 12.3-20 through 12.3-51. During normal operating conditions, the radiation control area has a single point of access in the compound building at elevation 30.48 m (100.0 ft). However, during post-accident conditions, emergency access and egress are possible on all elevations if needed.

a. Main control room (MCR)

The MCR is occupied continuously during post-accident situations. The design dose for this area does not exceed 0.15 mSv/hr averaged over 30 days for a TEDE of 50 mSv. The MCR is located in the auxiliary building at El. 47.5 m (156.0 ft). Access to the MCR is via the compound building. It is generally accessible on all elevations from stairwells and elevators located at 14-15, AH-AJ, and AB-AD. The locations of the MCR and associated access routes are shown in Figure 12.3-40.

b. Technical support center (TSC)

The TSC is continuously occupied during post-accident situations. The design dose for this area does not exceed 0.15 mSv/hr averaged over 30 days for a TEDE

The four (4) I&C equipment rooms house the safety related instrument and control systems, which require infrequent access to perform the vital function. The design dose for these areas shall not exceed TEDE of 50 mSv. The I&C equipment rooms are located in the auxiliary building at an elevation of 47.5 m (156.0 ft). The locations of the class 1E switchgear rooms and associated access routes are shown in Figure 12.3-40.

g. Access areas outside the CS and SC pump rooms

The areas outside the CS and SC pump rooms are irregularly accessed, when the manual actuation is required after post-accident situations. The design dose for these areas shall not exceed TEDE of 50 mSv. These areas are located in the auxiliary building at an elevation of 16.8 m (55.0 ft). The locations of these areas and associated access routes are shown in Figure 12.3-20.

12.3.2 Shielding

The shielding design is based on the source terms, design dose rates, and established design criteria in Subsection 12.2.1 and is in accordance with the calculation method and guidance in NRC RG 1.69 (Reference 10) and NRC RG 8.8.

12.3.2.1 General Shielding Design Criteria

Shield walls are provided around components that contain and handle radioactive materials for worker safety and to maintain radiation doses ALARA. The wall thicknesses listed in Table 12.3-4 are based on the shielding basis source terms of the component, the design dose rate, and the shielding material. This approach is consistent with NRC RG 8.8.

The shielding design for the MCR and the primary shielding in the reactor containment building is safety related. The shielding for the MCR meets the requirements of 10 CFR Part 50, Appendix A, GDC 19.

Radiation protection of personnel, equipment, and materials is dependent primarily on the adequacy of the design of the plant shielding. Radiation shielding has the passive protection function of radiation attenuation and consists of materials placed between

The manual actuation involves the opening and closing of valves for the interchanging of the CS and SC pumps and the opening or closing of valves for the connections of these two systems to the IRWST. These configurations may be implemented as back-up mitigation measures depending on the changing post-accident conditions.

ALARA. Occupational exposure is also reduced by using automatic cleaning equipment, remote fuel handling, and an integrated head assembly (IHA).

Examples of refueling activities are as follows:

a. RV opening/closure

b. Refueling

c. Stud bolt hole cleaning

DBA

Table 12.4-6 provides a breakdown of the collective doses for refueling activities.

12.4.1.2 Post-Accident Actions

approach

Following a ~~LOCA~~, the vital functions can be performed with an operator radiation exposure of no more than 50 mSv total effective dose equivalent (TEDE) in accordance with the alternative source term (AST), 10 CFR 50.34(f)(2)(vii), GDC 19, NUREG-0737 (Reference 5), Item II.B.2, and plant operating and emergency procedures.

The areas requiring continuous occupancy or infrequent access to perform post-accident vital functions are described in Subsection 12.3.1.8.

All vital areas requiring infrequent access are located in various rooms at different floor elevations in the auxiliary building (AB). The only significant submergence radiation dose that an individual would receive in accessing (transit time) and occupying (stay time) areas that are infrequently accessed is that from the airborne source. The plant emergency procedure mandates the use of respiratory protection to limit intake of airborne radioactive material when the potential for a radiation hazard of 1 DAC exists for the airborne activity. The minimum assigned protection factor (APF) of 10 for a half-mask respirator is used to calculate the inhaled dose rates for the areas requiring infrequent access. The respirator protections are not provided for areas requiring continuous occupancy, such as the main control room (MCR) and technical support center (TSC).

