ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Monday, January 31, 2011 5:28 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); WELLS Russell (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 431, FSARCh. 5, OPEN ITEM, Supplement 4
Attachments: RAI 431 Supplement 4 Response US EPR DC.pdf

Getachew,

On September 7, 2010, AREVA NP Inc. (AREVA NP), provided a schedule for the response to RAI 431. AREVA NP submitted Supplement 1 on October 25, 2010, Supplement 2 on November 29, 2010, and Supplement 3 on January 14, 2011, which provided a revised schedule for the response to RAI 431. The attached file, "RAI 431 Supplement 4 Response US EPR DC.pdf" provides a technically correct and complete response to the 1 question, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 431 Question 05.02.05-12.

The following table indicates the respective pages in the response document, "RAI 431 Supplement 4 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions

Question #	Start Page	End Page
RAI 431 — 05.02.05-12	2	5

This concludes the formal AREVA NP response to RAI 431, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, January 14, 2011 1:43 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); WELLS Russell (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 431, FSARCh. 5, OPEN ITEM, Supplement 3

Getachew,

On September 7, 2010, AREVA NP Inc. (AREVA NP), provided a schedule for the response to RAI 431. AREVA NP submitted Supplement 1 on October 25, 2010 and Supplement 2 on November 29, 2010 which

provided a revised schedule for the response to RAI 431. In order to allow time for interaction with the NRC, the schedule for a technically correct and complete FINAL response to this question has been revised and is provided below.

Question #	Response Date
RAI 431 — 05.02.05-12	February 18, 2011

Sincerely,

Martin (Marty) C. Bryan
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From: BRYAN Martin (External RS/NB)
Sent: Monday, November 29, 2010 3:32 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); WELLS Russell (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 431, FSARCh. 5, OPEN ITEM, Supplement 2

Getachew,

On September 7, 2010, AREVA NP Inc. (AREVA NP), provided a schedule for the response to RAI 431. On October 25, 2010, AREVA NP submitted Supplement 1 which provided a revised schedule I for the response to RAI 431. In order to allow time for interaction with the NRC, the schedule for a technically correct and complete FINAL response to this question has been revised and is provided below.

Question #	Response Date
RAI 431 — 05.02.05-12	January 18, 2011

Sincerely,

Martin (Marty) C. Bryan
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From: BRYAN Martin (External RS/NB)
Sent: Monday, October 25, 2010 5:25 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); WELLS Russell (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 431, FSARCh. 5, OPEN ITEM, Supplement 1

Getachew,

On September 7, 2010, AREVA NP Inc. (AREVA NP), provided a schedule for the response to RAI 431. In order to allow time for interaction with the NRC, the schedule for a technically correct and complete FINAL response to this question has been revised and is provided below.

Question #	Response Date
RAI 431 — 05.02.05-12	November 29, 2010

Sincerely,

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From: BRYAN Martin (External RS/NB)
Sent: Tuesday, September 07, 2010 10:14 AM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); WELLS Russell (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 431 (4977), FSARCh. 5, OPEN ITEM

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 431 Response U.S. EPR DC.pdf" provides a schedule for a technically correct and complete response to the 1 question.

The following table indicates the respective pages in the response document, RAI 431 Response U.S. EPR DC.pdf "that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 431 — 05.02.05-12	2	2

A complete answer is not provided for the 1 questions The schedule for a technically correct and complete response to this question is provided below.

Question #	Response Date
RAI __ — 05.02.05-12	October 27, 2010

Sincerely,

Martin (Marty) C. Bryan
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, August 13, 2010 5:44 PM
To: ZZ-DL-A-USEPR-DL
Cc: Li, Chang; Lee, Samuel; Segala, John; Hearn, Peter; Colaccino, Joseph
Subject: U.S. EPR Design Certification Application RAI No. 431 (4977), FSARCh. 5, OPEN ITEM

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 5, 2010, and on August 12, 2010, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 2498

Mail Envelope Properties (199EBB4D1CD9644D9472AA84D5D8EFA7192EA5)

Subject: Response to U.S. EPR Design Certification Application RAI No. 431, FSARCh. 5, OPEN ITEM, Supplement 4
Sent Date: 1/31/2011 5:28:20 PM
Received Date: 1/31/2011 5:28:23 PM
From: BRYAN Martin (EXTERNAL AREVA)

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MESSAGE	6848	1/31/2011 5:28:23 PM
RAI 431 Supplement 4 Response US EPR DC.pdf	205578	

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

Response to

Request for Additional Information No. 431(4977), Revision 1
Supplement 4

8/13/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.02.05 - Reactor Coolant Pressure Boundary Leakage Detection
Application Section: 5.2.5

QUESTIONS for Balance of Plant Branch 2 (SBPB)

Question 05.02.05-12:

OPEN ITEM

Follow-up to Open Item RAI 365, Question 05.02.05-11

RAI 365 Question 05.02.05-11 requested the applicant to include the RCPB leakage detection sensitivity and response time for the RCPB leakage detection instrument in the ITAAC. In reviewing the response to Question 05.02.05-11 pertaining to ITAAC markups (Tier 1 Table 2.4.8-1, Table 2.9.4-3, and Table 2.9.5-2), the staff noted that the proposed ITAAC have the leakage detection acceptance criterion of 1 gpm within 1 hour for the fan cooler condenser and sump level. The applicant is requested to provide the following information.

