September 19, 2011

TSTF-11-13
PROJ0753

Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Transmittal of TSTF-534, Revision 0, "Clarify Application of Pressure Boundary Leakage Definition"

Enclosed for NRC review is Revision 0 of TSTF-534, "Clarify Application of Pressure Boundary Leakage Definition." TSTF-534 is applicable to all plant types.

The TSTF requests that the NRC bill the Boiling Water Reactor Owners' Group and the Pressurized Water Reactor Owners Group for the review of this Traveler.

Should you have any questions, please do not hesitate to contact us.

Norman J. Stringfellow (PWROG/W)

Roy A. Browning (BWROG)

William J. Steelman (PWROG/CE)

Wendy E. Croft (PWROG/B&W)

Enclosure

cc: Robert Elliott, Technical Specifications Branch, NRC
Michelle Honcharik, Licensing Processes Branch, NRC

Technical Specifications Task Force
Improved Standard Technical Specifications Change Traveler

Clarify Application of Pressure Boundary Leakage Definition

NUREGs Affected: ☑ 1430 ☑ 1431 ☑ 1432 ☑ 1433 ☑ 1434

Classification 1) Technical Change

Recommended for CLIIP?: Yes

Correction or Improvement: Improvement

NRC Fee Status: Exemption Requested

Benefit: Avoids a Plant Shutdown

See attached.

Revision History

OG Revision 0 Revision Status: Active

Revision Proposed by: PWROG LSC

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 06-Jun-11

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 15-Jul-11

TSTF Review Information

TSTF Received Date: 11-Aug-11 Date Distributed for Review 11-Aug-11

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 19-Sep-11

NRC Review Information

NRC Received Date: 19-Sep-11

Affected Technical Specifications

1.1 Definitions

Change Description: Definition of LEAKAGE

Bkgnd 3.4.13 Bases	RCS Operational LEAKAGE	NUREG(s)- 1430 1431 1432 Only
S/A 3.4.13 Bases	RCS Operational LEAKAGE	NUREG(s)- 1430 1431 1432 Only
LCO 3.4.13 Bases	RCS Operational LEAKAGE	NUREG(s)- 1430 1431 1432 Only
Appl. 3.4.13 Bases	RCS Operational LEAKAGE	NUREG(s)- 1430 1431 1432 Only
SR 3.4.13.1 Bases	RCS Operational LEAKAGE	NUREG(s)- 1430 1431 1432 Only
Action 3.4.13.B Bases	RCS Operational LEAKAGE	NUREG(s)- 1431 Only
Bkgnd 3.4.4 Bases	RCS Operational LEAKAGE	NUREG(s)- 1433 Only
S/A 3.4.4 Bases	RCS Operational LEAKAGE	NUREG(s)- 1433 Only
LCO 3.4.4 Bases	RCS Operational LEAKAGE	NUREG(s)- 1433 Only
Appl. 3.4.4 Bases	RCS Operational LEAKAGE	NUREG(s)- 1433 Only
Ref. 3.4.4 Bases	RCS Operational LEAKAGE	NUREG(s)- 1433 Only
SR 3.4.4.1 Bases	RCS Operational LEAKAGE	NUREG(s)- 1433 Only
Bkgnd 3.4.5 Bases	RCS Operational LEAKAGE	NUREG(s)- 1434 Only
S/A 3.4.5 Bases	RCS Operational LEAKAGE	NUREG(s)- 1434 Only
LCO 3.4.5 Bases	RCS Operational LEAKAGE	NUREG(s)- 1434 Only
Appl. 3.4.5 Bases	RCS Operational LEAKAGE	NUREG(s)- 1434 Only
Ref. 3.4.5 Bases	RCS Operational LEAKAGE	NUREG(s)- 1434 Only
SR 3.4.5.1	RCS Operational LEAKAGE	NUREG(s)- 1434 Only

1 Summary Description

The proposed change expands the definition of "pressure boundary leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall.

The Improved Standard Technical Specifications define "Pressure Boundary LEAKAGE" as:

> "LEAKAGE [Pressurized Water Reactors (PWRs) only: (except primary to secondary LEAKAGE)] through a nonisolable fault in an RCS component body, pipe wall, or vessel wall."

The proposed change expands the definition to state (additions are shown in italics):

> "LEAKAGE [PWRs only: (except primary to secondary LEAKAGE)] through a nonisolable fault in an RCS component body, pipe wall, or vessel wall. *A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm.*"

The LCO Bases of the "RCS Operational LEAKAGE" specification (LCO 3.4.13 for pressurized water reactor (PWR) plants, LCO 3.4.4 for boiling water reactor (BWR)/4 plants and LCO 3.4.5 for BWR/6 plants) are proposed to be revised to reflect the changes to the definition (additions are shown in italics. Deletions are struck through):

> No pressure boundary LEAKAGE*, defined as LEAKAGE [PWR only:(except primary to secondary LEAKAGE)] through a nonisolable fault in an RCS component body, pipe wall, or vessel wall within the reactor coolant pressure boundary defined in 10 CFR 50.2,* is allowed~~, being indicative of material deterioration~~. LEAKAGE of this type is unacceptable as the leak itself could cause further *material* deterioration, resulting in higher LEAKAGE. *If LEAKAGE through a fault in an RCS component body, pipe wall, or vessel wall is isolated, it is no longer considered pressure boundary LEAKAGE. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm. This will prevent further material deterioration.* ~~Violation of this LCO could result in continued degradation of the RCPB.~~ LEAKAGE past seals*,* ~~and~~ gaskets*, valve seats, and mechanical or threaded connections* is not pressure boundary LEAKAGE.

In a related change, the "RCS Operational LEAKAGE" LCO Bases are revised to clarify that valve seats and mechanical or threaded connections, as well as the currently listed seals and gaskets, are not part of an RCS component body, pipe wall, or vessel wall. In NUREG-1431, similar statements are deleted from the Bases of Required Actions B.1 and B.2 and in two locations of the Bases of SR 3.4.13.1 for consistency with the other ISTS NUREGs and to eliminate unnecessary redundancy.

Editorial changes are made to the "RCS Operational LEAKAGE" Bases to increase consistency between the ISTS NUREGs and to consistently use the term "RCS Operational LEAKAGE," consistent with the title of the Specification.

Editorial changes are made to the "RCS Operational LEAKAGE" Bases to eliminate detail regarding the "RCS Leakage Detection Instrumentation" Specification requirements, which was revised by approved Travelers TSTF-513-A, Revision 3, "Revise PWR Operability Requirements and Actions for RCS Leakage Instrumentation," and TSTF-513-A, Revision 4, "Revise BWR Operability Requirements and Actions for RCS Leakage Instrumentation."

2 Detailed Description

The definition of "pressure boundary leakage" has existed in its current form since at least the mid-1970's. The Technical Specification Bases state that pressure boundary leakage is not allowed as it's an indication of material degradation and could lead to further leakage.

Two recent events have highlighted the need to clarify what is meant by pressure boundary leakage being "isolable."