For the radiation exposure assessment presented in this section and summarized in Table 12.4-8, the radiation exposures resulting from operator actions required during post-LOCA conditions are evaluated as the bounding DBA for post-accident radiation exposures.

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Docket No. 52-046

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Question No. 12.03-34

10 CFR 20.1602 requires that in addition to the requirements in 10 CFR 20.1601, the licensee shall institute additional measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

SRP 12.3-12.4 indicates that the staff will review the design features provided to control access to radiologically restricted areas (including potentially very high radiation areas) and that the staff's review will emphasize areas potentially greater than 100 Rad/hour.

In addition SRP 12.5 indicates that the staff will review the description of physical and administrative measures for controlling access to, and work within, radiation areas, high-radiation areas, and very high radiation areas.

In FSAR Table 12.3-5, the applicant lists areas in the plant that could potentially be greater than 100 Rad/hour. Many of these areas are also very high radiation areas (greater than 500 Rad/hour), as indicated in the normal radiation zone figures in FSAR Section 12.3.

While the applicant specifies design features to control access to a few of these significant radiation areas in FSAR Section 12.3.2.3, the applicant does not discuss design features to control access to the other areas. Please update the FSAR to discuss design features to control access for all areas potentially greater than 100 Rad/hour.

Response

As described in DCD Subsection 12.3.2.3 and Table 12.3-5, the APR1400 design contains areas identified to be high radiation areas (areas potentially greater than 1 Gy/hr) which are provided with access control features to prevent inadvertent high radiation exposure to plant personnel. DCD Subsection 12.3.2.3 addresses shielding, and a Subsection 12.3.2.4 will be

added to describe the design features provided for access control for the rooms and areas listed in Table 12.3-5.

Impact on DCD

DCD Subsection 12.3.2.4 will be added as indicated in the Attachment.

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 Environment Report.

pipe chase. The resin transfer lines are also provided with a flushing capability to minimize the potential for hot spots in the piping.

The ICI chase is potentially a high-radiation area (greater than 1 Gy/hr) during ICI withdrawal. Stringent access control is provided to this area during movement of the ICI. A lockable access door is provided with a warning light. During withdrawal of the ICI, the warning light illuminates, providing indication that the ICI is being moved. An area radiation monitor is located in the ICI chase to provide indication of radiation levels and to alarm the personnel when the ICI is being withdrawn. Emergency egress from the area is also provided from the ICI chase.

Components that handle a significant amount of radioactive materials, such as LWMS floor drain tanks and equipment waste tanks, are located in shielded cubicles separated from the pump and valve galleries that are provided with labyrinths for access to the galleries. This design approach minimizes radiation streaming and scattering but permits inspection and maintenance access and removal of smaller items such as pumps, valves, and instruments for repair in lower-radiation areas. This design approach meets the requirements of NRC RG 8.8 2.b(4). The plant shielding is designed not only to maintain personnel occupational exposure ALARA, but also to maintain exposure to the general public ALARA.

The APR1400 shielding design has target dose rates that are below the limits for radiation zone designations provided in Table 12.3-2 to provide a sufficient margin in maintaining radiation exposure to plant personnel and the public ALARA.

12.3.3 Ventilation

The spread of airborne contamination within the plant is minimized by the design of the plant HVAC systems to provide airflow from areas of lower potential for airborne contamination to areas of greater potential for airborne contamination. For building compartments with the potential for contamination, the exhaust from the areas is designed with pressure and flow balances to minimize the amount of uncontrolled exfiltration from these areas. These design features provide reasonable assurance that the average concentration of radioactive material in the air in the areas that are normally occupied is less than the small fraction of DAC prescribed in 10 CFR Part 20 Appendix B. Therefore,

DCD subsection 12.3.2.4 will be added to include "A" in next page

"A"