1. The sensitivity criterion of 1.0 gpm is inconsistent with Tier 2 FSAR Section 3.6.3.7, which indicates that to support leak-before-break (LBB), the leakage detection sensitivity of 0.5 gpm is needed for the main coolant loop piping (MCL) and pressurizer surge line (SL). Further, the leakage detection sensitivity of 0.1 gpm is needed for the main steam line (MSL). Revise the sensitivity criteria or justify the adequacy of the 1.0 gpm sensitivity criterion.
2. Include and specify the sensitivity and response time for radiation monitors in the ITAAC in terms of leakage detection (gpm).
3. Verify the initial testing specified in Tier 2 FSAR Section 14.2 to have consistent criteria for the sensitivity and response time of reactor coolant leakage detection.

Response to Question 05.02.05-12:

Background Information

As noted in U.S. EPR FSAR Tier 2, Section 5.2.5 and Technical Specification 3.4.14, the following methods are used to detect and monitor unidentified reactor coolant system (RCS) leakage for the U.S. EPR, in accordance with RG 1.45, Revision 1:

- Containment sump level monitoring.
- Containment atmosphere radiation monitoring.
- Containment air cooler condensate monitoring.

These monitors are also contained in the following U.S. EPR FSAR Tier 1 sections:

- U.S. EPR FSAR Tier 1, Section 2.9.5 for the containment sump level monitoring.
- U.S. EPR FSAR Tier 1, Section 2.9.4 for the containment atmosphere radiation monitoring.
- U.S. EPR FSAR Tier 1, Section 2.4.8 for the containment air cooler condensate monitoring.

As noted in U.S. EPR FSAR Tier 2, Section 5.2.5, the containment sump level and discharge flow monitoring and the containment air cooler condensate monitoring are also credited for main reactor coolant loop and pressurizer (PZR) SL LBB monitoring and can reliably detect a leakage rate of 0.5 gpm in one hour. Additionally, as noted in U.S. EPR FSAR Tier 2, Section 3.6.3.1, LBB is applied to the MSL piping inside the containment (i.e., from the steam generators (SGs) to the first anchor point location at the Containment Building penetration).

Response to NRC Question

1. The Reactor Building (RB) sump instrumentation used for reactor coolant pressure boundary (RCPB) leakage measures a change in level that can be used to determine leakage rate. This system also serves as backup for MSL LBB leakage detection. The sensitivity requirements for LBB for the reactor coolant system (RCS) are 0.5 gpm in one hour or a 30 gallon change in sump level. For MSL LBB, the sump level measurement sensitivity requirement is to detect a leak of 0.1 gpm in 4 hours or a 24 gallon level change. Because the MSL LBB level-change requirements require a greater sensitivity than the LBB for the RCS, the ITAAC for the RB sump level instrumentation will be revised to indicate that a 24 gallon increase in sump level is indicated in the main control room (MCR). The inspections, tests, analyses, and acceptance criteria (ITAAC) will be revised to reflect this sensitivity.

   The RB cooler condensate instrumentation will be designed to measure flow. U.S. EPR FSAR Tier 1 and Tier 2 material will be revised to clarify that flow measurement is provided. The sensitivity is the result of the RCS LBB requirement of 0.5 gpm. The ITAAC will be revised to reflect this sensitivity.

   The MSL humidity detection system will be designed to indicate flow based on humidity. The sensitivity requirement for this system is 0.1 gpm. The ITAAC will be revised to reflect this sensitivity.

   Based on the above, the following changes will be made to the U.S. EPR FSAR:

   - U.S. EPR FSAR Tier 1, Section 2.4.8, Item 1.0 will be revised to indicate that the leakage detection system also applies to leakage from the MSL piping inside the containment (i.e., from the steam generators to the first anchor point location at the Containment Building penetration).

   - U.S. EPR FSAR Tier 1, Section 2.4.8, Item 2.1 will be revised to change “level indication” to “flow indication” for the RB fan cooler condensate system.

   - U.S. EPR FSAR Tier 1, Section 2.4.8, will be revised to add new Item 2.2 to state that MSL humidity detection is provided in the MCR.

   - U.S. EPR FSAR Tier 1, Table 2.4.8-1, Item 2.1 will be revised to provide design ITAAC for the RB fan cooler condensate system and to change the leak detection system from 1.0 gpm to 0.5 gpm consistent with U.S. EPR FSAR Tier 2, Section 3.6.3.7. Similarly, U.S. EPR FSAR Tier 1, Table 2.4.8-1 will be revised to add Item 2.2 for design ITAAC for the MSL humidity detection and to add an acceptance criteria of 0.1 gpm for MSL leakage consistent with U.S. EPR FSAR Tier 2, Section 3.6.3.7.

   - U.S. EPR FSAR Tier 1, Section 2.9.5 will be revised to add new Item 3.3 to indicate the RB sump has level sensors that can be used to monitor system leakage. Similarly, new Item 3.3 will be added to U.S. EPR FSAR Tier 1, Table 2.9.5-2.

   - Acceptance criterion 3.1.b in U.S. EPR FSAR Tier 1, Table 2.9.5-2 will be deleted and replaced with the acceptance criterion in new Item 3.3 in EPR FSAR Tier 1, Table 2.9.5-2 which states that a sump level of 24 gallons is indicated in the MCR.

- U.S. EPR FSAR Tier 2, Section 7.1.1.5.12 will be revised to indicate that the MSL humidity detection system can detect leakage of 0.1 gpm, and to provide additional information on the containment air cooling condensate monitoring system.

- Consistent with the change to U.S. EPR FSAR Tier 1, Section 2.4.8, Item 2.1, the term "flow" will be removed from the following U.S. EPR FSAR Tier 2 sections:

  - U.S. EPR FSAR Tier 2, Section 5.2.5, first paragraph.

  - U.S. EPR FSAR Tier 2, Section 5.2.5.1, first bullet.

  - The title of U.S. EPR FSAR Tier 2, Section 5.2.5.1.1.

