ArevaEPRDCPEm Resource

From: RYAN Tom (AREVA) [Tom.Ryan@areva.com]
Sent: Friday, August 26, 2011 11:06 AM
To: Tesfaye, Getachew
Cc: LENTZ Tony (EXTERNAL AREVA); WILLIFORD Dennis (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); DELANO Karen (AREVA); RYAN Tom (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5, Supplement 4
Attachments: RAI 478 Supplement 4 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the one question in RAI No. 478 on April 5, 2010. A revised schedule was provided in Supplement 1 on May 25, 2011, Supplement 2 on June 24, 2011, and Supplement 3 on July 25, 2011.

The attached file, "RAI 478 Supplement 4 Response US EPR DC.pdf" provides technically correct and complete final FSAR responses to the remaining question, as committed.

The following table indicates the respective pages in the response document, "RAI 478 Supplement 4 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 478 — 05.02.05-13	2	2

This concludes the formal AREVA NP response to RAI 478, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Tom Ryan for

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WELLS Russell (RS/NB)
Sent: Monday, July 25, 2011 5:49 PM
To: Tesfaye, Getachew
Cc: LENTZ Tony (External RS/NB); WILLIFORD Dennis (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5, Supplement 3

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the one question in RAI No. 478 on April 5, 2010. A revised schedule was provided in Supplement 1 on May 25, 2011, and Supplement 2 on June 23, 2011.

The schedule for technically correct and complete responses to the questions has been revised and is provided below:

Question #	Response Date
RAI 478 — 05.02.05-13	August 26, 2011

Russ Wells for

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Thursday, June 23, 2011 5:18 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); LENTZ Tony (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5, Supplement 2

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to the one question in RAI No. 478 on April 5, 2010. A revised schedule was provided in Supplement 1 on May 25, 2011.

The schedule for a technically correct and complete response to this question has been revised as provided below:

Question #	Response Date
RAI 478 — 05.02.05-13	July 25, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B

Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, May 25, 2011 5:50 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); LENTZ Tony (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5, Supplement 1

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to the one question in RAI No. 478 on April 5, 2010.

The schedule has been revised and is provided below.

Question #	Response Date
RAI 478 — 05.02.05-13	June 24, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WELLS Russell (RS/NB)
Sent: Tuesday, April 05, 2011 5:51 PM
To: 'Tesfaye, Getachew'
Cc: LENTZ Tony (External RS/NB); BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 478 Response US EPR DC.pdf" provides a schedule since technically correct and complete responses to the one question is not provided.

The following table indicates the respective pages in the response document, "RAI 478 Response US EPR DC.pdf" that contain AREVA NP's responses to the subject question.

Question #	Start Page	End Page
RAI 478 — 05.02.05-13	2	2

A complete answer is not provided for the one question. The schedule for technically correct and complete responses to this question is provided below.

Question #	Response Date
RAI 478 — 05.02.05-13	May 25, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Monday, March 07, 2011 8:34 PM
To: ZZ-DL-A-USEPR-DL
Cc: Li, Chang; Segala, John; Lee, Samuel; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on March 4, 2011, and on the same day on March 4, 2011, 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: 3360

Mail Envelope Properties (8D609EE2F807714CBF5297D9BA8602FB014EBA40)

Subject: Response to U.S. EPR Design Certification Application RAI No. 478 (5434), FSAR Ch. 5, Supplement 4
Sent Date: 8/26/2011 11:05:52 AM
Received Date: 8/26/2011 11:05:56 AM
From: RYAN Tom (AREVA)

Created By: Tom.Ryan@areva.com

Recipients:
"LENTZ Tony (EXTERNAL AREVA)" <Tony.Lentz.ext@areva.com>
Tracking Status: None
"WILLIFORD Dennis (AREVA)" <Dennis.Williford@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	6861	8/26/2011 11:05:56 AM
RAI 478 Supplement 4 Response US EPR DC.pdf		163504

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

Response to

Request for Additional Information No. 478(5434), Revision 0, Supplement 4

3/07/2011

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 (ESBWR/ABWR) (SBPB)

Question 05.02.05-13:

OPEN ITEM

This RAI is related to RAI No. 431 Question 05.02.05-12. In the response to RAI No. 431, the applicant clarified that the leakage detection requirement for leak-before-break (LBB) of the main coolant loop piping (MCL) and pressurizer surge line (SL) is 0.5 gpm, and the leakage detection requirement for the main steam line (MSL) is 0.1 gpm. The initial testing and ITAAC acceptance criteria were revised accordingly. However, current Technical Specifications (TS) 3.4.12.b specifies a criterion of 1 gpm for unidentified RCS leakage. In addition, TS 3.7.18 specifies a criterion of 1 gpm for the main steam line leakage. Similar to the revision of ITAAC and initial testing acceptance criteria, revise the TS criteria in the FSAR for the above two TS limits to be consistent with the functional requirement of supporting LBB or justify the 1 gpm criterion to be adequate to support LBB.