12.3.2.4 Access Control to High Radiation Area

The high radiation and very high radiation areas (areas potentially greater than 1 Gy/hr) as identified in Table 12.3-5, which are located in the Containment Building have multiple features of access control to prevent inadvertent radiation exposure to plant personnel. These high radiation areas include the ICI cavity, the hold-up volume tank, the core debris chamber, the reactor cavity, the steam generator cavity, the reactor drain tank room, and the refueling pool area. Access to the Containment Building is strictly controlled and built-in design features to prevent inadvertent access include a secure air lock as the only point of entry for personnel, the door to which is locked and equipped with a security alarm.

The high radiation areas on Elevations 78' and 86' of the Auxiliary Building are located within a block where thick concrete walls are provided as shielding to the surrounding areas. There are no doors provided to allow access to the high radiation cubicles within this block. These cubicles include the pre-holdup ion exchanger pit, the purification ion exchanger pit, the purification filter pit, and the filter area. This block of filters and ion exchangers can only be accessed from the elevation 100' level via manway, which are locked at all times and are further under administrative controls to prevent unauthorized access. Also on Elevations 100' and 120' of the auxiliary building is the volume control tank cubicle, which is a potentially high radiation area. This cubicle, which is not normally accessed by personnel, is locked and can only be opened by key from the outside.

The areas listed in Table 12.3-5 at the Elevation 120' level of the auxiliary building, which are high radiation areas during refueling operations, include the fuel transfer tube, the cask loading pit, and the refueling canal. The cask loading pit, refueling canal, and the spent fuel pool do not allow for inadvertent personnel access as these areas do not have an entrance for personnel entry.

The areas listed in Table 12.3-5 as high radiation areas within the Compound Building are all provided with access control in the form of locked doors. These rooms are provided with a latch bolt operated by key from the outside or by rotating inside knob/lever. The two exceptions to this form of access control are the hot pipe way on Elevation 77' and the charcoal delay bed room. The hot pipe way and the charcoal delay bed room are not provided with a door for personnel access. The only accesses to the areas are via the hatches provided on Elevation 85' and 120', respectively. Since these hatches are intended for maintenances or equipment removal, and are equipped with heavy concrete block, inadvertent accesses are not probable.

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Question No. 12.03-35

10 CFR 20.1101(b) requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

10 CFR 20.1406(b) requires that applicants for standard design certifications describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

FSAR Section 12.3.1.2, item p, indicates that high-pressure demineralized water will be used to decontaminate equipment that has been in the spent fuel pool. Please discuss in the FSAR how the spread of contamination and the generation of airborne radioactive material will be minimized while using this equipment.

Response

The high pressure demineralized water is intended to be used for the decontamination of the SFP and any components (bulky items such as storage racks) that cannot be decontaminated in the decontamination facility. When high pressure demineralized water is used to decontaminate the SFP or bulky components, protective covers are required to be used to minimize the spread of contamination. High pressure demineralized water is not to be used in open areas above the pool. The requirement for the use of covers to minimize the spread of contamination will be added to the DCD for clarification.

Impact on DCD

DCD Tier 2 Section 12.3.1.2, item p, will be updated as indicated in the Attachment.

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 Environment Report.

quick-application type buckle fasteners. After the necessary panels are removed, remote equipment can be used to perform the required inspections.

n. Blanket-type thermal insulation

Blanket-type thermal insulation with hook-and-loop fasteners is selected where needed for components and piping containing radioactive fluids. A metal jacket around the insulation is provided. This jacket is held in place by quick-application type buckle fasteners. This insulation is easily removable to facilitate the performance of inservice weld inspections. This minimizes personnel exposures received during ISI.

o. Electrical service and lighting

The APR1400 design provides quality lighting and convenient electrical services to facilitate maintenance and inspection and reduce anticipated personnel exposure. Reliable lamps of extended service life are used in high-radiation areas whenever possible to minimize the frequency of maintenance/replacement. These features are included in the facility layout design in accordance with the guidance of NRC RG 8.8, Position C.2.i.

p. Spent fuel pool (SFP) decontamination

The APR1400 design provides the capability to use high-pressure demineralized water for the decontamination in the SFP. Alternative methods of decontamination, such as a strippable coating, may be evaluated by the operator for practicality.

q. Snubbers

Mechanical snubbers, rather than hydraulic snubbers, are used in radiation areas to minimize the frequency of required maintenance and inspections.

