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Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: RAI 440.17 RESPONSE REVISION 2 FOR RCS PRESSURE BOUNDARY  
LEAKAGE

Dear Mr. Quay:

During a June 4 telecon with Messrs. Huffman and Young of the NRC and Messrs. Winters and Lindgren and Robin Nydes of Westinghouse, Westinghouse took the action to revise the response to RAI 440.17 to reflect the Technical Specifications (Tech Specs) 3.4.8 and 3.4.10 LCO changes resulting from Revision 1 of this RAI response. Enclosed are three copies of Revision 2 to the response to NRC Request for Additional Information 440.17 for your review.

This response addresses the following open item tracking system items for DSER chapter 5.2.5 as noted below:

- 172 & 174 Westinghouse action was to provide the required information in the Tech Specs. The Westinghouse status is changed to Action-N for NRC to confirm acceptability of the attached markups. Upon NRC concurrence, the status for Westinghouse and NRC will be changed to Confirm-W with an action to confirm these changes are incorporated into the final Tech Specs being provided in SSAR Revision 14.
- 177 The Westinghouse action to provide a revision to the RAI 440.17 response is accomplished by this letter. The status is now Action-N for NRC to confirm acceptability of the revised response. Upon NRC concurrence, the NRC status will be changed to Resolved (since implementation of the Tech Spec changes will be confirmed by completion of items 172 and 174).

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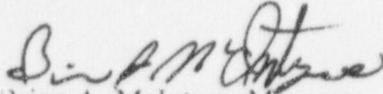
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June 5, 1997

NRC is requested to review this RAI response and provide Westinghouse with status feedback. If you have any questions regarding this transmittal or the AP600 Technical Specifications, please contact Robin Nydes at 412-374-4125.



Brian A. McIntyre, Manager  
Advanced Plant Safety and Licensing

jml

Enclosure

cc: William C. Huffman, NRC (w/Enclosure)  
Ronald M. Young, NRC (w/Enclosure)  
Angela T. Chu, NRC (w/Enclosure)  
Nicholas J. Liparulo, Westinghouse (w/o Enclosure)



Question 410.17 Revision 2

Position C.9 of RG 1.45 states that the technical specifications should address the availability of various types of instruments for RCPB leakage to ensure adequate coverage at all times. Describe how the AP600 design will meet this regulatory position (Section 5.2.5).

Response:

SSAR Chapter 16, Technical Specification 3.4.10 defines the operability requirements for RCS leakage detection instrumentation. This instrumentation, used to identify reactor coolant pressure boundary leakage, is designed so that its operability may be determined at all times. Should a detector fail (signal outside its calibrated range or self-detect trouble), the plant instrumentation system will alarm in the main control room that the specific leak detection display is questionable. The alarm prompts the operators to observe other sensors providing leak detection information. Technical Specification 3.4.10 requires instruments of diverse monitoring methods to be operable to provide a high degree of confidence that small leaks are detected in time to allow actions to place the plant in a safe condition when RCS leakage indicates possible reactor coolant pressure boundary degradation.

The primary methods of detecting leaks during stable plant operating conditions are sump level changes and reactor coolant inventory (pressurizer level) changes. The primary methods for detecting leaks during varying system conditions such as makeup and letdown operations and power transients are sump level changes and N13/F18 detection.

Table 410.17-1 summarizes the validity of the diverse methods of detecting RCPB leakage.

SSAR Revision: Revisions to SSAR Section 5.2.5 and Chapter 16 are attached. *Revision 2 of this RAI response is submitted to provide the complete markup for SSAR Chapter 16; the Revision 1 markup included only the BASES changes for Technical Specification 3.4.10 whereas the LCO changes are included in this revision.*

**NRC REQUEST FOR ADDITIONAL INFORMATION**



Table 410.17-1  
Validity of RCPB Leak Detection Methods

MODES	TITLE	REACTIVITY CONDITION ( $K_{eff}$ )	% RATED THERMAL POWER <sup>(a)</sup>	AVERAGE RCS TEMPERATURE (°F)	Validity of RCPB Leak Detection Method		
					Sump Level (d),(e)	N13/F18	RCS Inventory (g)
1	Power Operation	> 0.99	> 5	NA	Valid	Valid(f)	Valid
2	Startup	> 0.99	< 5	NA	Valid	Invalid	Valid
3	Hot Standby	< 0.99	NA	> 420	Valid	Invalid	Valid
4	Safe Shutdown <sup>(b)</sup>	< 0.99	NA	$420 > T_{avg} > 200$	Valid	Invalid	Valid
5	Cold Shutdown <sup>(b)</sup>	< 0.99	NA	< 200	NA	NA	NA
6	Refueling <sup>(c)</sup>	NA	NA	NA	NA	NA	NA

- (a) Excluding decay heat.
- (b) All reactor vessel head closure bolts fully tensioned.
- (c) One or more reactor vessel head closure bolts less than fully tensioned.
- (d) Sump level change detection of leaks not valid during extremely cold outside conditions when frost forms on interior of containment vessel.
- (e) Leak detection method not valid during containment atmosphere purge operations or within 2 hours of end of purge.
- (f) Power > 20%
- (g) RCS at steady state; i.e. no temp. change, no pressure change, no makeup or letdown.



### 5.2.5 Detection of Leakage Through Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary (RCPB) leakage detection monitoring provides a means of detecting and to the extent practical, identifying the source and quantifying the reactor coolant leakage. The detection monitors perform the detection and monitoring function in conformance with the requirements of General Design Criteria 2 and 30 and the recommendations of Regulatory Guide 1.45. Leakage detection monitoring is also maintained in support of the use of leak-before-break criteria for high-energy pipe in containment. See subsection 3.6.3 for the application of leak-before-break criteria.

Leakage detection monitoring is accomplished using instrumentation and other components of several systems. Diverse measurement methods including level, flow, and radioactivity measurements are used for leak detection. The equipment classification for each of the systems and components used for leak detection is generally determined by the requirements and functions of the system in which it is located. There is no requirement that leak detection and monitoring components be safety-related. See Figure 5.2-1 for the leak detection approach. The descriptions of the instrumentation and components used for leak detection and monitoring include information on the system.

To satisfy position 1 of Regulatory Guide 1.45, reactor coolant pressure boundary leakage is classified as either identified or unidentified leakage. As defined in SSAR Chapter 16.1, Technical Specification Section 1.1, identified leakage includes:

- Leakage such as seal or valve packing seal leaks that are captured and conducted to collection systems or a sump or collecting tank
- RCS leakage through a steam generator to the Secondary System or through the PRHR heat exchanger to the IRWST.
- Leakage into the containment atmosphere from sources that are specifically located and known not to interfere with the operation of leakage detection systems or pressure boundary leakage. (Up to 10 gpm of identified leakage is considered allowable by Technical Specification 3.4.8 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.)

Other leakage is unidentified leakage.



### 5.2.5.1 Collection and Monitoring of Identified Leakage

Identified leakage other than intersystem leakage is collected in the reactor coolant drain tank. The reactor coolant drain tank is a closed tank located in the reactor cavity in the containment. The tank vent is piped to the gaseous radwaste system to prevent release of radioactive gas to the containment atmosphere. For positions 1 and 7 of Regulatory Guide 1.45, the liquid level in the reactor coolant drain tank and total flow pumped out of the reactor coolant drain tank are used to calculate the identified leakage rate. These parameters are available in the main control room. The reactor coolant drain tank, pumps, and sensors are part of the liquid radwaste system. The following sections outline the various sources of identified leakage other than intersystem leakage.

#### 5.2.5.1.1 Valve Stem Leakoff Collection

Valve stem leakoff connections are not provided in the AP600.

#### 5.2.5.1.2 Reactor Head Seal

The reactor vessel flange and head flange are sealed by two concentric seals. Seal leakage is detected by two leak-off connections: one between the inner and outer seal, and one outside the outer seal. These lines are combined in a header before being routed to the reactor coolant drain tank. An isolation valve is installed in the common line. During normal plant operation, the leak-off valves are aligned so that leakage across the inner seal drains to the reactor coolant drain tank.

A surface-mounted resistance temperature detector installed on the bottom of the common reactor vessel seal leak pipe provides an indication and high temperature alarm signal in the main control room indicating the possibility of a reactor pressure vessel head seal leak. The temperature detector and drain line downstream of the isolation valve are part of the liquid radwaste system.

The reactor coolant pump closure flange is sealed with a welded canopy seal and does not require leak-off collection provisions.

Leakage from other flanges is discussed in subsection 5.2.5.3, Collection and Monitoring of Unidentified Leakage.

#### 5.2.5.1.3 Pressurizer Safety Relief and Automatic Depressurization Valves

Temperature is sensed downstream of each pressurizer safety relief valve and each automatic depressurization valve mounted on the pressurizer by a resistance temperature detector on the discharge piping just downstream of each valve. High temperature indications (alarms in the main control room) identify a reduction of coolant inventory as a result of seat leakage through one of the valves. These detectors are part of the reactor coolant system. This leakage is drained to the reactor coolant drain tank during normal plant operation and vented to containment atmosphere or the in-containment refueling water



storage tank during accident conditions. This identified leakage is measured by the change in level of the reactor coolant drain tank.

#### 5.2.5.1.4 Reactor Coolant Pump Drain

Leakage from the reactor coolant pump drain is directed to the reactor coolant drain tank. This identified leakage is measured by the change in level in the reactor coolant drain tank.

#### 5.2.5.1.5 Other Leakage Sources

In the course of plant operation, various minor leaks of the reactor coolant pressure boundary may be detected by operating personnel. If these leaks can be subsequently observed, quantified, and routed to the containment sump, this leakage will be considered identified leakage.

#### 5.2.5.2 Intersystem Leakage Detection

Substantial intersystem leakage from the reactor coolant pressure boundary to other systems is not expected. However, possible leakage points across passive barriers or valves and their detection methods are considered. In accordance with position 4 of Regulatory Guide 1.45, auxiliary systems connected to the reactor coolant pressure boundary incorporate design and administrative provisions that limit leakage. Leakage is detected by increasing auxiliary system level, temperature, flow, or pressure, by lifting the relief valves or increasing the values of monitored radiation in the auxiliary system.

The normal residual heat removal system and the chemical and volume control system, which are connected to the reactor coolant system, have potential for leakage past closed valves. For additional information on the control of reactor coolant leakage into these systems, see subsections 5.4.7 and 9.3.6 and the intersystem LOCA discussion in subsection 1.9.5.1.

#### 5.2.5.2.1 Steam Generator Tubes

An important potential identified leakage path for reactor coolant is through the steam generator tubes into the secondary side of the steam generator. Identified leakage from the steam generator primary side is detected by one, or a combination, of the following:

- High condenser air removal discharge radioactivity, as monitored and alarmed by the turbine island vent discharge radiation monitor
- Steam generator secondary side radioactivity, as monitored and alarmed by the steam generator blowdown radiation monitor
- Secondary side radioactivity, as monitored and alarmed by the main steam line radiation monitors



- Radioactivity, boric acid, or conductivity in condensate as indicated by laboratory analysis

Details on the radiation monitors are provided in Section 11.5, Radiation Monitoring.

#### 5.2.5.2.2 Component Cooling Water System

Leakage from the reactor coolant system to the component cooling water system is detected by the component cooling water system radiation monitor, by increasing surge tank level, by high flow downstream of selected components, or by some combination of the preceding. Refer to Section 11.5, Radiation Monitoring, and subsection 9.2.2, Component Cooling Water System.

#### 5.2.5.3 Collection and Monitoring of Unidentified Leakage

To detect unidentified leakage inside containment, in accordance with position 3 of Regulatory Guide 1.45, the following diverse methods may be utilized to quantify and assist in locating the leakage:

- Containment Sump Level
- Reactor Coolant System Inventory Balance
- Containment Atmosphere Radiation

Other methods that can be employed to supplement the above methods include:

- Containment Atmosphere Pressure, Temperature, and Humidity
- Visual Inspection

The reactor coolant system is an all-welded system, except for the connections on the pressurizer safety valves, reactor vessel head, pressurizer and steam generator manways, and reactor vessel head vent, which are flanged. During normal operation, variations in airborne radioactivity, containment pressure, temperature, or specific humidity above the normal level signify a possible increase in unidentified leakage rates and alert the plant operators that corrective action may be required. Similarly, increases in containment sump level signify an increase in unidentified leakage. The following sections outline the methods used to collect and monitor unidentified leakage.

