Vogtle PEmails

From: Hoellman, Jordan
Sent: Monday, June 20, 2016 12:39 PM
To: Vogtle PEmails
Subject: IRWST Minimum Screen Area Change and Containment Recirculation Screen Protective Plate Dimension Change - Non-Proprietary slides
Attachments: 2016-06-23 Non-prop slides - Debris Screen Related Dimensions.pdf

Hearing Identifier: Vogtle_COL_Docs_Public
Email Number: 37

Mail Envelope Properties (f50770667b10420e9ce7cde56fa3d2d6)

Subject: IRWST Minimum Screen Area Change and Containment Recirculation Screen Protective Plate Dimension Change - Non-Proprietary slides
Sent Date: 6/20/2016 12:38:49 PM
Received Date: 6/20/2016 12:38:51 PM
From: Hoellman, Jordan

Created By: Jordan.Hoellman2@nrc.gov

Recipients:
"Vogtle PEmails" <Vogtle.PEmails@nrc.gov>
Tracking Status: None

Post Office: HQPWMSMRS03.nrc.gov

Files	**Size**	**Date & Time**	
MESSAGE	3	6/20/2016 12:38:51 PM	
2016-06-23 Non-prop slides - Debris Screen Related Dimensions.pdf			800606

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Non-Proprietary Presentation Version

IRWST Minimum Screen Area Change and Containment Recirculation Screen Protective Plate Dimension Change (Non-Proprietary)

06/23/2016

Meeting Purpose and Agenda

Meeting Purpose

- Discuss the proposed changes to the IRWST Screen and Containment Recirculation Screen Protective Plate
- Receive and address Staff feedback

Agenda

- Discuss IRWST Screen change
- Discuss Containment Recirculation Screen Protective Plate change

Summary of Changes

IRWST Screen Change

- IRWST Screens A and B
  - Increase the screen frontal face areas from 20 ft^2 to 24 ft^2
  - Increase the screen surface area from 500 ft^2 to 550 ft^2
- IRWST Screen C
  - Increase the screen frontal face area from 40 ft^2 to 47ft^2
  - Increase the screen surface area from 1000 ft^2 to 1150 ft^2

Containment Recirculation Screen Protective Plate Change

- Increase the maximum spacing of the protective plate above both containment recirculation screens from 1 foot to 1 foot 3 inches
- Decrease the minimum length the plate must extend to the front of the screen from 10 feet to 8 feet 3 inches

Background Information

- Per UFSAR Section 6.3, the primary function of the AP1000 Passive Core Cooling System (PXS) is to provide emergency core cooling following postulated design basis events. To accomplish this primary function, the PXS is designed to perform:
  - Emergency core decay heat removal
  - Reactor coolant system emergency makeup and boration
  - Safety Injection
  - Containment pH control

- Per Tier 1 Subsection 2.2.3, the core makeup tanks (CMTs), accumulators, in-containment refueling water storage tank (IRWST) and containment recirculation provide reactor coolant system (RCS) makeup, boration, and safety injection during design basis events

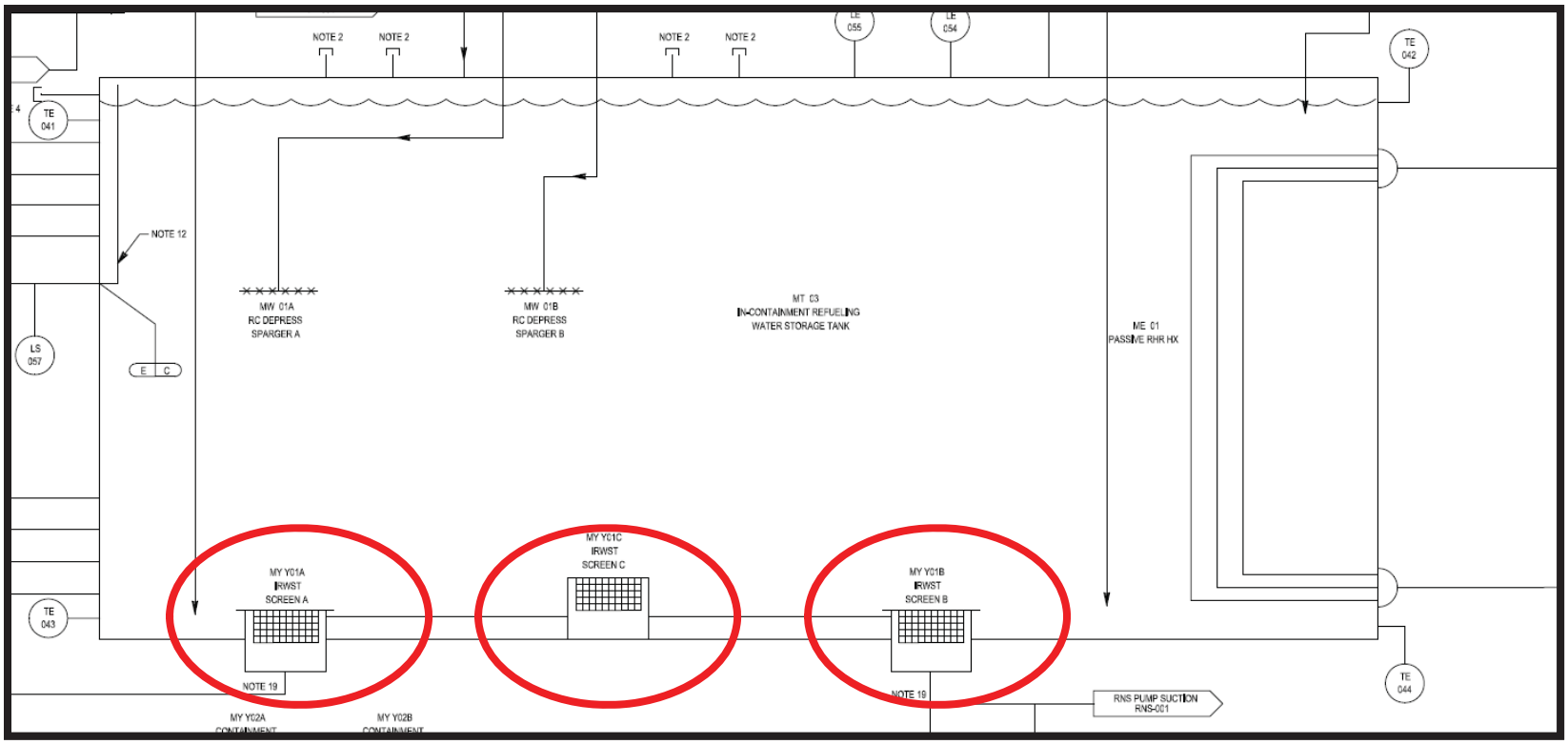
- UFSAR Subsection 6.3.2.1.3 discusses safety injection during loss of coolant accidents