When high pressure demineralized water is used to decontaminate the SFP or bulky components, protective covers are required to be used to minimize the spread of contamination. High pressure demineralized water is not to be used in open areas above the pool.

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Question No. 12.03-37

10 CFR 20.1101(b) requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

10 CFR 20.1406(b) requires that applicants for standard design certifications describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

SRP Section 12.3-12.4 states that the plant should be subdivided into radiation zones with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified.

In FSAR Chapter 11 the applicant describes the use of a mobile equipment for solid waste processing and the potential for mobile equipment to assist in liquid waste processing. Since the equipment used is the responsibility of the COL applicant, the FSAR should contain a COL item to describe how the systems are consistent with the guidance of SRP Section 12.3-12.4, how the systems meets the requirements of 10 CFR 20.1406 and RG 4.21, and to ensure that the radiation zones provided in the FSAR are appropriate.

Response

The APR1400 liquid waste management system (LWMS) comprises only permanently installed equipment; however, the LWMS does contain connections for mobile or temporary equipment to provide operational flexibility for future site-specific designs under the direction of the COL applicant. The gaseous radwaste management system (GWMS) does not contain any temporary or mobile equipment nor does it contain connections for such equipment. The solid radwaste management system (SWMS) includes the spent resin dewatering system which is

designed as a modular and mobile system. For the mobile and temporary equipment for all radwaste systems, it is the COL applicant's responsibility to provide reasonable assurance that the equipment and its interconnections to plant systems conform with regulatory requirements and guidance including SRP Sections 12.3-12.4, 10 CFR 20.1406, and RG 4.21. Further, any changes to the radiation zone maps as shown in DCD Section 12.3 that result from the addition of temporary or mobile equipment are to be evaluated and documented by the COL applicant.

COL Item 11.2(6) discusses the responsibility of the COL applicant to provide reasonable assurance that mobile and temporary liquid radwaste processing equipment and its interconnections to plant systems conform to the regulatory requirements and guidance. Section 11.2.1.6 and COL Item 11.2(6) will be updated to include RG 4.21 and the SRP Sections in the list of regulations and guidance which must be met.

COL Item 11.4(3) discusses the responsibility of the COL applicant to provide reasonable assurance that mobile and temporary solid radwaste processing equipment and its interconnections to plant systems conform to the regulatory requirements and guidance. Section 11.4.1.7 and COL Item 11.4(3) will be updated to include RG 4.21 and the SRP Sections in the list of regulations and guidance which must be met.

Impact on DCD

DCD Subsections 11.2.1.6, 11.2.5, 11.4.1.7, 11.4.9 and Table 1.8-2 will be updated as indicated in the Attachment.

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 Environment Report.

Table 1.8-2 (17 of 29)

