HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057

MFN 06-085 Supplement 4

Docket No. 52-010

March 5, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: Response to Portion of NRC Request for Additional Information Letter No. 109 Related to ESBWR Design Certification Application - Leak Detection and Isolation System - RAI Numbers 5.2-1 S03, 5.2-2 S03 and 16.2-4 S01

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) responses to the subject NRC RAIs originally transmitted via the Reference 1 letter and supplemented by NRC requests for clarification in Reference 2.

If you have any questions or require additional information, please contact me.

Sincerely,

R. E. Brown for/
James C. Kinsey
Vice President, ESBWR Licensing

DO68
NRO

References:

1. MFN 06-102, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 15 Related to ESBWR Design Certification Application*, March 30, 2006
2. MFN 07-555, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 109 Related to ESBWR Design Certification Application*, October 12, 2007

Enclosure:

1. MFN 06-085 Supplement 4 - Response to Portion of NRC Request for Additional Information Letter No. 109 Related to ESBWR Design Certification Application - Leak Detection and Isolation System - RAI Numbers 5.2-1 S03, 5.2-2 S03 and 16.2-4 S01

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	eDRFs	RAI 5.2-1 S03: 0000-0079-6803
		RAI 5.2-2 S03: 0000-0079-6807
		RAI 16.2-4 S01: 0000-0080-5690

Enclosure 1

MFN 06-085 Supplement 4

Response to Portion of NRC Request for Additional Information Letter No. 109 Related to ESBWR Design Certification Application

Leakage Detection and Isolation System

RAI Numbers 5.2-1 S03, 5.2-2 S03 and 16.2-4 S01

For historical purposes, the original text of RAIs 5.2-1 and 5.2-2, and the GE responses (including supplements) is included. The attachments included in the original responses (if any) are not included here to avoid confusion.

NRC RAI 5.2-1:

DCD Section 5.2.5 Item (3) indicates that the system is equipped with indicators and alarms for each leak detection system in the control room, and permits "qualitative" interpretations of such indicators. However, DCD Section 5.2.5.8 indicates that the monitoring instrumentation is designed to detect leakage rates of 1 gpm within one hour, satisfying Regulatory Guide (RG) 1.45, Position C.5. Leakage from unidentified sources inside drywell is collected in the floor drain sump to detect leakage of 1 gpm, thus satisfying RG. 1.45, Position C.2. Furthermore, DCD Section 5.2.5.8 indicates that the limit established for alarming unidentified leakage is 5 gpm, and the Technical Specification (TS) limit specified in Limiting Conditions for Operation (LCO) 3.4.2 for unidentified RCPB leakage is 5 gpm. The above DCD statements appear to be inconsistent in meeting 1 gpm guidance in RG 1.45. The following are the specific questions.

a. *Why does the system permit only "qualitative" rather than "quantitative" interpretations of such control room indicators? Qualitative control room indicators are not adequate in meeting RG 1.45.*

b. *Explain how the proposed TS limit and alarm limit for the unidentified leakage of 5 gpm, which is consistent with neither the design capability of 1 gpm nor Positions C.2 and C.5 of RG 1.45, is justified?*

GEH Response:

a. The term "qualitative" was quoted directly from SRP 5.2.5 Rev. 1 ("Area of Review") to provide acknowledgement that the design of the Leak Detection and Isolation system (LDIS) will be compliant with the guidance of the SRP in terms of information presented to the main control room operator. This information would be used for "interpretation" as the SRP implies. Nevertheless, the information presented to the main control room operator will be "quantitative" in the context that the operator can convert the various readings to an equivalent leakage rate. The sentence will be modified to indicate that information, which is "quantitative" in nature, will be provided.

b. The proposed TS limit is not considered to be inconsistent with either position C.2 or C.5 of RG 1.45. Position C.2 is interpreted as providing guidance as to the "accuracy" of the measurement of unidentified leakage and not the TS limit. i.e., the "accuracy" of a device is not necessarily equivalent to the total quantity allowed by TS for the monitored parameter.

   Position C.5 of RG 1.45 recommends that the "sensitivity and response time" of various instruments "employed for unidentified leakage should be adequate to detect a leakage rate, or its equivalent, of one gpm in less than one hour." Similar to this discussion above for C.2, the "sensitivity" of a detection method, does not necessarily imply, nor require, that it be the same as the limiting condition (or actionable TS limit) for the monitored parameter. The sensitivity of these detection methods to a specific leakage amount, i.e. tolerance of the instrument, is different from the value that is calculated to be significant in regards to the total leakage amount.

There is a long history of leakage detection/alarm limits as related to the BWRs. Early BWRs are designed and operated with instruments with a 1 gpm sensitivity and 5 gpm alarm limit, similar to what is included within the ESBWR design application. Given that earlier BWRs contain materials susceptible to IGSCC, a rate of change technical specification limitation was included, as required by Generic Letter 88-01, to detect increases in unidentified leakages inside of containment. The ESBWR however, does not use materials susceptible to IGSCC, therefore, the ESBWR technical specifications do not require a similar rate of change limitation.

Also, note that the Section 5.2.5.8 of the DCD addresses compliance to positions C.2 and C.5 of RG 1.45, specifically in regards to the 1 gpm limit. As noted in the evaluation against Criterion 30 (DCD Section 3.1.4.1), the allowable leakage rates have been based on the predicted and experimentally determined behavior of cracks in pipes, the ability to provide makeup water to the RCS, the normally expected background leakage due to equipment design, and the detection capability of the various sensors and instruments. The proposed TS limit of 5 gpm for unidentified leakage is considered acceptable, because, as noted in DCD Section 5.2.5.5, it is sufficiently low so that, even if the entire leakage rate were coming from a single crack in the nuclear system process barrier, corrective action could be taken before barrier integrity is threatened. Additional rationale for the proposed TS limit is included in the Bases discussion for LCO 3.4.2, which is provided in DCD Chapter 16B.