IRWST Minimum Screen Dimension Change

IRWST Screen Location and Function

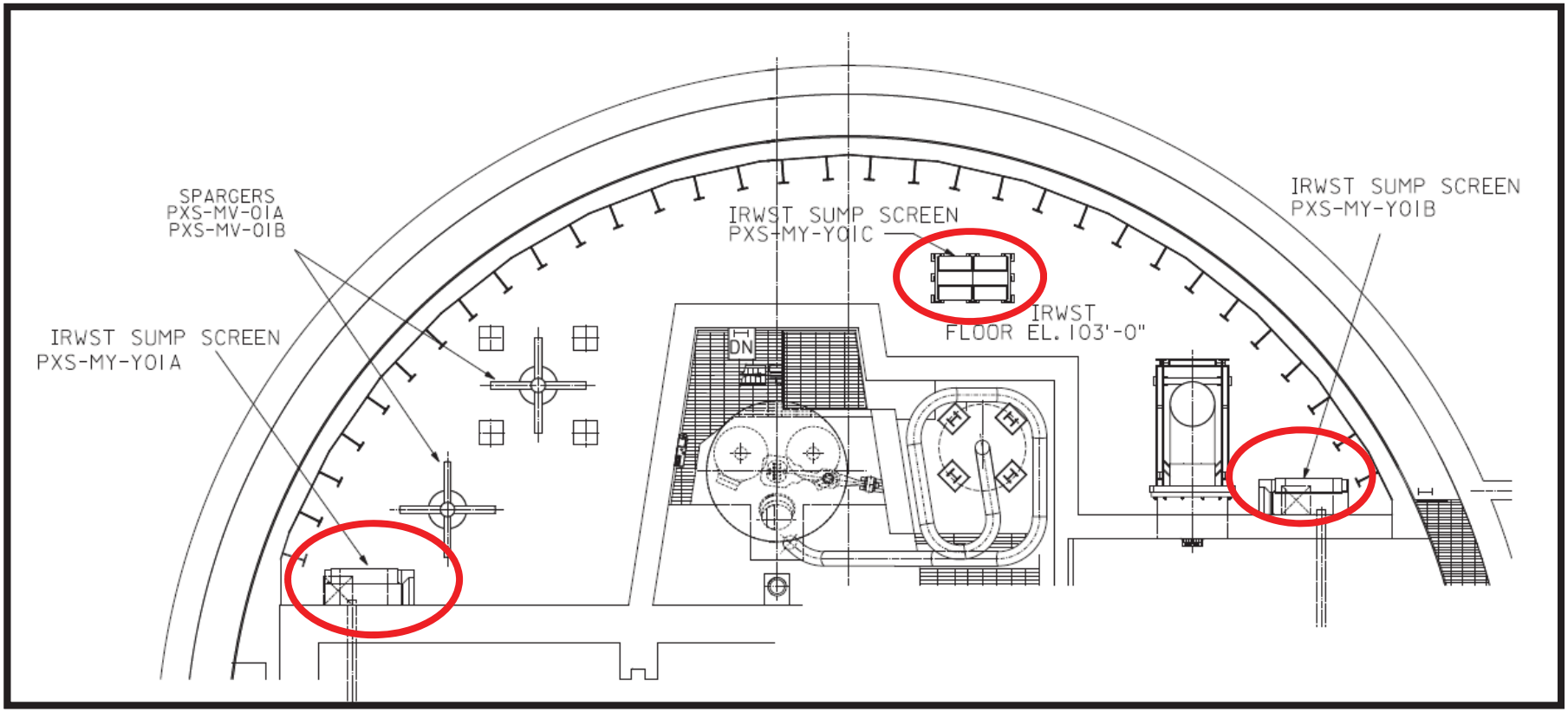
- Three cross connected screens are located at the bottom of the IRWST
- IRWST Screen functions to prevent debris from entering the Reactor Coolant System
- Potential for introducing debris to the IRWST is limited
  - The IRWST is closed off from the containment
  - Vents and overflows are normally closed by louvers
  - Per 6.3.8.1, a containment cleanliness program is required to prevent significant debris accumulation
  - Per Tech Spec 3.5.6.10, required inspections periodically confirm the IRWST screens are free of accumulated debris