Response to Question 05.02.05-13:

The leakage detection requirement for LBB of the main coolant loop (MCL) piping and pressurizer SL will be clarified in TS Bases 3.4.14, "RCS Leakage Detection Instrumentation." Technical Specification 3.7.20, "Main Steam Line Leakage Detection Instrumentation" and corresponding Bases will be added to the U.S. EPR FSAR Tier 2, Chapter 16 for the leakage detection requirement for LBB of MSL piping. Conforming changes will be made to U.S. EPR FSAR Tier 2, Section 7.1.1.5.12 and Chapter 16, Section 3.4.14.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 7.1.1.5.12 and Chapter 16, Sections 3.4.14, 3.7.18 and corresponding Bases will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Chapter 16, Section 3.7.20 and corresponding Bases will be added as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

05.02.05-13

The LDS includes these components:

- 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.

The local humidity detection system measures local increases in relative humidity along appropriate portions of the main steam lines (MSL) inside of the containment to detect and localize leakages from the lines. 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 Containment Building fan cooler collectors. Changes in the Reactor 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.

Humidity/temperature sensors are located inside containment inaccessible areas (equipment compartments). These areas surround the reactor coolant piping and sections of larger RCS components. The sample area is a low air flow and limited volume area, this design feature enhances the ability of the local humidity and temperature sensors to identify and quantify any leakage.

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. The TG I&C also performs a turbine trip when requested by either the PS or DAS. See Figure 7.1-27 for details. Refer to Section 10.2 for further information on the TG I&C.

7.1.1.5.14 Rod Position Measurement System (RPMS)

Classification

The RPMS is classified as safety-related.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.14 RCS Leakage Detection Instrumentation

LCO 3.4.14 The following RCS leakage detection instrumentation shall be OPERABLE:

05.02.05-13

a. One containment sump ~~(level or discharge flow)~~ level monitor;

b. One containment atmosphere radioactivity (particulate) monitor; and

c. One containment air cooler condensate flow rate monitor.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required containment sump level monitor inoperable.	A.1 --------------NOTE-------------- Not required until 12 hours after establishment of steady state operation. ------------------------------------	
	Perform SR 3.4.12.1.	Once per 24 hours
	AND	
	A.2 Restore required containment sump level monitor to OPERABLE status.	30 days

05.02.05-13

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required containment atmosphere radioactivity monitor inoperable.	B.1.1 Analyze grab samples of the containment atmosphere.	Once per 24 hours
	<u>OR</u>	
	B.1.2 --------------NOTE-------------- Not required until 12 hours after establishment of steady state operation. -------------------------------------	
	Perform SR 3.4.12.1.	Once per 24 hours
	<u>AND</u>	
	B.2.1 Restore required containment atmosphere radioactivity monitor to OPERABLE status.	30 days
	<u>OR</u>	
	B.2.2 Verify containment air cooler condensate flow rate monitor is OPERABLE.	30 days
C. Required containment air cooler condensate flow rate monitor inoperable.	C.1 Analyze grab samples of the containment atmosphere.	Once per 24 hours
	<u>OR</u>	
	C.2 --------------NOTE-------------- Not required until 12 hours after establishment of steady state operation. -------------------------------------	
	Perform SR 3.4.12.1.	Once per 24 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
D. Required containment atmosphere radioactivity monitor inoperable. AND Required containment air cooler condensate flow rate monitor inoperable.	D.1	Restore required containment atmosphere radioactivity monitor to OPERABLE status.	30 days
	OR		
	D.2	Restore required containment air cooler condensate flow rate monitor to OPERABLE status.	30 days
E. Required Action and associated Completion Time not met.	E.1	Be in MODE 3.	6 hours
	AND		
	E.2	Be in MODE 5.	36 hours
F. All required monitors inoperable.	F.1	Enter LCO 3.0.3.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.14.1	Perform a CHANNEL CHECK of the required containment atmosphere radioactivity monitor.	12 hours
SR 3.4.14.2	Perform a CALIBRATION of the required containment sump level monitor.	24 months

05.02.05-13

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.4.14.3	Perform a CALIBRATION of the required containment atmosphere radioactivity monitor.	24 months
SR 3.4.14.4	Perform a CALIBRATION of the required containment air cooler condensate flow rate monitor.	24 months
SR 3.4.14.5	Perform SENSOR OPERATIONAL TEST of the required containment atmosphere radioactivity monitor.	24 months

3.7 PLANT SYSTEMS

3.7.18 Main Steam Line Leakage

LCO 3.7.18 Main Steam Line leakage through the pipe walls inside containment shall be limited to 1.0 gpm.

