5.2.5.1.2.3 Primary Containment Atmosphere Monitoring - Airborne Particulate Radioactivity Monitoring

The primary containment is continuously monitored for airborne radioactivity. A sample is drawn from the primary containment and a sudden increase of activity indicates a steam or reactor water leakage.

5.2.5.1.2.3.1 Sensitivity and Response Time

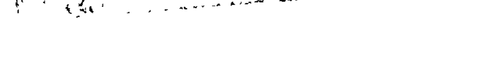
The objective of the drywell leak detection monitors as indicated in Regulatory Guide 1.45 is to be able to detect less than 1 gpm of unidentified primary coolant pressure boundary leakage in 1 hour. Several detection systems supplied to accomplish this are the drywell sump level monitor (see Subsection 5.2.5.1.2.4), a noble gas radiation monitor, a radioiodine monitor, and a particulates radiation monitor. The three radiation monitors sample drywell for the activity levels on the assumption that flashing coolant leakage will result in radioactivity in the atmosphere.

The reliability, sensitivity and response times of radiation monitors to detect 1 gpm in 1 hour of Reactor Coolant Pressure Boundary leakage will depend on many complex factors. The major factors are discussed below:

A. Source of Leakage

1) Location of Leakage

[illegible]mount of activity which would become airborne [illegible] 1 gpm leak from the RCPB will vary [illegible] on the leak location and the coolant temperatu[illegible] and pressure. For example, a feedwater pipe leak will have concentration factors of 100 to 1000 lower than a recirculation line leak. A steam line leak will be a factor of 50 to 100 lower in iodine and particulate concentrations than the recirculation line leak, but the noble gas concentrations may be comparable. A RWCU leak upstream of the demineralizers and heat exchangers will be a factor of 10 to 100 higher than downstream, except for noble gases. Differing coolant temperatures and pressures will affect the flashing fraction and partition factor for iodines and particulates. Thus, an airborne concentration cannot be correlated to a quantity of leakage without knowing the source of the leakage.



ATTACHMENT 1A

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SURVEILLANCE REQUIREMENTS

4.4.3.2.1 The reactor coolant system leakage shall be evaluated ~~demonstrated to be within each of the above limits~~ by:

a. Monitoring the primary containment atmospheric particulate and gaseous radioactivity at least once per 12 hours, and

b. Monitoring the drywell floor drain sump level at least once per 12 hours, and verifying that reactor coolant system leakage is within the above limits.

4.4.3.2.2 Each reactor coolant system pressure isolation valve specified in Table 3.4.3.2-1 shall be demonstrated OPERABLE by leak testing pursuant to Specification 4.0.5 and verifying the leakage of each valve to be within the specified limit:

a. At least once per 18 months, and

b. Prior to returning the valve to service following maintenance, repair or replacement work on the valve which could affect its leakage rate.

The provisions of Specification 4.0.4 are not applicable for entry into OPERATIONAL CONDITION 3.

4.4.3.2.3 The high/low pressure interface valve leakage pressure monitors shall be demonstrated OPERABLE with the alarm setpoints per Table 3.4.3.2-1 by performance of a:

a. CHANNEL FUNCTIONAL TEST at least once per 31 days, and

b. CHANNEL CALIBRATION at least once per 18 months.

2) Coolant Concentrations.

Variations in coolant concentrations during operation can be as much as several orders of magnitude within a time frame of several hours. These effects are mainly due to spiking during power transients or changes in the use of the RWCU system. Examples of these transients for I-131 can be found in NEDO-10585 (8/72), Behavior of Iodine in Reactor Water During Plant Shutdown and Startup. Thus, an increase in the coolant concentrations could give increased containment concentrations when no increase in unidentified leakage occurs.

3) Other Sources of Leakage

Since the unidentified leakage is not the sole source of activity in the containment, changes in other sources will result in changes in the containment airborne concentrations. For example, identified leakage is piped to the equipment drain tank in the drywell, but the tank is vented to the drywell atmosphere allowing the release of noble gases and some small quantities of iodines and particulates from the drain tank.

