Response to Action Item 3-75 Section 3.8

SEB Clarification Questions Regarding APR 1400, DCD Tier 2, Section 3.8

Clarification Question #1 (AI 3-75.1)

In DCD Tier 2, Section 3.8.1.3.2, the applicant states, "Other loads refer to postulated events or conditions that are not included in the design basis and that these loading conditions and their effects are evaluated without regard to the bounding under which structures, systems, and components (SSCs) perform design basis functions." The applicant provided a list of these loads that includes Aircraft Hazard, Combustible Gas, and Missile loads. The staff noticed that Section 3.8.1 of the DCD did not provide information on other site-related loads such as explosive hazards in proximity of the site and floods, per SRP 3.8.1, Section II.3. However, Section 3.8.4.3.3 does discuss this subject and there is a COL Item, COL 3.8(2), which states, "The COL applicant is to identify any applicable site-specific loads such as site proximity explosions and missiles, potential aircraft crashes, and the effects of seiches, surges, waves, and tsunamis. These loads are evaluated to prevent damage to safety-related structures, systems, and components beyond the design basis condition." Therefore, the following should be explained:

a) Why doesn't DCD Section 3.8.1 also discuss these other loads?

b) Since COL 3.8(2) only says to identify the site-specific loads, it's not clear who and where these loads are evaluated.

c) Explain what the phrase "…these loading conditions and their effects are evaluated without the bounding under which structures, systems, and components (SSCs) perform design basis functions."

Response

a) The reactor containment building (RCB) is surrounded by the auxiliary building (AB), so other loads described in Subsection 3.8.4.3.3, except aircraft hazard and combustible gas loads, are not expected to affect the RCB.

b) The word "identify" will be replaced by the word "evaluate" in COL 3.8(2) to prompt the applicant to identify and evaluate applicable site-specific loads and to combine loads in the proper load combinations. COL 3.8(2) will be revised as shown in Attachment 1 to this response.

c) The aircraft hazard and combustible gas loads are evaluated as beyond design-basis-conditions. Therefore, these loads exceed the conditions under which SSCs have been designed to perform their design basis functions. Section 3.8.1.3.2 will be revised as indicated in Attachment 2 to this response.

Response to Action Item 3-75 Section 3.8

Impact on DCD

DCD Tier 2, Sections 3.8.1.3.2, 3.8.4.3, 3.8.6 and Table 1.8-2 will be revised as indicated in the attachments associated with this response.

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 Report

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

Evaluation of the capability of a structure for a given load combination is based on providing a factor of safety appropriate to the probability of occurrence. The appropriate factor of safety is reflected in the load factors and allowable stresses for the various load combinations.

The COL applicant is to ~~identify~~ evaluate any applicable site-specific loads such as site proximity explosions and missiles, potential aircraft crashes, and the effects of seiches, surges, waves, and tsunamis (COL 3.8(2)).

3.8.4.3.1 Normal Loads

a. Dead loads – (D)

Dead load refers to loads that are constant in magnitude and point of application. The types and definitions of dead loads and their combination requirements are given in Table 3.8-8.

b. Live loads – (L)

Live load refers to any normal loads that may vary with intensity and location of occurrence. The types and definitions of live loads and their combination requirements are given in Table 3.8-8. The specified design values for live loads are summarized in Table 3.8-7.

1) Soil and surcharge load (L_g)

Soil and surcharge load refers to load due to weight and pressure of soil, water in soil, or other material such as soil surcharge. Maximum flood level is specified to be 0.30 m (1 ft) below plant grade for safety-related structures. For the construction loading condition, the minimum surcharge load is 48.0 kN/m^2 (1,000 psf) over any unoccupied area plus the actual construction loading surcharge from any known structures or load sources. For the normal loading condition, the minimum surcharge load is 24.0 kN/m^2 (500 psf). For the design of underground utilities, the minimum surcharge load for the construction loading condition is 24.0 kN/m^2 (500 psf) and for the

The COL applicant is to provide testing and inservice inspection programs to examine inaccessible areas of concrete structures for degradation and monitoring of groundwater chemistry (COL 3.8(9)).

