
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.: 332-8382
SRP Section: 03.08.03 - Concrete and Steel Internal Structures of Steel or Concrete Containments
Application Section: 3.8.3
Date of RAI Issue: 12/14/2015

Question No. 03.08.03-8

10 CFR 50.55a and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4 and 5, provide the regulatory requirements for the design of the mat foundation for the prestressed concrete containment. Standard Review Plan (SRP) 3.8.3.II, "Acceptance Criteria," Subsection 4, "Design Analysis Procedures," and in Item D states that, "For all containment internal structures, the design and analysis methods described in Subsections II.4 of SRP Sections 3.8.1 and 3.8.2, which are applicable to the containment internal concrete and steel structures, respectively, also need to be considered. These items include assumptions on boundary conditions, axisymmetric and non-axisymmetric loads, transient and localized loads, shrinkage and cracking of concrete, computer programs, and evaluation of liner plates and anchors." During the October 6, 2015 public meeting with the applicant, the staff discussed the use of leak-chase channels in the design of the APR1400 application. As a result of this meeting and the staff's further review of the components associated with the APR1400 containment internal structures, the staff determined that additional information related to the leak chase channels used in the carbon-steel containment liner plate; the stainless-steel in-containment refueling water storage tank (IRWST) liner plate; and the stainless-steel hold-up volume tank (HVT) liner plate are needed in order to better understand the applicant's analysis and design approach of the aforementioned structures. Per 10 CFR 50.55a, Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4 and 5, and SRP 3.8.3, the applicant is requested to address the following in detail:

- a. Describe and provide associated design drawings of leak chase channels in the containment liner plate, the IRWST, and the HVT liner plates.
- b. How and where are the leaked borated-water from IRWST and HVT leak chase channel systems collected? In case of blockage from of the crystalized boron in a leak chase channel collection system, how can this blockage be opened prior to spilling borated water into the adjacent reinforced concrete.

The applicant is also requested to update applicable portion of Section 3.8 of the DCD Tier 2, accordingly.

Response

- a. The in-containment water storage system (IWSS) includes the in-containment refueling water storage tank (IRWST) and the holdup volume tank (HVT). The IRWST and the HVT are integral parts of the containment building internal structure (refer to Subsection 3.8.3 in DCD Tier 2). The IRWST and the HVT are reinforced concrete structures with a stainless steel liner on surfaces expected to be in direct contact with boric acid. The primary function of these liners is to prevent leaks and the interaction of the boric acid with the concrete structures. Leaks that are postulated to occur are collected by leak chase channels behind liner seam welds, monitored, and quantified by the equipment and floor drainage system (EFDS).

The HVT is located between the primary shield wall and the IRWST inner wall. The IRWST is located below an elevation of 100ft in the floor slab between the secondary shield wall outside and the inner containment wall inside. The tank forms a continuous ring around the lower containment.

An elevation view of a typical section of the IRWST and the HVT is shown in Figure 1 (extracted from DCD Figure 1.2-2):