Diablo Canyon

On August 31, 2006, a leak occurred in a Diablo Canyon Unit 2 movable incore detector system (MIDS) detector thimble tube, resulting in leakage into the seal table area in containment. The leaking 3/8" inch thimble tube was isolated by a local manual isolation valve. The event was reported to the NRC.

On September 7, 2006, the licensee identified that the fitting upstream of the closed seal table isolation valve was leaking at approximately 4 drops per minute (dpm). The fitting was leaking at the threaded joint where the thimble tube enters the bottom side of the isolation valve body. At the time it was concluded by the licensee that the 4 dpm leakage was "identified leakage" and not "pressure boundary leakage" because the leak was not through a "non-isolable fault in an RCS component body, pipe wall, or vessel wall" as stated in the definition of pressure boundary leakage. The NRC resident was informed of the existence of the 4 dpm leakage and the evaluation of the leakage.

During a September 8, 2006 conference call with the NRC, the licensee was informed that NRC personnel did not agree with the licensee classification of the thimble tube threaded joint leakage as "identified leakage." The NRR personnel position was that it was RCS pressure boundary leakage. The licensee stopped the leakage by tightening the fitting threads. The elimination of the thimble tube threaded joint leakage precluded the need for further NRC evaluation of the appropriate leakage classification.

Byron

On June 24, 2009, licensee personnel identified a pinhole leak (approximately one drop every 5 minutes) on a welded connection inside the Unit 2 containment. The leak was on a 3/8 inch diameter pressurizer liquid sample line between a closed sample isolation valve and the closed inboard containment isolation valve. The closed sample isolation valve has a design rated seat leakage to be less than 1900 cubic centimeters per minute (0.5 gpm). The licensee verified that the valve upstream of the leak was closed and that both containment isolation valves downstream of the leak were closed. Based on the upstream valve being closed and with the leakage being insignificant, the leak was not considered by the licensee to be pressure boundary leakage.

The NRC concluded that although the isolation valve was closed, the leakage out of the pipe continued which demonstrated that the isolation valve was leaking and the fault was not fully isolated. As such, there was a fault through an RCS component pipe wall which was not isolable.

On June 26, 2009 the licensee was informed of the NRC's position and subsequently the licensee declared the RCS Operational LEAKAGE specification not met. The licensee completed their repair efforts and declared the LCO met prior to a plant shutdown.

From these examples, we have inferred the NRC position to be that the definition of pressure boundary leakage requires that leakage through a fault in an RCS component body, pipe wall, or vessel wall is pressure boundary leakage if there is any leakage past the isolating device.

<u>NRC Actions</u>

In a November 18, 2009 letter from Cynthia D. Pederson (NRC) to Charles G. Pardee (Exelon Generation Company) titled "Response to Disputed Non-Cited Violation Byron Station, Unit 2, Inspection Report 05000455/2009003," the NRC stated:

> "The staff does believe that the Standard Technical Specifications should be clarified to avoid future confusion on this issue. Accordingly, the staff will engage the Technical Specifications Task Force, and work with them to provide a solution, which can be made available for adoption by licensees through the NRC's Consolidated Line Item Improvement process."

This proposed change is in response to the NRC's statement.

3 <u>Technical Evaluation</u>

Technical Specification 1.1, "Definitions," defines RCS Pressure Boundary Leakage as "... leakage [PWRs only: (except primary to secondary leakage)] through a <u>nonisolable</u> fault in an RCS component body, pipe wall, or vessel wall" [emphasis added]. "Nonisolable fault" is not defined explicitly. A search of the Standard Review Plan (SRP), Regulatory Guide 1.45, "Guidance on Monitoring and Responding to Reactor Coolant System Leakage," the 1998 version of the Boiler and Pressure Vessel Code, NRC generic correspondence, and NRC internal historical documents discussing Technical Specifications did not identify any additional guidance on the meaning of "nonisolable fault" as it relates to pressure boundary leakage. Licensees are left with applying a "plain English" definition, which would be that no isolation device exists to separate the fault from the RCS. Conversely, "Isolable fault" would be reasonably defined as an isolation device exists to isolate the fault from the RCS.

The Bases for Specification 3.4.13 supports this distinction between a fault being isolable or nonisolable. The Bases states that pressure boundary leakage "... could cause further deterioration, resulting in higher leakage. Violation of this Limiting Condition for Operations (LCO) could result in continued degradation of the Reactor Coolant Pressure Boundary (RCPB). Leakage past seals and gaskets is not pressure boundary LEAKAGE." This indicates that for nonisolable faults, RCS leakage may increase due to material degradation while the RCS is pressurized. Since the fault's growth rate cannot be predicted, the fault could grow and RCS leakage could increase beyond the RCS makeup capabilities resulting in a Loss of Coolant Accident.

The potential for uncontrolled RCS leakage growth and further deterioration can be eliminated by isolating the fault. Reasonable and expected isolation valve leakage within the isolation valve's design criteria would limit any RCS leakage, prevent increases in RCS leakage, and prevent further deterioration of the RCS pressure boundary. However, this distinction is not included in the pressure boundary leakage definition.

The Bases for Specification 3.4.13 state that valve interfaces can produce a varying amount of reactor coolant leakage and leakage from these sources is limited by the LCO to amounts that do not compromise safety (i.e., one gpm for unidentified leakage and 10 gpm for identified leakage). Valve seat leakage is allowed by the RCS unidentified and identified leakage Specification, but is currently not allowed by the pressure boundary leakage requirement.

The concept that isolation valves are expected to have some leakage is consistent with other specifications. The specification on RCS Pressure Isolation Valve (PIV) Leakage (Specification 3.4.14 for PWRs, Specification 3.4.5 for BWR/4 plants and Specification 3.4.6 for BWR/6 plants) is directly comparable to the isolation of pressure boundary leakage. The function of RCS PIVs is to separate the high pressure RCS from an attached low pressure system to protect the RCS pressure boundary. RCS PIVs produce varying amounts of reactor coolant leakage through either normal operational wear or mechanical deterioration. The RCS PIV LCO allows RCS high pressure operation when leakage through these valves exists in amounts that do not compromise safety.

The RCS PIV LCO limits PIV leakage to 0.5 gpm per nominal inch of valve size with a maximum limit of 5 gpm. In 1972, the Working Group on ISI of pumps and valves developed criteria for Section XI, Subsection IWV. That criterion was 30ml/hour/inch of diameter. In 1988, valve testing was moved to the OM (Operation and Maintenance of Nuclear Power Plants) Code, Part 10, and the leakage limit was changed to the present value of 0.5 gpm/in of diameter, with a maximum of 5 gpm. This limit was based on engineering judgment and appears in OMa-1988 (1988 addenda to OM-1987), Section 4.2.2.3(e), "Analysis of Leakage Rates."