##### 5.2.5.3.1 Containment Sump Level Monitor

Leakage from the reactor coolant pressure boundary and other components not otherwise identified inside the containment will condense and flow by gravity via the floor drains and other drains to the containment sump.

A leak in the primary system would result in reactor coolant flowing into the containment sump. Leakage is indicated by an increase in the sump level. The containment sump level is monitored by two seismic Category I level sensors in accordance with position 6 of Regulatory Guide 1.45. The level sensors are powered from a safety-related Class 1E electrical source. These sensors remain functional when subjected



to a safe shutdown earthquake in conformance with the guidance in Regulatory Guide 1.45. The containment sump level and sump total flow sensors located on the discharge of the sump pump are part of the liquid radwaste system.

Failure of one of the level sensors will still allow the calculation of a 0.5 gpm in-leakage rate within 1 hour. The data display and processing system (DDS) computes the leakage rate and the plant control system (PLS) provides an alarm in the main control room if the average change in leak rate for any given measurement period exceeds 0.5 gpm for unidentified leakage. *The minimum detectable leak is 0.03 gpm.* Unidentified leakage is the total leakage minus the identified leakage. The leakage rate algorithm subtracts the identified leakage directed to the sump.

To satisfy positions 2 and 5 of Regulatory Guide 1.45, the measurement interval must be long enough to permit the measurement loop to adequately detect the increase in level that would correspond to 0.5 gpm leak rate, and yet short enough to ensure that such a leak rate is detected within an hour. The measurement interval is less than or equal to 1 hour.

When the sump level increases to the high level setpoint, one of the sump pumps automatically starts to pump the accumulated liquid to the waste holdup tanks in the liquid radwaste system. The sump discharge flow is integrated and available for display in the control room in accordance with position 7 of Regulatory Guide 1.45.

Procedures to identify the leakage source upon a change in the unidentified leakage rate into the sump include the following:

- Check for changes in containment atmosphere radiation monitor indications,
- Check for changes in containment humidity, pressure, and temperature,
- Check makeup rate to the reactor coolant system for abnormal increases,
- Check for changes in water levels and other parameters in systems which could leak water into the containment, and
- Review records for maintenance operations which may have discharged water into the containment.





### 5.2.5.3.2 Reactor Coolant System Inventory Balance

Reactor coolant system inventory monitoring provides an indication of system leakage. Net level change in the pressurizer is indicative of system leakage. Monitoring net makeup from the chemical and volume control system and net collected leakage provides an important method of obtaining information to establish a water inventory balance. An abnormal increase in makeup water requirements or a significant change in the water inventory balance can indicate increased system leakage.

The reactor coolant system inventory balance is a quantitative inventory or mass balance calculation. This approach allows determination of both the type and magnitude of leakage. Steady-state operation is required to perform a proper inventory balance calculation. Steady-state is defined as stable reactor coolant system pressure, temperature, power level, pressurizer level, and reactor coolant drain tank and in-containment refueling water storage tank levels. The reactor coolant inventory balance is done on a periodic basis and when other indication and detection methods indicate a change in the leak rate.

The mass balance involves isolating the reactor coolant system to the extent possible and observing the change in inventory which occurs over a known time period. This involves isolating the systems connected to the reactor coolant system. System inventory is determined by observing the level in the pressurizer. Compensation is provided for changes in plant conditions which affect water density. The change in the inventory determines the total reactor coolant system leak rate. Identified leakages are monitored (using the reactor coolant drain tank) to calculate a leakage rate and by monitoring the intersystem leakage. The unidentified leakage rate is then calculated by subtracting the identified leakage rate from the total reactor coolant system leakage rate. *The minimum detectable leak is 0.1 gpm.*

Since the pressurizer inventory is controlled during normal plant operation through the level control system, the level in the pressurizer will be reasonably constant even if leakage exists. The mass contained in the pressurizer may fluctuate sufficiently, however, to have a significant effect on the calculated leak rate. The pressurizer mass calculation includes both the steam and water mass contributions.

Changes in the reactor coolant system mass inventory are a result of changes in liquid density. Liquid density is a strong function of temperature and a lesser function of pressure. A range of temperatures exists throughout the reactor coolant system all of which may vary over time. A simplified, but acceptably accurate, model for determining mass changes is to assume all of the reactor coolant system is at  $T_{Average}$ .

The inventory balance calculation is done by the data display and processing system with additional input from sensors in the protection and safety monitoring system, chemical and volume control system, and liquid radwaste system. The use of components and sensors in systems required for plant operation provides conformance with the regulatory guidance of position 6 in Regulatory Guide 1.45 that leak detection should be provided following seismic events that do not require plant shutdown.



### 5.2.5.3.3 Containment Atmosphere Radioactivity Monitor

Leakage from the reactor coolant pressure boundary will result in an increase in the radioactivity levels inside containment. The containment atmosphere is continuously monitored for airborne gaseous radioactivity. Air flow through the monitor is provided by the suction created by a vacuum pump. Gaseous and  $N_{13}/F_{18}$  concentration monitors indicate radiation concentrations in the containment atmosphere.

~~The gas channel can respond rapidly to reactor coolant pressure boundary leakage.  $N_{13}$  and  $F_{18}$  are neutron activation products which are proportional to power levels. Additionally,  $N_{13}$  has a relatively short half life and consequently will reach equilibrium rapidly. An increase in activity inside containment would therefore indicate a leakage from the reactor coolant pressure boundary. Based on the concentration of  $N_{13}/F_{18}$  and the power level, reactor coolant pressure boundary leakage can be estimated.~~

~~The  $N_{13}/F_{18}$  monitoring system has a high sensitivity when the reactor is operating at a power range higher than 20 percent. The  $N_{13}$  and  $F_{18}$  monitor is seismic Category I. Conformance with the position 6 guidance of Regulatory Guide 1.45 that leak detection should be provided following seismic events that do not require plant shutdown is provided by the seismic Category I classification. Safety-related Class 1E power is not required since loss of power to the radiation monitor is not consistent with continuing operation following an earthquake. Above 20 percent power level, in one hour, a leak less than 0.5 gpm can be detected. Operating experience has indicated the average long-term leakage (from sampling losses, collected leakoffs, and unidentified leakage to the containment) from the reactor coolant system ranges between 0.1 and 0.3 gpm. The  $N_{13}$  concentration will increase by at least 25 percent above an existing 0.1 gpm leakage background and almost 10 percent for an existing 0.3 gpm leakage. Both increases are well within the sensitivity of the  $N_{13}/F_{18}$  monitor capabilities.~~

Radioactivity concentration indication and alarms for loss of sample flow, high radiation, and loss of indication are provided. Sample collection connections permit sample collection for laboratory analysis. The radiation monitor can be calibrated during power operation.

### 5.2.5.3.4 Containment Pressure, Temperature and Humidity Monitors

Reactor coolant pressure boundary leakage increases containment pressure, temperature, and humidity, values available to the operator through the plant control system. *At full power the minimum detectable leak is 0.1 gpm when the radionuclide concentration in containment reaches equilibrium. The  $N_{13}$  and  $F_{18}$  monitor can detect a 0.5 gpm leak when the plant is above 20% power and the concentration of radiogas in containment is at equilibrium.*

An increase in containment pressure is an indication of increased leakage or a high energy line break. Containment pressure is monitored by redundant Class 1E pressure transmitters. For additional discussion see subsection 6.2.2, Passive Containment Cooling System.



The containment average temperature is monitored using temperature instrumentation at the inlet to the containment fan cooler as an indication of increased leakage or a high energy line break. This instrumentation as well as temperature instruments within specific areas including steam generator areas, pressurizer area, and containment compartments are part of the containment recirculation cooling system.

An increase in the containment average temperature combined with an increase in containment pressure indicate increased leakage or a high energy line break. The individual compartment area temperatures can assist in identifying the location of the leak.

Containment humidity is monitored using temperature-compensated humidity detectors which determine the water-vapor content of the containment atmosphere. An increase in the containment atmosphere humidity indicates release of water vapor within the containment. The containment humidity monitors are part of the containment leak rate test system.

The humidity monitors supplement the containment sump level monitors and are most sensitive under conditions when there is no condensation. A rapid increase of humidity over the ambient value by more than 10 percent is indication of a probable leak.

Containment pressure, temperature and humidity can assist in identifying and locating a leak. They are not relied on to quantify a leak.



3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 RCS Operational LEAKAGE

LCO 3.4.8 RCS operational LEAKAGE shall be limited to:

- a. No pressure boundary LEAKAGE
- b. 0.5 gpm unidentified LEAKAGE,
- c. 10 gpm identified LEAKAGE from the RCS,
- d. 1000 gallons per day total primary to secondary LEAKAGE through both steam generators (SGs),
- e. 500 gallons per day primary to secondary LEAKAGE through any one SG, and
- f. 500 gallons per day primary to IRWST LEAKAGE through the passive residual heat removal heat exchanger (PRHR HX).

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. RCS LEAKAGE not within limits for reasons other than pressure boundary LEAKAGE.	A.1 Reduce LEAKAGE to within limits.	<del>4</del> <sup>575 3.4.13</sup> <del>8</del> hours A.1
B. Required Action and associated Completion Time not met.  <u>OR</u>  Pressure boundary LEAKAGE exists.	B.1 Be in MODE 3.  <u>AND</u>  B.2 Be in MODE 5.	<del>6</del> <del>8</del> hours  <del>36</del> <del>48</del> hours

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
3.4.8

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.4.8.1 -----NOTE----- Not required to be performed in MODE 3 and 4 until 12 hours of steady state operation. ----- Perform a RCS water inventory balance.	-----NOTE----- Only required to be performed during steady state operation. ----- 72 hours
SR 3.4.8.2 Verify steam generator tube integrity is in accordance with the Steam Generator Tube Surveillance Program.	In accordance with the Steam Generator Tube Surveillance Program



## B 3.4 REACTOR COOLANT SYSTEM (RCS)

## B 3.4.8 RCS Operational LEAKAGE

## BASES

## BACKGROUND

Components that contain or transport the coolant to or from the reactor core comprise 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 LEAKAGE.

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

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring RCS 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).

(continued)



NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

BASES (continued)

APPLICABLE SAFETY ANALYSES

Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses 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 a 1000 gpd primary to secondary LEAKAGE as the initial condition.

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 leak contaminates the secondary fluid.

The SSAR (Ref. 3) analyses for the accidents involving secondary side releases assume 500 gpd primary to secondary LEAKAGE in each generator as an initial condition. ~~The dose consequences resulting from the accidents are reported in Reference 3.~~

The RCS operational LEAKAGE satisfies Criterion 2 of the NRC Policy Statement.

The design basis radiological consequences resulting from a postulated SLB accident and SGTR are provided in Sections 15.1.5 and 15.6.3 of the AP600 SSAR (Ref. 3).

LCO

RCS operation LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

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

b. Unidentified LEAKAGE

*N13/F18* — 0.5 gpm of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air radioactivity monitoring and containment sump level monitoring equipment, can detect within a reasonable time period. This leak rate supports leak before break (LBB) criteria. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

(continued)



BASES

LCO  
(continued)

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. Violation of this LCO could result in continued degradation of a component or system.

d. Primary to Secondary LEAKAGE through Both Steam Generators (SGs)

Total primary to secondary LEAKAGE through both SGs amounting to 1000 gpd produces acceptable offsite doses in the Steam Line Break (SLB) accident analysis. Violation of this LCO could exceed the offsite dose limits for this accident. Primary to secondary LEAKAGE must be included in the total allowable limit for identified LEAKAGE.

e. Primary-to-Secondary LEAKAGE through One SG

The 500 gpd limit from one SG is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line rupture.

f. Primary to IRWST LEAKAGE through the PRHR Heat Exchanger HX

The 500 gpd limit from the PRHR HX is based on the assumption that a single crack leaking this amount would not lead to a PRHR tube rupture under the stress condition of an RCS pressure increase event. If leaked through many cracks, the cracks are very small, and the above assumption is conservative. This is conservative because the thickness of the PRHR HX tubes is approximately 60% greater than the thickness of the SG tubes. Furthermore, a PRHR HX tube rupture would result in an isolable leak and would not lead to a direct release of radioactivity to the atmosphere.

(continued)

# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

## BASES (continued)

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

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

## ACTIONS

### A.1

Unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE in excess of the LCO limits must be reduced to within limits within 8 hours. This Completion Time is based on risk considerations and allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

### B.1 and B.2

If any pressure boundary LEAKAGE exists, or if unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE cannot be reduced to within limits within 8 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that leakage past seal and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to MODE 3 within 8 hours and to MODE 5 within 8 hours. This action reduces the LEAKAGE and also reduces the factors which 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 ACTIONS 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 3.4.8.1

Verifying RCS LEAKAGE 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.