B. Drywell Conditions Affecting Monitor Performance

1) Equilibrium Activity Levels

During normal operation the activity release from acceptable quantities of identified and unidentified leakage will build up to significant amounts in the drywell air. Conversations with several operating plants indicate that levels as high as .1 to 10 times MPC are not uncommon for noble gases and iodines. (MPC refers to "maximum permissible concentration" as defined by 10CFR20, MPC is used here only as a convenient reference). Due to these high equilibrium activity levels the small increases due to a 1 gpm increase in leakage may be difficult to see within an hour. Typical MPC ranges are:

	.1 MPC to 10 MPC
Noble Gases	$1x10^{-6}$ - $1x10^{-4}$ μCi/cc
Particulates	$1x10^{-6}$ - $1x10^{-4}$ μCi/cc
Iodines	$5x10^{-7}$ - $5x10^{-5}$ μCi/cc

Fresh fuel backgrounds were not considered because no fission products are available at that point in time. The numbers given above include amounts of failed and/or irradiated fuel. These numbers also include normal expected leakage rates.

2) Purge and Pressure Release Effects

Changes in the detected activity levels have occurred during periodic drywell purges to lower the drywell pressure. These changes are of the same order of magnitude as approximately a 1 gpm leak, and are sufficient to invalidate the results from iodine and particulate monitors.

3) Plateout, Mixing, Fan Cooler Depletion

Plateout effects on iodines and particulates will vary with the distance from the coolant release point to the detector. Larger travel distances would result in more plateout. In addition the pathway of the leakage will influence the plateout effects. For example, a leak from a pipe with insulation will have greater plateout than a leak from an uninsulated pipe. Although the drywell air will be mixed by the fan coolers, it may be possible for a leak to develop in the vicinity of the radiation detector sample lines. In addition, condensation in the coolers will remove iodines and particulates from the air. Variations in the flow, temperature and number of coolers will affect the plateout fractions. Plateout within the detector sample tube will also add to the reduction of the iodine and particulate activity levels. The uncertainties in any estimate of plateout effects could be as much as one or two orders of magnitude.

C. Physical Properties and Capabilities of the Detectors

1) Detector Ranges

The detectors were chosen to ensure that the operating ranges covered the concentrations expected in the drywell. The operating ranges are:

Noble Gases	$1x10^{-6}$ to $1x10^{-2}$ μCi/cc
Particulates	$1x10^{-9}$ to $1x10^{-4}$ μCi/cc
Iodines	$1x10^{-9}$ to $1x10^{-4}$ μCi/cc

2) Sensitivity

In the absence of background radiation and equilibrium drywell activity levels, the detectors have the following minimum sensitivity:

Noble Gas	1x10^{-6} μCi/cc
Particulates	1x10^{-9} μCi/cc
Iodine	1x10^{-9} μCi/cc

3) Counting Statistics and Monitor Uncertainties

In theory these radioactivity monitors are statistically able to detect increases in concentration as small as 2 or 3 times the square root of the count rate, i.e., at 10^6 cpm an increase of 2x10^3, or 0.2%, is detectable; at 10^2 cpm an increase of 240, or 20% is detectable. In addition at high count rates the monitors have dead-time uncertainties and the potential for saturating the monitor or the electronics. Uncertainties in calibration (±5%) sample flow (±10%) and other instrument design parameters tend to make the uncertainty in a count rate closer to 20% to 40% of the equilibrium drywell activity.

4) Monitor Setpoints

Due to the uncertainty and extreme variability of the concentrations to be measured in the containment the use of alarm setpoints on the radioactivity monitors would not be practical or useful. As indicated in the following section the setpoints which would be required to alarm at 1 gpm would be well within the bounds of uncertainty of the measurements. The use of such setpoints would result in many unnecessary alarms and the frequent resetting of setpoints. A setpoint alarm on the sump level monitor alone is used; the radioactivity monitors are for supporting information to confirm that the leak is radioactive. The alarm setpoints for the radiation monitors will be set significantly above background to prevent nuisance alarms. The actual setpoint will be changed as background increases. At these levels, the radiation monitors will provide no warning of a 1 gpm leak in one hour.

5) Estimated Monitor Responses

Table 5.2-13 estimates the expected monitor responses for several types of leaks and several types of monitors. As indicated in column 3, the added activity in containment from a 1 gpm leak for 1 hour is less than the nominal 20% increase which could be meaningfully detected. The final columns estimate the detectable leakage in 1 hour.

1B (p.5)

6) Operator Action

There is no direct correlation or known relationship between the detector count rate and the leakage rate, because the coolant activity levels, source of leakage, and background radiation levels (from leakage alone) are not known and cannot be cost-effectively determined in existing reactors. There are also several other sources of containment airborne activity (e.g. safety relief valve leakage) which further complicate the correlation.