The long-term settlement is the site-specific characteristics. The COL applicant is to provide the soil parameters for APR1400 site (COL. 3.8(10).

3.8.6 Combined License Information

COL 3.8(1) The COL applicant is to provide the design of site-specific seismic Category I structures such as the essential service water building and the component cooling water heat exchanger building, essential service water condits, and class 1E electrical duct runs.

COL 3.8(2) The COL applicant is to ~~identify~~ evaluate any applicable site-specific loads such as site proximity explosions and missiles, potential aircraft crashes, and the effects of seiches, surges, waves, and tsunamis.

COL 3.8(3) The COL applicant is to determine the environmental condition associated with the durability of concrete structures and provide the concrete mix design that prevents concrete degradation including the reactions of sulfate and other chemicals, corrosion of reinforcing bars, and influence of reactive aggregates.

COL 3.8(4) The COL applicant is to determine construction techniques to minimize the effects of thermal expansion and contraction due to hydration heat, which could result in cracking.

COL 3.8(5) The COL applicant is to monitor the safety and serviceability of seismic Category I structures during the operation of the plant and provide the appropriate maintenance.

COL 3.8(6) The COL applicant is to provide reasonable assurance that the design criteria listed in Table 2.0-1 are met or exceeded.

Table 1.8-2 (4 of 29)

Item No.	Description
COL 3.7(3)	The COL applicant is to provide the seismic design of the seismic Category I SSCs that are not part of the APR1400 standard plant design. The seismic Category I structures are as follows: a. Seismic Category I essential service water building b. Seismic Category I component cooling water heat exchanger building
COL 3.7(4)	The COL applicant is to confirm that the any site-specific non-seismic Category I SSCs are designed not to degrade the function of a seismic Category I SSC to an unacceptable safety level due to their structural failure or interaction.
COL 3.7(5)	The COL applicant is to perform any site-specific seismic design for dams that is required.
COL 3.7(6)	The COL applicant is to perform seismic analysis of buried seismic Category I piping, conduits, and tunnels.
COL 3.7(7)	The COL applicant is to perform seismic analysis for the seismic Category I above-ground tanks.
COL 3.7(8)	The COL applicant that references the APR1400 design certification will determine whether essentially the same seismic response from a given earthquake is expected at each unit in a multi-unit site or each unit is to be provided with a separate set of seismic instruments.
COL 3.7(9)	The COL applicant is to confirm details of the locations of the triaxial time-history accelerograph.
COL 3.7(10)	The COL applicant is to identify the implementation milestones for the seismic instrumentation implementation program based on the discussion in Subsections 3.7.4.1 through 3.7.4.5.
COL 3.7B(1)	The COL applicant is to evaluate the HRHF response spectra.
COL 3.7B(2)	The COL applicant is to evaluate the representative items listed in Table 3.7B-2.
COL 3.8(1)	The COL applicant is to provide the design of site-specific seismic Category I structures such as the essential service water supply structure and the component cooling water heat exchanger building.
COL 3.8(2)	The COL applicant is to ~~identify~~ evaluate any applicable site-specific loads such as site proximity explosions and missiles, potential aircraft crashes, and the effects of seiches, surges, waves, and tsunamis.
COL 3.8(3)	The COL applicant is to determine the environmental condition associated with the durability of concrete structures and provide the concrete mix design that prevents concrete degradation including the reactions of sulfate and other chemicals, corrosion of reinforcing bars, and influence of reactive aggregates.
COL 3.8(4)	The COL applicant is to determine construction techniques to minimize the effects of thermal expansion and contraction due to hydration heat, which could result in cracking.
COL 3.8(5)	The COL applicant is to monitor the safety and serviceability of seismic Category I structures during the operation of the plant and provide the appropriate maintenance.
COL 3.8(6)	The COL applicant is to provide reasonable assurance that the design criteria listed in Table 2.0-1 are met or exceeded.

Y_r is defined as the equivalent static load on the structure generated by the reaction of the high-energy pipe during the postulated break.