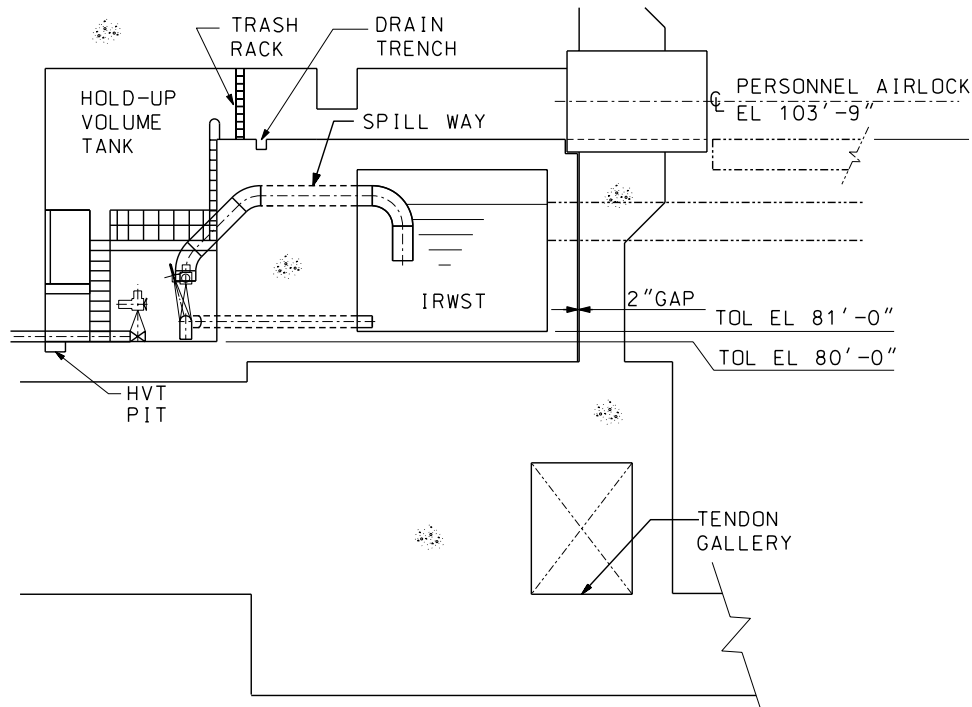


Figure 1. Typical section of IRWST and HVT

A plan view of the IRWST and the HVT is shown in Figure 2 (based on DCD Figure 1.2-4):