IRWST Screen Location



UFSAR Figure 6.3-2

IRWST Screen Location



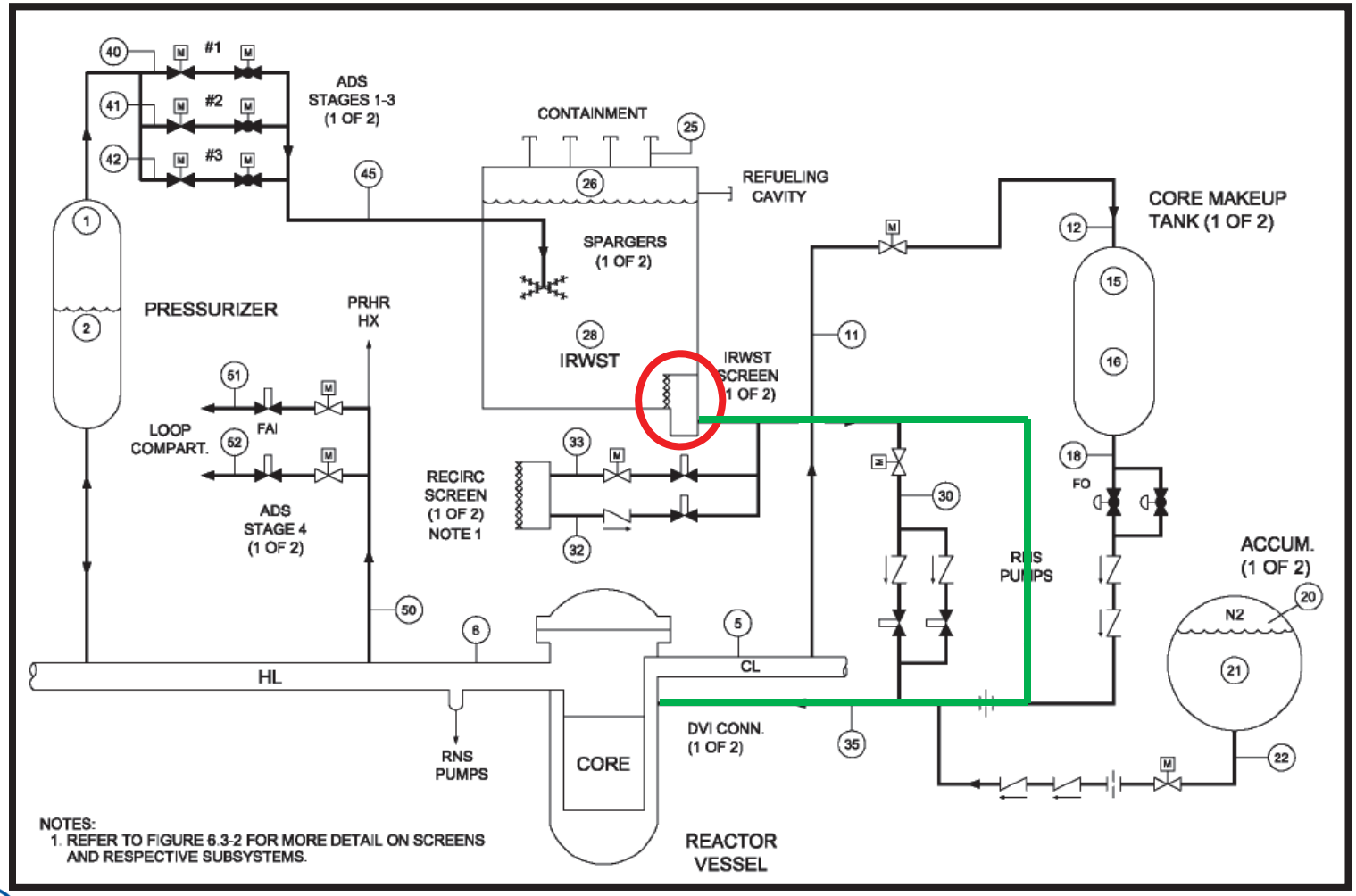
UFSAR Figure 6.3-6

Simplified Post-LOCA Operation Discussion

- Following a postulated LOCA, the RCS pressure decreases and initiates a reactor trip.
- As the CMTs' water level drops, level sensors in the tank actuate ADS Stage 1-3.
- Following ADS actuation, the operators are instructed to align and actuate the RNS to inject IRWST (or cask loading pit) water into the RCS once RCS pressure is within the RNS pump injection capability.
  - RNS injection will cause the CMT injection to stop before its level drops to the ADS Stage 4 actuation setpoint
  - The ADS fourth stage valves will not be actuated as long as RNS flow continues
- The operation of the nonsafety-related RNS is not required to cool the core; its operation allows for an easier/faster restart of the plant

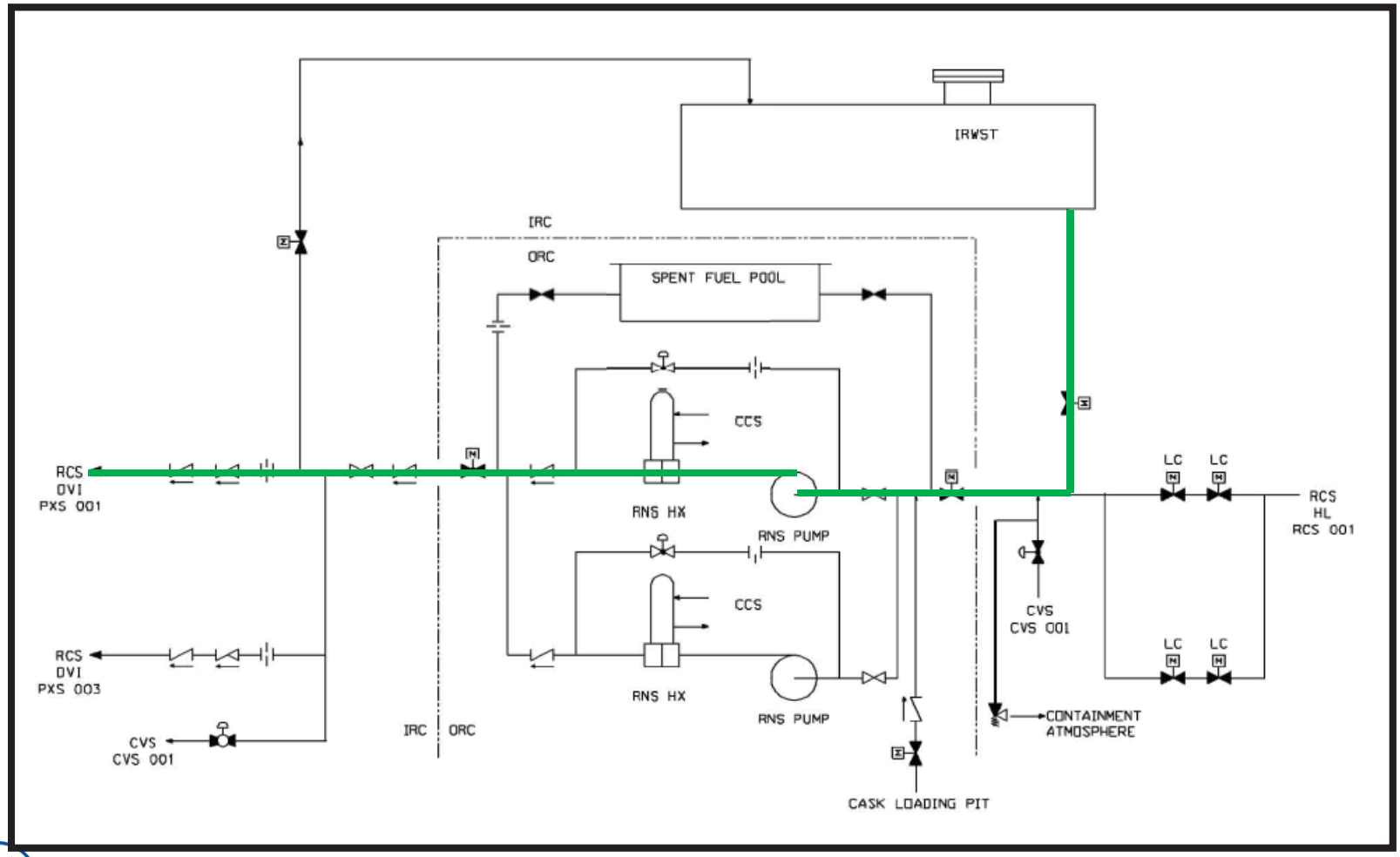
IRWST Minimum Screen Size is based on the maximum RNS flow