  - U.S. EPR FSAR Tier 2, Section 5.2.5.1.3. Additionally, this section will be revised to correctly describe the operation of the containment air cooling condensate monitoring system.

- U.S. EPR FSAR Tier 2, Technical Specification Basis 3.7.18, and Surveillance Requirement 3.7.18.1 will be revised to indicate that the local humidity detection system provides an indication of MSL leakage.

2. The radiation monitor used to indicate RCPB leakage is the low range RB Radioactivity Monitor (30KLK05CR031), which has a required sensitivity of 3E-10 uC/cc. The Response to RAI 276, Supplement 2, Question 11.05-13a provided the methodology used to demonstrate that the U.S. EPR particulate radiation monitor will be capable of satisfying the technical basis for RCS leakage detection instrumentation of a leakage increase of 1 gpm within one hour required by U.S. EPR FSAR Tier 2, Technical Specification 3.4.14 and the guidance of RG 1.45 (Revision1) and RIS-2009-02 (Revision1). U.S. EPR FSAR Tier 2, Section 5.2.5.1.2 and Section 5.2.5.5 include the correlation between the sensitivity of 3E-10 uC/cc and the RCS leakage detection of 1 gpm. These sections were revised in the Response to RAI 276, Supplement 2, Question 11.05-13, and the Response to RAI 392, Supplement 2, Question 11.05-21, which provided U.S. EPR FSAR Tier 2, Section 11.5.4.8. The sensitivity and response time for radiation monitors was also provided in the Response to RAI 392, Supplement 2, Question 11.05-21, Part 4. U.S. EPR FSAR Tier 2, Section 5.2.5.1.2 and Section 5.2.5.5.3 will be revised to add a reference to U.S. EPR FSAR Tier 2, Section 11.5.4.8.

   Accordingly, the ITAAC in U.S. EPR FSAR Tier 1, Table 2.9.4-3, Item 4.3 will be revised to specify the required sensitivity for this monitor (i.e., 3E-10 uC/cc) and to verify that this sensitivity correlates to a leakage increase of 1 gpm within one hour. As part of this clarification the three other RB Radioactivity Monitor(s) listed in U.S. EPR FSAR Tier 1, Table 2.9.4-1 (30KLK05CR001, 30KLK05CR071, and 30KLK05CR561) will be deleted from the table because they are not the monitors credited to perform an RCS leakage function.

3. U.S. EPR FSAR Tier 2, Section 14.2.12, test numbers 12, 137, 172, 187, and 189 describe the testing requirement for the leakage detection systems. However, only test numbers 12, 137, and 189 apply to the leakage detection for those systems that support LBB. For consistency, U.S. EPR FSAR Tier 2, Section 5.2.5 will be added to the acceptance criteria for tests 172 and 187, and U.S. EPR FSAR Tier 2, Section 3.6.3.7 will be added to the acceptance criteria for these tests.

FSAR Impact:

U.S. EPR FSAR Tier 1, Section 2.4.8, Section 2.9.4, and Section 2.9.5, and U.S. EPR FSAR Tier 2, Technical Specification Basis 3.7.18, Technical Specification Surveillance Requirement 3.7.18.1, Section 5.2.5, Section 7.1.1.5.12, and Section 14.2.12 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

2.4.8 Leakage Detection System

1.0 Description

05.02.05-12

The leakage detection system supports the identification of reactor coolant pressure boundary (RCPB) leakage and leakage from the main steam line (MSL) piping inside the containment (i.e., from the steam generators to the first anchor point location at the Containment Building penetration).

2.0 I&C Design Features, Displays and Controls

2.1 Reactor Building fan cooler condensate collector ~~level~~ flow indication is provided in the MCR.

2.2 MSL humidity detection indication is provided in the MCR.

3.0 System Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.8-1 lists the Leakage Detection System ITAAC.

Table 2.4.8-1—Leakage Detection System ITAAC

05.02.05-12

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
2.1	~~Reactor Building fan cooler condensate collector level indication is provided in the MCR~~RB cooler condensate flow measurement indication is provided in the MCR.	~~Testing will be performed for the Reactor Building condensate collector level indications.~~ a. Analyses and tests will be performed to design RB cooler condensate flow measurement equipment. b. Test of the as-installed RB cooler condensate flow detection equipment will be performed.	~~Condensate collector level change is indicated in the MCR on the Reactor Building condensate collector level indications.~~ ~~•Reactor Building fan cooler level condensate levels JYH11CF001 JYH14CF001 JYH21CF001 JYH22CF001 JYH23CF001 JYH24CF001 JYH22CF003 JYH22CF004 JYH23CF003 JYH23CF004~~ • ~~The system can detect 1.0 gpm condensate flow within 1 hour.~~ a. A design report exists and concludes that the as-designed RB cooler condensate flow detection equipment can detect condensate flow of 0.5 gpm. b. The installed RB cooler condensate flow detection equipment can detect a flow of 0.5 gpm.
2.2	Main steam line humidity detection indication is provided in the MCR.	a. Analyses and tests will be performed to design the MSL humidity detection equipment.	a. A design report exists and concludes that the as-designed MSL humidity detection equipment can detect MSL leakage of 0.1 gpm.

	05.02.05-12	b. Inspections of the installation of the MSL humidity detection equipment will be performed and deviations to the design report will be reconciled.	b. The installed MSL humidity detection equipment complies with the design and deviations have been reconciled.

Next File

2.9.4 Sampling Activity Monitoring System

1.0 Description

The sampling activity monitoring system provides the following safety-related function:

- Provides a radioactivity indication that initiates isolation of the main control room (MCR) ventilation intake.