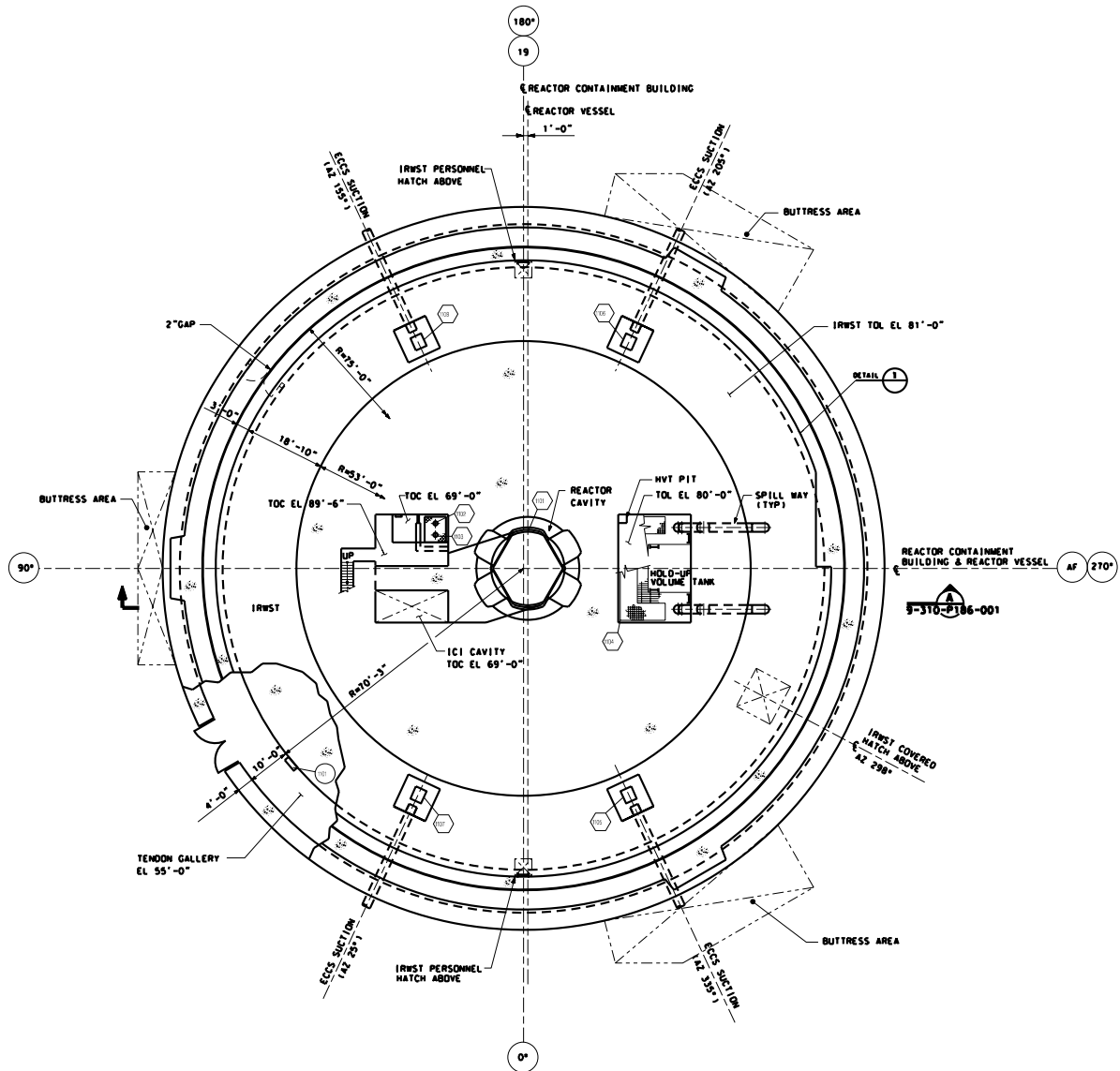


Figure 2. IRWST and HVT Plan View

A leak chase channel collection system is provided for the IRWST to prevent leakage of the borated water from the IRWST to its surrounding concrete and the containment liner below. The leak chase channel collection system consists of leak chase detection channels or angles seal welded to the back of the liner plate side walls and floor, leading to eight collection point sumps, each with a drain pipe leading to a downstream normally open globe valves and sight glasses, as shown in Figures 3 through 9. All leakage flows by gravity.