A leakage limit of 0.5 gpm per nominal inch of valve size with a maximum limit of 5 gpm is considered appropriate for valves isolating the RCS from low pressure systems to prevent an intersystem Loss of Coolant Accident. The 5.0 gpm leak rate limit is well within the normal RCS makeup capability. This leakage limit would also be appropriate for isolating a faulted pressure boundary component from the RCS as the pressure differential and safety consequences are the same. Therefore, it is proposed that the definition of "pressure boundary leakage" be expanded to state "A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm." This proposed change maintains the intent of the definition of "pressure boundary leakage" while allowing normal and expected leakage through isolation valves and not compromising safety.

4 Regulatory Evaluation

4.1 Applicable Regulatory Requirements / Criteria

The following NRC requirements and guidance document are applicable to the review of the proposed change.

10 CFR 50, Section 2, "Definitions," defines "reactor coolant pressure boundary," as:

> "all those pressure-containing components of boiling and pressurized water-cooled nuclear power reactors, such as pressure vessels, piping, pumps, and valves, which are:
>
> (1) Part of the reactor coolant system, or
>
> (2) Connected to the reactor coolant system, up to and including any and all of the following:
>
> > (i) The outermost containment isolation valve in system piping which penetrates primary reactor containment,
> >
> > (ii) The second of two valves normally closed during normal reactor operation in system piping which does not penetrate primary reactor containment,
> >
> > (iii) The reactor coolant system safety and relief valves.
>
> For nuclear power reactors of the direct cycle boiling water type, the reactor coolant system extends to and includes the outermost containment isolation valve in the main steam and feedwater piping."

The proposed change is consistent with the definition of reactor coolant pressure boundary.

10 CFR 50, Appendix A, General Design Criteria (GDC) 14, "Reactor coolant pressure boundary," requires the reactor coolant pressure boundary to be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

10 CFR 50, Appendix A, GDC 30, "Quality of reactor coolant pressure boundary," requires that systems be designed with a means for detecting and, to the extent practical, identifying the source of reactor coolant leakage.

10 CFR 50, Appendix A, GDC 33, "Reactor coolant makeup," requires that a system be designed to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary. The system should be designed to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the reactor coolant pressure boundary and rupture of small piping or other small components which are part of the boundary.

The proposed change is consistent with GDC 14, 30, and 33 in that the design requirements of the reactor coolant boundary are unaffected. The proposed change applies appropriate actions if a fault in the reactor coolant pressure boundary is discovered.

Regulatory Guide 1.45, "Guidance on Monitoring and Responding to Reactor Coolant System Leakage," describes methods the NRC considers acceptable for selecting reactor coolant leakage detection systems, monitoring for leakage, and responding to leakage. The proposed change is consistent with the Regulatory Guide methods.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

4.2 No Significant Hazards Consideration

The TSTF has evaluated whether or not a significant hazards consideration is involved with the proposed generic change by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed change expands the definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall from the pressurized portion of the RCS. Pressure boundary leakage is a precursor to accidents previously evaluated, such as a Loss of Coolant Accident (LOCA). However, the proposed change does not affect the prohibition on pressure boundary leakage but only provides necessary and safe limits on leakage from devices used to isolate pressure boundary leakage. This change will have no effect on the causes or frequency of pressure boundary leakage and will not affect the probability of an accident previously evaluated, such as a LOCA. The isolation of pressure boundary leakage does not affect the ability of any system to mitigate an accident previously evaluated as the proposed leakage limits on the isolation device are insignificant compared to the volume and flow rate of water that would be injected into the RCS following an accident previously evaluated.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change expands the definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in an RCS component body, pipe wall, or vessel wall from the pressurized portion of the RCS. Pressure boundary leakage is considered an initiator to accidents previously evaluated, such as a LOCA. The proposed change provides necessary and safe limits on leakage from devices used to isolate faults in the RCS, as all isolation devices are designed to allow for some leakage. Application of these leakage limits will not result in pressure boundary leakage creating a new or different kind of accident from those accidents previously evaluated. Allowing normal and expected leakage past isolation devices used to isolate pressure boundary leakage will not result in new or different operator actions or changes to the plant design or operation.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The proposed change expands the definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in an RCS component body, pipe wall, or vessel wall from the pressurized portion of the RCS. The margin of safety for the RCS is established by the requirement to immediately shut down the plant when pressure boundary leakage is discovered and cannot be isolated from the RCS. This requirement is unaffected by the proposed change. The proposed change allows normal and expected leakage past a device being used to isolate from the RCS, the fault that created the pressure boundary leakage. The limits will prevent further deterioration of the fault and protect the RCS.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, the TSTF concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.3 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

5 Environmental Consideration

A review has determined that the proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

6 References

None

Model Application

[DATE] 10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: PLANT NAME
DOCKET NO. 50-[xxx]
APPLICATION TO REVISE TECHNICAL SPECIFICATIONS TO ADOPT TSTF-534, "CLARIFY APPLICATION OF PRESSURE BOUNDARY LEAKAGE DEFINITION"

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, [LICENSEE] is submitting a request for an amendment to the Technical Specifications (TS) for [PLANT NAME, UNIT NOS.].

The proposed amendment modifies the TS definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate leakage from a fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall as described in TSTF-534, Revision 0, "Clarify Application of Pressure Boundary Leakage Definition."

Attachment 1 provides a description and assessment of the proposed changes. Attachment 2 provides the existing TS pages marked up to show the proposed changes. Attachment 3 provides revised (clean) TS pages. Attachment 4 provides existing TS Bases pages for information marked to show the proposed changes.

Approval of the proposed amendment is requested by [date]. Once approved, the amendment shall be implemented within [ ] days.

In accordance with 10 CFR 50.91, a copy of this application, with attachments, is being provided to the designated [STATE] Official.

[In accordance with 10 CFR 50.30(b), a license amendment request must be executed in a signed original under oath or affirmation. This can be accomplished by attaching a notarized affidavit confirming the signature authority of the signatory, or by including the following statement in the cover letter: "I declare under penalty of perjury that the foregoing is true and correct. Executed on (date)." The alternative statement is pursuant to 28 USC 1746. It does not require notarization.]

If you should have any questions regarding this submittal, please contact [NAME, TELEPHONE NUMBER].

Sincerely,

[Name, Title]

Attachments:

1. Description and Assessment
2. Proposed Technical Specification Changes (Mark-Up)
3. Revised Technical Specification Pages
4. Proposed Technical Specification Bases Changes (Mark-Up)

cc: NRC Project Manager
NRC Regional Office
NRC Resident Inspector
State Contact

ATTACHMENT 1 - DESCRIPTION AND ASSESSMENT

1.0 DESCRIPTION

The proposed amendment modifies the Technical Specifications (TS) definition of "Pressure Boundary LEAKAGE" to provide limits on acceptable leakage through a device that is being used to isolate a fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall as described in TSTF-534, Revision 0, "Clarify Application of Pressure Boundary Leakage Definition."