Also, it is worth noting that the initial ABWR design included a 1 gpm limit. However, the sensitivity and accuracy of available measuring equipment is +/- 1 gpm. Therefore, to assure proper system functionality, the limit was changed from 1 gpm to 5 gpm for current ABWR design, which is under construction at Lungmen site. Any future ABWR plants will also use the 5 gpm limit.

NRC RAI 5.2-1 S01:

Comments on response to RAI 5.2-1:

The response indicated that the sensitivity and accuracy of available leakage monitoring equipment is +/- 1 gpm. Based on the information in NUREG/CR-6861, "Barrier Integrity Research Program," it would appear that there are instruments available that could detect leakage at levels less than 1 gpm. Provide the basis for the +/- 1 gpm accuracy, and address whether all available leakage monitoring technologies have been explored.

The response indicated that the proposed technical specification limit of 5 gallons per minute (gpm) for unidentified leakage is considered acceptable because it is sufficiently low so that even if the entire leakage rate were coming from a single crack in the nuclear system process barrier, corrective action could be taken before barrier integrity *is threatened. Please provide the technical basis for this conclusion. Include in the response how the critical flaw size was determined for the range of materials and geometries used in the reactor coolant system.*

DCD Section 5.2.5.8, states that the monitoring instrumentation of the drywell floor drain sump, the air particulate radioactivity, and the drywell air cooler condensate flow rate are designed to detect leakage rates of 3.8 liters/min (1 gpm) within one hour, thus satisfying RG 1.45, Position C.5. How is this capability demonstrated?

NRC RAI 5.2-1 S02:

In RAI 5.2-1(b), the staff asked GE to explain how the proposed Technical Specification (TS) limit and alarm limit for the unidentified leakage of 5 gpm are consistent with the 1 gpm criterion specified in Positions C.2 and C.5 of RG 1.45. In GE's RAI response, MFN 06-085, and in a conference call on January 16, 2007, GE maintained its position for the TS limit and alarm limit being specified as 5 gpm based on its historical leakage detection/alarm limits being specified for BWRs. GE stated that Positions C.2 and C.5 only specified the "sensitivity" of the instrument rather than the TS limit or alarm limit, and stated that the ESBWR instrument has the sensitivity of 1 gpm. RG 1.45 (page 1.45-2) provides guidance on the "detector sensitivity," and states that "sumps and tanks used to collect unidentified leakage and air cooler condensate should be instrumented to alarm for increases of from 0.5 to 1.0 gpm." The sensitivity of 1 gpm, claimed by ESBWR design, is not demonstrated in the alarm set point, or in the TS limit, and is not explicitly shown being used by operators under any procedures. The staff believes that the alarm limit needs to be set as low as practicable to provide an early warning signal to alert operator taking actions. The current ESBWR alarm limit of 5 gpm is not acceptable because it is not consistent with RG 1.45 stated above, nor it serves the intended function to alert operator taking actions before the TS limit is reached.

Provide and justify a revised alarm limit for the unidentified leakage. Revise the DCD, Tier 2, Section 5.2.5.4, accordingly.

GEH Response:

The RAI 5.2-1 combined Supplement 1 and 2 requests ask GEH to respond on four issues:

a. *Based on the information in NUREG/CR-6861, there are instruments available that could detect leakage at levels less than 1 gpm. Provide the basis for the +/- 1 gpm accuracy, and address whether all available leakage monitoring technologies have been explored.*

   Drywell leakage detection methods are outlined in DCD Tier 2, Revision 3, Subsection 5.2.5.1.1. The relevant information from NUREG/CR-6861, Section 5 "Leak Monitoring Systems," has been reviewed and the following is a summary of the recommendations contained therein:

1) Visual monitoring. The method is not applicable to ESBWR containment leakage monitoring. As noted in NUREG/CR-6861, the emphasis is on observation of boron accumulation correlated to leak rates, which is not applicable for a pure-water BWR. Further, entry into the BWR containment during power operation is prohibited due to the nitrogen-inerted containment design.

2) Humidity change detection. This method is not applicable to ESBWR containment leakage monitoring. The report notes that sensitivity "could be in the range of gallons per minute when used in large volume containments." Given the large open water pools inside the ESBWR containment, humidity change detection sensitivity is further inhibited.

3) Temperature change detection. This method is not applicable to ESBWR containment leakage monitoring. The report notes that temperature change detection cannot meet the 1 gpm sensitivity goal. The ESBWR, as other BWR designs, does use temperature change detection in certain closed-volume systems to detect the onset of leakage, for example, in the tail pipes of safety-relief valves, but not for quantification of leakage.

4) Containment pressure increase. This method is not applicable to ESBWR containment leakage monitoring. The report notes that a leak would have to be large to result in a detectable pressure change. Further, containment pressure can be influenced by several factors including cooling water system temperature change or pneumatic subsystem leakage.

5) Reactor coolant inventory change. This method is not applicable to ESBWR containment leakage monitoring. NUREG/CR-6861 notes that this method is specific to PWRs and does not apply to BWRs.

6) Continuous sump level change measurement. This method is used in the ESBWR design to monitor for the 5 gpm leak rate limit with instrumentation accurate to as low as 1 gpm leak rate equivalent level change.

   As an example, a typical sump may have a surface area of 16 ft^2. This results in a volume of nearly 10 gallons per inch of level. With just a 10-inch volume of water present in the sump, temperature changes in the closed-cooling water supplied to the sump heat exchanger, and the ambient drywell conditions could combine to cause a volume expansion of greater than one-tenth inch. As sump volume increases, the potential thermal expansion affect increases. This could result in a false 1 gpm increase indication on a frequent basis, an adverse condition as evaluated for control room human factors. An alarm set at the 5 gpm equivalent detected unidentified leakage, a half-inch level change in the example, provides adequate margin to avoid false alarms. Therefore, a 5 gpm leak rate equivalent setpoint provides greater assurance of correct operator response without significant impact on the early detection of a potential gross RCPB loss of integrity.