05.02.05-13

APPLICABILITY: MODES 1, 2, and 3, ~~and 4.~~
MODE 4 when steam generator is relied upon for heat removal.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Main Steam Line leakage exceeds limit.	A.1 Be in MODE 3. AND A.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.7.18.1 Verify main steam line leakage ~~into the containment sump~~ ≤ 1.0 gpm.	72 hours

3.7 PLANT SYSTEMS

3.7.20 Main Steam Line Leakage Detection Instrumentation

LCO 3.7.20 The following main steam leakage detection instrumentation shall be OPERABLE:

a. The main steam local humidity detection system; and

b. One containment sump level monitor.

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 when steam generator is relied upon for heat removal.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Main steam local humidity detection system inoperable.	A.1 Restore main steam local humidity detection system to OPERABLE status.	30 days
B. Containment sump level monitor inoperable.	B.1 Restore containment sump level monitor to OPERABLE status.	30 days
C. Required Action and associated Completion Time of Condition A or B not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 5.	6 hours 36 hours

05.02.05-13

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.20.1	Perform a CHANNEL CHECK of the main steam local humidity detection system.	12 hours
SR 3.7.20.2	Perform a CALIBRATION of the main steam local humidity detection system.	24 months
SR 3.7.20.3	Perform a CALIBRATION of the containment sump level monitor.	24 months

05.02.05-13

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.12 RCS Operational LEAKAGE

BASES

BACKGROUND

Components that contain or transport the coolant to or from the reactor core make up the RCS. Component joints are made by welding, bolting, rolling, or pressure loading, and valves that isolate connecting systems from the RCS.

During plant life, the joint and valve interfaces can produce varying amounts of reactor coolant LEAKAGE, through either normal operational wear or mechanical deterioration. The purpose of the RCS Operational LEAKAGE LCO is to limit system operation in the presence of LEAKAGE from these sources to amounts that do not compromise safety. This LCO specifies the types and amounts of LEAKAGE.

10 CFR 50, Appendix A, GDC 30 (Ref. 1), requires means for detecting and, to the extent practical, identifying the source of reactor coolant LEAKAGE. Regulatory Guide 1.45 (Ref. 2) describes acceptable methods for selecting leakage detection systems.

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring reactor coolant LEAKAGE into the containment area is necessary. Quickly separating the identified LEAKAGE from the unidentified LEAKAGE is necessary to provide quantitative information to the operators, allowing them to take corrective action should a leak occur that is detrimental to the safety of the facility and the public.

A limited amount of leakage inside containment is expected from auxiliary systems that cannot be made 100% leak tight. Leakage from these systems should be detected, located, and isolated from the containment atmosphere, if possible, to not interfere with RCS leakage detection.

This LCO deals with protection of the reactor coolant pressure boundary (RCPB) from degradation and the core from inadequate cooling, in addition to preventing the accident analyses radiation release assumptions from being exceeded. The consequences of violating this LCO include the possibility of a loss of coolant accident (LOCA).

BASES

APPLICABLE SAFETY ANALYSES

Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses (Ref. 3) for LOCA; the amount of leakage can affect the probability of such an event. The safety analysis for an event resulting in steam discharge to the atmosphere assumes that primary to secondary LEAKAGE is 0.125 gallon per minute (gpm) per steam generator (SG) or increases to 0.125 gpm per SG as a result of accident induced conditions. The LCO requirement to limit primary to secondary LEAKAGE through any one SG to less than or equal to 150 gallons per day is lower than the primary to secondary leakage value used in the safety analysis.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from variety of accidents (such as a main steam line break, steam generator tube rupture, rod ejection accident, RCS pump locked rotor, etc.). The basic radiological acceptance criteria associated with the alternative source term (AST) methodology are found in 10 CFR 50.34(a)(1) for the offsite receptors, with a limit of 25 rem total effective dose equivalent (TEDE). 10 CFR Part 50, Appendix A, GDC 19 as incorporated by reference in 10 CFR 52.47(a)(1), includes the criteria for control room personnel (5 rem TEDE). These criteria, however, are used for evaluating potential reactor accidents of exceedingly low occurrence probability and low risk of public exposure to radiation. For events with higher probability of occurrence, the acceptance criteria for the offsite receptors are more stringent, while the criteria for the control room operators remains the same.