2.0 ASSESSMENT

2.1 Applicability of Published Safety Evaluation

[LICENSEE] has reviewed the model safety evaluation dated [DATE] as part of the Federal Register Notice of Availability. This review included a review of the Nuclear Regulatory Commission (NRC) staff's evaluation, as well as the information provided in TSTF-534. [As described in the subsequent paragraphs,][LICENSEE] has concluded that the justifications presented in the TSTF-534 proposal and the model safety evaluation prepared by the NRC staff are applicable to [PLANT, UNIT NOS.] and justify this amendment for the incorporation of the changes to the [PLANT] TS.

2.2 Optional Changes and Variations

[LICENSEE is not proposing any variations or deviations from the TS changes described in the TSTF-534, Revision 0, or the applicable parts of the NRC staff's model safety evaluation dated [DATE].] [LICENSEE is proposing the following variations from the TS changes described in the TSTF-534, Revision 0, or the applicable parts of the NRC staff's model safety evaluation dated [DATE].]

[The [PLANT] TS utilize different [numbering][and][titles] than the Standard Technical Specifications on which TSTF-534 was based. Specifically, [describe differences between the plant-specific TS numbering and/or titles and the TSTF-534 numbering and titles.] These differences are administrative and do not affect the applicability of TSTF-534 to the [PLANT] TS.]

3.0 REGULATORY ANALYSIS

3.1 No Significant Hazards Consideration Determination

[LICENSEE] requests adoption of TSTF-534, Revision 0, "Clarify Application of Pressure Boundary Leakage Definition," which is an approved change to the standard technical specifications (STS), into the [PLANT NAME, UNIT NOS] technical specifications (TS). The proposed change revises the definition of Pressure Boundary Leakage to provide limits on acceptable leakage through a device that is being used to isolate a fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall.

[LICENSEE] has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed change expands the definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall from the pressurized portion of the RCS. Pressure boundary leakage is a precursor to accidents previously evaluated, such as a Loss of Coolant Accident (LOCA). However, the proposed change does not affect the prohibition on pressure boundary leakage but only provides necessary and safe limits on leakage from devices used to isolate pressure boundary leakage. This change will have no effect on the causes or frequency of pressure boundary leakage and will not affect the probability of an accident previously evaluated, such as a LOCA. The isolation of pressure boundary leakage does not affect the ability of any system to mitigate an accident previously evaluated as the proposed leakage limits on the isolation device are insignificant compared to the volume and flow rate of water that would be injected into the RCS following an accident previously evaluated.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change expands the definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in an RCS component body, pipe wall, or vessel wall from the pressurized portion of the RCS. Pressure boundary leakage is considered an initiator to accidents previously evaluated, such as a LOCA. The proposed change provides necessary and safe limits on leakage from devices used to isolate faults in the RCS, as all isolation devices are designed to allow for some leakage. Application of these leakage limits will not result in pressure boundary leakage creating a new or different kind of accident from those accidents previously evaluated. Allowing normal and expected leakage past isolation devices used to isolate pressure boundary leakage will not result in new or different operator actions or changes to the plant design or operation.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The proposed change expands the definition of "Pressure Boundary Leakage" to provide limits on acceptable leakage through a device that is being used to isolate a fault in an RCS component body, pipe wall, or vessel wall from the pressurized portion of the RCS. The margin of safety for the RCS is established by the requirement to immediately shut down the plant when pressure boundary leakage is discovered and cannot be isolated from the RCS. This requirement is unaffected by the proposed change. The proposed change allows normal and expected leakage past a device being used to isolate from the RCS, the fault that created the pressure boundary leakage. The limits will prevent further deterioration of the fault and protect the RCS.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, [LICENSEE] concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

3.2 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

4.0 ENVIRONMENTAL EVALUATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

1.1 Definitions

LEAKAGE (continued)

3. Reactor Coolant System (RCS) LEAKAGE through a steam generator to the Secondary System (primary to secondary LEAKAGE),

b. Unidentified LEAKAGE

All LEAKAGE (except RCP seal water injection or leakoff) that is not identified LEAKAGE, and

c. Pressure Boundary LEAKAGE

LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm.

MODE

A MODE shall correspond to any one inclusive combination of core reactivity condition, power level, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.

NUCLEAR HEAT FLUX HOT CHANNEL FACTOR $F_Q(Z)$

$F_Q(Z)$ shall be the maximum local linear power density in the core divided by the core average fuel rod linear power density, assuming nominal fuel pellet and fuel rod dimensions.

NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR $F^N_{\Delta H}$

$F^N_{\Delta H}$ shall be the ratio of the integral of linear power along the fuel rod on which minimum departure from nucleate boiling ratio occurs, to the average fuel rod power.

OPERABLE – OPERABILITY

A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.13 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 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 RCS Operational 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 Operational 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 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% leaktight. 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 analysis radiation release assumptions from being exceeded. The consequences of violating this LCO include the possibility of a loss of coolant accident (LOCA). However, the ability to monitor leakage provides advance warning to permit plant shutdown before a LOCA occurs. This advantage has been shown by "leak before break" studies.

BASES

APPLICABLE SAFETY ANALYSES

Except for primary to secondary LEAKAGE, the safety analyses do not address RCS operational LEAKAGE. However, other forms of RCS Ooperational LEAKAGE isare related to the safety analyses 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 from all steam generators (SGs) is [1 gallon per minute] or increases to [1 gallon per minute] 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 significantly less than the conditions assumed in the safety analysis.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from a steam line break (SLB) accident. To a lesser extent, other accidents or transients involve secondary steam release to the atmosphere, such as a steam generator tube rupture (SGTR). The leakage contaminates the secondary fluid.

The FSAR (Ref. 3) analysis for SGTR assumes the contaminated secondary fluid is only briefly released via safety valves and the majority is steamed to the condenser. The [1 gpm] primary to secondary LEAKAGE safety analysis assumption is relatively inconsequential.

The SLB is more limiting for site radiation releases. The safety analysis for the SLB accident assumes the entire [1 gpm] primary to secondary LEAKAGE is through the affected generator as an initial condition. The dose consequences resulting from the SLB accident are well within the limits defined in 10 CFR 100.

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

LCO

RCS Ooperational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

No pressure boundary LEAKAGE, defined as LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall within the reactor coolant pressure boundary defined in 10 CFR 50.2, is allowed, being indicative of material deterioration. LEAKAGE of this type is unacceptable as the leak itself could cause further material deterioration, resulting in higher LEAKAGE. If LEAKAGE through a fault in an RCS component body, pipe wall, or vessel wall is isolated, it is no longer considered pressure boundary LEAKAGE. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm. This will prevent further material deterioration. ~~Violation of this LCO could result in continued degradation of the RCPB.~~ LEAKAGE past seals, ~~and~~ gaskets, valve seats, and mechanical or threaded connections 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 required by LCO 3.4.15, "RCS Leakage Detection Instrumentation," 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.

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.

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, RCS Operational LEAKAGE limits are not required because the reactor coolant pressure is far lower, resulting in lower stresses and reduced potentials for RCPB LEAKAGE.