2) Pipe break jet impingement load (Y_j)

Y_j is defined as the jet impingement equivalent static load on the structure generated by the postulated break.

3) Pipe break missile impact loads (Y_m)

Y_m is defined as the missile impact equivalent static load on the structure generated by or during the postulated break, such as pipe whipping.

r. Flooding load (Y_f)

Y_f is the load within or across a compartment or building due to flooding generated by a postulated pipe break. These loads are calculated considering the design basis flood heights.

s. Other Loads

These loading conditions and effects are not limited to the design conditions under which SSCs have been designed to perform design basis functions.

Other loads refer to postulated events or conditions that are not included in the design basis. ~~These loading conditions and effects are evaluated without regard to the bounding conditions under which SSCs perform design basis functions.~~ This load category includes:

1) Aircraft hazard (A)

Aircraft hazard refers to loads on a structure resulting from the impact of an aircraft. The evaluation of this loading condition is considered as part of the plant safeguards and security measures.

Response to Action Item 3-75 Section 3.8

SEB Clarification Questions Regarding APR 1400, DCD Tier 2, Section 3.8

Clarification Question #2 (AI 3-75.2)

In DCD Tier 2, Section 3.8.1.1.3.4, "Liner Plate Details and Anchorage," the applicant provided figures (Figures 3.8-5 through 3.8-7) that detail the liner plate and its anchorage system; and the containment liner below the containment internal structures and how it's anchored. Staff reviewed the figures and noted the following:

a) Figure 3.8-5, "Liner Plate and Anchorage System," on page 3.8-113 of the DCD, mentioned a few notes associated with the type of stiffeners and how the liner plates are typical embedment. However, the staff was not able to locate the descriptions of the notes. The applicant is requested to address where this information is located.

b) Additionally, since leak-chase channel has been identified as a potential degradation issue according to Information Notice 2014-07, the staff is requesting the applicant to explain how this issue is being addressed in Section 3.8 of the DCD application.

Response

a) The notes are errata. In general, these notes are provided in detailed design drawings. Figure 3.8-5 will be revised to eliminate mention of notes.

b) As shown in DCD Figure 3.8-7 Detail 1, the liner plates of the containment floor are typically installed by full penetration welding to H-beams which are embedded in the concrete basemat. The top of the containment liner plate floor is covered with fill concrete. Therefore, leak chase channels are not included in the design of the containment floor for detection of leakage because floor weld seams are inaccessible. The information notice is not applicable to the APR1400 design.

Impact on DCD

DCD Tier 2, Figure 3.8-5 will be revised as indicated in the attachment associated with this response.

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.