The sampling activity monitoring system provides the following non-safety-related function:

- Provides ventilation stack radiation monitoring indication in the MCR and remote shutdown station (RSS).
- Supports reactor coolant pressure boundary (RCPB) leakage detection.

2.0 Arrangement

2.1 The functional arrangement of the sampling activity monitoring system is shown on Figure 2.9.4-1—Sampling Activity Monitoring System Functional Arrangement.

2.2 The location of the sampling activity monitoring system equipment is as listed in Table 2.9.4-1—Sampling Activity Monitoring System Equipment Mechanical Design.

3.0 Mechanical Design Features

3.1 Components identified as Seismic Category I in Table 2.9.4-1 can withstand seismic design basis loads without a loss of the function listed in Table 2.9.4-1.

4.0 Displays and Controls

4.1 Each monitor listed in Table 2.9.4-1 initiates a MCR alarm when radiation level exceeds a preset limit.

05.02.05-12

4.2 The sampling activity monitoring system provides ventilation stack radiation monitoring.

4.3 Reactor Building radiation level, which supports reactor coolant pressure boundary RCPB leakage detection, is indicated in the MCR.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.9.4-2—Sampling Activity Monitoring System Equipment I&C and Electrical Design are powered from a Class 1E division in a normal or alternate feed condition.

6.0 Equipment and System Performance

6.1 MCR Ventilation Intake Radioactivity Monitors listed in Table 2.9.4-1 initiate isolation of the MCR ventilation and initiation of supplemental filtration upon receipt of high radioactivity levels.

Table 2.9.4-1—Sampling Activity Monitoring System Equipment Mechanical Design

Description	Tag Number (1)	Location	Function	Seismic Category
MCR Ventilation Intake Radioactivity Monitor	30KLK65CR001	Safeguard Building 2	Indicate Radioactivity Levels	I
MCR Ventilation Intake Radioactivity Monitor	30KLK65CR002	Safeguard Building 2	Indicate Radioactivity Levels	I
MCR Ventilation Intake Radioactivity Monitor	30KLK66CR001	Safeguard Building 3	Indicate Radioactivity Levels	I
MCR Ventilation Intake Radioactivity Monitor	30KLK66CR002	Safeguard Building 3	Indicate Radioactivity Levels	I
Ventilation Stack Radioactivity Monitor	30KLK95CR001	Vent Stack	Indicate Radioactivity Levels	Non-Seismic
Ventilation Stack Radioactivity Monitor	30KLK95CR002	Vent Stack	Indicate Radioactivity Levels	Non-Seismic
~~Reactor Building Radioactivity Monitor~~	~~30KLK05CR001~~	~~Reactor Building~~	~~Indicate Radioactivity Levels~~	~~I~~
Reactor Building Radioactivity Monitor	30KLK05CR031	Reactor Building	Indicate Radioactivity Levels	I
~~Reactor Building Radioactivity Monitor~~	~~30KLK05CR071~~	~~Reactor Building~~	~~Indicate Radioactivity Levels~~	~~I~~
~~Reactor Building Radioactivity Sampler~~	~~30KLK05CR561~~	~~Reactor Building~~	~~Indicate Radioactivity Levels~~	~~I~~

1) Equipment tag numbers are provided for information only and are not part of the certified design.

05.02.05-12

Table 2.9.4-3—Sampling Activity Monitoring System ITAAC (2 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
4.2	The sampling activity monitoring system provides ventilation stack radiation monitoring.	A test will be performed.	a. Ventilation stack radiation monitors listed in Table 2.9.4-1 and Table 2.9.4-2 provide ventilation stack radiation indication in the MCR. b. Ventilation stack radiation monitors listed in Table 2.9.4-1 and Table 2.9.4-2 provide ventilation stack radiation indication in the RSS.
4.3	Reactor Building radiation, which supports reactor coolant pressure boundary RCPB leakage detection, is indicated in the MCR.	05.02.05-12 a. A test will be performed to verify radiation level information in the MCR. ~~A testing will be performed to verify radiation level indication in the MCR.~~ b. An analysis will be performed to verify that the monitor sensitivity of 3E-10 µCi/cc correlates to an ability to detect a leakage increase of 1 gpm.	a. Radiation level indication is provided in the MCR for the Reactor Building radiation monitor~~s~~ listed in Table 2.9.4-1. b. A report exists and concludes that the monitor sensitivity of 3E-10 µCi/cc correlates to an ability to detect a leakage increase of 1 gpm.~~The monitor can detect 10^{-9} µCi/cc.~~
5.1	The components designated as Class 1E in Table 2.9.4-2 are powered from a Class 1E division in a normal or alternate feed condition.	a. Testing will be performed for components designated as Class 1E in Table 2.9.4-2 by providing a test signal in each normally aligned division. b. Testing will be performed for components designated as Class 1E in Table 2.9.4-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	a. The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.9.4-2. b. The test signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E component identified in Table 2.9.4-2.

2.9.5 Nuclear Island Drain and Vent System

1.0 Description

The nuclear island drain and vent system (NIDVS) collects, temporarily stores, and transfers radioactive fluids from the nuclear island area to other plant systems in a controlled manner. Portions of the NIDVS are classified as safety-related. The NIDVS operates during normal power, start-up, and shutdown conditions.

The NIDVS provides the following safety-related functions:

- Provides alarms in the main control room (MCR) to indicate a flooding event.
- Trips the essential service water system (ESWS) pump and closes the ESWS pump discharge valve in a Safeguard Building (SB) flooding event.
- Supports reactor coolant pressure boundary (RCPB) leakage detection.