The RCS Operational LEAKAGE satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

RCS operational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

   No pressure boundary LEAKAGE is allowed, being indicative of material deterioration. LEAKAGE of this type is unacceptable as the leak itself could cause further deterioration, resulting in higher LEAKAGE. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE.

BASES

LCO (continued)

b. Unidentified LEAKAGE

One gallon per minute (gpm) of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air monitoring and containment sump level monitoring equipment can detect within a reasonable time period. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary. A leak-before-break analysis (Ref. 6) of the main coolant loop and pressurizer surge line determined that a leakage rate of five gpm corresponded to the critical flaw size. For operational considerations, the allowable leakage for leak-before-break is limited to one gpm.

05.02.05-13

c. Identified LEAKAGE

Up to 10 gpm of identified LEAKAGE is considered allowable because LEAKAGE is from known sources that do not interfere with detection of unidentified LEAKAGE and is well within the capability of the RCS Makeup System. Identified LEAKAGE includes LEAKAGE to the containment from specifically known and located sources, but does not include pressure boundary LEAKAGE or controlled reactor coolant pump (RCP) seal leakoff (a normal function not considered LEAKAGE). Violation of this LCO could result in continued degradation of a component or system.

d. Primary to Secondary LEAKAGE Through Any One SG

The limit of 150 gallons per day per SG is based on the operational LEAKAGE performance criterion in NEI 97-06, Steam Generator Program Guidelines (Ref. 4). The Steam Generator Program operational LEAKAGE performance criterion in NEI 97-06 states, "The RCS operational primary to secondary leakage through any one SG shall be limited to 150 gallons per day." The limit is based on operating experience with SG tube degradation mechanisms that result in tube leakage. The operational leakage rate criterion in conjunction with the implementation of the Steam Generator Program is an effective measure for minimizing the frequency of steam generator tube ruptures.

BASES

APPLICABILITY

In MODES 1, 2, 3, and 4, the potential for RCPB LEAKAGE is greatest when the RCS is pressurized.

In MODES 5 and 6, LEAKAGE limits are not required because the reactor coolant pressure is far lower, resulting in lower stresses and reduced potentials for LEAKAGE.

LCO 3.4.13, "RCS Pressure Isolation Valve (PIV) Leakage," measures leakage through each individual PIV and can impact this LCO. Of the two PIVs in series in each isolated line, leakage measured through one PIV does not result in RCS LEAKAGE when the other is leak tight. If both valves leak and result in a loss of mass from the RCS, the loss must be included in the allowable identified LEAKAGE.

ACTIONS

A.1

Unidentified LEAKAGE or identified LEAKAGE in excess of the LCO limits must be reduced to within limits within 4 hours. This Completion Time allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

B.1 and B.2

If any pressure boundary LEAKAGE exists, or primary to secondary LEAKAGE is not within limit, or if unidentified or identified LEAKAGE cannot be reduced to within limits within 4 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. This action reduces the LEAKAGE and also reduces the factors that tend to degrade the pressure boundary.

The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. In MODE 5, the pressure stresses acting on the RCPB are much lower, and further deterioration is much less likely.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.4.12.1

Verifying RCS LEAKAGE to be within the LCO limits ensures the integrity of the RCPB is maintained. Pressure boundary LEAKAGE would at first appear as unidentified LEAKAGE and can only be positively identified by inspection. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. Unidentified LEAKAGE and identified LEAKAGE are determined by performance of an RCS water inventory balance.

The RCS water inventory balance must be met with the reactor at steady state operating conditions (stable temperature, power level, Pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The Surveillance is modified by two Notes. Note 1 states that this SR is not required to be performed until 12 hours after establishing steady state operation. The 12 hour allowance provides sufficient time to collect and process all necessary data after stable plant conditions are established.

Steady state operation is required to perform a proper inventory balance since calculations during maneuvering are not useful. For RCS operational LEAKAGE determination by water inventory balance, steady state is defined as stable RCS pressure, temperature, power level, Pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.

05.02.05-13

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems that monitor the containment atmosphere radioactivity, containment air cooler condensate flow rate, and the containment sump level. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. These leakage detection systems are specified in LCO 3.4.14, "RCS Leakage Detection Instrumentation."