IRWST Injection Flow Path Using RNS Pumps



UFSAR Figure 6.3-3

IRWST Injection Flow Path Using RNS Pumps



Westinghouse

UFSAR Figure 5.4-6

Problem Statement

- The maximum RNS flow range increased from 2320 gpm to 2600 gpm in order to account for instrument uncertainty and account for the RNS flow changes resulting from RCS pressure decreases during an accident

- The increase in the RNS maximum flow rate requires a corresponding increase in the IRWST minimum screen areas required to be credited
  - Ensures that the design basis for the IRWST screens remains consistent with the results of the screen head loss testing that demonstrated acceptability of the screens.

Proposed Change

IRWST Screen	Current Minimum Required Areas		Proposed Minimum Required Areas	
	Frontal Face Area (ft^2)	Screen Surface Area (ft^2)	Frontal Face Area (ft^2)	Screen Surface Area (ft^2)
A	20	500	24	550
B	20	500	24	550
C	40	1000	47	1150
Total	80	2000	95	2250

Justification

- By increasing the minimum areas, the screen head loss performance remains consistent with the screen testing results
- No impact on RNS design functions
- No change to applicable codes and standards
- No impact on equipment
  - The proposed minimum required IRWST screen areas remain below the actual IRWST screen areas provided in the design
- Substantial margin remains in the design
  - Proposed change results in credit of 86% of the total IRWST screen frontal area
  - Debris testing performed demonstrated a measured head loss of 0.0 psi when subjected to the very conservative debris loading (equivalent to 50% of the total fiber and debris assumed available inside containment)
  - Per UFSAR 6.3.2.2.7.1, head loss of 0.25 psi is acceptable based on sensitivity analysis
- Screen size based on:
  - the same design and analysis method used in the certification
  - scaled frontal face flowrates used in testing supporting certification
- No change to the design of debris mitigation features described in UFSAR Subsection 6.3.2.2.7.2
  - Such as the screen orientation or the inspection requirements
- The increase in credited IRWST screen area does not increase the risk of debris clogging the screen.

Licensing Basis Impacts

193	2.2.03.08c.viii	8.c) The PXS provides RCS makeup, boration, and safety injection during design basis events.	viii) Inspections of the IRWST and containment recirculation screens will be conducted. The inspections will include measurements of the pockets and the number of pockets used in each screen. The pocket frontal face area is based on a width times a height. The width is the distance between pocket centerlines for pockets located beside each other. The height is the distance between pocket centerlines for pockets located above each other. The pocket screen area is the total area of perforated plate inside each pocket; this area will be determined by inspection of the screen manufacturing drawings.	viii) The screens utilize pockets with a frontal face area of $\geq$ 6.2 in^2 and a screen surface area $\geq$ 140 in^2 per pocket. IRWST Screens A and B each have a sufficient number of pockets to provide a frontal face area $\geq$ 20 ft^2, a screen surface area $\geq$ 500 ft^2, and a screen mesh size of $\leq$ 0.0625 inch. IRWST Screen C has a sufficient number of pockets to provide a frontal face area $\geq$ 40 ft^2, a screen surface area $\geq$ 1000 ft^2, and a screen mesh size $\leq$ 0.0625 inch. Each containment recirculation screen has a sufficient number of pockets to provide a frontal face area $\geq$ 105 ft^2, a screen surface area $\geq$ 2500 ft^2, and a screen mesh size $\leq$ 0.0625 inch. A debris curb exists in front of the containment recirculation screens which is $\geq$ 2 ft above the loop compartment floor. The bottoms of the IRWST screens are located $\geq$ 6 in above the bottom of the IRWST.

viii) The screens utilize pockets with a frontal face area of ≥ 6.2 in2 and a screen surface area ≥ 140 in2 per pocket. IRWST Screens A and B each have a sufficient number of pockets to provide a frontal face area ≥ 24 ft2, a screen surface area ≥ 550 ft2, and a screen mesh size of ≤ 0.0625 inch. IRWST Screen C has a sufficient number of pockets to provide a frontal face area ≥ 47 ft2, a screen surface area ≥ 1150 ft2, and a screen mesh size ≤ 0.0625 inch.

Licensing Basis Impacts

Table 6.3-2 (Sheet 2 of 2)
Component Data - Passive Core Cooling System

Screens	IRWST	Containment Recirculation
Number	3	2
Surface area, screen (square feet)	IRWST Screens A and B: ≥ 500 per screen IRWST Screen C: ≥ 1000 ft^2	≥ 2,500 per screen
Material	Stainless steel	Stainless steel
AP1000 equipment class	C	C