7) Airborne radioactive gas and radioactive particulate monitoring. Fission products radioactivity monitoring is an additional method used in the ESBWR design. The report notes some sensitivity issues with the methods, with a preference toward particulate monitoring. There are some factors affecting BWR coolant activity

levels that are independent of leak rate, but leak rate change detection at a low value remains technically possible under sufficiently constrained conditions.

8) Sump flow rate change. This is an additional method employed in the ESBWR design. There can be maintenance problems, for example, sudden long pump run-times with little volume transfer measured can be caused by a failed open minimum flow line. Not withstanding such problems, flow measurement precision, accuracy and repeatability is sufficiently accurate to satisfy RG 1.45 Positions C.2 and C.5 as noted in the original response (see above). Detection capability permitting less than 1% accuracy is advertised for some devices, but is typically conditioned on flow purity and other requirements (e.g., long straight pipe run length for element installation, flow stability, thermal stability). A typical sump flow element full-scale (FS) range of 50-100 gpm and 1% FS accuracy provides detection within plus or minus 0.5-1.0 gpm of actual flow rate Depending on the total sensing system stability, the application of an alarm set for a 1 gpm change in flow rate could result in frequent alarm activation because the setpoint is in the tolerance band.

   Selection of the type of flow element to use for containment unidentified leakage must consider factors other than specific accuracy and precision. Of concern are the affect on transmitter performance of varying environmental conditions, and sump thermal conditions. Also a concern is particulate size distribution and concentration in the flow. Flow element selection must be biased in favor of flow element types resistant to error or plugging due to the presence of radioactive contaminants. And flow element installation is generally not in an ideal pipe run, but requires compromises to accommodate the layout and configuration of other systems and components.

9) Air-cooler condensation flow rate. This is also a method employed in the ESBWR design. Condensation will occur due to pool evaporation removed by the air-coolers. Packing leaks can also result in significant steam releases although there is no impairment of RCPB integrity. A 1 gpm condensation on the air-coolers would be a leak rate of about 497 lbm/hr of steam (assuming none of the condensate is deposited in any of the pools). The accuracy of the flow element and signal transmitting system is otherwise similar to that for sump flow measurement devices.

Further, data presented in Figure 20 of NUREG/CR-6861 show that about 80% of leaks used to develop the report were identified using methods not applicable to the ESBWR. Methods 6 through 9 reviewed above provide the ESBWR with sufficiently accurate detection of unidentified leak rate flow changes within the currently proposed ESBWR Technical Specification (TS) limit of 5 gpm.

b. *Please provide the technical basis for the conclusion that the proposed technical specification limit of 5 gallons per minute (gpm) for unidentified leakage is acceptable. Include in the response how the critical flaw size was determined for the range of materials and geometries used in the reactor coolant system.*

In review, a 5 gpm leak rate can be reverse calculated using Moody tables to approximate the equivalent break size. If the leak rate is measured at 100°F, the fluid density is 62 lbm/ft^3 and the mass flow can be found to be 0.69068 lbm/sec. This would equate to a saturated steam break opening of about 0.24 inch diameter, a size comparable to some instrumentation porting. A liquid break in the RCPB of equivalent flow is a smaller opening area than the saturated steam break due to the greater mass flux for liquid breaks. Pipe cracks bounding these sizes have been studied, as noted in the original response, demonstrating that the 5 gpm limit is conservative.

In Section 4 of NUREG/CR-6861 under subheading "Basis for RCS Leakage Monitoring Requirements," it is noted that one of the earliest established plant TS limits for leak rate was at the Monticello (BWR3/Mark I) plant in 1969. The TS limits were set at 1.6 kg/sec (25 gpm) for identified leakage and 0.32 kg/sec (5 gpm) for unidentified leakage. These values were established for BWR designs based upon reactor coolant makeup capability. The authors note that "The total allowed limit (identified plus unidentified) appears to be based on the inventory makeup capability and sump capacity rather than RCS integrity." However, the NUREG/CR-6861 authors also conclude about the current BWR leakage monitoring that "for many piping systems these limits provide significant margin against gross failure of reactor piping to sustained stress loads." This conclusion supports the original design basis of the BWR plants. Around circa 1969, the emphasis for plant licensing was placed on the ability to respond to a deterministically postulated (i.e., assumed without reference to any initiating or causative mechanism) double-ended guillotine pipe rupture of the BWR recirculation loop piping. Thus, reliance on assured RCS integrity was not the primary licensing basis.

The ESBWR plant design continues to use the same basis, rather than the alternative basis of leak-before-break (LBB). NUREG/CR--6861 contains several references indicating that the emphasis on RCS integrity is from the viewpoint of licensing on the LBB design basis. LBB requires analysis of critical flaw size, crack growth pattern and rate, and the correlation between crack size and growth and unidentified leak rate and leak rate change. The objective of LBB design is to assure detection of RCS leakage at very low values to provide early crack detection such that RCS pressure integrity is always assured. The ESBWR design is conversely based on being capable of responding within regulatory limits to a postulated RCPB bounding failure event. Therefore, calculations and analyses required to support LBB have not been performed. The leakage limits originally established for BWRs licensed on the basis of a deterministic RCPB failure response analysis remain valid for the ESBWR.

c. *DCD Section 5.2.5.8, states that the monitoring instrumentation is designed to detect leakage rates of 3.8 liters/min (1 gpm) within one hour. How is this capability demonstrated?*

This requirement is implemented through the "ITAAC for the Containment Monitoring System," DCD Tier 1, Revision 3, Table 2.15.7-1, Item No. 9. The ITAAC permits "Inspection, test, and/or analysis ... to verify that all the setpoints ... are in conformance with the design requirements."