2.0 Arrangement

2.1 The location of the sump level sensors is as listed in Table 2.9.5-1—NIDVS Equipment I&C and Electrical Design.

3.0 Instrumentation and Controls (I&C) Design Features, Displays, and Controls

3.1 Displays listed in Table 2.9.5-1 are retrievable in the main control room (MCR).

3.2 The sump level sensor in a Safeguard Building trips the ESWS pump and closes the pump discharge valve in response to a flooding signal.

05.02.05-12

3.3 The sump has level sensors that can be used to monitor system leakage.

4.0 Electrical Power Design Features

4.1 The sump level sensors designated as Class 1E in Table 2.9.5-1 are powered from the Class 1E division listed in Table 2.9.5-1.

5.0 Environmental Qualifications

5.1 The sump level sensors listed in Table 2.9.5-1 for EQ harsh environment can initiate an alarm in the MCR following exposure to the environments that exist during and following design basis events.

6.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.9.5-2 lists the NIDVS ITAAC.

Table 2.9.5-2—Nuclear Island Drain and Vent System ITAAC (2 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
2.1	The location of the sump level sensors is as listed in Table 2.9.5-1.	An inspection will be performed to verify the location of the sump level sensors listed in Table 2.9.5-1.	The location of the sump level sensors is as listed in Table 2.9.5-1.
3.1	Displays listed in Table 2.9.5-1 are retrievable in the MCR.	Tests will be performed for MCR displays listed in Table 2.9.5-1.	a. Displays listed in Table 2.9.5-1 are retrievable in the MCR. b. The system can detect 1.0 gpm inflow within one hour.
3.2	The sump level sensor in a Safeguard Building trips the ESWS pump and closes the pump discharge valve in response to a flooding signal.	a. A test will be performed on the SB 1 sump level sensor (30KTE20CL001) listed in Table 2.9.5-1. b. A test will be performed on the SB 2 sump level sensor (30KTE20CL003) listed in Table 2.9.5-1. c. A test will be performed on the SB 3 sump level sensor (30KTE20CL005) listed in Table 2.9.5-1. d. A test will be performed on the SB 4 sump level sensor (30KTE20CL007) listed in Table 2.9.5-1.	a. ESWS pump 1 trips and ESWS pump 1 discharge valve closes on a SB 1 sump level signal. b. ESWS pump 2 trips and ESWS pump 2 discharge valve closes on a SB 2 sump level signal. c. ESWS pump 3 trips and ESWS pump 3 discharge valve closes on a SB 3 sump level signal. d. ESWS pump 4 trips and ESWS pump 4 discharge valve closes on a SB 4 sump level signal.
3.3	The sump has level sensors that can be used to monitor system leakage.	Tests will be performed to verify RB sump level change capability.	Sump level change of 24 gallons is indicated in the MCR.
4.1	The sump level sensors designated as Class 1E in Table 2.9.5-1 are powered from the Class 1E division listed in Table 2.9.5-1.	Tests will be performed for sump level sensors designated as Class 1E in Table 2.9.5-1 by providing a test signal to the aligned Class 1E division.	The test signal provided in the aligned Class 1E division is present at the sump level sensors identified in Table 2.9.5-1.

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the provisions of IWB-3112(b), that exceed the standards of Table IWB-3410-1 must be corrected by a repair/replacement activity to the extent necessary to meet the acceptance standards prior to placing the component in service.

A component whose preservice visual examination detects the relevant conditions described in the standards of Table IWB-3410-1, unless such components are shown by supplemental volumetric or surface examinations to meet the requirements for those supplemental examinations (IWB-3110), must be corrected by a repair/replacement activity or by corrective measures to the extent necessary to meet the acceptance standards of Table IWB-3410-1.

The preservice testing (PST) program for Class 1 pumps and valves consists of testing of the Class 1 pumps and valves selected for the IST program, in accordance with the OM Code, as described in Section 3.9.6.

5.2.5 RCPB Leakage Detection

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The RCPB leakage detection systems are designed to detect and, to the extent practical, identify the source of reactor coolant leakage. Diverse measurement methods include monitoring of sump level ~~and flow~~, containment airborne radioactivity, and containment air cooler condensate flow.

The RCPB leakage detection systems are designed and classified in accordance with RG 1.29 (GDC 2). Section 3.2 identifies the seismic and system quality group classifications for the leakage detection systems.

The RCPB leakage detection systems conform to the guidance of RG 1.45, Revision 1 regarding detection, monitoring, quantifying, and identification of reactor coolant leakage (GDC 30).

The RCPB leakage detection systems are sufficiently reliable, redundant, and sensitive to support the application of LBB analyses to eliminate the need to consider the dynamic effects of main reactor coolant loop and PZR surge line ruptures from the design basis. LBB analyses are addressed in Section 3.6.3.

Reactor coolant leakage is categorized as either identified leakage or unidentified leakage. Identified leakage includes:

- Leakage into closed systems (e.g., pump seal or valve packing leaks). The leakage is captured, quantified, and directed to a sump or collection tank.
- Leakage into the containment atmosphere from sources that are both specifically located and known either not to interfere with the operation of unidentified leakage monitoring systems or not to be from a flaw in the RCPB.

- Intersystem leakage into connected systems, including leakage through steam generator tubes.

All other leakage is categorized as unidentified leakage.

The design leakage rates are:

- No pressure boundary leakage. (Seal and gasket leakage is not "pressure boundary leakage" in this context.)
- 1 gpm unidentified leakage.
- 10 gpm identified leakage.
- 150 gallons per day primary to secondary leakage through any one steam generator.

5.2.5.1 Detecting, Monitoring and Collecting Unidentified Leakage

These methods are used to detect and monitor unidentified leakage inside containment for the U.S. EPR:

- Containment sump level ~~and discharge flow~~ monitoring.
- Containment atmosphere radiation monitoring.
- Containment air cooler condensate monitoring.