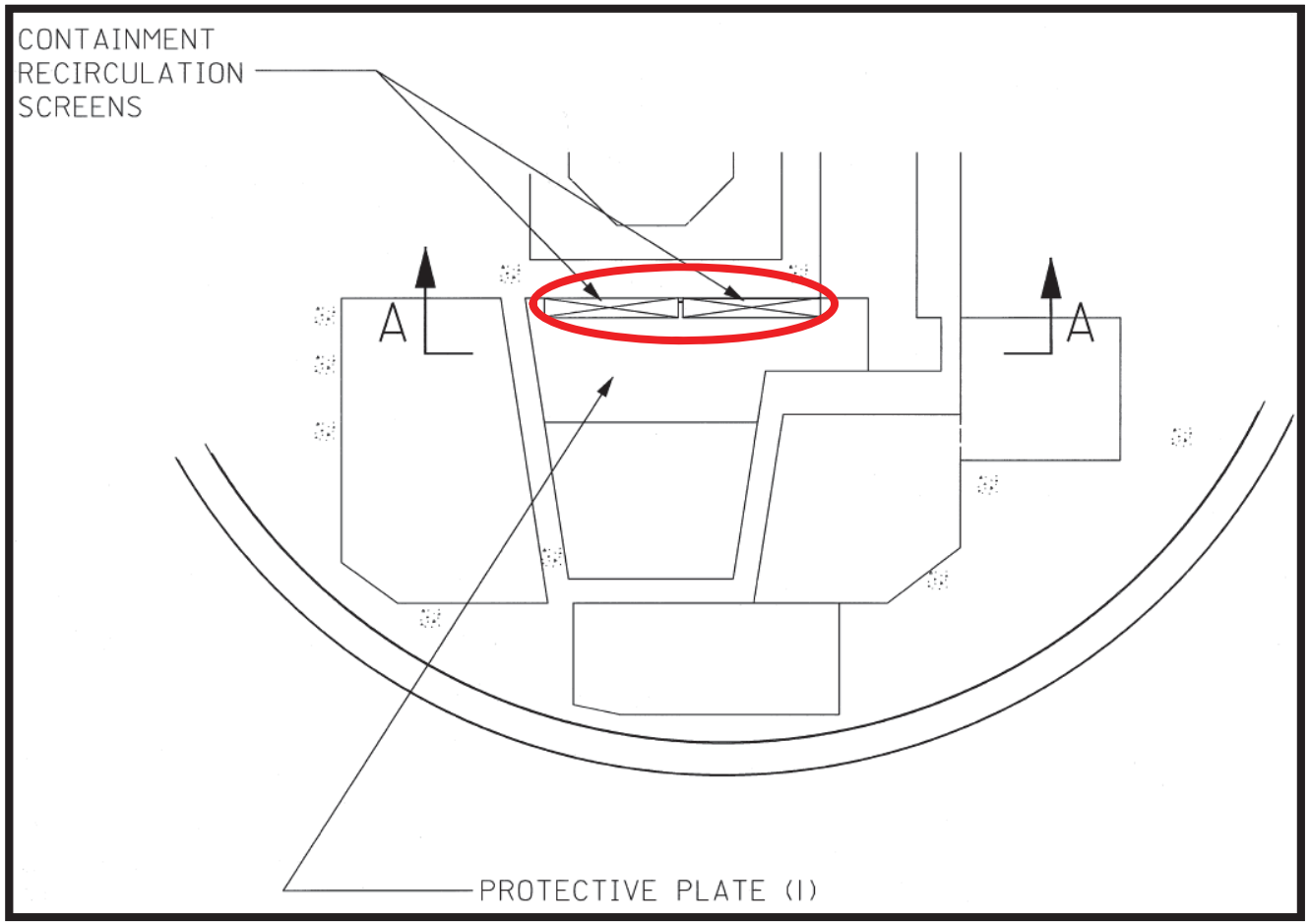
IRWST Screens A and B:
≥ 550 per screen
IRWST Screen C: ≥ 1150 ft2

Containment Recirculation Screen Protective Plate Dimension Change

Containment Recirc. Screen Location and Function

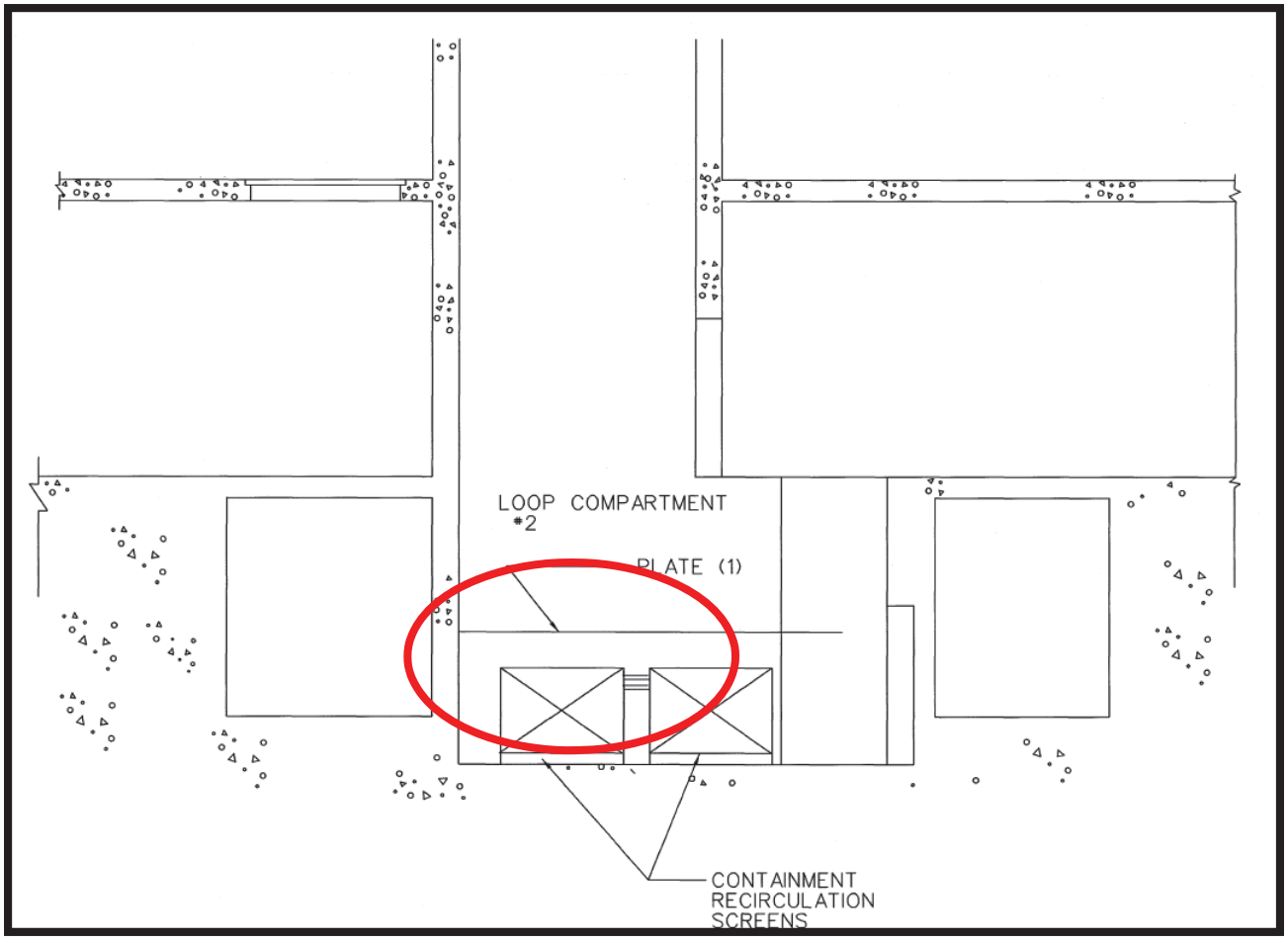
- Two screens are located vertically in the Steam Generator Compartment 2, significantly above the reactor vessel cavity
- Containment recirculation screens function to prevent debris from entering the Reactor Coolant System following a design basis accident
  - See UFSAR 6.3.2.2.7.3 for discussion
- Debris transported to screens following a design basis accident is limited
  - RCS blowdown will tend to carry debris created by the accident into the reactor cavity (located away from screens)
  - Two-foot-high debris curb is provided in front of the screens
  - Debris shield provided above the screens
  - Use of high density coatings
  - Debris limits established
  - Implementation of containment cleanliness requirements
  - Per Tech Spec 3.5.6.10, required inspections periodically confirm the recirculation screens are free of accumulated debris