(continued)



BASES

SURVEILLANCE  
REQUIREMENTS

SR 3.4.8.1 (continued)

Unidentified LEAKAGE and identified LEAKAGE are determined by performance of a RCS water inventory balance. Primary to secondary LEAKAGE is also measured by performance of an RCS water inventory balance in conjunction with effluent monitoring within the secondary steam and feedwater systems.

The RCS water inventory balance must be met with the reactor at steady state operating conditions and near operating pressure. Therefore, this SR is not required to be performed in MODES 3 and 4 until 12 hours of steady state operation near operating pressure have been established.

Steady state operation is required to perform a proper inventory balance; calculations during maneuvering are not useful and a Note requires the Surveillance to be met when steady state is established. For RCS operational LEAKAGE determination by inventory balance, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, and makeup <sup>OR</sup> ~~and~~ letdown. <sub>WITH NO</sub>

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems <sup>N13/F18</sup> that monitor the containment atmosphere <sup>radioactivity</sup> 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 3.4.10, "RCS LEAKAGE Detection Instrumentation."

INSERT 1 ->

The 72 hour Frequency is a reasonable interval to trend LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents. A Note under the Frequency column states that this SR is required to be performed during steady state operation.

SR 3.4.8.2

This SR provides the means necessary to determine SG OPERABILITY in an operational MODE. The requirement to demonstrate SG tube integrity in accordance with the Steam Generator Tube Surveillance Program emphasizes the importance of SG tube integrity, even though this Surveillance cannot be performed at normal operating conditions.

(continued)

# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

## BASES

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### REFERENCES

1. 10 CFR 50, Appendix A GDC 30.
  2. Regulatory Guide 1.45, May 1973.
  3. AP600 SSAR, Chapter 15, "Accident Analysis."
- 

AP600  
BASES 3.4.8

### INSERT 1

The containment atmosphere N13/F18 radioactivity leakage measurement is valid only for plant power > 20% RTP.

The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is forming in the interior of the containment vessel.

 AP600  
AP01:refProject1 8030408\_r08-080298

B 3.4-37

08/96 Amendment 0

410.17-18  
Rev. 2



Westinghouse



3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.10 RCS Leakage Detection Instrumentation

LCO 3.4.10 The following RCS leakage detection instrumentation shall be OPERABLE:

- a. One containment sump level channel;
- b. One containment atmosphere radioactivity monitor (gaseous N13/F18).

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

NOTE  
THE N13/F18 CONTAINMENT ATMOSPHERE RADIOACTIVITY MONITOR IS ONLY REQUIRED TO BE OPERABLE IN MODE 1 WITH RTP > 20%.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required containment sump channel inoperable.	-----NOTE----- LCO 3.0.4 is not applicable. -----	ETS 3.4.15 A.2
	A.1 Perform SR 3.4.8.1 (RCS inventory balance).	Once per 24 hours
	<u>AND</u> A.2 Restore containment sump channel to OPERABLE status.	30 DAYS <del>168 hours</del>

(continued)

NOTE  
MEASUREMENTS MADE BY OPERABLE SUMP LEVEL INSTRUMENTS CAN BE RENDERED INEFFECTIVE, IF LEAKAGE IS PREVENTED FROM REACHING THE SUMP SUCH AS BY REDIRECTION TO THE IRWST BY THE CONTAINMENT SUMP GUTTER SYSTEM.

# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
3.4.10

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required containment atmosphere radioactivity monitor inoperable.	-----NOTE----- LCO 3.0.4 is not applicable. -----	<i>STS 3.4.15 B.2</i>
	B.1.1 Analyze grab samples of containment atmosphere.  <u>OR</u> B.1.2 Perform SR 3.4.8.1.  <u>AND</u> B.2 Restore containment atmosphere radioactivity monitor to OPERABLE status.	Once per 24 hours  Once per 24 hours  <i>30 days <del>168 hours</del></i>
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.  <u>AND</u>	<i>6 8</i> hours
	C.2 Be in MODE <sup>5</sup> <del>4</del> .	<i>36 24</i> hours





# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

## BASES (continued)

**APPLICABLE SAFETY ANALYSES** The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify with indications from other systems is necessary. The system response times and sensitivities are described in the SSAR (Ref. 2).

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

RCS LEAKAGE detection instrumentation satisfies Criterion 1 of the NRC Policy Statement.

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

The LCO is satisfied when monitors of diverse measurement means are available. Thus, the containment sump monitor, in combination with an N13/F18 gaseous activity monitor provides an acceptable minimum. <sup>LEVEL</sup>

INSERT A →

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

In MODE 5 or 6, the temperature is  $\leq 200^\circ\text{F}$  and pressure is maintained low or at atmospheric pressure. Since the temperatures and pressures are lower than those for MODES 1, 2, 3, and 4, the likelihood of leakage and crack propagation are much smaller. Therefore, the requirements of this LCO are not applicable in MODES 5 and 6.

INSERT B →

(continued)

# NRC REQUEST FOR ADDITIONAL INFORMATION



AP600  
BASES 3.4.10

INSERTS PAGE 3.4.42

- A. Containment sump level monitoring is performed by two redundant seismically qualified level instruments. *THE LCO NOTE CLARIFIES THAT IF LEAKAGE IS PREVENTED FROM REACHING THE SWAMP, MEASUREMENTS MADE BY OPERABLE SWAMP LEVEL MONITOR INSTRUMENTS WILL NOT BE VALID.*
- B. Sump level monitoring is a valid method for MODES 1, 2, 3, and 4. Containment atmosphere N13/F18 monitoring is valid only in MODE 1 with reactor power > 20% RTP. RCS inventory monitoring via the pressurizer level changes is valid in MODES 1, 2, 3, and 4 only when RCS conditions are stable, i.e., temperature constant, pressure constant, no makeup and no letdown.
- The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.
- The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.
- The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is forming in the interior of the containment vessel.





BASES (continued)

ACTIONS

A.1 and A.2

LEVEL

With the required containment sump channel inoperable, no other form of sampling can provide the equivalent information; however, the containment atmosphere N13/F18 radioactivity monitor will provide indications of changes in LEAKAGE. Together with the atmosphere monitor, the periodic surveillance for RCS inventory balance, SR 3.4.8.1, must be performed at an increased frequency of 24 hours to provide information that is adequate to detect LEAKAGE.

Restoration of the sump channel to OPERABLE status is required to regain the function in a Completion Time of ~~168 hours~~ 30 DAYS after the monitor's failure. This time is acceptable, considering the frequency and adequacy of the RCS inventory balance required by Action A.1.

Required Action A.1 is modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the containment sump channel is inoperable. This allowance is provided because other instrumentation is available to monitor RCS Leakage.

B.1.1, B.1.2, and B.2

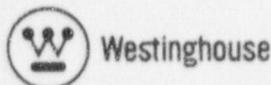
With one gaseous N13/F18 containment atmosphere radioactivity-monitoring instrumentation channel inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or RCS inventory balanced, in accordance with SR 3.4.8.1, must be performed to provide alternate periodic information.

With a sample obtained and analyzed or an RCS inventory balance performed every 24 hours, the reactor may be an RCS operated for up to ~~168 hours~~ 30 DAYS to allow restoration of the radioactivity monitor.

The 24 hours interval for grab samples or RCS inventory balance provides periodic information that is adequate to detect LEAKAGE. The ~~168 hours~~ Completion Time recognizes at least one other form of leak detection is available.

30 DAY

(continued)



# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

BASES

ACTIONS

B.1.1, B.1.2, and B.2 (continued)

Required Action B.1 and Required Action B.2 are modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the gaseous N13/F18 containment atmosphere radioactivity monitor channel is inoperable. This allowance is provided because other instrumentation is available to monitor for RCS LEAKAGE.

C.1 and C.2

If a Required Action of Condition A or B cannot be met within the required Completion Time, the reactor must be brought to MODE ~~4~~ where the probability and consequences of an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within ~~8~~ hours to MODE ~~4~~ <sup>5</sup> within ~~24~~ 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 without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.10.1

SR 3.4.10.1 requires the performance of a CHANNEL CHECK of the containment atmosphere radioactivity monitor. The check gives reasonable confidence that the channel is operating properly. The Frequency of ~~24~~ hours is based on instrument reliability and risk and is reasonable for detecting off normal conditions.

SR 3.4.10.2

SR 3.4.10.2 requires the performance of a CHANNEL OPERATIONAL TEST (COT) on the atmosphere radioactivity monitor. The test ensures that the monitor can perform its function in the desired manner. The test verifies the alarm setpoint and relative accuracy of the instrument string. The Frequency of 92 days considers risks and instrument reliability, and operating experience has shown that it is proper for detecting degradation.

(continued)

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

BASES

SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.4.10.3 and SR 3.4.10.4

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

REFERENCES

1. 10 CFR 50, Appendix A, Section IV, GDC 30.
2. Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary LEAKAGE Detection Systems," U.S. Nuclear Regulatory Commission.
3. AP600 SSAR Chapter 15, "Accident Analysis."

## NRC REQUEST FOR ADDITIONAL INFORMATION



Question 410.17 Revision 2

Position C.9 of RG 1.45 states that the technical specifications should address the availability of various types of instruments for RCPB leakage to ensure adequate coverage at all times. Describe how the AP600 design will meet this regulatory position (Section 5.2.5).

Response:

SSAR Chapter 16, Technical Specification 3.4.10 defines the operability requirements for RCS leakage detection instrumentation. This instrumentation, used to identify reactor coolant pressure boundary leakage, is designed so that its operability may be determined at all times. Should a detector fail (signal outside its calibrated range or self-detect trouble), the plant instrumentation system will alarm in the main control room that the specific leak detection display is questionable. The alarm prompts the operators to observe other sensors providing leak detection information. Technical Specification 3.4.10 requires instruments of diverse monitoring methods to be operable to provide a high degree of confidence that small leaks are detected in time to allow actions to place the plant in a safe condition when RCS leakage indicates possible reactor coolant pressure boundary degradation.

The primary methods of detecting leaks during stable plant operating conditions are sump level changes and reactor coolant inventory (pressurizer level) changes. The primary methods for detecting leaks during varying system conditions such as makeup and letdown operations and power transients are sump level changes and N13/F18 detection.

Table 410.17-1 summarizes the validity of the diverse methods of detecting RCPB leakage.

SSAR Revision: Revisions to SSAR Section 5.2.5 and Chapter 16 are attached. *Revision 2 of this RAI response is submitted to provide the complete markup for SSAR Chapter 16; the Revision 1 markup included only the BASES changes for Technical Specification 3.4.10 whereas the LCO changes are included in this revision.*

**NRC REQUEST FOR ADDITIONAL INFORMATION**



Table 410.17-1  
Validity of RCPB Leak Detection Methods

MODES	TITLE	REACTIVITY CONDITION ( $K_{eff}$ )	% RATED THERMAL POWER <sup>(a)</sup>	AVERAGE RCS TEMPERATURE (°F)	Validity of RCPB Leak Detection Method		
					Sump Level (d),(e)	N13/F18	RCS Inventory (g)
1	Power Operation	> 0.99	> 5	NA	Valid	Valid(f)	Valid
2	Startup	> 0.99	< 5	NA	Valid	Invalid	Valid
3	Hot Standby	< 0.99	NA	> 420	Valid	Invalid	Valid
4	Safe Shutdown <sup>(b)</sup>	< 0.99	NA	$420 > T_{avg} > 200$	Valid	Invalid	Valid
5	Cold Shutdown <sup>(b)</sup>	< 0.99	NA	< 200	NA	NA	NA
6	Refueling <sup>(c)</sup>	NA	NA	NA	NA	NA	NA

- (a) Excluding decay heat.
- (b) All reactor vessel head closure bolts fully tensioned.
- (c) One or more reactor vessel head closure bolts less than fully tensioned.
- (d) Sump level change detection of leaks not valid during extremely cold outside conditions when frost forms on interior of containment vessel.
- (e) Leak detection method not valid during containment atmosphere purge operations or within 2 hours of end of purge.
- (f) Power > 20%
- (g) RCS at steady state; i.e. no temp. change, no pressure change, no makeup or letdown.