Item No.	Description
COL 10.4(1)	The COL applicant is to establish operational procedures and maintenance programs for leak detection and contamination control
COL 10.4(2)	The COL applicant is to maintain the complete documentation of system design, construction, design modifications, field changes, and operations
COL 10.4(3)	The COL applicant is to provide the location and design of the cooling tower, basin, and CW pump house
COL 10.4(4)	The COL applicant is to provide elevation drawings
COL 10.4(5)	The COL applicant is to address the design features for the prevention of contamination
COL 10.4(6)	The COL applicant is to provide operating and maintenance procedures for the following items in accordance with NUREG-0927 and a milestone schedule for implementation of the procedures.
COL 10.4(7)	The COL applicant is to describe the nitrogen or equivalent system design for SG drain
COL 10.4(8)	The COL applicant is to prepare the Site Radiological Environmental Monitoring Program
COL 10.4(9)	The COL applicant is to determine the wet bulb temperature correction factor to account for potential interference and recirculation effects
COL 11.2(1)	The COL applicant is to prepare the site-specific ODCM in accordance with NEI 07-09A.
COL 11.2(2)	The COL applicant is to prepare operational procedures and programs related to operations, inspection, calibration, and maintenance of the contamination control program.
COL 11.2(3)	The COL applicant is to determine whether contaminated laundry is sent to an offsite facility for cleaning or for disposal.
COL 11.2(4)	The COL applicant is to prepare and provide the P&IDs.
COL 11.2(5)	The COL applicant is to perform a site-specific cost-benefit analysis following the guidance in the regulatory requirements of NRC RG 1.110.
COL 11.2(6)	The COL applicant is to provide reasonable assurance that the mobile or temporary equipment and interconnections to plant systems conform with the regulatory requirements and guidance of 10 CFR 50.34a, 10 CFR 20.1406, NRC RG 1.143, and ANSI/ANS 40.37.
COL 11.2(7)	The COL applicant is to develop the procedure for the collection and shipment of mixed wastes, if and when they are generated, for offsite treatment. The generation of mixed liquid wastes is minimized by process control and the controlled use of hazardous chemicals.
COL 11.2(8)	The COL applicant is to develop the interface design and provide the site-specific information for the LWMS effluent discharge, including radioactive release points, effluent temperature, the design (type, shape, and size) of flow orifices, and the sampling requirements following the guidance of NRC RG 1.21 and RG 4.15 and the standards incorporated therein by reference.

NRC RG 4.21

The COL applicant is to ensure that the implementation of mobile and temporary equipment meets the requirement of NUREG-0800 Sections 12.3 and 12.4 and that any impacts to the radiation zone maps are evaluated .

Table 1.8-2 (19 of 29)

Item No.	Description
COL 11.4(1)	The COL applicant can incorporate an onsite laundry facility for processing of contaminated clothing.
COL 11.4(2)	The COL applicant is to perform a site-specific cost-benefit analysis following the guidance in NRC RG 1.110.
COL 11.4(3)	The COL applicant is to provide reasonable assurance that the provisions and requirements of ANSI/ANS-40.37-2009 are met. The COL applicant is to provide reasonable assurance that mobile and temporary solid radwaste processing and its interconnection to plant systems conform with regulatory requirements and guidance such as 10 CFR 50.34a, 10 CFR 20.1406, ~~and~~ NRC RG 1.143. The COL applicant is to prepare a plan to develop and use operating procedures so the guidance and information in IE Bulletin 80-10 are followed.
COL 11.4(4)	The COL applicant is to provide P&IDs.
COL 11.4(5)	The COL applicant is to prepare the site process control program and the site radiological environmental monitoring program.
COL 11.4(6)	The COL applicant is responsible for the collection, temporary storage, and shipment of mixed waste for offsite treatment and disposal.
COL 11.4(7)	The COL applicant is responsible for the provision of a site-wide IRSF for interim storage of radioactive wastes.
COL 11.4(8)	The COL applicant is to provide a mobile crane to retrieve a waste package that becomes stuck in the lifted condition or that is dropped.
COL 11.4(9)	The COL applicant is also to provide operational procedures to properly ship low-level wastes to external sites in accordance with US NRC and US Department of Transportation (DOT) regulations.
COL 11.4(10)	The COL applicant is to prepare the operational procedures and maintenance programs for the SWMS as related to leak detection and contamination control.
COL 11.4(11)	The COL applicant is to develop plant-wide RG 4.21 life-cycle planning for minimization of contamination program following the guidance in NEI 08-08A, in which the SWMS procedures and programs are to be integrated.
COL 11.4(12)	The COL applicant is to maintain the complete documentation of system design, construction, design modifications, field changes, and operations.
COL 11.5(1)	The COL applicant is to determine the WARN and ALARM setpoints of the PERMSS based on the site-specific conditions and operational requirements.
COL 11.5(2)	The COL applicant is to develop an annual report that specifies the quantity of each principal radionuclide released to unrestricted areas in liquid and gaseous effluents.
COL 11.5(3)	The COL applicant is to provide site-specific procedures that conform with the numerical guides of 10 CFR 50.34a and 10 CFR Part 50, Appendix I.