Note 2 states that this SR is not applicable to primary to secondary LEAKAGE because LEAKAGE of 150 gallons per day cannot be measured accurately by an RCS water inventory balance.

The 72 hour Frequency is a reasonable interval to trend LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.12.2

This SR verifies that primary to secondary LEAKAGE is less or equal to 150 gallons per day through any one SG. Satisfying the primary to secondary LEAKAGE limit ensures that the operational LEAKAGE performance criterion in the Steam Generator Program is met. If this SR is not met, compliance with LCO 3.4.16, "Steam Generator Tube Integrity," should be evaluated. The 150 gallons per day limit is measured at room temperature as described in Reference 5. The operational LEAKAGE rate limit applies to LEAKAGE through any one SG. If it is not practical to assign the LEAKAGE to an individual SG, the entire primary to secondary LEAKAGE should be conservatively assumed to be from one SG, in which case the LEAKAGE rate limit of 150 gallons per day would still apply.

The Surveillance is modified by a Note which states that the Surveillance is not required to be performed until 12 hours after establishment of steady state operation. For RCS primary to secondary LEAKAGE determination, steady state is defined as stable RCS pressure, temperature, power level, Pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.

The Surveillance Frequency of 72 hours is a reasonable interval to trend primary to secondary LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents. The primary to secondary LEAKAGE is determined using continuous process radiation monitors or radiochemical grab sampling in accordance with the EPRI guidelines (Ref. 5).

REFERENCES

1. 10 CFR 50, Appendix A, GDC 30.
2. Regulatory Guide 1.45, Rev. 1, May 2008.
3. FSAR Chapter 15.
4. NEI 97-06, Steam Generator Program Guidelines.
5. EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines."
6. FSAR Section 3.6.

05.02.05-13

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.14 RCS Leakage Detection Instrumentation

BASES

BACKGROUND

GDC 30 of Appendix A to 10 CFR 50 (Ref. 1) requires means for detecting and, to the extent practical, identifying the location of the source of RCS LEAKAGE. Regulatory Guide 1.45 (Ref. 2) describes acceptable methods for selecting leakage detection systems.

Leakage detection systems must have the capability to detect significant reactor coolant pressure boundary (RCPB) degradation as soon after occurrence as practical to minimize the potential for propagation to a gross failure. Thus, an early indication or warning signal is necessary to permit proper evaluation of all unidentified LEAKAGE.

05.02.05-13

The U.S. EPR design applies the leak-before-break (LBB) methodology to eliminate the dynamic effects of pipe rupture in the main coolant loop and pressurizer surge line (Ref. 4). The analysis demonstrates that the probability of pipe rupture is extremely low under conditions consistent with the design basis for the piping.

Industry practice has shown that water flow changes of 0.5 to 1.0 gpm can be readily detected in contained volumes by monitoring changes in water level, in flow rate, or in the operating frequency of a pump. The containment sump level ~~used to collect unidentified LEAKAGE~~ and containment air cooler condensate flow rate monitor, which are used to collect unidentified LEAKAGE, are instrumented to alarm for increases of 0.5 ~~to 1.0~~ gpm in the normal flow rates. This sensitivity is acceptable for detecting increases in unidentified LEAKAGE which includes leakage relating to leak-before-break. The containment sump instrumentation is also used to identify leakage from the main steam lines inside containment.

The reactor coolant contains radioactivity that, when released to the containment, can be detected by radiation monitoring instrumentation. Reactor coolant radioactivity levels will be low during initial reactor startup and for a few weeks thereafter, until activated corrosion products have been formed and fission products appear from fuel element cladding contamination or cladding defects. The instrument sensitivity of 10^{-9} μCi/cc radioactivity for particulate monitoring is practical for this leakage detection system.

BASES

BACKGROUND (continued)

An increase in humidity of the containment atmosphere would indicate release of water vapor to the containment. Dew point temperature measurements can thus be used to monitor humidity levels of the containment atmosphere as an indicator of potential RCS LEAKAGE. A 1°F increase in dew point is well within the sensitivity range of available instruments.

Since the humidity level is influenced by several factors, a quantitative evaluation of an indicated leakage rate by this means may be questionable and should be compared to observed increases in liquid flow into or from the containment sump and condensate flow from air coolers. Humidity level monitoring is considered most useful as an indirect alarm or indication to alert the operator to a potential problem. Humidity monitors are not required by this LCO.