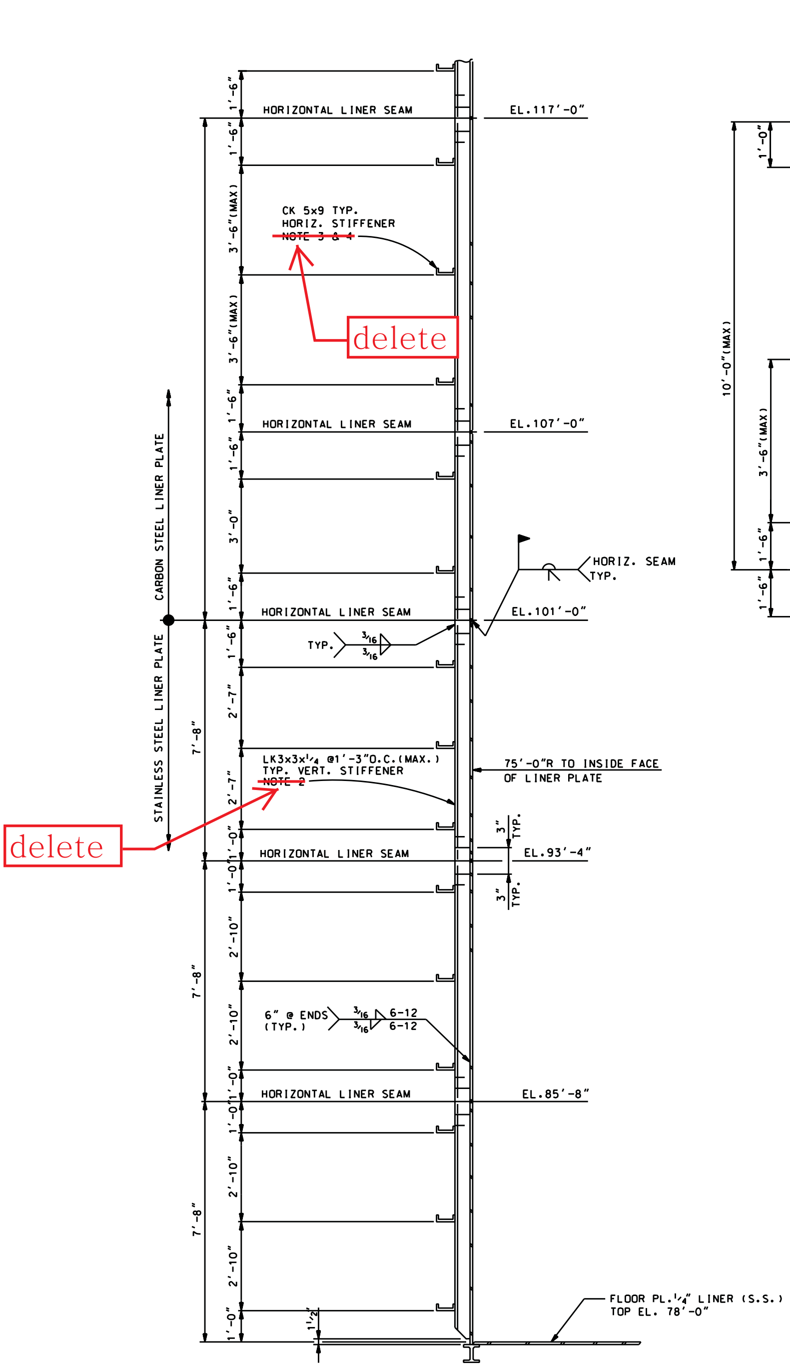

Figure 3.8-5 Liner Plate and Anchorage System

Response to Action Item 3-75 Section 3.8

SEB Clarification Questions Regarding APR 1400, DCD Tier 2, Section 3.8

Clarification Question #3 (AI 3-75.3)

In DCD Tier 2, Section 3.8.3.1.1 "Reactor Support System," the applicant provided a figure (Figure 3.8-15, Sheets 1 and 2) which shows how the reactor vessel is laterally supported and how the loads are transmitted to the cavity wall. The staff reviewed Sheets 1 and 2 and noted that additional information is needed in order to better understand the reactor support mechanism. As such, the applicant is requested to clarify the following:

a) The staff believes that Section B-B of Figure 3.8-15, Sheet 2 of 2, shows what seems to be a sliding plate being used as part of the reactor support system. The applicant is requested to clarify whether a sliding plate is being used, and if so, explain why it's not described in the DCD.

b) Since the reactor support column is flexible horizontally, the staff is concerned that large loads can be developed on the support columns and anchor bolts. The applicant is requested to clarify whether the development of these large loads is considered in the analysis and design of the reactor support system including the anchors.

c) Since DCD Figure 3.8-19 shows the reactor vessel support anchors are close to the edge of the concrete cavity wall ledge and also close to each other, the applicant is requested to clarify whether the edge distance and distance between the anchors were considered in determining the reduced design strength of the anchors.

Response

a) The RV support is fixed with anchor bolts at the bottom. No sliding plate is used for the RV vertical support system. Section B-B of Figure 3.8-15 shows the lateral support of the RV support to restrain tangential motions for dynamic load conditions. There are small gaps (0.020 ~0.050 in) between the integral column pad and non-integral RV supports attached to the building structures, so that they do not contact each other under normal operating conditions, but restrain lateral movement under dynamic load conditions such as SSE, BLPB, and IRWST discharge events.

b) The RV support system, including anchors, is designed to maintain its structural integrity under all service loading conditions, including SSE and BLPB events, as specified in DCD Subsection 3.9.3.

c) The short edge distance was considered in accordance with ACI 349, Appendix B.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Response to Action Item 3-75 Section 3.8

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.