, and NRC RG 4.21. The COL applicant is to ensure that the implementation of mobile and temporary equipment meets the requirements of NUREG-0800 Sections 12.3 and 12.4 and that any impacts to the radiation zone maps are evaluated.

11.2.1.5 Site-Specific Cost-Benefit Analysis

The cost-benefit analysis approach stipulated by Paragraph II.D of 10 CFR 50, Appendix I (Reference 4) requires that a population dose analysis be performed to demonstrate that the LWMS is designed in accordance with the ALARA criterion.

Due to the site-specific nature of the population dose analyses, the cost-benefit analysis is deferred to the site-specific environmental reports.

The COL applicant is to perform a site-specific cost-benefit analysis to demonstrate conformance with the regulatory requirements of NRC RG 1.110 (COL 11.2(5)) (Reference 22).

11.2.1.6 Mobile or Temporary Equipment

The LWMS is designed with permanently installed equipment. The LWMS does not include the use of mobile or temporary equipment. To provide the flexibility for future use of mobile or temporary equipment in accordance with site-specific requirements, space and connections are provided for the installation of mobile equipment.

The COL applicant is to provide assurance that the use of mobile or temporary equipment and interconnections to plant systems conform with regulatory requirements and guidance such as 10 CFR 50.34a, 10 CFR 20.1406, and NRC RG 1.143, and NRC RG 4.21 (COL 11.2(6)) (References 11, 14, and ~~1~~ 8).

The COL applicant is responsible for the identification of mobile/portable LWMS connections that are considered nonradioactive but may later become radioactive through contact with contaminated radioactive systems, and for the preparation of operating procedures for mobile/portable LWMS connections in conformance with the guidance and information in IE Bulletin 80-10 (Reference 13) and ANSI/ANS 40.37 (Reference 23) (COL 11.2(6)).

The COL applicant is to ensure that the implementation of mobile and temporary equipment meets the requirements of NUREG-0800 Sections 12.3 and 12.4 and that any impacts to the radiation zone maps are evaluated (COL 11.2(6)).

COL 11.2(2) The COL applicant is to prepare operational procedures and programs related to operations, inspection, calibration, and maintenance of the contamination control program.

COL 11.2(3) The COL applicant is to determine whether contaminated laundry is sent to an offsite facility for cleaning or for disposal.

COL 11.2(4) The COL applicant is to prepare and provide the P&IDs.

COL 11.2(5) The COL applicant is to perform a site-specific cost-benefit analysis following the guidance in the regulatory requirements of NRC RG 1.110.

COL 11.2(6) The COL applicant is to provide reasonable assurance that the mobile or temporary equipment and interconnections to plant systems conform with the regulatory requirements and guidance of 10 CFR 50.34a, 10 CFR 20.1406, NRC RG 1.143, and ANSI/ANS 40.37.

NRC RG 4.21

COL 11.2(7) The COL applicant is to develop the procedure for the collection and shipment of mixed wastes, if and when they are generated, for offsite treatment. The generation of mixed liquid wastes is minimized by process control and the controlled use of hazardous chemicals.

COL 11.2(8) The COL applicant is to develop the interface design and provide the site-specific information for the LWMS effluent discharge, including radioactive release points, effluent temperature, the design (type, shape, and size) of flow orifices, and the sampling requirements following the guidance of NRC RG 1.21 and RG 4.15 and the standards incorporated therein by reference.

COL 11.2(9) The COL applicant is to develop a plant-wide NRC RG 4.21 Program following the guidance in NEI 08-08A for contamination control.

COL 11.2(10) The COL applicant is to maintain the complete documentation of system design, construction, design modifications, field changes, and operations

The COL applicant is to ensure that the implementation of mobile and temporary equipment meets the requirements of NUREG-0800 Sections 12.3 and 12.4 and that any impacts to the radiation zone maps are evaluated.