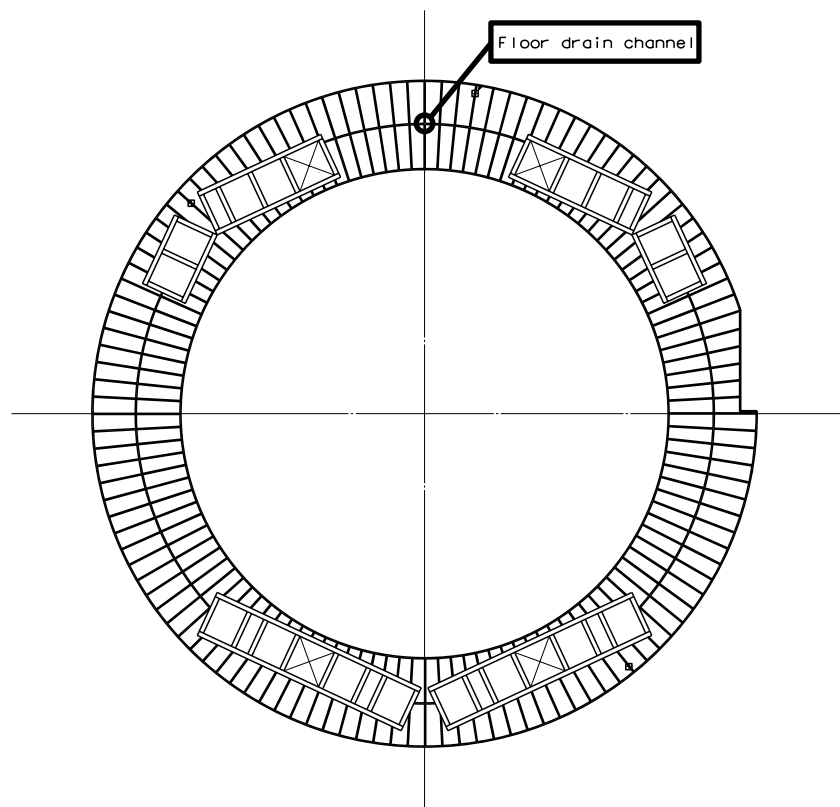


Figure 3. Leak Chase Channel in IRWST

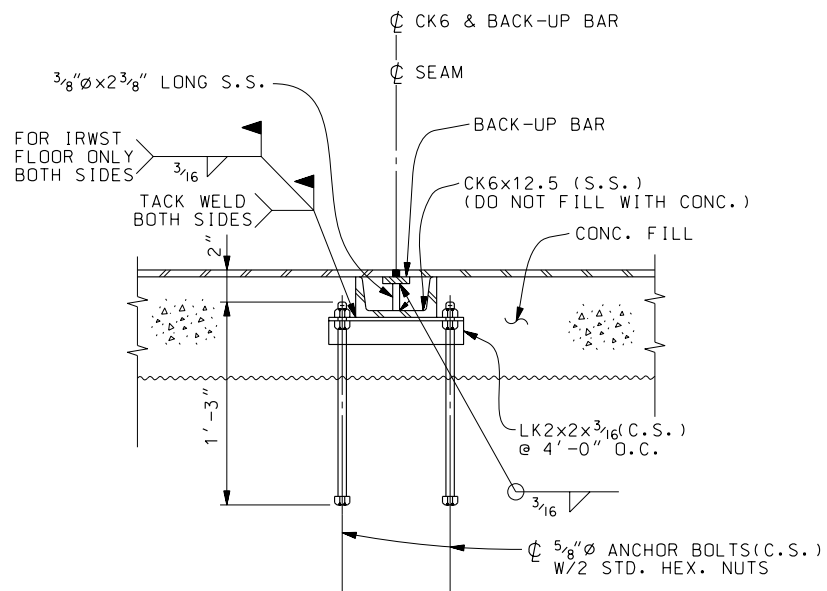


Figure 4. Leak Chase Channel at the IRWST Floor

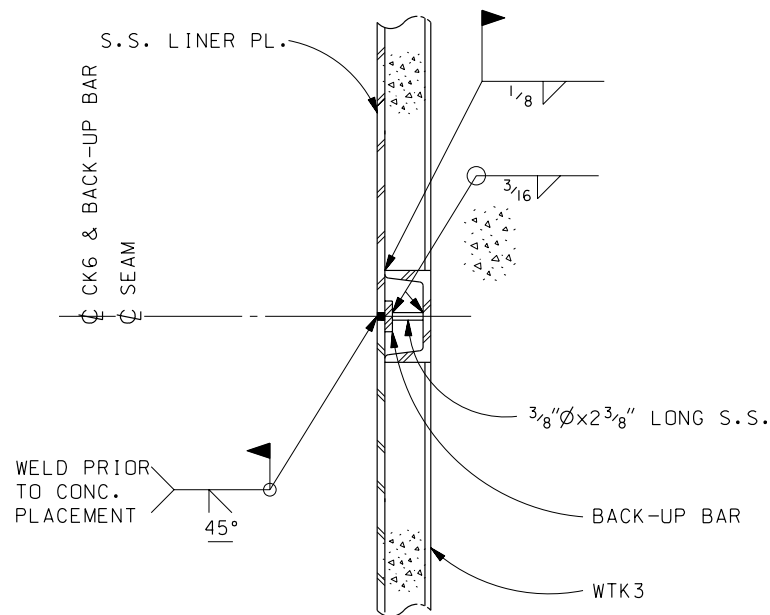


Figure 5. Leak Chase Channel at the IRWST Wall

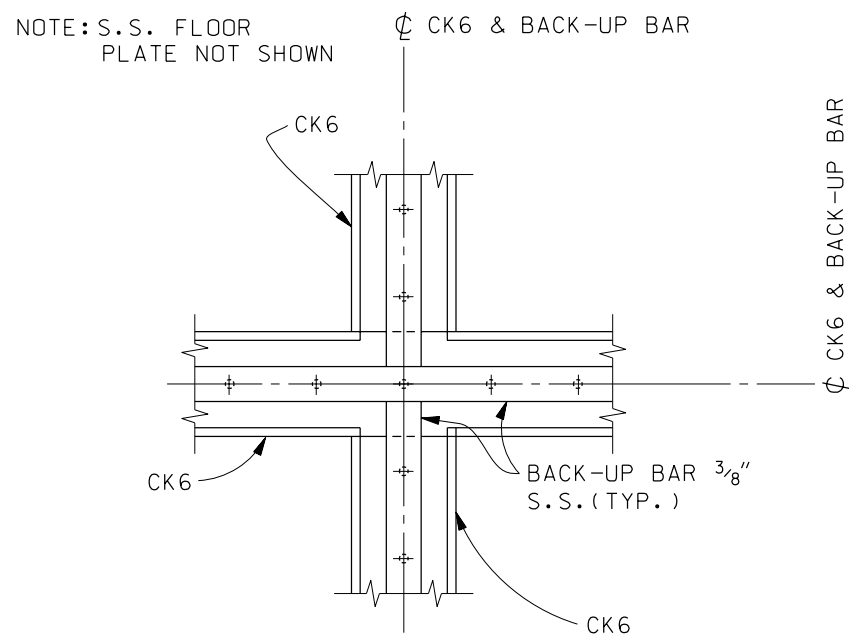


Figure 6. IRWST Leak Chase Channel Floor Intersection

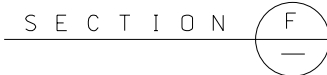


Figure 7. IRWST Drain Pipe and Detection Channel

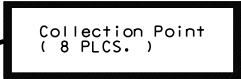


Figure 8. IRWST Collection Points

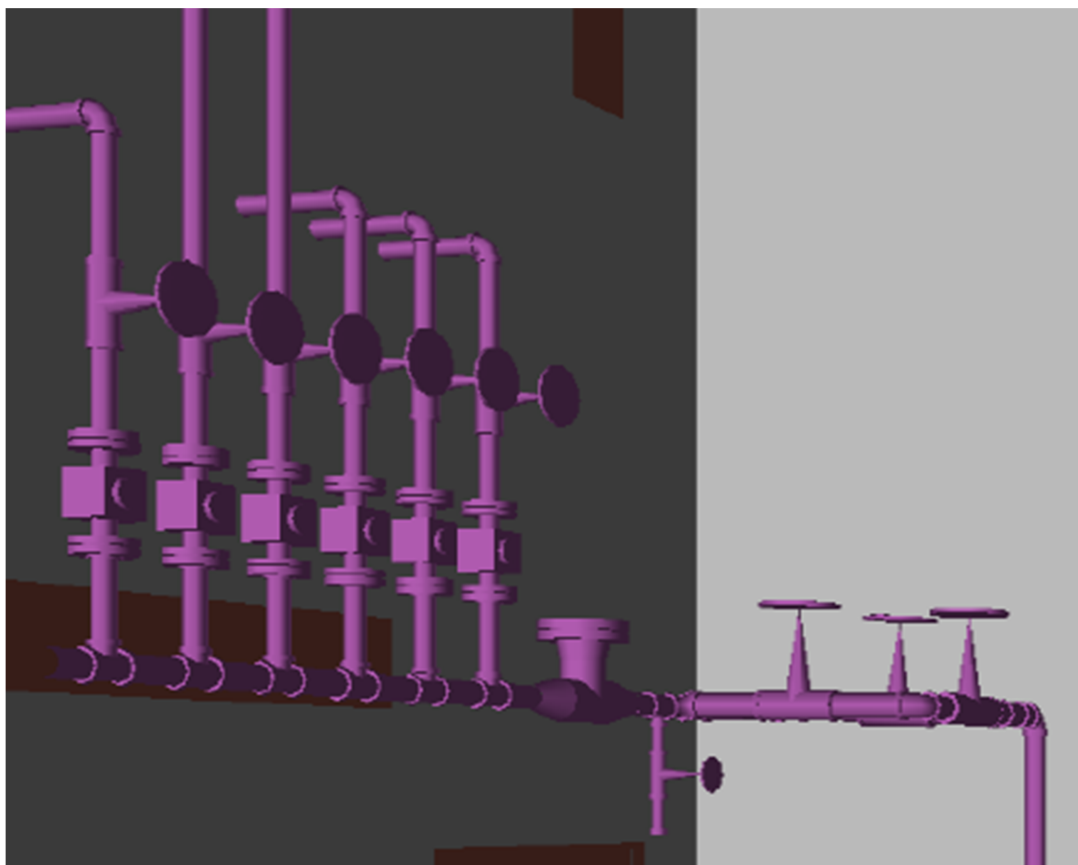


Figure 9. IRWST Collection Plumbing Showing Valves and Sight Glasses

A leak chase channel collection system is not provided for the containment liner floor liner plate seams as these are attached together by full penetration welds on top of H-beams which are embedded in the concrete basemat, with the top of the containment liner plate floor covered with fill concrete. Note that contrary to the second paragraph of the RAI Question, the material specified for containment floor liner plate is stainless steel and not carbon steel. DCD Tier 2 Chapter 3, Figure 3.8-5, shows that the liner plate material is specified as stainless steel up to EL. 101 ft and carbon steel is specified above the EL. 101 ft.

The leak chase channel collection system is not needed for the HVT because the HVT does not normally store borated water. Instead, the Trisodium Phosphate (TSP) is placed in baskets mounted on the wall of the HVT to be dissolved by the containment spray water during post-accident condition and without any operator action. Under post-accident conditions, water from breaks and containment spray is collected in the HVT and then flows into the IRWST through the IRWST spillways, as shown in Figure 1.