Recirculation Screen Location



UFSAR Figure 6.3-8

Recirculation Screen Location

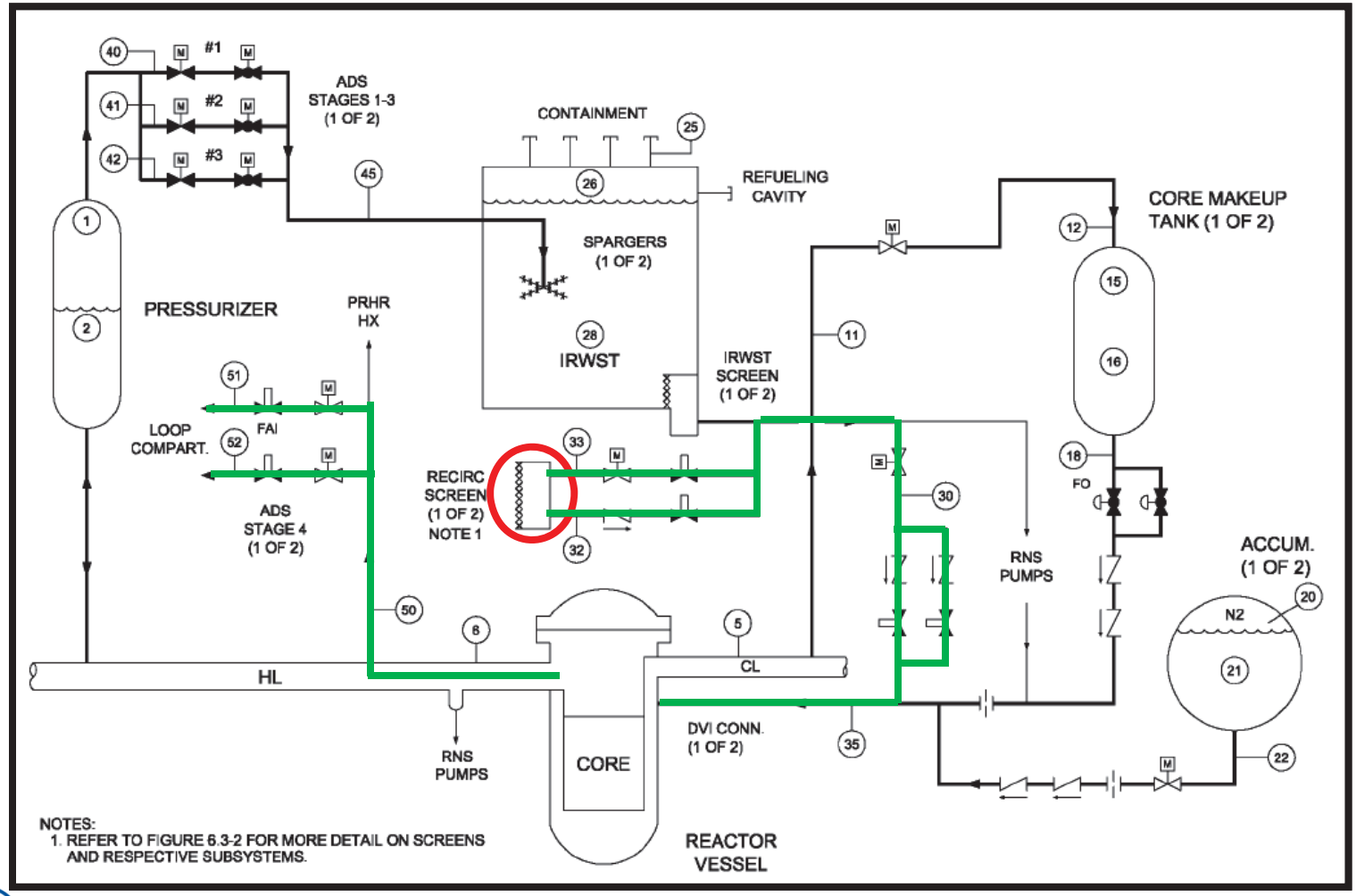


UFSAR Figure 6.3-9

Simplified Post-LOCA Operation Discussion

- Following a postulated LOCA, the RCS pressure decreases and initiates a reactor trip.
- As the CMTs' water level drops, level sensors in the tank actuate ADS Stage 1-3.
- Without operation of the RNS, the CMT level would continue to drop, actuating ADS Stage 4 valve paths
  - discharge directly to the steam generator compartments
- Accumulators begin to inject when the reactor coolant system depressurizes to about 700 psig
- When Stage 4 ADS valves are actuated, the IRWST injection squib valves are also actuated. When RCS pressure drops below IRWST injection head, check valves open and the IRWST gravity injects
- The containment water level increases
- When the IRWST level drops to a low level setpoint, the containment recirculation lines are opened
- Recirculation begins. Water in containment will flow into the reactor to provide core cooling.