Response to Action Item 3-75 Section 3.8

SEB Clarification Questions Regarding APR 1400, DCD Tier 2, Section 3.8

Clarification Question #1 (AI 3-75.4)

In DCD Tier 2, Section 3.8.1.6, "Materials, Quality Control, and Special Construction Techniques," the applicant listed the applicable codes and standards and regulatory guidance used in the fabrication and construction of the concrete containment. The staff noticed that DCD Section 3.8.1.6 a. refers to ASME CC-9000. The staff is not familiar with this article and perhaps the applicant meant to say NCA-9000 (glossary). Please confirm that ASME CC-9000 does not exist. Section 3.8.1.6 should be updated accordingly.

Response

DCD Tier 2, Subsection 3.8.1.6 will be revised to eliminate reference to ASME CC-9000, since its inclusion was an editorial error. KHNP did not intend to reference NCA-9000. The proposed revision to DCD, Tier 2, Subsection 3.8.1.6 is included in the attachment associated with this response.

Impact on DCD

DCD Subsection 3.8.1.6 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.

the piping is capable of producing or (b) penetration loads based on a dynamic analysis considering pipe rupture thrust as a function of time. In (b), penetration designs are later verified using results of piping analysis to provide reasonable assurance that the load used in the design is not exceeded.

Typically for the APR1400, in order to preclude pipe rupture effects, flued heads are used for high-energy piping if large pipe rupture design loads are anticipated. See Section 3.6 for further details on this topic.

Brackets and Attachments

The allowables given in the ASME Section III, Subarticles CC-3650 and CC-3750, are used as the acceptance criteria for brackets and attachments to the liner.

The APR1400 design avoids the use of brackets and similar items that transmit loads to the liner in the through-thickness direction. As much as practical in the design of attachments that have structural components carrying major loads, for example the upper plates of crane brackets, such a structural component of the attachment is made continuous through the liner. When through-thickness liner loads cannot be avoided and the liner is 25 mm (1 in) or more thick, then the special welding and material requirements of Subarticle CC-4543.6 are applied. In addition to the requirements given in Subarticle CC-4543.6 (a) through (d), ultrasonic examinations are required prior to fabrication to preclude the existence of laminations in the installed material.

3.8.1.6 Materials, Quality Control, and Special Construction Techniques

This section contains information relating to the materials, quality control program, and special construction techniques used in the fabrication and construction of the containment. Materials and quality control satisfy the following requirements:

a. ASME 2001 Edition with 2003 Addenda, Section III, Division 2, Code for Concrete Containments, Articles CC-2000, CC-4000, CC-5000, CC-6000, ~~and CC-9000~~

and

delete

Response to Action Item 3-75 Section 3.8

SEB Clarification Questions Regarding APR 1400, DCD Tier 2, Section 3.8

Clarification Question #2 (AI 3-75.5)

In DCD Tier 2, Section 3.8.3.1, “IRWST,” the applicant stated, “The IRWST is lined with a stainless steel liner plate to prevent leakage.” Please confirm whether there are leak chase channels in the IRWST.

Also, the staff reviewed the connection between the containment liner and the basemat (See DCD Figures 3.8-5 through 3.8-7, 3.8-10, and 3.8-11), and was unable to determine whether leak chase channels are included as part of the design. Such leak chase channels are typically used in containments to allow for pressure testing of the seam welds for leak-tightness. The applicant is requested to confirm whether leak chase channels are included at the welds of the containment liner along the top of the concrete basemat.

Response

Leak chase channels are included in the design of the in-containment refueling water storage tank (IRWST). The leak chase channels are located on the back side of welded seams between stainless steel liner plates.

As shown in DCD Figure 3.8-7 Detail 1, the liner plates of the containment floor are installed by full penetration welding to H-beams which are embedded in the concrete basemat. The top of the containment liner plate floor is covered with fill concrete. Therefore, leak chase channels are not included to the design of the containment liner plate floor for detection of leakage at the seams of the containment liner plates.