APPLICABILITY (continued)

LCO 3.4.14, "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 Operational LEAKAGE when the other is leaktight. 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

If unidentified LEAKAGE or identified LEAKAGE are in excess of the LCO limits, the RCS Operational LEAKAGE 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 RCS Operational 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 RCS Operational LEAKAGE and its potential consequences. The reactor must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. This action reduces the RCS Operational LEAKAGE and also reduces the factors that tend to degrade the pressure boundary.

The Completion Times allowed are reasonable, based on operating experience, to reach the required 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.

SURVEILLANCE REQUIREMENTS

SR 3.4.13.1

Verifying RCS Operational LEAKAGE within the LCO limits ensures that 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. Unidentified LEAKAGE and identified LEAKAGE are determined by performance of an RCS water inventory balance.

The RCS water inventory balance must be performed with the reactor at steady state operating conditions (stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, [and RCP seal

BASES

SURVEILLANCE REQUIREMENTS (continued)

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 water inventory balance since calculations during maneuvering are not useful. For RCS Ooperational 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 pump seal injection and return flows.

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems that monitor the containment atmosphere radioactivity and the containment sump level. These leakage detection systems are specified in LCO 3.4.15, "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 RCS Operational LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents.

SR 3.4.13.2

This SR verifies that primary to secondary LEAKAGE is less than 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 3.4.17, "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, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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, May 1973.
3. FSAR, Chapter [15].
4. NEI 97-06, "Steam Generator Program Guidelines."
5. EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines."

1.1 Definitions

ENGINEERED SAFETY FEATURE (ESF) RESPONSE TIME	The ESF RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.
LEAKAGE	LEAKAGE shall be:

a. Identified LEAKAGE

1. LEAKAGE, such as that from pump seals or valve packing (except reactor coolant pump (RCP) seal water injection or leakoff), that is captured and conducted to collection systems or a sump or collecting tank,

2. LEAKAGE into the containment atmosphere from sources that are both specifically located and known either not to interfere with the operation of leakage detection systems or not to be pressure boundary LEAKAGE, or

3. Reactor Coolant System (RCS) LEAKAGE through a steam generator to the Secondary System (primary to secondary LEAKAGE);

b. Unidentified LEAKAGE

All LEAKAGE (except RCP seal water injection or leakoff) that is not identified LEAKAGE, and

c. Pressure Boundary LEAKAGE

LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.13 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 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 RCS Operational 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 Operational 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% leaktight. 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 RCS O~~o~~perational LEAKAGE. However, other forms of RCS O~~o~~perational LEAKAGE ~~is~~are related to the safety analyses 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 from all steam generators (SGs) is [1 gallon per minute] or increases to [1 gallon per minute] 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 significantly less than the conditions assumed in the safety analysis.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from a steam line break (SLB) accident. To a lesser extent, other accidents or transients involve secondary steam release to the atmosphere, such as a steam generator tube rupture (SGTR). The leakage contaminates the secondary fluid.

The FSAR (Ref. 3) analysis for SGTR assumes the contaminated secondary fluid is only briefly released via safety valves and the majority is steamed to the condenser. The [1 gpm] primary to secondary LEAKAGE safety analysis assumption is relatively inconsequential.

The SLB is more limiting for site radiation releases. The safety analysis for the SLB accident assumes the entire [1 gpm] primary to secondary LEAKAGE is through the affected generator as an initial condition. The dose consequences resulting from the SLB accident are well within the limits defined in 10 CFR 100 or the staff approved licensing basis (i.e., a small fraction of these limits).

The RCS O~~o~~perational LEAKAGE satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

RCS O~~o~~perational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

No pressure boundary LEAKAGE, defined as LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall within the reactor coolant pressure boundary defined in 10 CFR 50.2, is allowed~~, being indicative of material deterioration~~. LEAKAGE of this type is unacceptable as the leak itself could cause further material deterioration, resulting in higher LEAKAGE. If LEAKAGE through a fault in an RCS component body, pipe wall, or vessel wall is isolated, it is no longer considered pressure boundary LEAKAGE. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm. This will prevent further material deterioration. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals, and gaskets, valve seats, and mechanical or threaded connections 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 required by LCO 3.4.15, "RCS Leakage Detection Instrumentation," 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.

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.

APPLICABILITY

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

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

BASES

APPLICABILITY (continued)

LCO 3.4.14, "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 Operational 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 RCS Operational 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 RCS Operational 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 RCS Operational 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.

SURVEILLANCE REQUIREMENTS

SR 3.4.13.1

Verifying RCS Operational 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The RCS water inventory balance must be met with the reactor at steady state operating conditions (stable RCS pressure, 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 Ooperational 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.

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the ~~automatic systems that monitor the containment atmosphere radioactivity 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 3.4.15, "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 RCS Operational LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents.

SR 3.4.13.2

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 3.4.20, "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, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG.

SURVEILLANCE REQUIREMENTS (continued)

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, May 1973.
3. FSAR, Section [15].
4. NEI 97-06, "Steam Generator Program Guidelines."
5. EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines."

1.1 Definitions

LEAKAGE (continued)

3. Reactor Coolant System (RCS) LEAKAGE through a steam generator to the Secondary System (primary to secondary LEAKAGE),

b. Unidentified LEAKAGE

All LEAKAGE (except RCP seal water injection or leakoff) that is not identified LEAKAGE, and

c. Pressure Boundary LEAKAGE

LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm.

MODE — A MODE shall correspond to any one inclusive combination of core reactivity condition, power level, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.

OPERABLE – OPERABILITY — A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).

PHYSICS TESTS — PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation.

These tests are:

a. Described in Chapter [14, Initial Test Program] of the FSAR,

b. Authorized under the provisions of 10 CFR 50.59, or

c. Otherwise approved by the Nuclear Regulatory Commission.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.13 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 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 RCS Operational 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 Operational 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 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% leaktight. Leakage from these systems should be detected, located, and isolated from the containment atmosphere, if possible, to not interfere with RCS Operational 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 analysis 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 RCS O~~o~~perational LEAKAGE. However, other forms of RCS O~~o~~perational LEAKAGE ~~is~~are related to the safety analyses 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 from all steam generators (SGs) is [1 gallon per minute] or increases to [1 gallon per minute] 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 significantly less than the conditions assumed in the safety analysis.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from a steam line break (SLB) accident. To a lesser extent, other accidents or transients involve secondary steam release to the atmosphere, such as a steam generator tube rupture (SGTR). The leakage contaminates the secondary fluid.

The FSAR (Ref. 3) analysis for SGTR assumes the contaminated secondary fluid is only briefly released via safety valves and the majority is steamed to the condenser. The [1 gpm] primary to secondary LEAKAGE safety analysis assumption is relatively inconsequential.

The SLB is more limiting for site radiation releases. The safety analysis for the SLB accident assumes the entire [1 gpm] primary to secondary LEAKAGE is through the affected generator as an initial condition. The dose consequences resulting from the SLB accident are well within the limits defined in 10 CFR 50 or the staff approved licensing basis (i.e., a small fraction of these limits).