Air temperature and pressure monitoring methods may also be used to infer unidentified LEAKAGE to the containment. Containment temperature and pressure fluctuate slightly during plant operation, but a rise above the normally indicated range of values may indicate RCS leakage into the containment. The relevance of temperature and pressure measurements are affected by containment free volume and, for temperature, detector location. Alarm signals from these instruments can be valuable in recognizing rapid and sizable leakage to the containment. Temperature and pressure monitors are not required by this LCO.

APPLICABLE SAFETY ANALYSES

The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify with indications from other systems is necessary. The system response times and sensitivities are described in Reference 3. Multiple instrument locations are utilized, if needed, to ensure that the transport delay time of the leakage from its source to an instrument location yields an acceptable overall response time.

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring RCS LEAKAGE into the containment area is necessary. Quickly separating the identified LEAKAGE from the unidentified LEAKAGE provides quantitative information to the operators, allowing them to take corrective action should a leakage occur detrimental to the safety of the unit and the public.

RCS leakage detection instrumentation satisfies Criterion 1 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

One method of protecting against large RCS leakage derives from the ability of instruments to rapidly detect extremely small leaks. This LCO requires instruments of diverse monitoring principles to be OPERABLE to provide a high degree of confidence that extremely small leaks are detected in time to allow actions to place the plant in a safe condition, when RCS LEAKAGE indicates possible RCPB degradation.

05.02.05-13

The LCO is satisfied when monitors of diverse measurement means are available. Thus, the containment sump level monitor, in combination with a particulate radioactivity monitor, and a containment air cooler condensate flow rate monitor provides an acceptable minimum.

APPLICABILITY

Because of elevated RCS temperature and pressure in MODES 1, 2, 3, and 4, RCS leakage detection instrumentation is required to be OPERABLE.

In MODE 5 or 6, the temperature is to be ≤ 200°F and pressure is maintained low or at atmospheric pressure. Since the temperatures and pressures are far lower than those for MODES 1, 2, 3, and 4, the likelihood of leakage and crack propagation are much smaller. Therefore, the requirements of this LCO are not applicable in MODES 5 and 6.

ACTIONS

A.1 and A.2

05.02.05-13

With the required containment sump level monitor inoperable, no other form of sampling can provide the equivalent information; however, the containment air cooler condensate flow rate monitor and the containment atmosphere radioactivity monitor will provide indications of changes in leakage. Together with the atmosphere monitor, the periodic surveillance for RCS water inventory balance, SR 3.4.12.1, must be performed at an increased Frequency of 24 hours to provide information that is adequate to detect leakage. A Note is added allowing that SR 3.4.12.1 is not required to be performed until 12 hours after establishing steady state operation (stable temperature, power level, Pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The 12 hour allowance provides sufficient time to collect and process all necessary data after stable plant conditions are established.

Restoration of the required sump level monitor to OPERABLE status within a Completion Time of 30 days is required to regain the function after the monitor's failure. This time is acceptable, considering the Frequency and adequacy of the RCS water inventory balance required by Required Action A.1.

BASES

ACTIONS (continued)

B.1.1, B.1.2, B.2.1, and B.2.2

05.02.05-13

With the required particulate containment atmosphere radioactivity monitoring instrumentation channel inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or water inventory balances, in accordance with SR 3.4.12.1, must be performed to provide alternate periodic information.

With a sample obtained and analyzed or water inventory balance performed every 24 hours, the reactor may be operated for up to 30 days to allow restoration of the required containment atmosphere radioactivity monitor. Alternatively, continued operation is allowed if the air cooler condensate flow rate monitoring system is OPERABLE, provided grab samples are taken or water inventory balances performed every 24 hours.

The 24 hour interval provides periodic information that is adequate to detect leakage. A Note is added allowing that SR 3.4.12.1 is not required to be performed until 12 hours after establishing steady state operation (stable temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The 12 hour allowance provides sufficient time to collect and process all necessary data after stable plant conditions are established. The 30 day Completion Time recognizes at least one other form of leakage detection is available.

C.1 and C.2

With the required containment air cooler condensate flow rate monitor inoperable, alternative action is again required. Either grab samples of the containment atmosphere must be taken and analyzed or water inventory balances, in accordance with SR 3.4.12.1, must be performed to provide alternate periodic information. Provided the isotopic analysis or a water inventory balance is performed every 24 hours, reactor operation may continue while awaiting restoration of the containment air cooler condensate flow rate monitor to OPERABLE status.