### 5.2.5 Detection of Leakage Through Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary (RCPB) leakage detection monitoring provides a means of detecting and to the extent practical, identifying the source and quantifying the reactor coolant leakage. The detection monitors perform the detection and monitoring function in conformance with the requirements of General Design Criteria 2 and 30 and the recommendations of Regulatory Guide 1.45. Leakage detection monitoring is also maintained in support of the use of leak-before-break criteria for high-energy pipe in containment. See subsection 3.6.3 for the application of leak-before-break criteria.

Leakage detection monitoring is accomplished using instrumentation and other components of several systems. Diverse measurement methods including level, flow, and radioactivity measurements are used for leak detection. The equipment classification for each of the systems and components used for leak detection is generally determined by the requirements and functions of the system in which it is located. There is no requirement that leak detection and monitoring components be safety-related. See Figure 5.2-1 for the leak detection approach. The descriptions of the instrumentation and components used for leak detection and monitoring include information on the system.

To satisfy position 1 of Regulatory Guide 1.45, reactor coolant pressure boundary leakage is classified as either identified or unidentified leakage. As defined in SSAR Chapter 16.1, Technical Specification Section 1.1, identified leakage includes:

- Leakage such as seal or valve packing seal leaks that are captured and conducted to collection systems or a sump or collecting tank
- RCS leakage through a steam generator to the Secondary System or through the PRHR heat exchanger to the IRWST.
- Leakage into the containment atmosphere from sources that are specifically located and known not to interfere with the operation of leakage detection systems or pressure boundary leakage. (Up to 10 gpm of identified leakage is considered allowable by Technical Specification 3.4.8 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.)

Other leakage is unidentified leakage.



### 5.2.5.1 Collection and Monitoring of Identified Leakage

Identified leakage other than intersystem leakage is collected in the reactor coolant drain tank. The reactor coolant drain tank is a closed tank located in the reactor cavity in the containment. The tank vent is piped to the gaseous radwaste system to prevent release of radioactive gas to the containment atmosphere. For positions 1 and 7 of Regulatory Guide 1.45, the liquid level in the reactor coolant drain tank and total flow pumped out of the reactor coolant drain tank are used to calculate the identified leakage rate. These parameters are available in the main control room. The reactor coolant drain tank, pumps, and sensors are part of the liquid radwaste system. The following sections outline the various sources of identified leakage other than intersystem leakage.

#### 5.2.5.1.1 Valve Stem Leakoff Collection

Valve stem leakoff connections are not provided in the AP600.

#### 5.2.5.1.2 Reactor Head Seal

The reactor vessel flange and head flange are sealed by two concentric seals. Seal leakage is detected by two leak-off connections: one between the inner and outer seal, and one outside the outer seal. These lines are combined in a header before being routed to the reactor coolant drain tank. An isolation valve is installed in the common line. During normal plant operation, the leak-off valves are aligned so that leakage across the inner seal drains to the reactor coolant drain tank.

A surface-mounted resistance temperature detector installed on the bottom of the common reactor vessel seal leak pipe provides an indication and high temperature alarm signal in the main control room indicating the possibility of a reactor pressure vessel head seal leak. The temperature detector and drain line downstream of the isolation valve are part of the liquid radwaste system.

The reactor coolant pump closure flange is sealed with a welded canopy seal and does not require leak-off collection provisions.

Leakage from other flanges is discussed in subsection 5.2.5.3, Collection and Monitoring of Unidentified Leakage.

#### 5.2.5.1.3 Pressurizer Safety Relief and Automatic Depressurization Valves

Temperature is sensed downstream of each pressurizer safety relief valve and each automatic depressurization valve mounted on the pressurizer by a resistance temperature detector on the discharge piping just downstream of each valve. High temperature indications (alarms in the main control room) identify a reduction of coolant inventory as a result of seat leakage through one of the valves. These detectors are part of the reactor coolant system. This leakage is drained to the reactor coolant drain tank during normal plant operation and vented to containment atmosphere or the in-containment refueling water





storage tank during accident conditions. This identified leakage is measured by the change in level of the reactor coolant drain tank.

#### 5.2.5.1.4 Reactor Coolant Pump Drain

Leakage from the reactor coolant pump drain is directed to the reactor coolant drain tank. This identified leakage is measured by the change in level in the reactor coolant drain tank.

#### 5.2.5.1.5 Other Leakage Sources

In the course of plant operation, various minor leaks of the reactor coolant pressure boundary may be detected by operating personnel. If these leaks can be subsequently observed, quantified, and routed to the containment sump, this leakage will be considered identified leakage.

#### 5.2.5.2 Intersystem Leakage Detection

Substantial intersystem leakage from the reactor coolant pressure boundary to other systems is not expected. However, possible leakage points across passive barriers or valves and their detection methods are considered. In accordance with position 4 of Regulatory Guide 1.45, auxiliary systems connected to the reactor coolant pressure boundary incorporate design and administrative provisions that limit leakage. Leakage is detected by increasing auxiliary system level, temperature, flow, or pressure, by lifting the relief valves or increasing the values of monitored radiation in the auxiliary system.

The normal residual heat removal system and the chemical and volume control system, which are connected to the reactor coolant system, have potential for leakage past closed valves. For additional information on the control of reactor coolant leakage into these systems, see subsections 5.4.7 and 9.3.6 and the intersystem LOCA discussion in subsection 1.9.5.1.

#### 5.2.5.2.1 Steam Generator Tubes

An important potential identified leakage path for reactor coolant is through the steam generator tubes into the secondary side of the steam generator. Identified leakage from the steam generator primary side is detected by one, or a combination, of the following:

- High condenser air removal discharge radioactivity, as monitored and alarmed by the turbine island vent discharge radiation monitor
- Steam generator secondary side radioactivity, as monitored and alarmed by the steam generator blowdown radiation monitor
- Secondary side radioactivity, as monitored and alarmed by the main steam line radiation monitors



- Radioactivity, boric acid, or conductivity in condensate as indicated by laboratory analysis

Details on the radiation monitors are provided in Section 11.5, Radiation Monitoring.

#### 5.2.5.2.2 Component Cooling Water System

Leakage from the reactor coolant system to the component cooling water system is detected by the component cooling water system radiation monitor, by increasing surge tank level, by high flow downstream of selected components, or by some combination of the preceding. Refer to Section 11.5, Radiation Monitoring, and subsection 9.2.2, Component Cooling Water System.

#### 5.2.5.3 Collection and Monitoring of Unidentified Leakage

To detect unidentified leakage inside containment, in accordance with position 3 of Regulatory Guide 1.45, the following diverse methods may be utilized to quantify and assist in locating the leakage:

- Containment Sump Level
- Reactor Coolant System Inventory Balance
- Containment Atmosphere Radiation

Other methods that can be employed to supplement the above methods include:

- Containment Atmosphere Pressure, Temperature, and Humidity
- Visual Inspection

The reactor coolant system is an all-welded system, except for the connections on the pressurizer safety valves, reactor vessel head, pressurizer and steam generator manways, and reactor vessel head vent, which are flanged. During normal operation, variations in airborne radioactivity, containment pressure, temperature, or specific humidity above the normal level signify a possible increase in unidentified leakage rates and alert the plant operators that corrective action may be required. Similarly, increases in containment sump level signify an increase in unidentified leakage. The following sections outline the methods used to collect and monitor unidentified leakage.

#### 5.2.5.3.1 Containment Sump Level Monitor

Leakage from the reactor coolant pressure boundary and other components not otherwise identified inside the containment will condense and flow by gravity via the floor drains and other drains to the containment sump.

A leak in the primary system would result in reactor coolant flowing into the containment sump. Leakage is indicated by an increase in the sump level. The containment sump level is monitored by two seismic Category I level sensors in accordance with position 6 of Regulatory Guide 1.45. The level sensors are powered from a safety-related Class 1E electrical source. These sensors remain functional when subjected



to a safe shutdown earthquake in conformance with the guidance in Regulatory Guide 1.45. The containment sump level and sump total flow sensors located on the discharge of the sump pump are part of the liquid radwaste system.

Failure of one of the level sensors will still allow the calculation of a 0.5 gpm in-leakage rate within 1 hour. The data display and processing system (DDS) computes the leakage rate and the plant control system (PLS) provides an alarm in the main control room if the average change in leak rate for any given measurement period exceeds 0.5 gpm for unidentified leakage. *The minimum detectable leak is 0.03 gpm.* Unidentified leakage is the total leakage minus the identified leakage. The leakage rate algorithm subtracts the identified leakage directed to the sump.

To satisfy positions 2 and 5 of Regulatory Guide 1.45, the measurement interval must be long enough to permit the measurement loop to adequately detect the increase in level that would correspond to 0.5 gpm leak rate, and yet short enough to ensure that such a leak rate is detected within an hour. The measurement interval is less than or equal to 1 hour.

When the sump level increases to the high level setpoint, one of the sump pumps automatically starts to pump the accumulated liquid to the waste holdup tanks in the liquid radwaste system. The sump discharge flow is integrated and available for display in the control room in accordance with position 7 of Regulatory Guide 1.45.

Procedures to identify the leakage source upon a change in the unidentified leakage rate into the sump include the following:

- Check for changes in containment atmosphere radiation monitor indications,
- Check for changes in containment humidity, pressure, and temperature,
- Check makeup rate to the reactor coolant system for abnormal increases,
- Check for changes in water levels and other parameters in systems which could leak water into the containment, and
- Review records for maintenance operations which may have discharged water into the containment.



### 5.2.5.3.2 Reactor Coolant System Inventory Balance

Reactor coolant system inventory monitoring provides an indication of system leakage. Net level change in the pressurizer is indicative of system leakage. Monitoring net makeup from the chemical and volume control system and net collected leakage provides an important method of obtaining information to establish a water inventory balance. An abnormal increase in makeup water requirements or a significant change in the water inventory balance can indicate increased system leakage.

The reactor coolant system inventory balance is a quantitative inventory or mass balance calculation. This approach allows determination of both the type and magnitude of leakage. Steady-state operation is required to perform a proper inventory balance calculation. Steady-state is defined as stable reactor coolant system pressure, temperature, power level, pressurizer level, and reactor coolant drain tank and in-containment refueling water storage tank levels. The reactor coolant inventory balance is done on a periodic basis and when other indication and detection methods indicate a change in the leak rate.

The mass balance involves isolating the reactor coolant system to the extent possible and observing the change in inventory which occurs over a known time period. This involves isolating the systems connected to the reactor coolant system. System inventory is determined by observing the level in the pressurizer. Compensation is provided for changes in plant conditions which affect water density. The change in the inventory determines the total reactor coolant system leak rate. Identified leakages are monitored (using the reactor coolant drain tank) to calculate a leakage rate and by monitoring the intersystem leakage. The unidentified leakage rate is then calculated by subtracting the identified leakage rate from the total reactor coolant system leakage rate. *The minimum detectable leak is 0.1 gpm.*

Since the pressurizer inventory is controlled during normal plant operation through the level control system, the level in the pressurizer will be reasonably constant even if leakage exists. The mass contained in the pressurizer may fluctuate sufficiently, however, to have a significant effect on the calculated leak rate. The pressurizer mass calculation includes both the steam and water mass contributions.

Changes in the reactor coolant system mass inventory are a result of changes in liquid density. Liquid density is a strong function of temperature and a lesser function of pressure. A range of temperatures exists throughout the reactor coolant system all of which may vary over time. A simplified, but acceptably accurate, model for determining mass changes is to assume all of the reactor coolant system is at  $T_{Average}$ .

The inventory balance calculation is done by the data display and processing system with additional input from sensors in the protection and safety monitoring system, chemical and volume control system, and liquid radwaste system. The use of components and sensors in systems required for plant operation provides conformance with the regulatory guidance of position 6 in Regulatory Guide 1.45 that leak detection should be provided following seismic events that do not require plant shutdown.





### 5.2.5.3.3 Containment Atmosphere Radioactivity Monitor

Leakage from the reactor coolant pressure boundary will result in an increase in the radioactivity levels inside containment. The containment atmosphere is continuously monitored for airborne gaseous radioactivity. Air flow through the monitor is provided by the suction created by a vacuum pump. Gaseous and  $N_{13}/F_{18}$  concentration monitors indicate radiation concentrations in the containment atmosphere.

~~The gas channel can respond rapidly to reactor coolant pressure boundary leakage.  $N_{13}$  and  $F_{18}$  are is a neutron activation products which ~~is are~~ proportional to power levels. Additionally,  $N_{13}$  has a relatively short half life and consequently will reach equilibrium rapidly.~~ An increase in activity inside containment would therefore indicate a leakage from the reactor coolant pressure boundary. Based on the concentration of  $N_{13}/F_{18}$  and the power level, reactor coolant pressure boundary leakage can be estimated.