There are standard calibration tests for flow and level instruments, and these may be performed either at the installed location or on a calibration test bench, depending on the type of instrument and installation method used. There are also standard calibration sources and calibration test methods for radiation detection based unidentified leakage monitoring instruments. It may also be feasible to conduct some form of in-place simulated leakage test for flow or level measurement instrumentation. However, such testing for radiation detectors involves considerable risk.

d. *The current ESBWR alarm limit of 5 gpm is not acceptable because it is not consistent with RG 1.45. The staff believes that the alarm limit needs to be set as low as practicable to provide an early warning signal to alert operator taking actions. Provide and justify a revised alarm limit for the unidentified leakage. Revise the DCD, Tier 2, Section 5.2.5.4, accordingly.*

   GEH disagrees, as noted in the original response, that the 5 gpm limit is in any way not consistent with RG 1.45. RG 1.45 does not explicitly take a position on the relationship of leakage alarm setpoint limits to leakage detection sensitivity and response time. The setpoint of 5 gpm is as low as practical without incurring the adverse Human Factors Engineering (HFE) condition of frequent spurious and nuisance control room alarms. This is due to the characteristics of a pressure-suppression containment and pure-water primary coolant system of all BWR designs including the ESBWR. The setpoint is also sufficiently low to provide a large margin prior to a gross pressure boundary failure, as pointed out in NUREG/CR-6861. A lower setpoint is not required because the ESBWR design is predicated on the deterministic assumption of a large pipe rupture occurring as the bounding RCPB integrity failure, and not on prevention of such pipe ruptures by early detection under the LBB risk-informed design approach.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 5.2-1 S03:

How does ESBWR meet quantitative Regulatory Guide (RG) 1.45 Positions C.2 and C.5 of 1 gpm limit, if the alarm and Technical Specification (TS) limit is specified as 5 gpm?

The staff reviewed the responses to RAI Supplements 5.2-1 S02, 5.2-2 S02, and RAI 16.2-4 and found the proposed Technical Specification limit of 5 gpm unidentified leakage is acceptable. However, the staff finds that the current ESBWR leakage alarm setpoint of 5 gpm is not acceptable because it is not consistent with RG 1.45 and it does not serve the intended function of alerting the operator before the TS limit is reached. RG 1.45 states "[s]umps and tanks used to collect unidentified leakage and air cooler condensate should be instrumented to alarm for increases of from 0.5 to 1.0 gpm in the normal flow rates." In order to comply with RG 1.45, the applicant needs to establish a low leakage alarm setpoint that is set at 0.5 to 1.0 gpm above normal leakage and below the TS limit of 5 gpm to provide the operator with sufficient time to take actions before the TS limit is reached, or the applicant needs to provide an acceptable alternative to RG 1.45.

(This RAI is associated with RAI 5.2-2 S03 and RAI 16.2-4 S01)

GEH Response:

Based on discussions with the NRC Staff (Videoconference on Thursday, September 6, 2007), GEH agrees that the leak detection and isolation system (LD&IS) described in DCD Tier 2, Subsection 5.2.5 should also include the requirement for an unidentified leakage step-increase alarm. This alarm complements the total unidentified leakage rate limit alarm, that is established with a 5 gpm Technical Specifications value, and provides the operating staff with a prompt to initiate investigation of the cause for the leak rate change in a timely manner.

The NRC Staff requests that GEH provide a step-increase alarm setpoint value that is 0.5-to-1.0 gpm (about 114-to-227 l/hr) above the nominal expected ESBWR containment unidentified leakage rate or to provide a basis to justify an alternative value. GEH believes that a leak rate step-increase value of 2.2 gpm (500 l/hr) in one hour is an appropriate value for detecting step-increases of unidentified leakage rate. This value provides a satisfactory alarm value to prompt investigation of the change while minimizing the potential for nuisance alarms. The value allows for a 1 gpm detection sensitivity with a margin for range error, plus an allowance for environmental condition-driven apparent leakage rate changes.

Sources of unidentified leakage that have commonly occurred in operating BWR plants include valve packing gland leaks, drywell cooler tube-sheet leaks, and pump seal leaks. Less frequently have been leaks from tubing and small-bore pipe threaded connection joints, leaks from flanged pipe and valve connections, or though leaking vent, drain and/or test connection valves. These are the sources of leakage that are correctable through routine maintenance. In the ESBWR design, additional effort is made to limit the potential for these leaks. The ESBWR has no pumps inside containment and, where practical, the ESBWR fluid systems use valves that are hermetically sealed to minimize potential leaks.

As previously noted, a small steam leak equivalent to 5 gpm requires the area equivalent of only a 6 mm (0.24 inch) diameter hole. A similar calculation for a liquid leak size using simplifying assumptions (e.g, ignoring fluid flashing, 2-phase drag affect, and choking) finds that at nominal Reactor Coolant System (RCS) operating pressure a 2.5 gpm leak requires only a 1.29 mm (0.051 inch) diameter hole. Further analytical work was performed for this response using a thermal-hydraulics tool to investigate larger breaks. As a comparison, a rough break hole of the approximate size of 1/8th-inch Schedule 80 pipe (nominal ID = 0.215 inch or ~5.5 mm) with source conditions comparable to ESBWR feedwater would result in a break flow exceeding 27 gpm. The same method predicts a mass flow of 0.215 lbm/sec for the previously determined 0.051 inch-diameter hole, which equates to about 1.6 gpm. Thus, a 5 gpm leak would occur with a break area equivalent to a hole larger than 1.3 mm-diameter but smaller than 5 mm-diameter. This hole or crack is sufficiently small to allow timely detection of incipient breaks or ruptures of large-bore piping (example: feedwater and steam lines) and small-bore piping that experience high pressure in the Reactor Coolant Pressure Boundary (RCPB) environment (example: instrument taps, bottom head drains, and control rod drive (CRD) lines). A flow rate change of 2.2 gpm in one hour will provide an adequate early warning of a potential pipe crack while the break flow remains within manageable size for both containment response and reactor vessel makeup systems.