Containment Recirculation Flow Path



UFSAR Figure 6.3-3

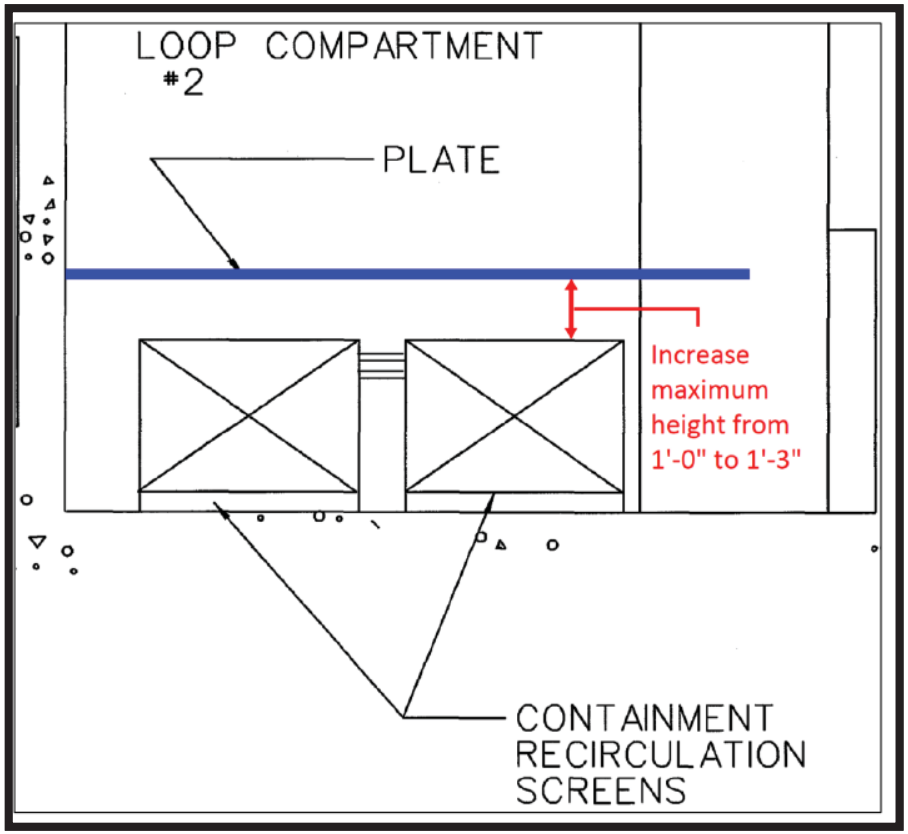
Problem Statement

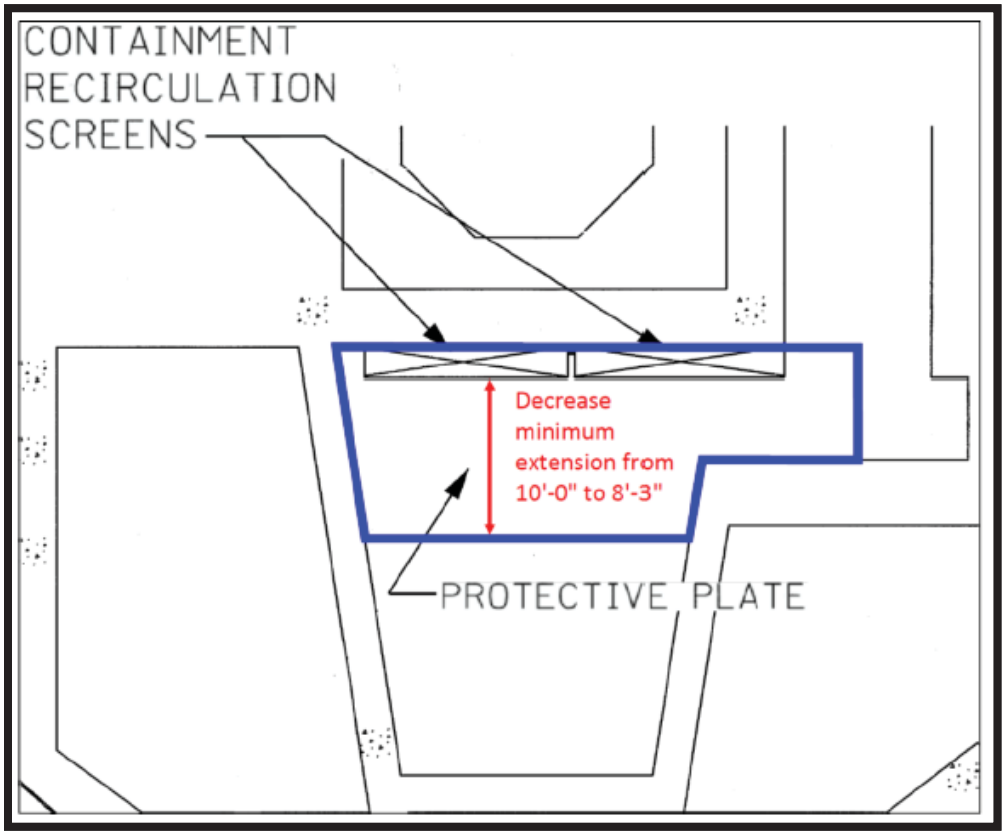
- As identified in UFSAR Subsection 6.3.2.2.7.3, the screen protective plate is provided to prevent nonsafety-related (Service Level II) coating debris that could detach in the post-accident environment from falling too close to the recirculation screens, where it could be transported to the screens.

- The UFSAR currently specifies that the plates located over the containment recirculation screen extend at least 10 feet perpendicular to the side of the screen surface
  - In order to facilitate reactor coolant pump maintenance, additional clearance is proposed in this LAR.