During construction, pressure testing of welded seams of the containment liner plate floor is performed by vacuum box testing in accordance with ASME Section III, Division 2, Subsection CC.

The details of leak chase channels in the IRWST, and the containment liner plate floor, are shown in the attachment associated with this response.

Impact on DCD

There is no impact on the DCD.

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.

Section and Details of Stainless Steel Liner Plate for IRWST

and Containment Liner Plate

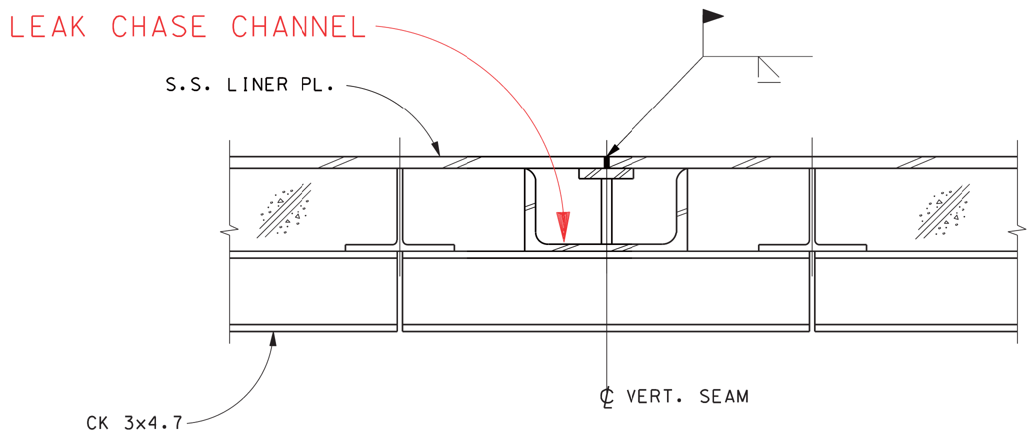

Figure 1. Typical Section of IRWST Wall

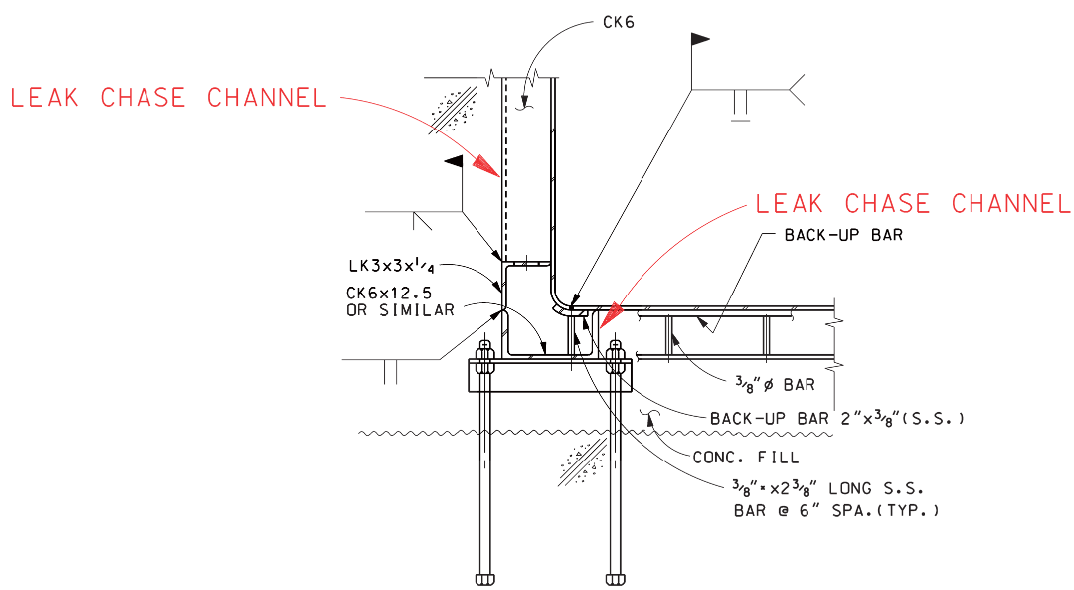

Figure 2. Detail of Floor-Wall Intersection

Section and Details of Stainless Steel Liner Plate for IRWST and Containment Liner Plate