Apparent leak rate changes can also occur in the ESBWR containment (as in previous BWR containment designs) that can create false indications of a change in unidentified leakage rate. This is due to the wet environment (i.e., open and exposed pools of water) of the pressure-suppression containment design and the susceptibility of the monitoring methods to changes in containment environmental conditions not associated with leaks or breaks in process fluid systems. In the ESBWR, the drywell is connected to the wetwell pool by 12 cylindrical vents of a nominal 1.2 meter diameter each, and there are three large open pools for the Gravity-Driven Cooling System (GDCS). The vents and pools provide ample surface for evaporation to the drywell atmosphere, with the rate of evaporation dependent on several factors (e.g., water temperature, drywell temperature, drywell atmosphere relative humidity).

As noted in the RAI 5.2-1 Supplement 2 response, Item a.6 (see above), a change in sump volume can be caused by warming of the sump volume resulting in an apparent 1 gpm-in-one-hour or more depending on the rate and magnitude of temperature change and the initial volume and temperature of the sump. Such a change can occur due simply to a change of sump cooling resulting from an external adjustment (rebalancing) of closed-cooling water flows or an adjustment to the closed-cooling water system heat exchanger primary-side or secondary-side flows. Evaluating and adjusting leak rate monitoring to compensate for each possible event would be a tedious and potentially distracting use of operating personnel resources. Licensees of ESBWRs are required to develop an appropriate leak monitoring administrative procedure per the DCD (COL Item 5.2-2-H). The licensees will use currently available operating experience and guidelines for this procedure, and use proven methods to track, investigate, evaluate and monitor sources of leakage that will effectively determine "compensating adjustments" without additional constraints on operating practices imposed by DCD Tier 2, Section 5.2.

An additional example, typical of operating BWR containments, is a rapid change of drywell bulk atmospheric temperature. Using published ASHRAE psychrometric charts, the quantity of water as atmospheric vapor can be determined for the free-volume of the drywell. The water vapor mass for initial and final conditions of 135°F (57.2°C)/50% Relative Humidity (RH) and 125°F (51.7°C)/50% RH, respectively, is determined by straight-forward calculation. The result is a mass of about 252 pounds (114.5 kg) or a volume of about 30.5 gallons (115.3 liters). A change that increases air-cooler chilled-water temperature could initially cause a bulk temperature to increase to the 135°F (57.2°C) value, and the drywell atmosphere would absorb additional water by evaporation form the exposed pool surfaces. A subsequent reduction of chilled water temperature would cause the air-coolers to extract moisture from the drywell atmosphere. Since the discharge air from the air-cooler will be cooled below the desired bulk average, there is an interim period during which the cooler will overshoot the steady-state cooling duty in order to force down the bulk temperature. This extracts more moisture than necessary to reach the steady-state (dry-bulb) temperature of

125°F (51.7°C). Thus, the actual moisture removal can easily exceed the 30.5 gallons calculated for this example. Depending on the rate of air temperature change, the flow from the coolers could signal a sudden rate of flow change of up to several gallons-per-minute (>3 gpm with 10 minute transient; >2 gpm with 15 minute transient; and, >1 gpm with 30 minute transient). A fifteen minute temperature change evolution is a reasonable minimum period for normal plant operations, thus limiting the containment leak rate flow step-increase alarm setpoint to a value of 2.2 gpm (500 liters/hr) detected within one hour is sufficient to provide an early alert for the control room operators of a potential break in the RCPB while avoiding spurious alarms.

Therefore, GEH proposes for the ESBWR to adopt a value of 2.2 gpm (500 liters/hr) flow rate step-increase detected within one hour to meet the step-change increase detection requirement of RG 1.45 in place of the standard 1 gpm step-change detection value.

DCD Impact:

DCD Tier 2, Subsection 5.2.5 will be revised as shown in the attached markup.

NRC RAI 5.2-2:

All certified advanced reactor designs (CE System 80+, AP600, AP1000, ABWR) have Technical Specification (TS) limit of 1 gpm or less for unidentified reactor coolant system (RCS) operational leakage to satisfy RG 1.45. Standard Technical Specifications for current operating GE BWRs have the limit of 5 gpm for unidentified RCS operational leakage. ESBWR TS LCO 3.4.2 specifies a limit of 5 gpm (the criterion used by the last generation BWR technology) for unidentified RCS operational leakage, even though it has the design capability of 1 gpm for unidentified leakage.

Why would ESBWR TS LCO 3.4.2 need a more relaxed limit (5 gpm) for RCPB leakage detection than ABWR (1 gpm)? The more relaxed limit indicates higher operating RCPB leakage rates, less RCPB leakage control, potentially more humid environment inside containment, increased probability of abnormal leakage.

a. *Evaluate the adverse effects to instrument and degradation effects (such as corrosion) to components caused by the additional humidity.*
b. *Specifying a leakage limit of 5 gpm instead of 1 gpm would allow a plant to operate in a potentially degraded condition longer. Provide compensatory measures to correct the degraded condition in accordance with the requirements of Criterion XVI of 10 CFR 50, Appendix B, as discussed in NRC Generic letter 91-18, Revision 1.*

GEH Response:

The equipment that is currently available can measure leakage with an accuracy of 1 gpm. It is considered to be unnecessarily restrictive with respect to plant operation and the avoidance of spurious alarms and presents an unnecessary hardship to the plant operator if the unidentified leakage limit is established at 1 gpm. Additionally, it should be noted that measures have been taken to reduce the likelihood of pipe cracks contributing to leakage. According to DCD section 3E.5, "the ESBWR plant design specifies use of austenitic stainless steel piping made of material (e.g., nuclear grade or low carbon type) that is recognized as resistant to Inter-Granular Stress Corrosion Cracking (IGSCC)". Therefore, the 5 gpm limit of ESBWR TS LCO 3.4.2 will provide detection in sufficient time to initiate corrective action.

a. An evaluation of the effects of relative humidity including that which is attributable to the proposed leakage limits up to 5 gpm would be included as part of equipment qualification requirements in the procurement of equipment. Because this value, i.e., 5 gpm, has been acceptable for operating BWRs, GE does not anticipate any additional adverse effects because current installed equipment in operating BWRs would already be qualified to that limit.

b. The BWR evolution has continued to reduce the likelihood of leaks because of Stress Corrosion Cracking (SCC) of austenitic stainless steels by reducing and limiting the use of austenitic stainless steel, eliminating large penetrations in the lower vessel region and using SCC resistant fabrication processes. Stainless steel piping continuously active during normal reactor operation is limited to the Reactor Water Cleanup System and the Isolation Condenser System return lines. Large penetrations in the lower vessel region have been avoided by the elimination of the external recirculation system and internal recirculation pumps and most vessel connections are above the core.