- b. Leakage of borated-water from the IRWST into the leak chase channel collection system is detected using valves or caps and monitored using sight glasses described above. Regularly scheduled patrols will be conducted for this purpose. In the event that blockage of the leak chase channel collection system is suspected, such as by

detection of accumulated boric acid residue and minerals, further inspection and cleaning of the inside of the leakage collection pipes will be performed. Provisions for monitoring and inspection are to be defined by the COL applicant as shown in Attachment (5/5) for the added COL Item 9.3(5) in DCD Tier 2 Table 1.8-2.

Impact on DCD

DCD Tier 2, Subsections 3.8.3.1.8, 9.3.3.2.6, 9.3.5 and Table 1.8-2 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.

APR1400 DCD TIER 2**3.8.3.1.8 In-Containment Refueling Water Storage Tank**

The in-containment refueling water storage tank (IRWST) provides storage of refueling water, a single source of water for the safety injection and containment spray pumps, and a heat sink for the safety depressurization system. The IRWST is annular and uses the lower section of the internal structure as its outer boundary. The IRWST is lined with a stainless steel liner plate to prevent leakage. The IRWST consists of the top and bottom slab and the exterior wall. The bottom slab of IRWST rests on the reactor containment building basemat, and the top and bottom slabs are rigidly connected to the secondary shield wall. The design of the IRWST considers pressurization as a result of the reactor containment building systems design basis accident. Refer to Section 6.8 for a description of the IRWST.

The leak chase channels are seal welded to the back of the liner plate to control the potential leakage of borated water from the IRWST. The design features of the leak chase channel collection pipe drain system are described in Subsection 9.3.3.2.6.

3.8.3.1.9 Holdup Volume Tank

The holdup volume tank (HVT) is a rectangular structural tank located between the primary shield wall and the IRWST inner wall. A screen is provided at the top of the HVT to prevent debris from getting into the tank. The HVT has a sump with pumps to measure the leakage rate and route the liquid to the liquid waste management system. During an accident, the water from breaks and the reactor containment building spray is collected in the HVT and overflows into the IRWST. Refer to Section 6.8 for a description of the HVT.

3.8.3.1.10 Operating and Intermediate Floors

The operating floor provides access for operating personnel functions and biological shielding. Intermediate floors provide access to equipment and components. The operating floor is located at elevation 156 ft 0 in, and intermediate floors are located at elevations 114 ft 0 in and 136 ft 6 in. These floors consist of reinforced concrete or steel grating supported by structural steel framing that spans between the containment wall and the secondary shield wall. The steel framing has a horizontally sliding connection at the containment wall side to allow axial displacement of framing due to seismic displacement and thermal expansion. Openings are provided in the floor for equipment removal.

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for pumping nonradioactive floor and equipment drainage and condensate overflow to the [[WWTF]].

- d. The discharge from TGB sump pumps are monitored for radiation contamination level. The auxiliary boiler blowdown and drains are routed to the local sump, from which the condensate is routed to the TGB sump for radiation monitoring. When contamination level is detected at or exceeding a predetermined setpoint, the drains are routed to the LWMS for processing and release via the condensate polishing area sump. This approach prevents unintended contamination of the [[WWTF]].



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Adequate and Early Leak Detection

- a. In areas that are not normally accessible during power operation, such as the ICI cavity sump, the RCB drain sump, and the AB floor drain sumps, continual level indication is provided in the MCR and the RSR. In the event the sump liquid level reaches a preset limit, the level instrument initiates a signal to alarm in the MCR and the RSR for operator actions. This design approach, supplemented with operational procedures, provides adequate leak detection capability and minimizes the potential for the spread of contamination.
- b. Radiation monitors are provided in the discharge piping from the TGB north and south pit sumps and the condensate polishing area sump to detect contamination levels of the drains.