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These additional methods also indicate leakage inside containment:

- RCS inventory balance.
- Localized humidity and temperature monitoring.

5.2.5.1.1 Containment Sump Level ~~and Discharge Flow~~ Monitoring

The nuclear island drain and vent system (NIDVS) leakage detection function consists of water level measurements provided within the system sumps and collection tanks. The NIDVS instrumentation is credited for main reactor coolant loop and PZR surge line LBB monitoring and can reliably detect a leakage rate of 0.5 gpm in one hour.

Increased frequency of sump pump actuation may be an indication of RCS leakage. An alarm is provided to the operator in the MCR when a pump is running. An alarm is also generated if the pump continues to run for an extended period without reaching the low level, indicating that there is a large continuous flow towards the reactor building sump.

The NIDVS is designed and equipped with provisions to permit testing for operability and calibration.

The reactor building floor drains collect leakage from contaminated spaces in the Reactor Building and from process drains that cannot be recycled. The RCPB leakage drains to the floor drains system and ultimately to the sump where it is identified and quantified by the sump instrumentation. The reactor building floor drains have five small intermediate collection sumps where separate branches of the drain system intersect. The total volume of all five of these intermediate sumps is less than 0.5 gallons, so that they have no significant effect on the flow from an unidentified leakage source, or the prompt identification of it by the sump instrumentation.

5.2.5.1.2 Containment Atmosphere Radiation Monitoring

Gaseous and airborne particulate radiation monitors continuously monitor radioactivity levels in the containment atmosphere. Radiation levels are indicated in the MCR and alarms alert the operator to elevated levels of radioactivity.

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The airborne particulate radiation monitors can detect a 1.0 gpm leakage rate within one hour at full power operation, as described in Section 11.5.4.8. The sensitivity of the containment atmosphere particulate radiation monitors is sufficient for detection of the limiting leakage based on the realistic source terms analysis presented in the environmental report as addressed in Section 11.1. Section 11.5 addresses radiation monitors in more detail.

The airborne particulate radioactivity monitors are designed to withstand the effects of the safe shutdown earthquake and remain functional.

5.2.5.1.3 Containment Air Cooler Condensate Monitoring

Condensate ~~level and~~ flow sensors are installed in the ~~collection tank and~~ drain line of each containment air cooler unit. The system is credited for main reactor coolant loop and PZR surge line LBB monitoring and can reliably detect a leakage rate of 0.5 gpm in one hour. The condensation rate can be determined by ~~rate of level change or by~~ direct flow indication and is indicated in the MCR. An alarm is generated when the threshold is reached.

5.2.5.1.4 RCS Inventory Balance

The RCS inventory balance is a quantitative inventory or mass balance calculation to measure RCS leakage. This approach allows both the type and magnitude of leakage to be determined.

To perform an inventory balance accurately, the plant must be in a steady-state condition. This condition is defined as stable RCS pressure, temperature, and power level. The PZR, PRT, reactor coolant drain tank (RCDT), and in-containment refueling water storage tank (IRWST) levels must be known and trended for the calculation. The mass balance calculation may also require temporary isolation of

leakage rate (gpm) from each detection system and a common leakage equivalent (gpm) from both identified and unidentified sources. Alarms indicate that leakage has exceeded predetermined limits. The instrumentation system is described in Section 7.1. A COL applicant that references the U.S. EPR design certification will develop procedures in accordance with RG 1.45, Revision 1.

5.2.5.5.1 RCDT Indications

The RCDT collects continuous flow during operation from PZR degassing and the RCP seals' leakoff. This flow is quantified from tank level and pump run time indications and a baseline normal in-leakage rate is established. Changes in this rate indicate leakage from additional components whose discharge is routed to the RCDT. Such leakage can be identified through indications from these components and, once quantified, can be monitored as identified leakage.

The additional monitored leakage connections that discharge to the RCDT include the PSRV valve body drains, the reactor vessel O-ring seal leakoff, RCP static seal (main flange) leakoff, valve stem packing leakage, and safety valve discharge lines from the combined RCP #1 seal return line, the four RCP thermal barrier return lines, the CVCS letdown line, and the CVCS charging line. Additional equipment and component drain connections to the RCDT are used only during shutdown or during startup operations and are isolated from the RCDT by a closed manual valve, or are disconnected and flanged, during power operation and are not expected to affect RCPB leakage monitoring efforts.

5.2.5.5.2 Reactor Building Sump Level

During normal operation the Reactor Building sump collects water from the reactor building floor drains and the Reactor Building annular space floor drain sump. Sump level and automatic pump operation for both sumps are indicated in the MCR to allow prompt identification of any unidentified leakage in the Reactor Building.

5.2.5.5.3 Containment Atmosphere Particulate Radiation Monitoring

Containment atmosphere particulate radioactivity monitoring is one of the systems used in the US EPR design for RCS leakage detection. The particulate monitor is a low range monitor capable of detecting 3E-10 to 1E-6μCi/cc. The monitor sensitivity requirement is to be able to detect a leakage increase of one gpm within one hour (see U.S. EPR FSAR, Tier 2, Chapter 16, TS 16.3.4.12 and corresponding Bases, RG 1.45 and RIS-2009-02), based on a realistic RCS source term, as described in Section 11.5.4.8. The particulate radiation monitoring system continuously monitors airborne radioactivity in the containment equipment area. Radiation levels are indicated in theMCR. Alarms alert the operators of elevated levels of radioactivity to allow for prompt identification of RCS leakage into the equipment area. The monitor is located in the service area of the containment, which is accessible during normal operation. It

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- Condensate mass flow measurement devices inside containment.
- Humidity and temperature sensors inside containment.
- Local humidity detection system for the main steam piping.