RCS O~~o~~perational LEAKAGE satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

RCS O~~o~~perational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

No pressure boundary LEAKAGE, defined as LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall within the reactor coolant pressure boundary defined in 10 CFR 50.2, is allowed~~, being indicative of material deterioration~~. LEAKAGE of this type is unacceptable as the leak itself could cause further material deterioration, resulting in higher LEAKAGE. If LEAKAGE through a fault in an RCS component body, pipe wall, or vessel wall is isolated, it is no longer considered pressure boundary LEAKAGE. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm. This will prevent further material deterioration. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals, and gaskets, valve seats, and mechanical or threaded connections 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 required by LCO 3.4.15, "RCS Leakage Detection Instrumentation," 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.

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.

LCO 3.4.14, "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 Operational LEAKAGE when the other is leaktight. If both valves leak and result in a loss of mass from the RCS, the loss must be included in the allowable identified LEAKAGE.

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~~ RCS Operational LEAKAGE is greatest when the RCS is pressurized.

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

LCO 3.4.14, "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 Operational 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 RCS Operational 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 RCS Operational LEAKAGE and its potential consequences. The reactor must be brought to MODE 3 within 6 hours and to MODE 5 within 36 hours. This action reduces the RCS Operational 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 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.

SURVEILLANCE REQUIREMENTS

SR 3.4.13.1

Verifying RCS Operational 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. Unidentified LEAKAGE and identified LEAKAGE are determined by performance of an RCS water inventory balance.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The RCS water inventory balance must be performed with the reactor at steady state operating conditions (stable RCS pressure, 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 water inventory balance since calculations during maneuvering are not useful. For RCS oOperational 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.

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the ~~automatic systems that monitor the containment atmosphere radioactivity and the containment sump level. These~~ leakage detection systems ~~are~~ specified in LCO 3.4.15, "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 RCS Operational LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents.

SR 3.4.13.2

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 3.4.18, "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, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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, May 1973.
3. FSAR, Section [15].
4. NEI 97-06, "Steam Generator Program Guidelines."
5. EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines."

1.1 Definitions

LEAKAGE (continued)

b. Unidentified LEAKAGE

All LEAKAGE into the drywell that is not identified LEAKAGE,

c. Total LEAKAGE

Sum of the identified and unidentified LEAKAGE, and

d. Pressure Boundary LEAKAGE

LEAKAGE through a nonisolable fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm.

[LINEAR HEAT GENERATION RATE (LHGR)	The LHGR shall be the heat generation rate per unit length of fuel rod. It is the integral of the heat flux over the heat transfer area associated with the unit length.]
LOGIC SYSTEM FUNCTIONAL TEST	A LOGIC SYSTEM FUNCTIONAL TEST shall be a test of all logic components required for OPERABILITY of a logic circuit, from as close to the sensor as practicable up to, but not including, the actuated device, to verify OPERABILITY. The LOGIC SYSTEM FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping, or total system steps so that the entire logic system is tested.
[MAXIMUM FRACTION OF LIMITING POWER DENSITY (MFLPD)	The MFLPD shall be the largest value of the fraction of limiting power density in the core. The fraction of limiting power density shall be the LHGR existing at a given location divided by the specified LHGR limit for that bundle type.]
MINIMUM CRITICAL POWER RATIO (MCPR)	The MCPR shall be the smallest critical power ratio (CPR) that exists in the core [for each class of fuel]. The CPR is that power in the assembly that is calculated by application of the appropriate correlation(s) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
MODE	A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.4 RCS Operational LEAKAGE

BASES

BACKGROUND

The RCS includes systems and components that contain or transport the coolant to or from the reactor core. The pressure containing components of the RCS and the portions of connecting systems out to and including the isolation valves define the reactor coolant pressure boundary (RCPB). The joints of the RCPB components are welded or bolted.

During plant life, the joint and valve interfaces can produce varying amounts of reactor coolant LEAKAGE, through either normal operational wear or mechanical deterioration. Limits on RCS ~~o~~Operational LEAKAGE are required to ensure appropriate action is taken before the integrity of the RCPB is impaired. This LCO specifies the types and limits of RCS Operational LEAKAGE. This protects the RCS pressure boundary described in 10 CFR 50.2, 10 CFR 50.55a(c), and GDC 55 of 10 CFR 50, Appendix A (Refs 1, 2, and 3).

The safety significance of RCS Operational LEAKAGE from the RCPB varies widely depending on the source, rate, and duration. Therefore, detection of RCS Operational LEAKAGE in the primary containment is necessary. Methods for quickly separating the identified LEAKAGE from the unidentified LEAKAGE are necessary to provide the operators quantitative information to permit them to take corrective action should a leak occur that is detrimental to the safety of the facility or the public.

A limited amount of ~~leakage~~ LEAKAGE inside primary containment is expected from auxiliary systems that cannot be made 100% leaktight. ~~Leakage~~ LEAKAGE from these systems should be detected and isolated from the primary containment atmosphere, if possible, so as not to mask RCS ~~o~~Operational LEAKAGE detection.

This LCO deals with protection of the 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.

BASES

APPLICABLE SAFETY ANALYSES

The allowable RCS ~~o~~Operational LEAKAGE limits are based on the predicted and experimentally observed behavior of pipe cracks. The normally expected background RCS Operational LEAKAGE due to equipment design and the detection capability of the instrumentation for determining system RCS Operational LEAKAGE were also considered. The evidence from experiments suggests that, for RCS Operational LEAKAGE even greater than the specified unidentified LEAKAGE limits, the probability is small that the imperfection or crack associated with such RCS Operational LEAKAGE would grow rapidly.

The unidentified LEAKAGE flow limit allows time for corrective action before the RCPB could be significantly compromised. The 5 gpm limit is a small fraction of the calculated flow from a critical crack in the primary system piping. Crack behavior from experimental programs (Refs. 2 and 3) shows that leakage rates of hundreds of gallons per minute will precede crack instability (Ref. 4).

The low limit on increase in unidentified LEAKAGE assumes a failure mechanism of intergranular stress corrosion cracking (IGSCC) that produces tight cracks. This flow increase limit is capable of providing an early warning of such deterioration.

No applicable safety analysis assumes the total RCS Operational LEAKAGE limit. The total RCS Operational LEAKAGE limit considers RCS inventory makeup capability and drywell floor sump capacity.

RCS O~~o~~perational LEAKAGE satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

RCS O~~o~~perational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

No pressure boundary LEAKAGE, defined as LEAKAGE through a nonisolable fault in an RCS component body, pipe wall, or vessel wall within the reactor coolant pressure boundary defined in 10 CFR 50.2, is allowed~~, being indicative of material degradation~~. LEAKAGE of this type is unacceptable as the leak itself could cause further material deterioration, resulting in higher LEAKAGE. If LEAKAGE through a fault in an RCS component body, pipe wall, or vessel wall is isolated, it is no longer considered pressure boundary LEAKAGE. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm. This will prevent further material deterioration. ~~Violation of this LCO could result in continued degradation of the RCPB.~~ LEAKAGE past seals, ~~and~~ gaskets, valve seats, and mechanical or threaded connections is not pressure boundary LEAKAGE.

b. Unidentified LEAKAGE

The 5 gpm of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the ~~containment air monitoring, drywell sump level monitoring, and containment air cooler condensate flow rate~~ monitoring equipment required by LCO 3.4.6, "RCS Leakage Detection Instrumentation," can detect within a reasonable time period. Violation of this LCO could result in continued degradation of the RCPB.