Reduction of Cross-Contamination, Decontamination, and Waste Generation

- a. The sumps in the reactor containment building, the auxiliary building, the compound building and the turbine generator building that handle contaminated or potentially contaminated fluids are designed to minimize the spread of contamination through the use of liners, coatings, and seals. This design approach is nuclear-industry proven and is compatible with the chemical, physical, and radiological environment, thus minimizing waste generation.
- b. The EFDS sumps are strategically located to collect floor and equipment drainage. Drains are segregated for different handling and processing requirements to

- e. Potential leakage of borated water from the IRWST is detected with the IRWST leak chase channels described in Subsection 3.8.3.1.8, using valves and caps and sight glasses installed in the drain pipes as shown in Figure 9.3.3-1, Radioactive Drain System Flow Diagram (1 of 7). For the event of blockage of the leak chase channel collection system due to crystallized boron, connection provisions at the nearest accessible area to the valve and sight glass room for cleaning the inside of the leakage collection pipes are made by the COL applicant (COL 9.3(5)).

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activity. The process radiation monitor serves only as a trending device to alert the operator of possible fuel cladding failure.

9.3.4.5.6 Boronometer

The boronometer provides indication and a continuous recording in the MCR of reactor coolant boron concentration. High and low alarms warn the operator of deviations from the required boron concentration in the reactor coolant. The principle of operation is neutron absorption. The unit is provided with shielding as required to limit the maximum external radiation level from its source to a low value. All portions of the unit that contact reactor coolant are constructed of austenitic stainless steel. Refer to Subsection 7.7.1.1 for further information on the boron control system.

9.3.5 Combined License Information

COL 9.3(1) The COL applicant is to prepare operational procedures and maintenance programs as related to leak detection and contamination control.

COL 9.3(2) The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.

COL 9.3(3) The COL applicant is to prepare the site radiological environmental monitoring program.

COL 9.3(4) The COL applicant is to provide the supply systems of the nitrogen gas subsystem, the hydrogen subsystem, the carbon dioxide subsystem, and the breathing air systems.

9.3.6 References

1. 10 CFR 50.63, "Station Blackout Rule," U.S. Nuclear Regulatory Commission.
2. ANSI/ISA 7.0.01-1996, "Quality Standard for Instrument Air," International Society of Automation, 1996.

COL 9.3(5) The COL applicant is to provide connection provisions at the nearest accessible area to the valve and sight glass room of the IRWST leakage pipe line for detecting and cleaning blockage due to crystallized boron inside the leakage collection channel and pipes.

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Table 1.8-2 (15 of 29)

Item No.	Description
COL 9.3(2)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.
COL 9.3(3)	The COL applicant is to prepare the site radiological environmental monitoring program.
COL 9.3(4)	The COL applicant is to provide the supply systems of the nitrogen gas subsystem, the hydrogen subsystem, the carbon dioxide subsystem, and the breathing air systems.
COL 9.4(1)	The COL applicant is to provide the capacities of heating coils in the safety-related air handling units and cooling and heating coils in the non safety-related air handling units affected by site-specific conditions.
COL 9.4(2)	The COL applicant is to provide the capacities of heating coils of electric duct heaters affected by site-specific conditions.
COL 9.4(3)	The COL applicant is to provide the system design information of ESW building and CCW heat exchanger building HVAC system including flow diagram, if the ESW building and CCW heat exchanger building require the HVAC system.
COL 9.4(4)	The COL applicant is to establish operational procedures and maintenance programs as related to leak detection and contamination control.
COL 9.5(1)	The COL applicant is to establish a fire protection program, including organization, training, and qualification of personnel, administrative controls of combustibles and ignition sources, firefighting procedures, and quality assurance.
COL 9.5(2)	The COL applicant is to address the design and fire protection aspects of the facilities, buildings and equipment, and a fire protection water supply system, which are site specific and/or are not a standard feature of the APR1400.
COL 9.5(3)	The COL applicant is to describe the provided apparatus for plant personnel and fire brigades such as portable fire extinguishers, self-contained breathing apparatus, and radio communication systems.
COL 9.5(4)	The COL applicant is to address the final FHA and FSSA based on the final plant design, including a detailed post-fire safe-shutdown circuit analysis.
COL 9.5(5)	The COL applicant is to provide a reliable starting method for the AAC GTG.
COL 9.5(6)	The COL applicant is to provide details of emergency response facilities and associated communication capabilities.

COL 9.3(5) The COL applicant is to provide connection provisions at the nearest accessible area to the valve and sight glass room of the IRWST leakage pipe line for detecting and cleaning blockage due to crystallized boron inside the leakage collection channel and pipes.