Thus, the recommended procedure for the control room operator is to set an alarm setpoint at 1 gpm in 1 hour on the sump level monitor (measuring water collected in the sump which may not exactly correspond to water leaking from an unidentified source). When the alarm is actuated, the operator will review all other monitors (e.g., noble gas, particulates, temperature, pressure, fan cooler drains, etc.) to determine if the leakage is from the primary coolant pressure boundary and not from an SRV or cooling water system, etc. Appropriate actions will then be taken in accordance with Technical Specifications. The review of other monitors will consist of comparisons of the increases and rates of increase in the values previously recorded on the strip chart recorders. Increases in all parameters except sump level will not be correlated to a RCPB leakage rate. Instead, the increases will be compared to normal operating limits and limitations (e.g., 2 psi maximum pressure for ECCS initiation) and abnormal increases will be investigated.

Since the Technical Specification limit for leakage is allowed to be averaged over 24 hours, quick and accurate responses are not necessary unless the leakage is very large and indicative of a pipe break. In this case, the containment pressure and reactor vessel water level monitors will alarm within seconds, and the sump level monitor would alarm within minutes or tens of minutes.

The radiation monitor alarms will not be set to levels that correspond to RCPB leakage levels since the correlations can't be made. Also, since the containment airborne activity levels vary by orders of magnitude during operation due to power transients, spiking, steam leaks, and outgassing from sumps, etc., an appropraite alarm setpoint, if one is used, should be determined by the operator based on experience with the specific plant. A setpoint level of 2 to 3 times the background level during full power steady state operation may be useful for alarming large leaks and pipe breaks, but it would not always alarm for 1 gpm in 1 hour.

7) Conclusion

Due to the sum total of the uncertainties identified in the previous paragraphs the iodine and particulate monitors will not be relied upon for leak detection purposes but only as supporting instrumentation. The noble gas monitor is used to give supporting information to that supplied by the sump level monitor and it would be able to give an early warning of a major leak especially if equilibrium containment activity levels are low. However, the uncertainties and variations in noble gas leaks and concentrations would preclude the setting of a meaningful set point on the monitors.

5.2.5.1.2.4 Drywell Floor Drain Sump Monitoring System

The drywell floor drain sump monitoring system is designed to permit leak detection in accordance with Regulatory Guide 1.45.

5.2.5.1.2.4.1 System Description

Two drywell floor drain sumps are located in the primary containment for collection of leakage from vent coolers, control rod drive flange leakage, chilled water drains, cooling water drains, and overflow from the equipment drain sump.

The drywell floor drain sump is located at the drywell diaphragm slab low point. Unidentified leakages will, by gravity, flow down the slab surface into the floor drain sump. No floor drain piping system is employed. Piped inputs to the drywell floor drain sump are from clean system drains. No surveillance program is planned to detect piped equipment drain system blockage.

Small, unidentified leakages of concern flowing into the drywell floor drain sump will not be masked by larger, acceptable, identified leakages overflowing from the drywell equipment drain tank. The drywell equipment drain tank drains by gravity. During conditions of acceptable identified leakage rates, the gravity flow from the drywell equipment drain tank will be

ATTACHMENT 2A

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EMERGENCY CORE COOLING SYSTEMS

3/4.5.3 SUPPRESSION CHAMBER#

LIMITING CONDITION FOR OPERATION

3.5.3 The suppression chamber shall be OPERABLE: ~~with a contained water volume of at least 122,410 ft³, equivalent to a level of 22'0", except that in OPERATIONAL CONDITION 4 and 5* the suppression chamber level may be less than the limit or may be drained provided that:~~

a. In OPERATIONAL CONDITION 1, 2 or 3 with a contained water volume of at least 122,410 ft³, equivalent to a level of 22'0".

b. In OPERATIONAL CONDITION 4 or 5* with a contained water volume of at least 111,280 ft³, equivalent to a level of 20'0", except that the suppression chamber level may be less than the limit or may be drained in OPERATIONAL CONDITION 4 or 5* provided that:

1. ~~a.~~ No operations are performed that have a potential for draining the reactor vessel,
2. ~~b.~~ The reactor mode switch is locked in the Shutdown or Refuel position,
3. ~~c.~~ The condensate storage tank contains at least 135,000 available gallons of water, equivalent to a level of 49%, and
4. ~~d.~~ The core spray system is OPERABLE per Specification 3.5.2 with an OPERABLE flow path capable of taking suction from the condensate storage tank and transferring the water through the spray sparger to the reactor vessel.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3, 4 and 5*.