The COL applicant is to provide reasonable assurance that mobile and temporary solid radwaste processing equipment and its interconnections to plant systems conform with regulatory requirements and guidance such as 10 CFR 50.34a (Reference 21), 10 CFR 20.1406 (Reference 26), and NRC RG 1.143 (Reference 15) (COL 11.4(3)). The COL applicant is to prepare a plan to develop and use operating procedures so the guidance and information in IE Bulletin 80-10 (Reference 1) are followed (COL 11.4(3)).

, and NRC RG 4.21 (Reference 2)

11.4.2 System Description

The primary functions of the SWMS are to process, package, and store the dry and wet solid wastes generated from the plant in accordance with regulatory guidelines, to handle and store dry and low-activity wastes prior to shipment to the offsite disposal facility, and to provide reasonable assurance that plant personnel and public radiation exposure is ALARA.

The SWMS handles wet and dry solid wastes, prepares for the waste transportation and offsite disposal as described in Subsection 11.4.1.4, and is divided into the following subsystems:

The COL applicant is to ensure that the implementation of mobile and temporary equipment meets the requirements of NUREG-0800 Sections 12.3 and 12.4 and that any impacts to the radiation zone maps are evaluated (COL 11.4(3)).

a. Spent resin transfer and packaging subsystem

b. Spent filter handling subsystem

c. Dry active waste subsystem

d. R/O concentrate treatment subsystem

e. Temporary waste storage subsystem

The expected and maximum annual waste volumes are shown in Table 11.4-1. The expected and design basis (1 percent fuel defect) activity levels of solid waste in the SWMS are presented in Tables 11.4-2 and 11.4-3.

The SWMS boundary starts at the receipt of waste from various waste generation components and ends where the packaged and dewatered waste is loaded onto a truck for

Instruments, including backflushing provisions, are located in low-radiation areas when possible for accessibility and fulfillment of the ALARA provisions. A list of alarm instruments and location of readouts is presented in Table 11.4-6.

, and NRC RG 4.21. The COL applicant is to ensure that the implementation of mobile and temporary equipment meets the requirements of NUREG-0800 Sections 12.3 and 12.4 and that any impacts to the radiation zone maps are evaluated.

11.4.9 Combined License Information

COL 11.4(1) The COL applicant can incorporate an onsite laundry facility for processing of contaminated clothing.

COL 11.4(2) The COL applicant is to perform a site-specific cost-benefit analysis following the guidance in NRC RG 1.110.

COL 11.4(3) The COL applicant is to provide reasonable assurance that the provisions and requirements of ANSI/ANS-40.37-2009 are met. The COL applicant is to provide reasonable assurance that mobile and temporary solid radwaste processing and its interconnection to plant systems conform with regulatory requirements and guidance such as 10 CFR 50.34a, 10 CFR 20.1406, ~~and~~ NRC RG 1.143. The COL applicant is to prepare a plan to develop and use operating procedures so the guidance and information in IE Bulletin 80-10 are followed.

COL 11.4(4) The COL applicant is to provide P&IDs.

COL 11.4(5) The COL applicant is to prepare the site process control program and the site radiological environmental monitoring program.

COL 11.4(6) The COL applicant is responsible for the collection, temporary storage, and shipment of mixed waste for offsite treatment and disposal.

COL 11.4(7) The COL applicant is responsible for the provision of a site-wide IRSF for interim storage of radioactive wastes.

COL 11.4(8) The COL applicant is to provide a mobile crane to retrieve a waste package that becomes stuck in the lifted condition or that is dropped.

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.:	**235-8275**
SRP Section:	**12.03 – 12.04 – Radiation Protection Design Features**
Application Section:	**12.03 – 12.04**
Date of RAI Issue:	**10/07/2015**

Question No. 12.03-38

10 CFR 20.1101(b) requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

10 CFR 20.1406(b) requires that applicants for standard design certifications describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

SRP Section 12.3-12.4 states that the plant should be subdivided into radiation zones with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified. It also indicates that the assumptions and technics used for radiation shielding should be provided and that anticipated operational occurrences should be considered in the determination of plant shielding and zoning.