The leak-before-break approach for the U.S. EPR is described in Section 3.6.3. The RCPB leakage detection approach is described in Section 5.2.5.

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The local humidity detection system measures local increases in relative humidity along appropriate portions of the ~~MS lines~~MSL inside of the containment to detect and localize leakages from the lines~~ with a high degree of accuracy~~. The local humidity detection system is capable of detecting MSL leakage as low as 0.1 gallons per minute

The condensate mass flow measurement devices inside containment measure condensate flow from the Reactor Building fan cooler collectors. Changes in the Containment Building relative humidity levels result in changes in the condensate flow rate. The condensate mass flow measurement devices inside containment are capable of measuring fan cooler condensate collector flow rates as low as 0.5 gallons per minute. Alarms and indications associated with the LDS are available to the operators in the MCR.

7.1.1.5.13 Turbine Generator I&C

The turbine generator (TG) I&C system regulates the operation of the turbine generator for power generation. It provides speed and load control, as well as control of TG auxiliaries. Refer to Section 10.2 for further information on the TG I&C.

7.1.1.6 I&C Architecture Design Principles

7.1.1.6.1 Defense-in-Depth

The U.S. EPR implements the following lines of defense to establish the defense-in-depth principle:

- Preventive line of defense.
- Main line of defense.
- Risk reduction line of defense.

These lines of defense are described in the Diversity and Defense-in-Depth Assessment Technical Report (ANP-10304) (Reference 8).

To implement the defense-in-depth principle, four primary functional categories are defined for proper operation of the plant. These categories are mapped to the various sections of this document.

5.0 ACCEPTANCE CRITERIA

5.1 Verify performance and alarms of the RCS and RCPs as designed (refer to ~~Sections~~ Sections 3.6.3.7, 5.1, 5.2.5, and 5.4.1):

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5.1.1 Verify valve performance per design requirements.

5.1.2 Verify alarm and interlocks function as designed.

5.1.3 Verify that controls function as designed.

5.1.4 Verify that RCP operation and vibration levels are within design limits.

5.1.5 Verify that the RCP ratchet pawls on idle RCPs prevent reverse rotation when RCPs are started.

5.1.6 Verify that RCP startup and operating currents are within design limits.

5.1.7 Verify that humidity instrumentation is functional.

5.1.8 Verify that RCS venting is accomplished.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2 Front Line Safety Systems

14.2.12.2.1 Combustible Gas Control System (Test #013)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the combustible gas control system (CGCS) in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the CGCS is properly installed and is functional prior to fuel loading.

1.3 To demonstrate the ability of the containment combustion gas controls to ensure that combustible hydrogen concentrations do not exist in the post-accident containment environment:

1.3.1 Convection foils are installed per design drawings (refer to Section 6.2.5).

1.3.2 Rupture foils are installed per design drawings (refer to Section 6.2.5).

1.3.3 Mixing dampers are installed per design drawings (refer to Section 6.2.5).

1.4 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

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5.5 The LDS functions as designed (refer to ~~Sections~~Sections 3.6.3.7, 5.2.5 and 7.1.1.5.12).

5.6 Verify that the LDS meets the regulatory requirements for leakage detection, refer to Regulatory Guide 1.45, Rev. 1.

14.2.12.11.15 Safety Automation System (Test #139)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the safety-related Safety Automation System (SAS) to perform automatic and selected manual control functions on safety-related processes during normal operations, abnormal operational occurrences, postulated accidents, and post accidents.

2.0 PREREQUISITES

2.1 Construction activities on the SAS have been completed.

2.2 SAS instrumentation has been calibrated and is functional for performance of this test.

2.3 Support system(s) required for operation of the SAS is complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate the operation of the SAS meets design requirements.

3.2 Verify that SAS operates over the design range using actual or simulated signals.

3.3 Verify that SAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the SAS design.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 SAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Monitoring and control of safety related automatic and manual functions after initiation through the Protection System.

5.2 Monitoring and control of essential auxiliary support systems.

5.3 Processing Type A-C PAM variables for display on the SICS.

2.4 The VCT level is high in the operating band but letdown diversion is not expected during the test.

2.5 The RCDT level is low in the operating band and a pump down is not expected to be necessary during the test.

3.0 TEST METHOD

3.1 Measure and record the changes in water inventory of the RCS and CVCS for a specified interval of time as follows:

3.1.1 Maintain SG levels constant.

3.1.2 Maintain VCT temperature constant.

3.1.3 Maintain RCS temperature constant, if this is not possible make sure that initial and final readings are as close as possible.

3.1.4 Maintain RCS pressure constant, if this is not possible make sure that initial and final readings are as close as possible. May be easier to energize available pressurizer heaters and let the pressurizer spray valves stabilize prior to starting the test.

3.1.5 Maintain pressurizer level constant, if this is not possible make sure that initial and final readings are as close as possible (control letdown flow as necessary).

3.1.6 Measure the final VCT level and determine the equivalent volume change (gallons).

3.1.7 Measure the final RCDT level and determine the equivalent volume change (gallons).

4.0 DATA REQUIRED

4.1 Pressurizer pressure, level, and temperature.

4.2 VCT level, temperature, and pressure.

4.3 Reactor drain tank level, temperature, and pressure.

4.4 RCS temperature and pressure.

4.5 Safety injection accumulator level and pressure.

4.6 Time interval.

5.0 ACCEPTANCE CRITERIA

5.1 Identified and unidentified leakage shall be within the limits described in the Technical Specification as described in Section 16.3.4.12.

05.02.05-12 → 5.2 The LDS functions as designed (refer to Section 5.2.5).