The 24 hour interval provides periodic information that is adequate to detect RCS LEAKAGE. A Note is added allowing that SR 3.4.12.1 is not required to be performed until 12 hours after establishing steady state operation (stable temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The 12 hour allowance provides sufficient time to collect and process all necessary data after stable plant conditions are established.

BASES

ACTIONS (continued)

D.1 and D.2

With the required containment atmosphere radioactivity monitor and the required containment air cooler condensate flow rate monitor inoperable, the only means of detecting leakage is the containment sump level monitor. This Condition does not provide the required diverse means of leakage detection. The Required Action is to restore either of the inoperable required monitors to OPERABLE status within 30 days to regain the intended leakage detection diversity. The 30 day Completion Time ensures that the plant will not be operated in a reduced configuration for a lengthy time period.

05.02.05-13

E.1 and E.2

If a Required Action of Condition A, B, C, or D cannot be met, the plant must be brought to a MODE in which the requirement does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

F.1

With all required monitors inoperable, no automatic means of monitoring leakage are available, and immediate plant shutdown in accordance with LCO 3.0.3 is required.

SURVEILLANCE REQUIREMENTS

SR 3.4.14.1

A CHANNEL CHECK of the containment atmosphere radioactivity monitor provides reasonable confidence that the instrument is operating properly. The Frequency of 12 hours is based on instrument reliability and is reasonable for detecting off normal conditions.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.14.2, SR 3.4.14.3, and SR 3.4.14.4

These SRs require the performance of a CALIBRATION for each of the RCS leakage detection instrumentation channels. The CALIBRATION verifies the accuracy of the instrument string, including the instruments located inside containment. The Frequency of 24 months is a typical refueling cycle and considers channel reliability. ~~Again, o~~Operating experience has proven that this Frequency is acceptable.

05.02.05-13

SR 3.4.14.5

A SOT is performed on the containment atmosphere radioactivity monitor every 24 months to ensure the instrument will perform its intended function when needed. A SOT shall be the injection of a simulated or actual signal into the division as close to the sensor as practicable to verify OPERABILITY of all devices in the instrument for OPERABILITY. The SOT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for division OPERABILITY such that the setpoints are within the necessary range and accuracy. The SOT may be performed by means of any series of sequential, overlapping, or total steps.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 30.
2. Regulatory Guide 1.45, Rev. 1, May 2008.
3. FSAR Section 5.2.5.
4. FSAR Section 3.6.3.

05.02.05-13

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.

BASES

LCO

Main steam line leakage is defined as leakage inside containment in any portion of the four (4) main steam line pipe walls. Up to 1.0 gpm of leakage is allowable because it is below the leak rate for LBB analyzed cases of a main steam line crack twice as long as a crack leaking at ten (10) times the detectable leak rate under normal operating load conditions. Violation of this LCO could result in continued degradation of the main steam line.

APPLICABILITY

05.02.05-13

Because of elevated Main Steam System temperatures and pressures, the potential for main steam line leakage is greatest in MODES 1, 2, 3, and 4 when a steam generator is relied upon for heat removal.

In MODES 4 when a steam generator is not relied upon for heat removal, 5, and 6, a main steam line leakage limit is not provided because the Main Steam System pressure is greatly reduced from normal operating pressure, resulting in lower stresses and a reduced potential for leakage. In addition, the steam generators are not the primary method of RCS heat removal in MODES 5 and 6.

ACTIONS

A.1 and A.2

With main steam line leakage in excess of the LCO limit, the unit must be brought to lower pressure conditions to reduce the severity of the leakage and its potential consequences. The reactor must be placed in MODE 3 within 6 hours and MODE 5 within 36 hours. This action reduces the main steam line pressure and leakage, and also reduces the factors which tend to degrade the main steam lines. The Completion Time of 6 hours to reach MODE 3 from full power without challenging plant systems is reasonable based on operating experience. Similarly, the Completion Time of 36 hours to reach MODE 5 without challenging plant systems is also reasonable based on operating experience. In MODE 5, the pressure stresses acting on the main steam line are much lower, and further deterioration of the main steam line is less likely.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.18.1

05.02.05-13

Verifying that main steam line leakage is within the LCO limit assures that the integrity of those lines inside containment is maintained. A local humidity detection system (Reference 2) provides an indication of main steam line leakage. Also, 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.. 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.