   Additional measures taken in the ESBWR to reduce challenges to the 5 gpm unidentified leakage limit are use of SCC resistant materials for bottom head penetrations, CRD housings and in-core housings. The 5 gpm limit for unidentified RCS operational leakage is based on the behavior of pipe cracks. It has been shown that, for leakage even greater than 5 gpm, the probability is small that the associated imperfection or crack would grow rapidly. And, 5 gpm is a small fraction of the calculated flow from a critical crack in the primary system piping.

   Additionally, pipe cracks are addressed in DCD Table 1.11-1. According to the resolution for Action Plan Item/Issue number A-42 in this table, the RCS piping in the ESBWR design complies with NUREG-0313, Rev. 2 and Generic Letter (GL) 88-01 through the selection of materials and processes that avoid sensitization or susceptibility to IGSCC. According to DCD Section 5.2.3.4.1, the RCS piping is designed to avoid sensitization and susceptibility to IGSCC through the use of reduced carbon content material and process controls. During fabrication, solution heat treatment is utilized. During welding, heat input is controlled. Austenitic stainless steels that have become sensitized or susceptible to cracking because of IGSCC are not used in the ESBWR design.

   Historically, good operator practice plays a role in the event of an anomaly in unidentified leakage. The duties and responsibilities of the operating staff to regularly observe and record data, monitor trends in plant parameters and detect abnormal conditions during their shift provide a means to alert the plant staff to a condition that warrants further scrutiny and assessment. For example, if leakage is observed to be more than the normal expected leakage, yet less than the 5 gpm limit, the plant operators typically will be alerted to investigate, record, and track pertinent data, evaluate trends in the data and make an assessment of the cause for any change that could ultimately lead to a reactor shutdown to make a drywell entry to take further action to locate, assess and potentially repair the source of leakage. Therefore, this typical practice identifies that utilities have established measures for taking action before reaching the 5 gpm leakage limit.

Based on the above considerations, the proposed TS values and required actions are considered to be proper and adequate to assure plant safety and, therefore, operation in compliance with the proposed TS would not constitute a degraded or non-conforming condition requiring corrective action in accordance with Criterion XVI of 10 CFR 50, Appendix B, as discussed in NRC Regulatory Issue Summary 2005-20, September 26, 2005 (Note: RIS 2005-20 superseded NRC Generic Letter 91-18, Revision 1).

NRC RAI 5.2-2 S01:

Comments on response to RAI 5.2-2:

a. *The response states that "an evaluation of the effects of relative humidity including that which is attributable to the proposed leakage limits up to 5 gpm would be included as part of equipment qualification requirements in the procurement of equipment." Is this a commitment (COL action item)?*

b. *The response discusses "good operator practice" would result in actions being taken before reaching a 5 gpm limit. Is this a commitment (COL Action Item) to address this in plant procedures?*

c. *Because there is no test data or operating experience of sufficient long term operation to eliminate the probability of the stress corrosion cracking, the concern of stress corrosion cracking is not completely resolved. Please discuss the extent to which comprehensive long term (e.g., 60 year) testing has been performed under the range of material and water chemistry conditions that could exist, given current NRC requirements pertaining to water chemistry and material selection, fabrication, and installation.*

d. *GE's response indicates that design improvements in ESBWR would reduce the likelihood of a leak. If this is the case, the development of leakage could indicate that something is not performing as expected (i.e., an unexpected or unanticipated condition). As indicated in the response, action is taken at many operating BWR plants before reaching the 5 gpm leakage limit (for similar reasons). In light of the above, the lowest possible leakage limit should be incorporated while limiting the potential for unnecessary plant shutdowns.*

GE's response to RAI 5.2-2 stated that "An evaluation of the effects of relative humidity including that which is attributable to the proposed leakage limits up to 5 gpm would be included as part of equipment qualification requirements in the procurement of equipment." Which Equipment Qualification is GE referring to, and what leak duration would the qualification tests support? How is this leakage duration applied as a limit for a prolonged RCS leakage rate of up to 5 gpm?

<u>NRC RAI 5.2-2 S02:</u>

In GEs response to RAI 5.2-2, MFN 06-085, GE stated that an evaluation of the effects of relative humidity including that which is attributable to the proposed leakage limits up to 5 gpm would be included as part of equipment qualification requirements in the procurement of equipment. The staff reviewed the current equipment qualification and found that it was not adequate to address the concern of long term leakage. Under current TS, the plant operators could continuously operate the plant for years with unidentified reactor coolant system (RCS) leakage of less than 5 gpm. In response to the RAI, GE stated that the design of ESBWR has been improved to reduce the likelihood of leaks resulting from stress corrosion cracking (SCC), and historically, good operator practice plays a role in the event of an anomaly in unidentified leakage. Typical operator practice will investigate, record, track, evaluate trends of the leakage, and take necessary measures to locate, assess, and repair the source of the leakage. The staff agreed that the material design improvement can reduce the likelihood of leaks resulting from SCC, but the improvement cannot eliminate all the possible leaks. The staff also agreed that good operator actions at low level leakage below the TS limit are acceptable measures to address the concern of long term leakage. To account for the good operator practice, every COL applicant should have operating procedures to manage the low level RCS leakage, and the alarm limit should be set as low as practicable to provide an early warning signal to the operators to implement the procedures. Therefore, it needs a new COL action item, and an appropriate alarm limit in the design.