4.2 VCT level, temperature, and pressure.

4.3 RCDT level, temperature, and pressure.

4.4 RCS temperature and pressure.

4.5 SI Accumulator level and pressure.

4.6 Time interval.

5.0 ACCEPTANCE CRITERIA

5.1 Identified and unidentified leakage shall be within the limits described in Section 5.2.5 and ~~in~~ Technical Specification 3.4.12.

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5.2 The values determined by the radiation monitoring instrumentation described in Technical Specification 3.4.14 are within reasonable agreement with the instrumentation used to calculate Technical Specification 3.4.12 leakage.

14.2.12.14.10 Post-Core Incore Instrumentation (Test #188)

1.0 OBJECTIVE

1.1 To measure the leakage resistance of the fixed incore detectors.

1.2 To demonstrate that the incore thermocouples are functional (refer to Section 7.1.1.5.2 for a description of fixed thermocouples).

2.0 PREREQUISITES

2.1 Permanently installed instrumentation is calibrated and is operating satisfactorily prior to performing the following test.

2.1.1 The calibration will demonstrate that currents generated by the thermocouples will be accurately translated into temperature indications.

2.2 Special test equipment for measurement of thermocouple resistance is available and calibrated.

2.3 The reactor is at 350°F conditions.

3.0 TEST METHOD

3.1 Measure and record the leakage resistance of each incore detector. This step can be performed at a lower RCS temperature than 350°F but the test can not be completed until the various temperature indications are compared at 350°F.

3.2 Verify that the core exit thermocouples indicate a temperature that corresponds to 350°F.

3.3 Increase RCS temperature by 50°F and collect corresponding thermocouple and RTD data.

3.4 Repeat data collection until RCS temperature is ≥568°F.

4.0 DATA REQUIRED

4.1 RCS temperature and pressure.

4.2 Leakage resistance measurements.

4.3 Plant monitoring system readout.

5.0 ACCEPTANCE CRITERIA

5.1 Leakage resistance of the fixed incore detectors is as described in manufacturer's recommendations.

5.2 The calibration of the thermocouples meets the requirements of 10 CFR 50.34(f)(2)(viii).

14.2.12.14.11 Leak Detection Systems (Test #189)

1.0 OBJECTIVE

1.1 To obtain baseline data on the LDS.

1.2 To adjust leak detection alarm setpoints as necessary to reflect actual plant operational conditions.

2.0 PREREQUISITES

2.1 Preoperational test (Test #137) on the LDS has been completed.

2.2 The leak detection instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Collect baseline data using the LDS during plant heatup and at normal operation.

4.0 DATA REQUIRED

4.1 Leak detection baseline data.

4.2 RCS temperature and pressure.

5.0 ACCEPTANCE CRITERIA

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5.1 Performance of the LDS is as designed (refer to ~~Section~~Sections 3.6.3.7 and 5.2.5).

5.2 The leak detection alarm setpoints have been adjusted using the baseline data.

B 3.7 PLANT SYSTEMS

B 3.7.18 Main Steam Line Leakage

BASES

BACKGROUND

A limit on leakage from the main steam line inside containment is required to limit system operation in the presence of excessive leakage. Leakage is limited to an amount which would not compromise safety consistent with the Leak-Before-Break (LBB) analysis discussed in Reference 1. This leakage limit ensures appropriate action can be taken before the integrity of the lines is impaired.

LBB is an argument which allows elimination of design for dynamic load effects of postulated pipe breaks. The fundamental premise of LBB is that the materials used in nuclear plant piping are strong enough that even a large throughwall crack leaking well in excess of rates detectable by present leak detection systems would remain stable, and would not result in a double-ended guillotine break under maximum loading conditions. The benefit of LBB is the elimination of pipe whip restraints, jet impingement effects, subcompartment pressurization, and internal system blowdown loads.

As described in Reference 1, LBB has been applied to the main steam line pipe runs inside containment. Hence, the potential safety significance of secondary side leaks inside containment requires detection and monitoring of leakage inside containment. This LCO protects the main steam lines inside containment against degradation, and helps assure that serious leaks will not develop. The consequences of violating this LCO include the possibility of further degradation of the main steam lines, which may lead to pipe break.

APPLICABLE SAFETY ANALYSES

The safety significance of plant leakage inside containment varies depending on its source, rate, and duration. Therefore, both detection and monitoring of plant leakage inside containment are necessary. This is accomplished via the instrumentation required by LCO 3.4.14, “RCS Leakage Detection Instrumentation,” and the RCS water inventory balance (SR 3.4.12.1). Subtracting RCS leakage as well as any other identified non-RCS leakage into the containment area from the total plant leakage inside containment provides qualitative information to the operators regarding possible main steam line leakage. This allows the operators to take corrective action should leakage occur which is detrimental to the safety of the facility and/or the public. A local humidity detection system (Reference 2) also provides an indication of main steam line leakage. The main steam line leakage limit is not required by the 10 CFR 50.36(c)(2)(ii) criteria.

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BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.18.1

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Verifying that main steam line leakage is within the LCO limit assures that the integrity of those lines inside containment is maintained. An early warning of main steam line leakage is provided by the automatic system which monitors the containment sump level. Main steam line leakage would appear as unidentified leakage inside containment via this system. A local humidity detection system (Reference 2) also provides an indication of main steam line leakage.~~, and can only be positively identified by inspection~~. However, by performance of an RCS water inventory balance (SR 3.4.12.1) and evaluation of the cooling and chilled water systems inside containment, determination of whether the main steam line is a potential source of unidentified leakage inside containment is possible.

REFERENCES

1. FSAR Section 3.6.3.
2. FSAR Section 7.1.1. 05.02.05-12