B 3.7 PLANT SYSTEMS

B 3.7.20 Main Steam Line Leakage Detection Instrumentation

BASES

BACKGROUND

GDC 4 of Appendix A to 10 CFR 50 (Ref. 1) requires components be designed to withstand the environmental and dynamic effects associated with both normal plant operation and postulated accidents. The U.S. EPR design applies the leak-before-break (LBB) methodology to eliminate the dynamic effects of main steam line pipe rupture from the steam generators to the first anchor point location (i.e., the Reactor Containment Building penetration) inside the Reactor Containment Building (Ref. 2). The analysis demonstrates that the probability of pipe rupture is extremely low under conditions consistent with the design basis for the piping

Leakage detection systems must have the capability to detect pressure boundary degradation as soon after occurrence as practical to minimize the potential for propagation to a gross failure. Thus, an early indication or warning signal is necessary to permit proper evaluation of leakage.

An increase in humidity of the containment atmosphere would indicate release of water vapor to the containment. Humidity levels of the containment atmosphere as an indicator of potential leakage. Since the humidity level is influenced by several factors, a quantitative evaluation of an indicated leakage rate by this means may be questionable and should be compared to observed increases in liquid flow into or from the containment sump and condensate flow from air coolers. Humidity level monitoring is considered most useful as an direct alarm or indication to alert the operator to a potential problem.

The primary method used to detect leakage from the main steam line is the local humidity detection system, which has the capability of detecting a leakage of 0.1 gpm within four hours. Regulatory Guide 1.45 (Ref. 3) specifies a time frame of one hour for leakage detection. However, as noted in NUREG-1793 (Ref. 4), leakage detection for LBB purposes does not require the same degree of timeliness. A secondary method of detecting a leakage of 0.1 gpm within four hours for the main steam line is the containment sump level monitor.

05.02.05-13

BASES

APPLICABLE SAFETY ANALYSES

The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify with indications from other systems is necessary. Multiple instrument locations are utilized, if needed, to ensure that the transport delay time of the leakage from its source to an instrument location yields an acceptable overall response time.

Main steam line leakage detection instrumentation satisfies Criterion 1 of 10 CFR 50.36(c)(2)(ii).

LCO

One method of protecting against large main steam leakage derives from the ability of instruments to rapidly detect extremely small leaks. This LCO requires the main steam local humidity detection system to be OPERABLE to provide a high degree of confidence that extremely small leaks are detected in time to allow actions to place the plant in a safe condition, when main steam line leakage indicates possible main steam line degradation.

APPLICABILITY

Because of elevated steam generator temperature and pressure in MODES 1, 2, 3, and 4 when a steam generator is relied upon for heat removal, main steam line leakage detection instrumentation is required to be OPERABLE.

In MODES 4 when a steam generator is not relied upon for heat removal, 5, and 6, main steam line leakage detection instrumentation is not required because the Main Steam System pressure is greatly reduced from normal operating pressure, resulting in lower stresses and a reduced potential for leakage. In addition, the steam generators are not the primary method of RCS heat removal in MODES 5 and 6.

ACTIONS

A.1

With the main steam local humidity detection system inoperable, the containment sump level monitor can provide the equivalent information.

Restoration of the main steam local humidity detection system to OPERABLE status within a Completion Time of 30 days is required to regain the function after the system's failure. The 30 day Completion Time recognizes at least one other form of leakage detection is available.

05.02.05-13

BASES

ACTIONS (continued)

B.1

With the containment sump level monitor inoperable, the main steam local humidity detection system can provide the equivalent information.

Restoration of the containment sump level monitor to OPERABLE status within a Completion Time of 30 days is required to regain the function after the system's failure. The 30 day Completion Time recognizes at least one other form of leakage detection is available.

C.1 and C.2

If the Required Action of Condition A or B cannot be met, the plant must be brought to a MODE in which the requirements do not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.7.20.1

A CHANNEL CHECK of the main steam local humidity detection system provides reasonable confidence that the instrument is operating properly. The Frequency of 12 hours is based on instrument reliability and is reasonable for detecting off normal conditions.

SR 3.7.20.2, SR 3.7.20.3

These SRs require the performance of a CALIBRATION for each of the main steam line leakage detection instrumentation channels. The CALIBRATION verifies the accuracy of the instrument string, including the instruments located inside containment. The Frequency of 24 months is a typical refueling cycle and considers channel reliability. Operating experience has proven that this Frequency is acceptable.

05.02.05-13

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 4.

2. FSAR Section 3.6.3.

3. Regulatory Guide 1.45, Rev. 1, May 2008.

4. NUREG-1793, “Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design,” U.S. Nuclear Regulatory Commission, September 2004.

05.02.05-13