FSAR Section 11.4 provides COL 11.4(7) indicating that the COL applicant is responsible for the provisions of a site-wide IRSF for interim storage of radioactive wastes.

In order to ensure that any additional storage facilities meet the guidance of SRP Section 12.3-12.4, please include a COL item in FSAR Section 12.3-12.4 to specify that the COL applicant will describe how any additional waste storage facilities meet the guidance provided in SRP 12.3-12.4.

Response

The provision for a facility for the on-site storage of radioactive wastes is a site-specific feature under the responsibility and direction of the COL applicant. The interim radwaste storage facility (IRSF) is to be designed to meet the regulations and guidance specified in NUREG-0800,

Sections 12.3 and 12.4, including 10 CFR 20.1101(b), 10 CFR 20.1406(b), RG 4.21 and RG 8.8.

COL Item 11.4(7) is included in DCD Section 11.4 to specify the responsibility of the COL applicant for the design of the IRSF including the meeting of the requirements of the applicable regulations and guidance. DCD Section 11.4.2.2.5 and COL Item 11.4(7) will be updated to specify the COL applicant's responsibility for meeting the applicable regulations and guidance for the site-specific IRSF.

Impact on DCD

DCD Subsections 11.4.2.2.5, 11.4.9 and Table 1.8-2 will be updated as indicated in the Attachment.

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 Environment Report.

Table 1.8-2 (19 of 29)

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COL 11.5(2)	The COL applicant is to develop an annual report that specifies the quantity of each principal radionuclide released to unrestricted areas in liquid and gaseous effluents.
COL 11.5(3)	The COL applicant is to provide site-specific procedures that conform with the numerical guides of 10 CFR 50.34a and 10 CFR Part 50, Appendix I.

The COL applicant is to provide reasonable assurance that the design and operation of such a facility meets the regulations and guidance specified in NUREG-0800, Section 12.3 and 12.4, including 10 CFR 20.1101, 10 CFR 20.1406, RG 4.21and RG 8.8

Cartridge filters are replaced based on the measured differential pressure or radiation level. During replacement, water is drained from the filter housing and the spent filter media is removed following the same process used for the high-activity spent filters. The cartridge is then lifted from the housing and placed in a drum. The drum is then moved to the shielded temporary waste storage area for shipment and disposal.

11.4.2.2.3 R/O Concentrate Processing

The concentrate generated from the R/O system is dried by the concentrate treatment subsystem. The dried waste is packaged in drums and stored in a temporary waste storage area in the compound building prior to shipment to the offsite disposal facility.

11.4.2.2.4 Mixed Waste

Mixed waste, which contains radioactive and hazardous contaminants, may be generated during normal operation. The COL applicant is responsible for the collection, temporary storage, and shipment of mixed waste for offsite treatment and disposal (COL 11.4(6)).

11.4.2.2.5 Interim Radwaste Storage Facility (IRSF)

The provision of an IRSF is site-specific and may be common to other nuclear power generating units at the same site. The COL applicant is responsible for the provision of a site-wide IRSF (COL 11.4(7)).

11.4.2.3 Packaging, Storage, and Shipping

The SWMS is designed to package wastes in a 200 L (55 gal) drum, a HIC, or other DOT-approved container, for temporary storage and offsite shipment. The HIC is typically used to package spent resin. Radioactive wastes such as concentrates, cartridge filters, and miscellaneous solid wastes are typically packaged in a 200 L (55 gal) drum or boxes. Large components that have been contaminated and cannot be compacted are prepared appropriately for packaging in shipping casks.

and to ensure the the design and operation of such a facility meets the regulations and guidance specified in NUREG-0800, Section 12.3 and 12.4, including 10 CFR 20.1101, 10 CFR 20.1406, RG 4.21and RG 8.8

Instruments, including backflushing provisions, are located in low-radiation areas when possible for accessibility and fulfillment of the ALARA provisions. A list of alarm instruments and location of readouts is presented in Table 11.4-6.

11.4.9 Combined License Information

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