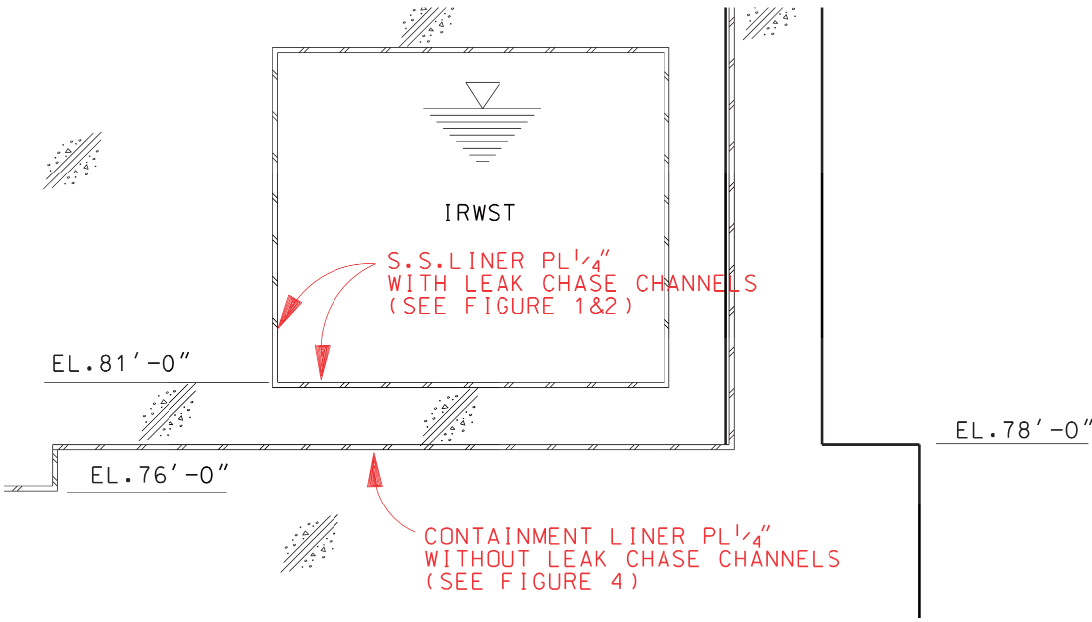

Figure 3. Section of Containment Building around IRWST

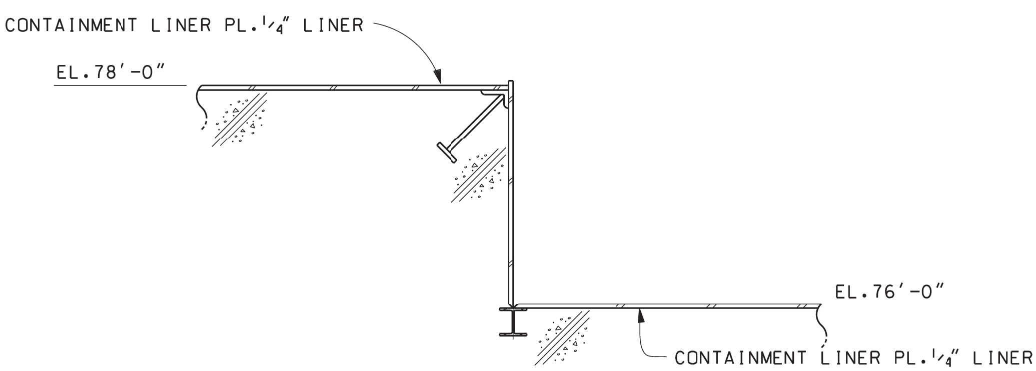

Figure 4. Edge Detail of Containment Liner Plate