- The UFSAR currently specifies that the plates located over the containment recirculation screen are no more that 1 ft. above the top of the screen.
  - Changes are proposed to clearly specify where the measurements will be taken and account for the final location of the plate

Proposed Change





Proposed Change

- Specify in UFSAR Subsection 6.3.2.7.3 that the north edge of the north containment recirculation screen face is located at least 3 feet, 6 inches from the north corner of the west wall of steam generator compartment 2

Justification

- The coating debris settling and transport analysis was revised to demonstrate that the proposed revisions to the protective plate configuration would continue to prevent coating debris from reaching the screens
  - Debris settling rates used for the calculations were developed by using the most conservative settling rate reported in NUREG/CR-6916, “Hydraulic Transport of Coating Debris,” for coating materials representative of the AP1000 design, and applying an additional margin factor of 1.4 to the selected rate for additional conservatism.
- The proposed changes do not adversely affect the structural qualification of the CR protective plate module; the structure remains qualified for its required load combinations.
- No impact on PXS design functions
- No change to applicable codes and standards

Licensing Basis Impacts

Table 2.2.3-4
Inspections, Tests, Analyses, and Acceptance Criteria

No.	ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
192	2.2.03.08c.vii	8.c) The PXS provides RCS makeup, boration, and safety injection during design basis events.	vii) Inspection of the as-built components will be conducted for plates located above the containment recirculation screens.	vii) Plates located above each containment recirculation screen are no more than 1 ft above the top of the screen and extend out at least 10 ft perpendicular to and at least 7 ft to the side of the screen surface.

plate

vii) The plate located above the containment recirculation screens is no more than 1 ft, 3 in above the top of the face of the screens and extends at least 8 ft, 3 in perpendicular to the front and at least 7 ft to the side of the face of the screens.

Licensing Basis Impacts

198	2.2.03.08c.xiii	8.c) The PXS provides RCS makeup, boration, and safety injection during design basis events.	xiii) Inspections will be conducted of the surfaces in the vicinity of the containment recirculation screens. The surfaces in the vicinity of the containment recirculation screens are the surfaces located above the bottom of the recirculation screens up to and including the bottom surface of the plate discussed in Table 2.2.3-4, item 8.c.vii, out at least 10 feet perpendicular to and at least 7 feet perpendicular to the side of the screen face.	xiii) These surfaces are stainless steel.

xiii) Inspections will be conducted of the surfaces in the vicinity of the containment recirculation screens. The surfaces in the vicinity of the containment recirculation screens are the surfaces located above the bottom of the recirculation screens up to and including the bottom surface of the plate discussed in Table 2.2.3-4, item 8.c.vii, out at least 8 ft, 3 in perpendicular to the front and at least 7 feet to the side of the face of the screens.

Licensing Basis Impacts

6.3.2.2.7.1 General Screen Design Criteria

1. Screens are designed to Regulatory Guide 1.82, including:

   - Screens have solid top cover. Containment recirculation screens have a protective plate that is located no more than 1 foot, 3 inches above the top of the face of the screens, which extends at least 8 feet, 3 inches perpendicular to the front and at least 7 feet to the side of the face of the screens. The plate dimensions are relative to the portion of the screens where water flow enters the screen openings. The protective plate maximum height dimension is the distance between the top of the screens and the underside of the protective plate module top plate at the exposed edges of the protective plate, which extend into the containment recirculation water flow (east toward steam generator 2, and north toward the corridor).

Licensing Basis Impacts

- **6.3.2.2.7.3 Containment Recirculation Screens**

  …The containment recirculation screens are protected by a plate located above them. The protective plate prevents debris from the failure of nonsafety-related coatings from getting into the water close to the screens (closer than 8 feet, 3 inches from the front of the face of the screens and 7 feet from the side of the face of the screens) where the recirculation flow could cause the debris to be swept to the screens before it settles to the floor. The north edge of the north containment recirculation screen face is located at least 3 feet, 6 inches from the north corner of the west wall of steam generator compartment 2 (Room 11202), to which the containment recirculation screens are attached. Placement of the north containment recirculation screen prevents debris falling into the vertical access corridor (Room 11204) from entering the water closer than 3 feet, 6 inches from the face of the north containment recirculation screen. Stainless steel is used on the underside of the plate and on surfaces located below the plate, above the bottom of the screen face, extending at least 8 feet, 3 inches perpendicular to the front and at least 7 feet to the side of the face of the screens to prevent coating debris from reaching the screens.

Licensing Basis Impacts

Table 14.3-2 (Sheet 5 of 17)
Design Basis Accident Analysis

Section	6.3.2.2.7.1	The containment recirculation screens have plates that are located no more than 1 foot above the top of the screens and extend out at least 10 feet in front and at least 7 feet to the side of the screens to prevent coating debris from reaching the screens.

The containment recirculation screens have a protective plate that is located no more than 1 foot, 3 inches above the top of the face of the screens, which extends at least 8 feet, 3 inches perpendicular to the front and at least 7 feet to the side of the face of the screens, to prevent coating debris from reaching the screens.

Licensing Basis Impacts

Table 14.3-2 (Sheet 6 of 17)
Design Basis Accident Analysis

Reference	Design Feature	Value
Section 6.3.2.2.7.3	The surface materials used in the vicinity of the containment recirculation screens are stainless steel. In the vicinity of the containment recirculation screens includes surfaces located above the bottom of the recirculation screens up to and including the bottom surface of the plate discussed in subsection 6.3.2.2.7.1, and the surfaces 10 feet in front and 7 feet to the sides of the screen face.	

The surface materials used in the vicinity of the containment recirculation screens are stainless steel. In the vicinity of the containment recirculation screens includes surfaces located above the bottom of the recirculation screens up to and including the bottom surface of the plate discussed in subsection 6.3.2.2.7.1, and the surfaces extending at least 8 feet, 3 inches perpendicular to the front and at least 7 feet to the side of the face of the screens.

Licensing Basis Impacts

19E.2.3.2.7 Containment Recirculation Screens

The PXS containment recirculation screens may have to function in the longer-term during a shutdown accident that results in ADS operation. Effective screen design, plant layout, and other factors prevent clogging of these screens by debris during such accident operations.

- Screens have a protective plate located no more than 1 foot, 3 inches above the top of the face of the screens, which extends at least 8 feet, 3 inches perpendicular to the front and at least 7 feet to the side of the face of the screens.

Discussion/Questions