~~The  $N_{13}/F_{18}$  monitoring system has a high sensitivity when the reactor is operating at a power range higher than 20 percent. The  $N_{13}$  and  $F_{18}$  monitor is seismic Category I. Conformance with the position 6 guidance of Regulatory Guide 1.45 that leak detection should be provided following seismic events that do not require plant shutdown is provided by the seismic Category I classification. Safety-related Class 1E power is not required since loss of power to the radiation monitor is not consistent with continuing operation following an earthquake. Above 20 percent power level, in one hour, a leak less than 0.5 gpm can be detected. Operating experience has indicated the average long-term leakage (from sampling losses, collected leakoffs, and unidentified leakage to the containment) from the reactor coolant system ranges between 0.1 and 0.3 gpm. The  $N_{13}$  concentration will increase by at least 25 percent above an existing 0.1 gpm leakage background and almost 10 percent for an existing 0.3 gpm leakage. Both increases are well within the sensitivity of the  $N_{13}/F_{18}$  monitor capabilities.~~

Radioactivity concentration indication and alarms for loss of sample flow, high radiation, and loss of indication are provided. Sample collection connections permit sample collection for laboratory analysis. The radiation monitor can be calibrated during power operation.

### 5.2.5.3.4 Containment Pressure, Temperature and Humidity Monitors

Reactor coolant pressure boundary leakage increases containment pressure, temperature, and humidity, values available to the operator through the plant control system. *At full power the minimum detectable leak is 0.1 gpm when the radionuclide concentration in containment reaches equilibrium. The  $N_{13}$  and  $F_{18}$  monitor can detect a 0.5 gpm leak when the plant is above 20% power and the concentration of radiogas in containment is at equilibrium.*

An increase in containment pressure is an indication of increased leakage or a high energy line break. Containment pressure is monitored by redundant Class 1E pressure transmitters. For additional discussion see subsection 6.2.2, Passive Containment Cooling System.

## NRC REQUEST FOR ADDITIONAL INFORMATION



The containment average temperature is monitored using temperature instrumentation at the inlet to the containment fan cooler as an indication of increased leakage or a high energy line break. This instrumentation as well as temperature instruments within specific areas including steam generator areas, pressurizer area, and containment compartments are part of the containment recirculation cooling system.

An increase in the containment average temperature combined with an increase in containment pressure indicate increased leakage or a high energy line break. The individual compartment area temperatures can assist in identifying the location of the leak.

Containment humidity is monitored using temperature-compensated humidity detectors which determine the water-vapor content of the containment atmosphere. An increase in the containment atmosphere humidity indicates release of water vapor within the containment. The containment humidity monitors are part of the containment leak rate test system.

The humidity monitors supplement the containment sump level monitors and are most sensitive under conditions when there is no condensation. A rapid increase of humidity over the ambient value by more than 10 percent is indication of a probable leak.

Containment pressure, temperature and humidity can assist in identifying and locating a leak. They are not relied on to quantify a leak.



3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 RCS Operational LEAKAGE

LCO 3.4.8 RCS operational LEAKAGE shall be limited to:

- a. No pressure boundary LEAKAGE
- b. 0.5 gpm unidentified LEAKAGE,
- c. 10 gpm identified LEAKAGE from the RCS,
- d. 1000 gallons per day total primary to secondary LEAKAGE through both steam generators (SGs),
- e. 500 gallons per day primary to secondary LEAKAGE through any one SG, and
- f. 500 gallons per day primary to IRWST LEAKAGE through the passive residual heat removal heat exchanger (PRHR HX).

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. RCS LEAKAGE not within limits for reasons other than pressure boundary LEAKAGE.	A.1 Reduce LEAKAGE to within limits.	4 8 hours <sup>575 3.4.13</sup> A.1
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	6 8 hours
<u>OR</u>	<u>AND</u>	
Pressure boundary LEAKAGE exists.	B.2 Be in MODE 5.	36 48 hours

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
3.4.8

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.4.8.1 -----NOTE----- Not required to be performed in MODE 3 and 4 until 12 hours of steady state operation. -----  Perform a RCS water inventory balance.	-----NOTE----- Only required to be performed during steady state operation. -----  72 hours
SR 3.4.8.2 Verify steam generator tube integrity is in accordance with the Steam Generator Tube Surveillance Program.	In accordance with the Steam Generator Tube Surveillance Program



## B 3.4 REACTOR COOLANT SYSTEM (RCS)

## B 3.4.8 RCS Operational LEAKAGE

## BASES

## BACKGROUND

Components that contain or transport the coolant to or from the reactor core comprise 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 LEAKAGE.

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

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring RCS 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).

(continued)

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

BASES (continued)

APPLICABLE SAFETY ANALYSES

Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses 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 a 1000 gpd primary to secondary LEAKAGE as the initial condition.

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 leak contaminates the secondary fluid.

The SSAR (Ref. 3) analyses for the accidents involving secondary side releases assume 500 gpd primary to secondary LEAKAGE in each generator as an initial condition. ~~The dose consequences resulting from the accidents are reported in Reference 3.~~

The RCS operational LEAKAGE satisfies Criterion 2 of the NRC Policy Statement.

The design basis radiological consequences resulting from a postulated SLB accident and SGTR are provided in Sections 15.1.5 and 15.6.3 of the AP600 SSAR (Ref. 3).

LCO

RCS operation LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

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

b. Unidentified LEAKAGE

0.5 gpm of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air, radioactivity monitoring and containment sump level monitoring equipment, can detect within a reasonable time period. This leak rate supports leak before break (LBB) criteria. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

(continued)



BASES

LCO  
(continued)

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. Violation of this LCO could result in continued degradation of a component or system.

d. Primary to Secondary LEAKAGE through Both Steam Generators (SGs)

Total primary to secondary LEAKAGE through both SGs amounting to 1000 gpd produces acceptable offsite doses in the Steam Line Break (SLB) accident analysis. Violation of this LCO could exceed the offsite dose limits for this accident. Primary to secondary LEAKAGE must be included in the total allowable limit for identified LEAKAGE.

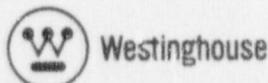
e. Primary-to-Secondary LEAKAGE through One SG

The 500 gpd limit from one SG is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line rupture.

f. Primary to IRWST LEAKAGE through the PRHR Heat Exchanger HX

The 500 gpd limit from the PRHR HX is based on the assumption that a single crack leaking this amount would not lead to a PRHR tube rupture under the stress condition of an RCS pressure increase event. If leaked through many cracks, the cracks are very small, and the above assumption is conservative. This is conservative because the thickness of the PRHR HX tubes is approximately 60% greater than the thickness of the SG tubes. Furthermore, a PRHR HX tube rupture would result in an isolable leak and would not lead to a direct release of radioactivity to the atmosphere.

(continued)



# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

BASES (continued)

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

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

ACTIONS

A.1

Unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE in excess of the LCO limits must be reduced to within limits within 8 hours. This Completion Time is based on risk considerations and allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

B.1 and B.2

If any pressure boundary LEAKAGE exists, or if unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE cannot be reduced to within limits within 8 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that leakage past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to MODE 3 within 8 hours and to MODE 5 within 8 hours. This action reduces the LEAKAGE and also reduces the factors which 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 ACTIONS 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 3.4.8.1

Verifying RCS LEAKAGE 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.

(continued)

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

BASES

SURVEILLANCE  
REQUIREMENTS

SR 3.4.8.1 (continued)

Unidentified LEAKAGE and identified LEAKAGE are determined by performance of a RCS water inventory balance. Primary to secondary LEAKAGE is also measured by performance of an RCS water inventory balance in conjunction with effluent monitoring within the secondary steam and feedwater systems.

The RCS water inventory balance must be met with the reactor at steady state operating conditions and near operating pressure. Therefore, this SR is not required to be performed in MODES 3 and 4 until 12 hours of steady state operation near operating pressure have been established.

Steady state operation is required to perform a proper inventory balance; calculations during maneuvering are not useful and a Note requires the Surveillance to be met when steady state is established. For RCS operational LEAKAGE determination by inventory balance, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, and makeup ~~and~~ <sup>WITH NO</sup> letdown. <sup>OR</sup>

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems <sup>NIS/FIB</sup> that monitor the containment atmosphere <sup>radioactivity</sup> 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 LCD 3.4.10, "RCS LEAKAGE Detection Instrumentation."

INSERT 1 ->

The 72 hour Frequency is a reasonable interval to trend LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents. A Note under the Frequency column states that this SR is required to be performed during steady state operation.

SR 3.4.8.2

This SR provides the means necessary to determine SG OPERABILITY in an operational MODE. The requirement to demonstrate SG tube integrity in accordance with the Steam Generator Tube Surveillance Program emphasizes the importance of SG tube integrity, even though this Surveillance cannot be performed at normal operating conditions.

(continued)





RCS Leakage Detection Instrumentation  
3.4.10

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.10 RCS Leakage Detection Instrumentation

LCO 3.4.10 The following RCS leakage detection instrumentation shall be OPERABLE:

- a. One containment sump level channel;
- b. One containment atmosphere radioactivity monitor (gaseous N13/F18).

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

NOTE  
THE N13/F18 CONTAINMENT ATMOSPHERE RADIOACTIVITY MONITOR IS ONLY REQUIRED TO BE OPERABLE IN MODE 1 WITH RTP > 20%.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required containment sump channel inoperable.	-----NOTE----- LCO 3.0.4 is not applicable. -----	STS 3.4.15 A.2
	A.1 Perform SR 3.4.8.1 (RCS inventory balance).	Once per 24 hours
	<u>AND</u> A.2 Restore containment sump channel to OPERABLE status.	30 DAYS <del>168 HOURS</del>

(continued)

NOTE  
MEASUREMENTS MADE BY OPERABLE SUMP LEVEL INSTRUMENTS CAN BE RENDERED INEFFECTIVE, IF LEAKAGE IS PREVENTED FROM REACHING THE SUMP SUCH AS BY REDIRECTION TO THE IRWST BY THE CONTAINMENT SHELL GUTTER SYSTEM.

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
3.4.10

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>B. Required containment atmosphere radioactivity monitor inoperable.</p>	<p>-----NOTE-----                      LCO 3.0.4 is not applicable.                      -----</p> <p>B.1.1 Analyze grab samples of containment atmosphere.</p> <p><u>OR</u></p> <p>B.1.2 Perform SR 3.4.8.1.</p> <p><u>AND</u></p> <p>B.2 Restore containment atmosphere radioactivity monitor to OPERABLE status.</p>	<p>575 3.4.15 B.2</p> <p>Once per 24 hours</p> <p>Once per 24 hours</p> <p>30 days <del>168 hours</del></p>
<p>C. Required Action and associated Completion Time not met.</p>	<p>C.1 Be in MODE 3.</p> <p><u>AND</u></p> <p>C.2 Be in MODE <sup>5</sup> 4.</p>	<p><sup>6</sup> 8 hours</p> <p>36 24 hours</p>

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
3.4.10

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.10.1	Perform a CHANNEL CHECK of required containment atmosphere radioactivity monitor.	12 hours <sup>STS</sup> <del>24</del> hours <sup>SR3.4.15.1</sup>
SR 3.4.10.2	Perform an <sup>COT</sup> CHANNEL OPERATIONAL TEST of required containment atmosphere radioactivity monitor.	92 days
SR 3.4.10.3	Perform a CHANNEL CALIBRATION of required containment sump monitor.	24 months
SR 3.4.10.4	Perform a CHANNEL CALIBRATION of required containment atmosphere radioactivity monitor.	24 months

# MRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

## B 3.4 REACTOR COOLANT SYSTEM (RCS) B 3.4.10 RCS Leakage Detection Instrumentation

### BASES

#### BACKGROUND

GDC 30 of Appendix A to 10CFR50 (Ref. 1) requires means for detecting, and, to the extent practical, identifying the source of RCS LEAKAGE. Regulatory Guide 1.45 (Ref. 2) describes acceptable methods for selecting LEAKAGE detection systems.

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

Industry practice has shown that water flow changes of 0.5 gpm can be readily detected in contained volumes by monitoring changes in water level, in flow rate, or in the operating frequency of a pump. The containment sump used to collect unidentified LEAKAGE, is instrumented to alarm for increases of 0.5 gpm in the normal flow rates. This sensitivity is acceptable for detecting increases in unidentified LEAKAGE.

Reactor coolant radioactivity used for leak detection is the decay of N13/F18.