BASES

LCO (continued)

c. Total LEAKAGE

The total LEAKAGE limit is based on a reasonable minimum detectable amount. The limit also accounts for LEAKAGE from known sources (identified LEAKAGE). Violation of this LCO indicates an unexpected amount of LEAKAGE and, therefore, could indicate new or additional degradation in an RCPB component or system.

d. Unidentified LEAKAGE Increase

An unidentified LEAKAGE increase of > 2 gpm within the previous [4] hour period indicates a potential flaw in the RCPB and must be quickly evaluated to determine the source and extent of the LEAKAGE. The increase is measured relative to the steady state value; temporary changes in LEAKAGE rate as a result of transient conditions (e.g., startup) are not considered. As such, the 2 gpm increase limit is only applicable in MODE 1 when operating pressures and temperatures are established. Violation of this LCO could result in continued degradation of the RCPB.

APPLICABILITY

In MODES 1, 2, and 3, the RCS ~~o~~Operational LEAKAGE LCO applies, because the potential for RCPB LEAKAGE is greatest when the reactor is pressurized.

In MODES 4 and 5, RCS ~~o~~Operational LEAKAGE limits are not required since the reactor is not pressurized and stresses in the RCPB materials and potential for RCPB LEAKAGE are reduced.

LCO 3.4.5, "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 Operational 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

With RCS unidentified or total LEAKAGE greater than the limits, actions must be taken to reduce the leak. Because these LEAKAGE limits are conservatively below the LEAKAGE that would constitute a critical crack size, 4 hours is allowed to reduce the RCS Operational LEAKAGE rates before the reactor must be shut down. If an unidentified LEAKAGE has been identified and quantified, it may be reclassified and considered as identified LEAKAGE; however, the total LEAKAGE limit would remain unchanged.

BASES

ACTIONS (continued)

B.1 and B.2

An unidentified LEAKAGE increase of > 2 gpm within a 4 hour period is an indication of a potential flaw in the RCPB and must be quickly evaluated. Although the increase does not necessarily violate the absolute unidentified LEAKAGE limit, certain susceptible components must be determined not to be the source of the LEAKAGE increase within the required Completion Time. For an unidentified LEAKAGE increase greater than required limits, an alternative to reducing LEAKAGE increase to within limits (i.e., reducing the LEAKAGE rate such that the current rate is less than the "2 gpm increase in the previous [4] hours" limit; either by isolating the source or other possible methods) is to evaluate service sensitive type 304 and type 316 austenitic stainless steel piping that is subject to high stress or that contains relatively stagnant or intermittent flow fluids and determine it is not the source of the increased LEAKAGE. This type piping is very susceptible to IGSCC.

The 4 hour Completion Time is reasonable to properly reduce the RCS Operational LEAKAGE increase or verify the source before the reactor must be shut down without unduly jeopardizing plant safety.

C.1 and C.2

If any Required Action and associated Completion Time of Condition A or B is not met or if pressure boundary LEAKAGE exists, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 3 within 12 hours and to MODE 4 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 safety systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.4.1

The RCS Operational LEAKAGE is monitored by a variety of instruments designed to provide alarms when RCS Operational LEAKAGE is indicated and to quantify the various types of LEAKAGE. Leakage detection instrumentation is discussed in more detail in the Bases for LCO 3.4.6, "RCS Leakage Detection Instrumentation." ~~Sump level and flow rate are typically monitored to~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

determine actual LEAKAGE rates; however, any method may be used to quantify LEAKAGE within the guidelines of Reference 5. In conjunction with alarms and other administrative controls, an 8 hour Frequency for this Surveillance is appropriate for identifying RCS Operational LEAKAGE and for tracking required trends (Ref. 65).

REFERENCES

1. 10 CFR 50, Appendix A, GDC 30.

2. GEAP-5620, April 1968.

3. NUREG-76/067, October 1975.

4. FSAR, Section [5.2.7.5.2].

5. Regulatory Guide 1.45.

65. Generic Letter 88-01, Supplement 1.

1.1 Definitions

LEAKAGE (continued)

b. Unidentified LEAKAGE

All LEAKAGE into the drywell that is not identified LEAKAGE,

c. Total LEAKAGE

Sum of the identified and unidentified LEAKAGE, and

d. Pressure Boundary LEAKAGE

LEAKAGE through a nonisolable fault in a Reactor Coolant System (RCS) component body, pipe wall, or vessel wall. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm.

[LINEAR HEAT GENERATION RATE (LHGR)	The LHGR shall be the heat generation rate per unit length of fuel rod. It is the integral of the heat flux over the heat transfer area associated with the unit length.]
LOGIC SYSTEM FUNCTIONAL TEST	A LOGIC SYSTEM FUNCTIONAL TEST shall be a test of all logic components required for OPERABILITY of a logic circuit, from as close to the sensor as practicable up to, but not including, the actuated device, to verify OPERABILITY. The LOGIC SYSTEM FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping, or total system steps so that the entire logic system is tested.
[MAXIMUM FRACTION OF LIMITING POWER DENSITY (MFLPD)	The MFLPD shall be the largest value of the fraction of limiting power density in the core. The fraction of limiting power density shall be the LHGR existing at a given location divided by the specified LHGR limit for that bundle type.]
MINIMUM CRITICAL POWER RATIO (MCPR)	The MCPR shall be the smallest critical power ratio (CPR) that exists in the core [for each class of fuel]. The CPR is that power in the assembly that is calculated by application of the appropriate correlation(s) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
MODE	A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.5 RCS Operational LEAKAGE

BASES

BACKGROUND

The RCS includes systems and components that contain or transport the coolant to or from the reactor core. The pressure containing components of the RCS and the portions of connecting systems out to and including the isolation valves define the reactor coolant pressure boundary (RCPB). The joints of the RCPB components are welded or bolted.

During plant life, the joint and valve interfaces can produce varying amounts of reactor coolant LEAKAGE, through either normal operational wear or mechanical deterioration. Limits on RCS ~~o~~Operational LEAKAGE are required to ensure appropriate action is taken before the integrity of the RCPB is impaired. This LCO specifies the types and limits of RCS Operational LEAKAGE.

This protects the RCS pressure boundary described in 10 CFR 50.2, 10 CFR 50.55a(c), and GDC 55 of 10 CFR 50, Appendix A (Refs. 1, 2, and 3).

The safety significance of RCS Operational LEAKAGE ~~leaks~~ from the RCPB varies widely depending on the source, rate, and duration. Therefore, detection of RCS Operational LEAKAGE in the drywell is necessary. Methods for quickly separating the identified LEAKAGE from the unidentified LEAKAGE are necessary to provide the operators quantitative information to permit them to take corrective action should a leak occur detrimental to the safety of the facility or the public.