In the conference calls, dated August 14, 2006, and January 16, 2007, the applicant agreed to add a COL holder item in Revision 3 of DCD Section 5.2.6. The COL holder item now states that "operators will be provided with procedures to assist in monitoring, recording, trending, determining the source of leakage, and evaluating potential corrective action." The staff find this statement unacceptable for the following reasons.

A. Revise the COL Holder item to state that "The COL Holder is responsible for the development of a procedure ..." rather than the current statement that the "Operators will be provided with procedures ..."

B. Revise the COL Holder item to indicate that the procedures are for low level unidentified leakage, (lower than the TS limit). {This RAI response is associated with the above RAI 5.2-1 supplement resolution as it needs an appropriate alarm limit in the design to provide an early warning signal to the operators to implement the procedures.}

<u>GEH Response:</u>

<u>NRC RAI 5.2-2 S01, item a.</u> Environmental qualification of components is addressed by an Inspection, Test, Analysis, and Acceptance Criteria (ITAAC) listed in DCD Tier 1, Revision 3, Table 2.15.7-1, Item No. 7. The environmental qualification of equipment and components is addressed in DCD Tier 2, Revision 3, Section 3.11 and Reference 3.11-3 "General Electric Environmental Qualification Program," NEDE-24326-1-P. Relative humidity is one parameter of environmental qualification.

NRC RAI 5.2-2 S01, item b. The original response using the phrase "good operator practice" is not a design commitment. The context is that the role expected of the operators is to carry out those activities as required under the surveillance requirements of plant Technical Specifications LCO 3.4.3. The issues of operating procedure and methodologies for evaluating detected leakage, with an associated COL commitment, has already been addressed in response to RAI 5.2-4 S02 (MFN 06-085 Supplement 2, submitted June 1, 2007, identified as resolved by NRC).

NRC RAI 5.2-2 S01, item c. In addition to laboratory testing, the existing world-wide operating BWR fleet represents a real-time accumulation of data and experience with the phenomenon of stress-corrosion cracking (SCC). That accumulation presently extends over 4 decades and will proceed to more than 6 decades due to the number of BWRS with license extensions, possibly achieving this milestone before the first ESBWR reaches 10 years of operating history. The selection of material, the selection of material processing, fabrication and post-fabrication treatment methods, and the water chemistry requirements and operating recommendations for the ESBWR are based upon the accumulated knowledge on SCC in addition to the regulatory guidance available.

NRC RAI 5.2-2 S01, item d. The ESBWR design is not predicated on an LBB risk-informed early detection of leakage. The reductions both of systems penetrating containment and of large penetrations below the top-of-active-fuel vessel elevation are primarily intended to reduce the severity of the postulated design base accidents and permit the passive Emergency Core Cooling System (ECCS) response of the ESBWR design. The design leakage limit for unidentified containment leakage remains at 5 gpm, which represents the lowest value without spurious alarm activations or plant shutdowns. The operating organization actions to be taken upon indication of a potential change in leak rate below the alarm limit are controlled under administrative procedures developed under the COL applicant's responsibility as per DCD Tier 2, Revision 3, Section 13.5.

NRC RAI 5.2-2 S02, items A and B. These requests are redundant to RAI 5.2-4 S02 (MFN 06-085 Supplement 2, submitted June 1, 2007, identified as resolved by NRC). The response to RAI 5.2-4 S02 was already in process to be transmitted to the NRC when this response to RAI 5.2-2 S02 was being prepared.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 5.2-2 S03:

How does ESBWR meet quantitative Regulatory Guide (RG) 1.45 Positions C.2 and C.5 of 1 gpm limit, if the alarm and Technical Specification (TS) limit is specified as 5 gpm?

The staff reviewed the responses to RAI Supplements 5.2-1 S02, 5.2-2 S02, and RAI 16.2-4 and found the proposed Technical Specification limit of 5 gpm unidentified leakage is acceptable. However, the staff finds that the current ESBWR leakage alarm setpoint of 5 gpm is not acceptable because it is not consistent with RG 1.45 and it does *not serve the intended function of alerting the operator before the TS limit is reached. RG 1.45 states "[s]umps and tanks used to collect unidentified leakage and air cooler condensate should be instrumented to alarm for increases of from 0.5 to 1.0 gpm in the normal flow rates." In order to comply with RG 1.45, the applicant needs to establish a low leakage alarm setpoint that is set at 0.5 to 1.0 gpm above normal leakage and below the TS limit of 5 gpm to provide the operator with sufficient time to take actions before the TS limit is reached, or the applicant needs to provide an acceptable alternative to RG 1.45.*

(This RAI is associated with RAI 5.2-1 S03 and RAI 16.2-4 S01)

GEH Response:

Response to this RAI supplement has been completely addressed in the response to RAI 5.2-1 S03 above.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 16.2-4 S01

How does ESBWR meet quantitative Regulatory Guide (RG) 1.45 Positions C.2 and C.5 of 1 gpm limit, if the alarm and Technical Specification (TS) limit is specified as 5 gpm?

The staff reviewed the responses to RAI Supplements 5.2-1 S02, 5.2-2 S02, and RAI 16.2-4 and found the proposed Technical Specification limit of 5 gpm unidentified leakage is acceptable. However, the staff finds that the current ESBWR leakage alarm setpoint of 5 gpm is not acceptable because it is not consistent with RG 1.45 and it does not serve the intended function of alerting the operator before the TS limit is reached. RG 1.45 states "[s]umps and tanks used to collect unidentified leakage and air cooler condensate should be instrumented to alarm for increases of from 0.5 to 1.0 gpm in the normal flow rates." In order to comply with RG 1.45, the applicant needs to establish a low leakage alarm setpoint that is set at 0.5 to 1.0 gpm above normal leakage and below the TS limit of 5 gpm to provide the operator with sufficient time to take actions before the TS limit is reached, or the applicant needs to provide an acceptable alternative to RG 1.45.

(This RAI is associated with RAI 5.2-1 S03 and RAI 5.2-2 S03.)

GEH Response

Response to RAI 5.2-1 S03 completely addresses this supplemental request.