REPLACE WITH

AND F18

F18 has a longer half life and is the dominant source used for leak detection.

The reactor coolant contains radioactivity that, when released to the containment, can be detected by radiation monitoring instrumentation. Reactor coolant radioactivity levels will be low during initial reactor startup and for a few weeks thereafter, until activated corrosion products have been formed and fission products appear from fuel element cladding contamination or cladding defects. The production of N13 is proportional to the reactor power level. N13 has a short half life and comes to equilibrium quickly. Instrument sensitivities for gaseous monitoring are practical for these LEAKAGE detection systems. The Radiation Monitoring System includes monitoring N13/F18 gaseous activities to provide leak detection.

(continued)



BASES (continued)

APPLICABLE SAFETY ANALYSES

The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify with indications from other systems is necessary. The system response times and sensitivities are described in the SSAR (Ref. 2).

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

RCS LEAKAGE detection instrumentation satisfies Criterion 1 of the NRC Policy Statement.

LCO

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

The LCO is satisfied when monitors of diverse measurement means are available. Thus, the containment sump monitor, in combination with an N13/F18 gaseous activity monitor provides an acceptable minimum.

INSERT A →

APPLICABILITY

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

In MODE 5 or 6, the temperature is  $\leq 200^\circ\text{F}$  and pressure is maintained low or at atmospheric pressure. Since the temperatures and pressures are lower than those for MODES 1, 2, 3, and 4, the likelihood of leakage and crack propagation are much smaller. Therefore, the requirements of this LCO are not applicable in MODES 5 and 6.

INSERT B →

(continued)



AP600  
BASES 3.4.10

INSERTS PAGE 3.4-42

A. Containment sump level monitoring is performed by two redundant seismically qualified level instruments. *THE LCO NOTE CLARIFIES THAT IF LEAKAGE IS PREVENTED FROM REACHING THE SWAMP, MEASUREMENTS MADE BY OPERABLE SWAMP LEVEL MONITORS WILL NOT BE VALID.*

B. Sump level monitoring is a valid method for MODES 1, 2, 3, and 4. Containment atmosphere N13/F18 monitoring is valid only in MODE 1 with reactor power > 20% RTP. RCS inventory monitoring via the pressurizer level changes is valid in MODES 1, 2, 3, and 4 only when RCS conditions are stable, i.e., temperature constant, pressure constant, no makeup and no letdown.

The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is forming in the interior of the containment vessel.



BASES (continued)

ACTIONS

A.1 and A.2

With the required containment sump channel inoperable, no other form of sampling can provide the equivalent information; however, the containment atmosphere <sup>LEVEL</sup> N13/F18 radioactivity monitor will provide indications of changes in LEAKAGE. Together with the atmosphere monitor, the periodic surveillance for RCS inventory balance, SR 3.4.8.1, must be performed at an increased frequency of 24 hours to provide information that is adequate to detect LEAKAGE.

Restoration of the sump channel to OPERABLE status is required to regain the function in a Completion Time of <sup>30 DAYS</sup> ~~168 hours~~ after the monitor's failure. This time is acceptable, considering the frequency and adequacy of the RCS inventory balance required by Action A.1.

Required Action A.1 is modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the containment sump channel is inoperable. This allowance is provided because other instrumentation is available to monitor RCS Leakage.

B.1.1, B.1.2, and B.2

With one gaseous N13/F18 containment atmosphere radioactivity-monitoring instrumentation channel inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or RCS inventory balanced, in accordance with SR 3.4.8.1, must be performed to provide alternate periodic information.

With a sample obtained and analyzed or an RCS inventory balance performed every 24 hours, the reactor may be an RCS operated for up to ~~168 hours~~ <sup>30 DAYS</sup> to allow restoration of the radioactivity monitor.

The 24 hours interval for grab samples or RCS inventory balance provides periodic information that is adequate to detect LEAKAGE. The ~~168 hours~~ <sup>30 DAY</sup> Completion Time recognizes at least one other form of leak detection is available.

(continued)

# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

## BASES

### ACTIONS

B.1.1, B.1.2, and B.2 (continued)

Required Action B.1 and Required Action B.2 are modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the gaseous N13/F18 containment atmosphere radioactivity monitor channel is inoperable. This allowance is provided because other instrumentation is available to monitor for RCS LEAKAGE.

C.1 and C.2

If a Required Action of Condition A or B cannot be met within the required Completion Time, the reactor must be brought to MODE 4 where the probability and consequences of an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within 8 hours to MODE 5 within 24 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 without challenging plant systems.

### SURVEILLANCE REQUIREMENTS

SR 3.4.10.1

SR 3.4.10.1 requires the performance of a CHANNEL CHECK of the containment atmosphere radioactivity monitor. The check gives reasonable confidence that the channel is operating properly. The Frequency of 24 hours is based on instrument reliability and risk and is reasonable for detecting off normal conditions.

SR 3.4.10.2

SR 3.4.10.2 requires the performance of a CHANNEL OPERATIONAL TEST (COT) on the atmosphere radioactivity monitor. The test ensures that the monitor can perform its function in the desired manner. The test verifies the alarm setpoint and relative accuracy of the instrument string. The Frequency of 92 days considers risks and instrument reliability, and operating experience has shown that it is proper for detecting degradation.

(continued)

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

BASES

SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.4.10.3 and SR 3.4.10.4

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

REFERENCES

1. 10 CFR 50, Appendix A, Section IV, GDC 30.
2. Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary LEAKAGE Detection Systems," U.S. Nuclear Regulatory Commission.
3. AP600 SSAR Chapter 15, "Accident Analysis."



Question 410.17 Revision 2

Position C.9 of RG 1.45 states that the technical specifications should address the availability of various types of instruments for RCPB leakage to ensure adequate coverage at all times. Describe how the AP600 design will meet this regulatory position (Section 5.2.5).

Response:

SSAR Chapter 16, Technical Specification 3.4.10 defines the operability requirements for RCS leakage detection instrumentation. This instrumentation, used to identify reactor coolant pressure boundary leakage, is designed so that its operability may be determined at all times. Should a detector fail (signal outside its calibrated range or self-detect trouble), the plant instrumentation system will alarm in the main control room that the specific leak detection display is questionable. The alarm prompts the operators to observe other sensors providing leak detection information. Technical Specification 3.4.10 requires instruments of diverse monitoring methods to be operable to provide a high degree of confidence that small leaks are detected in time to allow actions to place the plant in a safe condition when RCS leakage indicates possible reactor coolant pressure boundary degradation.

The primary methods of detecting leaks during stable plant operating conditions are sump level changes and reactor coolant inventory (pressurizer level) changes. The primary methods for detecting leaks during varying system conditions such as makeup and letdown operations and power transients are sump level changes and N13/F18 detection.

Table 410.17-1 summarizes the validity of the diverse methods of detecting RCPB leakage.

SSAR Revision: Revisions to SSAR Section 5.2.5 and Chapter 16 are attached. *Revision 2 of this RAI response is submitted to provide the complete markup for SSAR Chapter 16; the Revision 1 markup included only the BASES changes for Technical Specification 3.4.10 whereas the LCO changes are included in this revision.*

**NRC REQUEST FOR ADDITIONAL INFORMATION**



Table 410.17-1  
Validity of RCPB Leak Detection Methods

MODES	TITLE	REACTIVITY CONDITION ( $K_{eff}$ )	% RATED THERMAL POWER <sup>(a)</sup>	AVERAGE RCS TEMPERATURE (°F)	Validity of RCPB Leak Detection Method		
					Sump Level (d),(e)	N13/F18	RCS Inventory (g)
1	Power Operation	> 0.99	> 5	NA	Valid	Valid(f)	Valid
2	Startup	> 0.99	< 5	NA	Valid	Invalid	Valid
3	Hot Standby	< 0.99	NA	> 420	Valid	Invalid	Valid
4	Safe Shutdown <sup>(b)</sup>	< 0.99	NA	$420 > T_{avg} > 200$	Valid	Invalid	Valid
5	Cold Shutdown <sup>(b)</sup>	< 0.99	NA	< 200	NA	NA	NA
6	Refueling <sup>(c)</sup>	NA	NA	NA	NA	NA	NA

- (a) Excluding decay heat.
- (b) All reactor vessel head closure bolts fully tensioned.
- (c) One or more reactor vessel head closure bolts less than fully tensioned.
- (d) Sump level change detection of leaks not valid during extremely cold outside conditions when frost forms on interior of containment vessel.
- (e) Leak detection method not valid during containment atmosphere purge operations or within 2 hours of end of purge.
- (f) Power > 20%
- (g) RCS at steady state; i.e. no temp. change, no pressure change, no makeup or letdown.



### 5.2.5 Detection of Leakage Through Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary (RCPB) leakage detection monitoring provides a means of detecting and to the extent practical, identifying the source and quantifying the reactor coolant leakage. The detection monitors perform the detection and monitoring function in conformance with the requirements of General Design Criteria 2 and 30 and the recommendations of Regulatory Guide 1.45. Leakage detection monitoring is also maintained in support of the use of leak-before-break criteria for high-energy pipe in containment. See subsection 3.6.3 for the application of leak-before-break criteria.

Leakage detection monitoring is accomplished using instrumentation and other components of several systems. Diverse measurement methods including level, flow, and radioactivity measurements are used for leak detection. The equipment classification for each of the systems and components used for leak detection is generally determined by the requirements and functions of the system in which it is located. There is no requirement that leak detection and monitoring components be safety-related. See Figure 5.2-1 for the leak detection approach. The descriptions of the instrumentation and components used for leak detection and monitoring include information on the system.

To satisfy position 1 of Regulatory Guide 1.45, reactor coolant pressure boundary leakage is classified as either identified or unidentified leakage. As defined in SSAR Chapter 16.1, Technical Specification Section 1.1, identified leakage includes:

- Leakage such as seal or valve packing seal leaks that are captured and conducted to collection systems or a sump or collecting tank
- RCS leakage through a steam generator to the Secondary System or through the PRHR heat exchanger to the IRWST.
- Leakage into the containment atmosphere from sources that are specifically located and known not to interfere with the operation of leakage detection systems or pressure boundary leakage. (Up to 10 gpm of identified leakage is considered allowable by Technical Specification 3.4.8 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.)

Other leakage is unidentified leakage.



### 5.2.5.1 Collection and Monitoring of Identified Leakage

Identified leakage other than intersystem leakage is collected in the reactor coolant drain tank. The reactor coolant drain tank is a closed tank located in the reactor cavity in the containment. The tank vent is piped to the gaseous radwaste system to prevent release of radioactive gas to the containment atmosphere. For positions 1 and 7 of Regulatory Guide 1.45, the liquid level in the reactor coolant drain tank and total flow pumped out of the reactor coolant drain tank are used to calculate the identified leakage rate. These parameters are available in the main control room. The reactor coolant drain tank, pumps, and sensors are part of the liquid radwaste system. The following sections outline the various sources of identified leakage other than intersystem leakage.

#### 5.2.5.1.1 Valve Stem Leakoff Collection

Valve stem leakoff connections are not provided in the AP600.

#### 5.2.5.1.2 Reactor Head Seal

The reactor vessel flange and head flange are sealed by two concentric seals. Seal leakage is detected by two leak-off connections: one between the inner and outer seal, and one outside the outer seal. These lines are combined in a header before being routed to the reactor coolant drain tank. An isolation valve is installed in the common line. During normal plant operation, the leak-off valves are aligned so that leakage across the inner seal drains to the reactor coolant drain tank.

A surface-mounted resistance temperature detector installed on the bottom of the common reactor vessel seal leak pipe provides an indication and high temperature alarm signal in the main control room indicating the possibility of a reactor pressure vessel head seal leak. The temperature detector and drain line downstream of the isolation valve are part of the liquid radwaste system.

The reactor coolant pump closure flange is sealed with a welded canopy seal and does not require leak-off collection provisions.

Leakage from other flanges is discussed in subsection 5.2.5.3, Collection and Monitoring of Unidentified Leakage.

#### 5.2.5.1.3 Pressurizer Safety Relief and Automatic Depressurization Valves

Temperature is sensed downstream of each pressurizer safety relief valve and each automatic depressurization valve mounted on the pressurizer by a resistance temperature detector on the discharge piping just downstream of each valve. High temperature indications (alarms in the main control room) identify a reduction of coolant inventory as a result of seat leakage through one of the valves. These detectors are part of the reactor coolant system. This leakage is drained to the reactor coolant drain tank during normal plant operation and vented to containment atmosphere or the in-containment refueling water



storage tank during accident conditions. This identified leakage is measured by the change in level of the reactor coolant drain tank.