ACTION:

a. In OPERATIONAL CONDITION 1, 2 or 3 with the suppression chamber water level less than the above limit, restore the water level to within the limit within 1 hour or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

b. In OPERATIONAL CONDITION 4 or 5* with the suppression chamber water level less than the above limit or drained and the above required conditions not satisfied, suspend CORE ALTERATIONS and all operations that have a potential for draining the reactor vessel and lock the reactor mode switch in the Shutdown position. Establish SECONDARY CONTAINMENT INTEGRITY within 8 hours.

c. With only one suppression chamber water level indicator OPERABLE, restore at least two indicators to OPERABLE status within 7 days or verify the suppression chamber water level to be greater than or equal to 22'0" at least once per 12 hours by local indication.

#See Specification 3.6.2.1 for pressure suppression requirements.

*The suppression chamber is not required to be OPERABLE provided that the reactor vessel head is removed, the cavity is flooded, or being flooded from the suppression pool, the spent fuel pool gates are removed, when the cavity is flooded, and the water level is maintained within the limits of Specification 3.9.8 and 3.9.9.

EMERGENCY CORE COOLING SYSTEMS

3/4.5.3 SUPPRESSION CHAMBER#

LIMITING CONDITION FOR OPERATION

3.5.3 The suppression chamber shall be OPERABLE:

a. In OPERATIONAL CONDITION 1, 2 or 3 with a contained water volume of at least 128,800 ft^3, equivalent to a level of 26'2½".

b. In OPERATIONAL CONDITION 4 or 5* with a contained water volume of at least 70,000 ft^3, equivalent to a level of 14'0", except that the suppression chamber level may be less than the limit or may be drained in OPERATIONAL CONDITION 4 or 5* provided that:

   1. No operations are performed that have a potential for draining the reactor vessel,

   2. The reactor mode switch is locked in the Shutdown or Refuel position,

   3. The condensate storage tank contains at least 135,000 available gallons of water, equivalent to a level of 14.5 feet, and

   4. The HPCS system is OPERABLE per Specification 3.5.2 with an OPERABLE flow path capable of taking suction from the condensate storage tank and transferring the water through the spray sparger to the reactor vessel.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3, 4 and 5*.

ACTION:

a. In OPERATIONAL CONDITION 1, 2, or 3 with the suppression chamber water level less than the above limit, restore the water level to within the limit within 1 hour or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

b. In OPERATIONAL CONDITION 4 or 5* with the suppression chamber water level less than the above limit or drained and the above required conditions not satisfied, suspend CORE ALTERATIONS and all operations that have a potential for draining the reactor vessel and lock the reactor mode switch in the Shutdown position. Establish SECONDARY CONTAINMENT INTEGRITY within 8 hours.

#See Specification 3.6.2.1 for pressure suppression requirements.
*The suppression chamber is not required to be OPERABLE provided that the reactor vessel head is removed, the cavity is flooded or being flooded from the suppression pool, the spent fuel pool gates are removed when the cavity is flooded, and the water level is maintained within the limits of Specifications 3.9.8 and 3.9.9.

ATTACHMENT 3A

TABLE 4.8.2.1-1

BATTERY SURVEILLANCE REQUIREMENTS

	CATEGORY A[1]	CATEGORY B[2]	
Parameter	Limits for each designated pilot cell	Limits for each connected cell	Allowable[3] value for each connected cell
Electrolyte Level	>Minimum level indication mark, and ≤ ¼" above maximum level indication mark	>Minimum level indication mark, and ≤ ¼" above maximum level indication mark	Above top of plates, and not overflowing
Float Voltage	≥ 2.13 volts	≥ 2.13 volts[c]	> 2.07 volts
Specific Gravity[a][b]	≥ 1.200	≥ 1.195 Average of all connected cells > 1.205	Not more than .020 below the average of all connected cells Average of all connected cells ≥ 1.195

(a) Corrected for electrolyte temperature and level.
(b) Or battery charging current is less than 1, 2, and 4 amperes for the I24, 125 and 250 volt batteries, respectively when on float charge.
(c) May be corrected for average electrolyte temperature.
(1) For any Category A parameter(s) outside the limit(s) shown, the battery may be considered OPERABLE provided that within 24 hours all the Category B measurements are taken and found to be within their allowable values, and provided all Category A and B parameter(s) are restored to within limits within the next 6 days.
(2) For any Category B parameter(s) outside the limit(s) shown, the battery may be considered OPERABLE provided that the Category B parameters are within their allowable values and provided the Category B parameter(s) are restored to within limits within 7 days.
(3) Any Category B parameter not within its allowable value indicates an inoperable battery.

[illegible]