A limited amount of LEAKAGE ~~leakage~~ inside the drywell is expected from auxiliary systems that cannot be made 100% leaktight. ~~Leakage~~ LEAKAGE from these systems should be detected and isolated from the drywell atmosphere, if possible, so as not to mask RCS ~~o~~Operational LEAKAGE detection.

This LCO deals with protection of the 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.

BASES

APPLICABLE SAFETY ANALYSES

The allowable RCS oOperational LEAKAGE limits are based on the predicted and experimentally observed behavior of pipe cracks. The normally expected background RCS Operational LEAKAGE due to equipment design and the detection capability of the instrumentation for determining system RCS Operational LEAKAGE were also considered. The evidence from experiments suggests, for RCS Operational LEAKAGE even greater than the specified unidentified LEAKAGE limits, the probability is small that the imperfection or crack associated with such RCS Operational LEAKAGE would grow rapidly.

The unidentified LEAKAGE flow limit allows time for corrective action before the RCPB could be significantly compromised. The 5 gpm limit is a small fraction of the calculated flow from a critical crack in the primary system piping. Crack behavior from experimental programs (Refs. 4 and 5) shows leak rates of hundreds of gallons per minute will precede crack instability (Ref. 6).

The low limit on increase in unidentified LEAKAGE assumes a failure mechanism of intergranular stress corrosion cracking (IGSCC) that produces tight cracks. This flow increase limit is capable of providing an early warning of such deterioration.

No applicable safety analysis assumes the total RCS Operational LEAKAGE limit. The total RCS Operational LEAKAGE limit considers RCS inventory makeup capability and drywell floor sump capacity.

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

LCO

RCS Ooperational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

No pressure boundary LEAKAGE, defined as LEAKAGE through a nonisolable fault in an RCS component body, pipe wall, or vessel wall within the reactor coolant pressure boundary defined in 10 CFR 50.2, is allowed, being indicative of material degradation. LEAKAGE of this type is unacceptable as the leak itself could cause further material deterioration, resulting in higher LEAKAGE. If LEAKAGE through a fault in an RCS component body, pipe wall, or vessel wall is isolated, it is no longer considered pressure boundary LEAKAGE. A fault in an RCS component body, pipe wall, or vessel wall is isolated if LEAKAGE through the isolation device is ≤ 0.5 gpm per nominal inch of valve size up to a maximum limit of 5 gpm. This will prevent further material deterioration. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals, and gaskets, valve seats, and mechanical or threaded connections is not pressure boundary LEAKAGE.

b. Unidentified LEAKAGE

Five gpm of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the ~~drywell air monitoring, drywell sump level monitoring, and drywell air cooler condensate flow rate~~ monitoring equipment required by LCO 3.4.7, "RCS Leakage Detection Instrumentation," can detect within a reasonable time period. Violation of this LCO could result in continued degradation of the RCPB.

BASES

LCO (continued)

c. Total LEAKAGE

The total LEAKAGE limit is based on a reasonable minimum detectable amount. The limit also accounts for LEAKAGE from known sources (identified LEAKAGE). Violation of this LCO indicates an unexpected amount of LEAKAGE and, therefore, could indicate new or additional degradation in an RCPB component or system.

d. Unidentified LEAKAGE Increase

An unidentified LEAKAGE increase of > 2 gpm within the previous 4 hour period indicates a potential flaw in the RCPB and must be quickly evaluated to determine the source and extent of the LEAKAGE. The increase is measured relative to the steady state value; temporary changes in LEAKAGE rate as a result of transient conditions (e.g., startup) are not considered. As such, the 2 gpm increase limit is only applicable in MODE 1 when operating pressures and temperatures are established. Violation of this LCO could result in continued degradation of the RCPB.

APPLICABILITY

In MODES 1, 2, and 3, the RCS ~~o~~Operational LEAKAGE LCO applies because the potential for RCPB LEAKAGE is greatest when the reactor is pressurized.

In MODES 4 and 5, RCS ~~o~~Operational LEAKAGE limits are not required since the reactor is not pressurized and stresses in the RCPB materials and potential for RCPB LEAKAGE are reduced.

LCO 3.4.6, "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 Operational 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

With RCS unidentified or total LEAKAGE greater than the limits, actions must be taken to reduce the leak. Because these LEAKAGE limits are conservatively below the LEAKAGE that would constitute a critical crack size, 4 hours is allowed to reduce the RCS Operational LEAKAGE rates before the reactor must be shut down. If an unidentified LEAKAGE has been identified and quantified, it may be reclassified and considered as identified LEAKAGE. However, the total LEAKAGE limit would remain unchanged.

BASES

ACTIONS (continued)

B.1 and B.2

An unidentified LEAKAGE increase of > 2 gpm within a 4 hour period is an indication of a potential flaw in the RCPB and must be quickly evaluated. Although the increase does not necessarily violate the absolute unidentified LEAKAGE limit, certain susceptible components must be determined not to be the source of the LEAKAGE increase within the required Completion Time. For an unidentified LEAKAGE increase greater than required limits, an alternative to reducing LEAKAGE increase to within limits (i.e., reducing the leakage rate such that the current rate is less than the "2 gpm increase in the previous [4] hours" limit; either by isolating the source or other possible methods) is to evaluate RCS type 304 and type 316 austenitic stainless steel piping that is subject to high stress or that contains relatively stagnant or intermittent flow fluids and determine it is not the source of the increased LEAKAGE. This type of piping is very susceptible to IGSCC.

The 4 hour Completion Time is needed to properly reduce the RCS Operational LEAKAGE increase or verify the source before the reactor must be shut down.

C.1 and C.2

If any Required Action and associated Completion Time of Condition A or B is not met or if pressure boundary LEAKAGE exists, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 3 within 12 hours and to MODE 4 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 3.4.5.1

The RCS Operational LEAKAGE is monitored by a variety of instruments designed to provide alarms when RCS Operational LEAKAGE is indicated and to quantify the various types of LEAKAGE. Leakage detection instrumentation is discussed in more detail in the Bases for LCO 3.4.7, "RCS Leakage Detection Instrumentation." ~~Sump level and flow rate are typically monitored to determine actual LEAKAGE rates. However, any method may be used to quantify LEAKAGE within the guidelines of Reference 7.~~ In conjunction with alarms and other administrative controls, an 8 hour Frequency for this Surveillance is appropriate for identifying changes in RCS Operational LEAKAGE and for tracking required trends (Ref. 7~~8~~).

BASES

REFERENCES

1. 10 CFR 50.2.
2. 10 CFR 50.55a(c).
3. 10 CFR 50, Appendix A, GDC 55.
4. GEAP-5620, April 1968.
5. NUREG-76/067, October 1975.
6. FSAR, Section [5.2.5.5.3].
7. ~~Regulatory Guide 1.45.~~

78. Generic Letter 88-01, Supplement 1.