#### 5.2.5.1.4 Reactor Coolant Pump Drain

Leakage from the reactor coolant pump drain is directed to the reactor coolant drain tank. This identified leakage is measured by the change in level in the reactor coolant drain tank.

#### 5.2.5.1.5 Other Leakage Sources

In the course of plant operation, various minor leaks of the reactor coolant pressure boundary may be detected by operating personnel. If these leaks can be subsequently observed, quantified, and routed to the containment sump, this leakage will be considered identified leakage.

#### 5.2.5.2 Intersystem Leakage Detection

Substantial intersystem leakage from the reactor coolant pressure boundary to other systems is not expected. However, possible leakage points across passive barriers or valves and their detection methods are considered. In accordance with position 4 of Regulatory Guide 1.45, auxiliary systems connected to the reactor coolant pressure boundary incorporate design and administrative provisions that limit leakage. Leakage is detected by increasing auxiliary system level, temperature, flow, or pressure, by lifting the relief valves or increasing the values of monitored radiation in the auxiliary system.

The normal residual heat removal system and the chemical and volume control system, which are connected to the reactor coolant system, have potential for leakage past closed valves. For additional information on the control of reactor coolant leakage into these systems, see subsections 5.4.7 and 9.3.6 and the intersystem LOCA discussion in subsection 1.9.5.1.

#### 5.2.5.2.1 Steam Generator Tubes

An important potential identified leakage path for reactor coolant is through the steam generator tubes into the secondary side of the steam generator. Identified leakage from the steam generator primary side is detected by one, or a combination, of the following:

- High condenser air removal discharge radioactivity, as monitored and alarmed by the turbine island vent discharge radiation monitor
- Steam generator secondary side radioactivity, as monitored and alarmed by the steam generator blowdown radiation monitor
- Secondary side radioactivity, as monitored and alarmed by the main steam line radiation monitors



- Radioactivity, boric acid, or conductivity in condensate as indicated by laboratory analysis

Details on the radiation monitors are provided in Section 11.5, Radiation Monitoring.

#### 5.2.5.2.2 Component Cooling Water System

Leakage from the reactor coolant system to the component cooling water system is detected by the component cooling water system radiation monitor, by increasing surge tank level, by high flow downstream of selected components, or by some combination of the preceding. Refer to Section 11.5, Radiation Monitoring, and subsection 9.2.2, Component Cooling Water System.

#### 5.2.5.3 Collection and Monitoring of Unidentified Leakage

To detect unidentified leakage inside containment, in accordance with position 3 of Regulatory Guide 1.45, the following diverse methods may be utilized to quantify and assist in locating the leakage:

- Containment Sump Level
- Reactor Coolant System Inventory Balance
- Containment Atmosphere Radiation

Other methods that can be employed to supplement the above methods include:

- Containment Atmosphere Pressure, Temperature, and Humidity
- Visual Inspection

The reactor coolant system is an all-welded system, except for the connections on the pressurizer safety valves, reactor vessel head, pressurizer and steam generator manways, and reactor vessel head vent, which are flanged. During normal operation, variations in airborne radioactivity, containment pressure, temperature, or specific humidity above the normal level signify a possible increase in unidentified leakage rates and alert the plant operators that corrective action may be required. Similarly, increases in containment sump level signify an increase in unidentified leakage. The following sections outline the methods used to collect and monitor unidentified leakage.

##### 5.2.5.3.1 Containment Sump Level Monitor

Leakage from the reactor coolant pressure boundary and other components not otherwise identified inside the containment will condense and flow by gravity via the floor drains and other drains to the containment sump.

A leak in the primary system would result in reactor coolant flowing into the containment sump. Leakage is indicated by an increase in the sump level. The containment sump level is monitored by two seismic Category I level sensors in accordance with position 6 of Regulatory Guide 1.45. The level sensors are powered from a safety-related Class 1E electrical source. These sensors remain functional when subjected



to a safe shutdown earthquake in conformance with the guidance in Regulatory Guide 1.45. The containment sump level and sump total flow sensors located on the discharge of the sump pump are part of the liquid radwaste system.

Failure of one of the level sensors will still allow the calculation of a 0.5 gpm in-leakage rate within 1 hour. The data display and processing system (DDS) computes the leakage rate and the plant control system (PLS) provides an alarm in the main control room if the average change in leak rate for any given measurement period exceeds 0.5 gpm for unidentified leakage. *The minimum detectable leak is 0.03 gpm.* Unidentified leakage is the total leakage minus the identified leakage. The leakage rate algorithm subtracts the identified leakage directed to the sump.

To satisfy positions 2 and 5 of Regulatory Guide 1.45, the measurement interval must be long enough to permit the measurement loop to adequately detect the increase in level that would correspond to 0.5 gpm leak rate, and yet short enough to ensure that such a leak rate is detected within an hour. The measurement interval is less than or equal to 1 hour.

When the sump level increases to the high level setpoint, one of the sump pumps automatically starts to pump the accumulated liquid to the waste holdup tanks in the liquid radwaste system. The sump discharge flow is integrated and available for display in the control room in accordance with position 7 of Regulatory Guide 1.45.

Procedures to identify the leakage source upon a change in the unidentified leakage rate into the sump include the following:

- Check for changes in containment atmosphere radiation monitor indications,
- Check for changes in containment humidity, pressure, and temperature,
- Check makeup rate to the reactor coolant system for abnormal increases,
- Check for changes in water levels and other parameters in systems which could leak water into the containment, and
- Review records for maintenance operations which may have discharged water into the containment.



### 5.2.5.3.2 Reactor Coolant System Inventory Balance

Reactor coolant system inventory monitoring provides an indication of system leakage. Net level change in the pressurizer is indicative of system leakage. Monitoring net makeup from the chemical and volume control system and net collected leakage provides an important method of obtaining information to establish a water inventory balance. An abnormal increase in makeup water requirements or a significant change in the water inventory balance can indicate increased system leakage.

The reactor coolant system inventory balance is a quantitative inventory or mass balance calculation. This approach allows determination of both the type and magnitude of leakage. Steady-state operation is required to perform a proper inventory balance calculation. Steady-state is defined as stable reactor coolant system pressure, temperature, power level, pressurizer level, and reactor coolant drain tank and in-containment refueling water storage tank levels. The reactor coolant inventory balance is done on a periodic basis and when other indication and detection methods indicate a change in the leak rate.

The mass balance involves isolating the reactor coolant system to the extent possible and observing the change in inventory which occurs over a known time period. This involves isolating the systems connected to the reactor coolant system. System inventory is determined by observing the level in the pressurizer. Compensation is provided for changes in plant conditions which affect water density. The change in the inventory determines the total reactor coolant system leak rate. Identified leakages are monitored (using the reactor coolant drain tank) to calculate a leakage rate and by monitoring the intersystem leakage. The unidentified leakage rate is then calculated by subtracting the identified leakage rate from the total reactor coolant system leakage rate. *The minimum detectable leak is 0.1 gpm.*

Since the pressurizer inventory is controlled during normal plant operation through the level control system, the level in the pressurizer will be reasonably constant even if leakage exists. The mass contained in the pressurizer may fluctuate sufficiently, however, to have a significant effect on the calculated leak rate. The pressurizer mass calculation includes both the steam and water mass contributions.

Changes in the reactor coolant system mass inventory are a result of changes in liquid density. Liquid density is a strong function of temperature and a lesser function of pressure. A range of temperatures exists throughout the reactor coolant system all of which may vary over time. A simplified, but acceptably accurate, model for determining mass changes is to assume all of the reactor coolant system is at  $T_{Average}$ .

The inventory balance calculation is done by the data display and processing system with additional input from sensors in the protection and safety monitoring system, chemical and volume control system, and liquid radwaste system. The use of components and sensors in systems required for plant operation provides conformance with the regulatory guidance of position 6 in Regulatory Guide 1.45 that leak detection should be provided following seismic events that do not require plant shutdown.





### 5.2.5.3.3 Containment Atmosphere Radioactivity Monitor

Leakage from the reactor coolant pressure boundary will result in an increase in the radioactivity levels inside containment. The containment atmosphere is continuously monitored for airborne gaseous radioactivity. Air flow through the monitor is provided by the suction created by a vacuum pump. Gaseous and  $N_{13}/F_{18}$  concentration monitors indicate radiation concentrations in the containment atmosphere.

~~The gas channel can respond rapidly to reactor coolant pressure boundary leakage.  $N_{13}$  and  $F_{18}$  are is a neutron activation products which ~~is are~~ proportional to power levels. Additionally,  $N_{13}$  has a relatively short half life and consequently will reach equilibrium rapidly.~~ An increase in activity inside containment would therefore indicate a leakage from the reactor coolant pressure boundary. Based on the concentration of  $N_{13}/F_{18}$  and the power level, reactor coolant pressure boundary leakage can be estimated.

~~The  $N_{13}/F_{18}$  monitoring system has a high sensitivity when the reactor is operating at a power range higher than 20 percent. The  $N_{13}$  and  $F_{18}$  monitor is seismic Category I. Conformance with the position 6 guidance of Regulatory Guide 1.45 that leak detection should be provided following seismic events that do not require plant shutdown is provided by the seismic Category I classification. Safety-related Class 1E power is not required since loss of power to the radiation monitor is not consistent with continuing operation following an earthquake. Above 20 percent power level, in one hour, a leak less than 0.5 gpm can be detected. Operating experience has indicated the average long term leakage (from sampling losses, collected leakoffs, and unidentified leakage to the containment) from the reactor coolant system ranges between 0.1 and 0.3 gpm. The  $N_{13}$  concentration will increase by at least 25 percent above an existing 0.1 gpm leakage background and almost 10 percent for an existing 0.3 gpm leakage. Both increases are well within the sensitivity of the  $N_{13}/F_{18}$  monitor capabilities.~~

Radioactivity concentration indication and alarms for loss of sample flow, high radiation, and loss of indication are provided. Sample collection connections permit sample collection for laboratory analysis. The radiation monitor can be calibrated during power operation.

### 5.2.5.3.4 Containment Pressure, Temperature and Humidity Monitors

Reactor coolant pressure boundary leakage increases containment pressure, temperature, and humidity, values available to the operator through the plant control system. *At full power the minimum detectable leak is 0.1 gpm when the radionuclide concentration in containment reaches equilibrium. The  $N_{13}$  and  $F_{18}$  monitor can detect a 0.5 gpm leak when the plant is above 20% power and the concentration of radiogas in containment is at equilibrium.*

An increase in containment pressure is an indication of increased leakage or a high energy line break. Containment pressure is monitored by redundant Class 1E pressure transmitters. For additional discussion see subsection 6.2.2, Passive Containment Cooling System.

## NRC REQUEST FOR ADDITIONAL INFORMATION



The containment average temperature is monitored using temperature instrumentation at the inlet to the containment fan cooler as an indication of increased leakage or a high energy line break. This instrumentation as well as temperature instruments within specific areas including steam generator areas, pressurizer area, and containment compartments are part of the containment recirculation cooling system.

An increase in the containment average temperature combined with an increase in containment pressure indicate increased leakage or a high energy line break. The individual compartment area temperatures can assist in identifying the location of the leak.

Containment humidity is monitored using temperature-compensated humidity detectors which determine the water-vapor content of the containment atmosphere. An increase in the containment atmosphere humidity indicates release of water vapor within the containment. The containment humidity monitors are part of the containment leak rate test system.

The humidity monitors supplement the containment sump level monitors and are most sensitive under conditions when there is no condensation. A rapid increase of humidity over the ambient value by more than 10 percent is indication of a probable leak.

Containment pressure, temperature and humidity can assist in identifying and locating a leak. They are not relied on to quantify a leak.

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
3.4.8

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 RCS Operational LEAKAGE

LCO 3.4.8 RCS operational LEAKAGE shall be limited to:

- a. No pressure boundary LEAKAGE
- b. 0.5 gpm unidentified LEAKAGE,
- c. 10 gpm identified LEAKAGE from the RCS,
- d. 1000 gallons per day total primary to secondary LEAKAGE through both steam generators (SGs),
- e. 500 gallons per day primary to secondary LEAKAGE through any one SG, and
- f. 500 gallons per day primary to IRWST LEAKAGE through the passive residual heat removal heat exchanger (PRHR HX).

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. RCS LEAKAGE not within limits for reasons other than pressure boundary LEAKAGE.	A.1 Reduce LEAKAGE to within limits.	<sup>4</sup> / <sub>8</sub> hours <i>575 3.4.13 A.1</i>
B. Required Action and associated Completion Time not met.  <u>OR</u>  Pressure boundary LEAKAGE exists.	B.1 Be in MODE 3.  <u>AND</u>  B.2 Be in MODE 5.	<sup>6</sup> / <sub>8</sub> hours  <sup>36</sup> / <sub>48</sub> hours

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
3.4.8

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.4.8.1 -----NOTE----- Not required to be performed in MODE 3 and 4 until 12 hours of steady state operation. ----- Perform a RCS water inventory balance.	-----NOTE----- Only required to be performed during steady state operation. ----- 72 hours
SR 3.4.8.2 Verify steam generator tube integrity is in accordance with the Steam Generator Tube Surveillance Program.	In accordance with the Steam Generator Tube Surveillance Program



B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.8 RCS Operational LEAKAGE

BASES

BACKGROUND

Components that contain or transport the coolant to or from the reactor core comprise 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 LEAKAGE.

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

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring RCS 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).

(continued)

# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

BASES (continued)

APPLICABLE  
SAFETY ANALYSES

Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses 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 a 1000 gpd primary to secondary LEAKAGE as the initial condition.

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 leak contaminates the secondary fluid.

The design basis radiological consequences resulting from a postulated SLB accident and SGTR are provided in Sections 15.1.5 and 15.6.3 of the AP600 SSAR (Ref. 3).

The SSAR (Ref. 3) analyses for the accidents involving secondary side releases assume 500 gpd primary to secondary LEAKAGE in each generator as an initial condition. ~~The dose consequences resulting from the accidents are reported in Reference 3.~~

The RCS operational LEAKAGE satisfies Criterion 2 of the NRC Policy Statement.

LCO

RCS operation LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

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

b. Unidentified LEAKAGE

*N13/F18* 0.5 gpm of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air, radioactivity monitoring and containment sump level monitoring equipment, can detect within a reasonable time period. This leak rate supports leak before break (LBB) criteria. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

(continued)



# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

BASES (continued)

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

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

ACTIONS

A.1

Unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE in excess of the LCO limits must be reduced to within limits within 8 hours. This Completion Time is based on risk considerations and allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

B.1 and B.2

If any pressure boundary LEAKAGE exists, or if unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE cannot be reduced to within limits within 8 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that leakage past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to MODE 3 within 8 hours and to MODE 5 within 8 hours. This action reduces the LEAKAGE and also reduces the factors which 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 ACTIONS 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 3.4.8.1

Verifying RCS LEAKAGE 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.

(continued)



# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Operational LEAKAGE  
B 3.4.8

## BASES

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### REFERENCES

1. 10 CFR 50, Appendix A GDC 30.
  2. Regulatory Guide 1.45, May 1973.
  3. AP600 SSAR, Chapter 15, "Accident Analysis."
- 

AP600  
BASES 3.4.8

### INSERT /

The containment atmosphere N13/F18 radioactivity leakage measurement is valid only for plant power > 20% RTP.

The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is forming in the interior of the containment vessel.



NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
3.4.10

3.4 REACTOR COOLANT SYSTEM (RCS)  
3.4.10 RCS Leakage Detection Instrumentation

LCO 3.4.10 The following RCS leakage detection instrumentation shall be OPERABLE:

- a. One containment sump level channel;
- b. One containment atmosphere radioactivity monitor (gaseous N13/F18).

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

NOTE  
THE N13/F18 CONTAINMENT ATMOSPHERE RADIOACTIVITY MONITOR IS ONLY REQUIRED TO BE OPERABLE IN MODE 1 WITH RTP > 20%.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required containment sump channel inoperable.	-----NOTE----- LCO 3.0.4 is not applicable.	STS 3.4.15 A.2
	A.1 Perform SR 3.4.8.1 (RCS inventory balance).	Once per 24 hours
	<u>AND</u>	
	A.2 Restore containment sump channel to OPERABLE status.	30 DAYS <del>±68 hours</del>

(continued)

NOTE  
MEASUREMENTS MADE BY OPERABLE SUMP LEVEL INSTRUMENTS CAN BE RENDERED INEFFECTIVE, IF LEAKAGE IS PREVENTED FROM REACHING THE SUMP SUCH AS BY REDIRECTION TO THE IRWST BY THE CONTAINMENT SUMP GUTTER SYSTEM.

# NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
3.4.10

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required containment atmosphere radioactivity monitor inoperable.	-----NOTE----- LCO 3.0.4 is not applicable. -----	<i>SR 3.4.15 B.2</i>
	B.1.1 Analyze grab samples of containment atmosphere.  <u>OR</u> B.1.2 Perform SR 3.4.8.1.  <u>AND</u> B.2 Restore containment atmosphere radioactivity monitor to OPERABLE status.	Once per 24 hours  Once per 24 hours  <i>30 days <del>168 hours</del></i>
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.  <u>AND</u>	<i>6 8</i> hours
	C.2 Be in MODE <sup>5</sup> <del>4</del> .	<i>36 24</i> hours

NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
3.4.10

SURVEILLANCE REQUIREMENTS

SURVEILLANCE			FREQUENCY
SR	3.4.10.1	Perform a CHANNEL CHECK of required containment atmosphere radioactivity monitor.	12 <del>24</del> hours STS SR3.4.15.1
SR	3.4.10.2	Perform an <sup>COT</sup> <del>CHANNEL OPERATIONAL TEST</del> of required containment atmosphere radioactivity monitor.	92 days
SR	3.4.10.3	Perform a CHANNEL CALIBRATION of required containment sump monitor.	24 months
SR	3.4.10.4	Perform a CHANNEL CALIBRATION of required containment atmosphere radioactivity monitor.	24 months



B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.10 RCS Leakage Detection Instrumentation

BASES

BACKGROUND

GDC 30 of Appendix A to 10CFR50 (Ref. 1) requires means for detecting, and, to the extent practical, identifying the source of RCS LEAKAGE. Regulatory Guide 1.45 (Ref. 2) describes acceptable methods for selecting LEAKAGE detection systems.

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

Industry practice has shown that water flow changes of 0.5 gpm can be readily detected in contained volumes by monitoring changes in water level, in flow rate, or in the operating frequency of a pump. The containment sump used to collect unidentified LEAKAGE, is instrumented to alarm for increases of 0.5 gpm in the normal flow rates. This sensitivity is acceptable for detecting increases in unidentified LEAKAGE.

Reactor coolant radioactivity used for leak detection is the decay of N13/F18.

REPLACE WITH

AND F18

F18 has a longer half life and is the dominant source used for leak detection.

The reactor coolant contains radioactivity that, when released to the containment, can be detected by radiation monitoring instrumentation. Reactor coolant radioactivity levels will be low during initial reactor startup and for a few weeks thereafter, until activated corrosion products have been formed and fission products appear from fuel element cladding contamination or cladding defects. The production of N13 is proportional to the reactor power level. N13 has a short half life and comes to equilibrium quickly. Instrument sensitivities for gaseous monitoring are practical for these LEAKAGE detection systems. The Radiation Monitoring System includes monitoring N13/F18 gaseous activities to provide leak detection.

(continued)



BASES (continued)

APPLICABLE  
SAFETY ANALYSES

The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify with indications from other systems is necessary. The system response times and sensitivities are described in the SSAR (Ref. 2).

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

RCS LEAKAGE detection instrumentation satisfies Criterion 1 of the NRC Policy Statement.

LCO

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

The LCO is satisfied when monitors of diverse measurement means are available. Thus, the containment sump monitor, in combination with an N13/F18 gaseous activity monitor provides an acceptable minimum.

INSERT A →

APPLICABILITY

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

In MODE 5 or 6, the temperature is  $\leq 200^{\circ}\text{F}$  and pressure is maintained low or at atmospheric pressure. Since the temperatures and pressures are lower than those for MODES 1, 2, 3, and 4, the likelihood of leakage and crack propagation are much smaller. Therefore, the requirements of this LCO are not applicable in MODES 5 and 6.

INSERT B →

(continued)

# NRC REQUEST FOR ADDITIONAL INFORMATION



AP600  
BASES 3.4.10

INSERTS PAGE 3.4-42

- A. Containment sump level monitoring is performed by two redundant seismically qualified level instruments. *THE LCO NOTE CLARIFIES THAT IF LEAKAGE IS PREVENTED FROM REACHING THE SUMP, MEASUREMENTS MADE BY OPERABLE SUMP LEVEL INSTRUMENTS WILL NOT BE VALID.*
- B. Sump level monitoring is a valid method for MODES 1, 2, 3, and 4. Containment atmosphere N13/F18 monitoring is valid only in MODE 1 with reactor power > 20% RTP. RCS inventory monitoring via the pressurizer level changes is valid in MODES 1, 2, 3, and 4 only when RCS conditions are stable, i.e., temperature constant, pressure constant, no makeup and no letdown.
- The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.
- The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.
- The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is formed in the interior of the containment vessel.





BASES (continued)

ACTIONS

A.1 and A.2

With the required containment sump channel inoperable, no other form of sampling can provide the equivalent information; however, the containment atmosphere <sup>LEVEL</sup> N13/F18 radioactivity monitor will provide indications of changes in LEAKAGE. Together with the atmosphere monitor, the periodic surveillance for RCS inventory balance, SR 3.4.8.1, must be performed at an increased frequency of 24 hours to provide information that is adequate to detect LEAKAGE.

Restoration of the sump channel to OPERABLE status is required to regain the function in a Completion Time of ~~168 hours~~ <sup>30 DAYS</sup> after the monitor's failure. This time is acceptable, considering the frequency and adequacy of the RCS inventory balance required by Action A.1.

Required Action A.1 is modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the containment sump channel is inoperable. This allowance is provided because other instrumentation is available to monitor RCS Leakage.

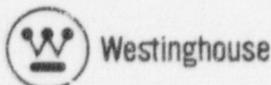
B.1.1, B.1.2, and B.2

With one gaseous N13/F18 containment atmosphere radioactivity-monitoring instrumentation channel inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or RCS inventory balanced, in accordance with SR 3.4.8.1, must be performed to provide alternate periodic information.

With a sample obtained and analyzed or an RCS inventory balance performed every 24 hours, the reactor may be an RCS operated for up to ~~168 hours~~ <sup>30 DAYS</sup> to allow restoration of the radioactivity monitor.

The 24 hours interval for grab samples or RCS inventory balance provides periodic information that is adequate to detect LEAKAGE. The ~~168 hours~~ <sup>30 DAY</sup> Completion Time recognizes at least one other form of leak detection is available.

(continued)



NRC REQUEST FOR ADDITIONAL INFORMATION



RCS Leakage Detection Instrumentation  
B 3.4.10

BASES

ACTIONS

B.1.1, B.1.2, and B.2 (continued)

Required Action B.1 and Required Action B.2 are modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the gaseous N13/F18 containment atmosphere radioactivity monitor channel is inoperable. This allowance is provided because other instrumentation is available to monitor for RCS LEAKAGE.

C.1 and C.2

If a Required Action of Condition A or B cannot be met within the required Completion Time, the reactor must be brought to MODE ~~4~~ where the probability and consequences of an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within ~~8~~<sup>5</sup> hours to MODE ~~4~~<sup>5</sup> within ~~24~~<sup>36</sup> 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 without challenging plant systems.

SURVEILLANCE REQUIREMENTS

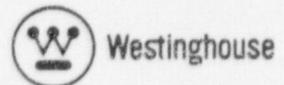
SR 3.4.10.1

SR 3.4.10.1 requires the performance of a CHANNEL CHECK of the containment atmosphere radioactivity monitor. The check gives reasonable confidence that the channel is operating properly. The Frequency of ~~24~~<sup>N13/F18</sup> hours is based on instrument reliability and risk and is reasonable for detecting off normal conditions.

SR 3.4.10.2

SR 3.4.10.2 requires the performance of a CHANNEL OPERATIONAL TEST (COT) on the atmosphere radioactivity monitor. The test ensures that the monitor can perform its function in the desired manner. The test verifies the alarm setpoint and relative accuracy of the instrument string. The Frequency of 92 days considers risks and instrument reliability, and operating experience has shown that it is proper for detecting degradation.

(continued)





BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.4.10.3 and SR 3.4.10.4

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

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REFERENCES

1. 10 CFR 50, Appendix A, Section IV, GDC 30.
  2. Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary LEAKAGE Detection Systems," U.S. Nuclear Regulatory Commission.
  3. AP600 SSAR Chapter 15, "Accident Analysis."
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