DCD Impact

No DCD changes will be made in response to this RAI.

generate the trip on low vacuum level. The trip signal is used by the isolation logic for closure of the MSIVs and the steam drain line valves. The condenser vacuum measurement is bypassed during startup and shutdown operations to guard against unnecessary isolation.

Intersystem Leakage Monitoring

Intersystem leakage of radioactive material into each RCCWS train is monitored continuously by the PRMS. A radiation monitor is provided at the RCCWS common discharge line that connects the cooling water output flows from the RWCU/SDC non-regenerative heat exchanger, the Fuel and Auxiliary Pools Cooling System (FAPCS) heat exchanger, the reactor building chiller, and the RCCWS air cooler. A high level of radioactivity is indicative of reactor coolant leakage into the closed loop RCCWS train. The high radiation level is alarmed in the control room.

Differential Temperature Monitoring in Equipment Areas

Differential temperature monitoring is provided in key areas in the reactor building to detect for small leaks. Such areas as the main steamline tunnel and the equipment areas of the RWCU/SDC System are instrumented with thermocouples that provide differential temperature measurements for alarm indication only.

Large Leaks External to the Drywell

The instrumentation provided to monitor main steamline flow, reactor vessel low water levels, IC steamline flow, and RWCU/SDC reactor coolant flow (as discussed under the appropriate paragraphs in Subsections 5.2.5.2.1 and 5.2.5.2.2) also indicates large leaks from the reactor coolant piping external to the drywell.

5.2.5.2.3 Summary of Plant Variables Monitored for Leak Detection

The plant variables monitored for leakage are summarized in Tables 5.2-6 and 5.2-7 for areas within and outside the containment. The automatic LD&IS isolation functions that are provided for detection and isolation of gross leakage within the plant are identified in Table 5.2-6. The leakage parameters of the plant that are monitored and annunciated in the main control room are identified in Table 5.2-7. Also, Table 5.2-6 lists at least two or more leakage parameters that are monitored for containment isolation.

5.2.5.3 Display and Indications in the Main Control Room

Monitored plant leakage parameters are measured, recorded and displayed on the appropriate panels in the main control room. All abnormal indications are annunciated ~~to alert the~~for operator ~~for~~ alert to initiate corrective action. All initiated automatic or manual isolation functions are also alarmed in the main control room.

5.2.5.4 Limits for Reactor Coolant Leakage Rates Within the Drywell

The total reactor coolant leakage rate consists of all identified and unidentified leakages that flow to the drywell floor drain and equipment drain sumps. The reactor coolant leakage rate limits for alarm annunciation are established at less than or equal to 95 liters/min (25 gpm) from identified sources and at 19 liters/min (5 gpm) from unidentified sources. The instrumentation is designed to detect leakage rate step changes from unidentified sources of as low as 3.8 liters/min (1 gpm) in one hour under ideal conditions. An alarm annunciates if a step increase of the unidentified leak rate occurs, equal to or greater than a flow rate increase of 8.33 liters/min (2.2 gpm) within one hour.

5.2.5.5 Criteria to Evaluate the Adequacy and Margin of Leak Detection System

For process lines that penetrate the containment, at least two different methods are used for detecting and isolating the leakage for the affected system. The instrumentation is designed to initiate alarms at established leakage limits and isolate the affected systems. The alarm setpoints are determined analytically or are based on actual measurements made during startup and pre-operational tests.

The unidentified leakage rate limit is based, with an adequate margin for contingencies, on a crack size large enough for leakage to propagate rapidly. The established limit is sufficiently low so that, even if the entire leakage rate were coming from a single crack in the nuclear system process barrier, corrective action could be taken before barrier integrity is threatened.

Sump instrumentation is capable of detecting unidentified leakage step changes of as low as 3.8 liters/min (1 gpm) in one hour within the drywell under ideal conditions. To account for normal operating condition changes, the evolution of drywell moisture, and parameter variations (e.g., temperature, turbidity) affecting leakage detection accuracy, a rate-of-change alarm setpoint is established at a lower limit value of 8.33 liters/minute (2.2 gpm). The rate-of-change alarm provides an early alert for the control room operators to initiate investigation of the cause and proper response actions for the change of unidentified leakage flow prior to reaching or exceeding the Technical Specifications limit.

5.2.5.6 Separation of Identified and Unidentified Leakages in the Containment

Identified and unidentified leakages from sources within the drywell are collected and directed to separate sumps, the LCW equipment drain sumps for identified leakages and the HCW floor drain sumps for unidentified leakages.

5.2.5.7 Testing, Calibration and Inspection Requirements

The requirements for testing, calibration and inspection of the LD&IS are covered in Subsection 7.3.3.4.

5.2.5.8 Regulatory Guide 1.45 Compliance

This Regulatory Guide (RG) specifies acceptable methods of implementing 10 CFR 50, Appendix A, GDC 30 with regard to the selection of leakage detection systems for the reactor coolant pressure boundary.

Leakage is collected separately in drain sumps for identified and unidentified sources in the containment and total flow rate from each sump is independently monitored, thus satisfying RG 1.45, Position C.1.

Leakage from unidentified sources from inside the drywell is collected into the floor drain sump to detect leakage step changes using instruments with a quiescent system accuracy of as low as 3.8 liters/min (1 gpm), thus satisfying RG 1.45, Position C.2. A leakage rate-of-change alarm value of 8.33 liters/min (2.2 gpm) is used to account for normal operating plant evolutions, satisfying the intent of RG 1.45, Position C2.

Three separate detection methods are used for leakage monitoring: (1) the floor drain sump level and pump operating frequency, (2) radioactivity of the airborne particulates, and (3) the drywell air coolers condensate flow rate, thus satisfying RG 1.45, Position C.3.

Intersystem radiation leakage into the Reactor Component Cooling Water System is monitored as described in Subsection 5.2.5.2.2, thus satisfying RG 1.45, Position C.4.

The monitoring instrumentation of the drywell floor drain sump, the air particulate radioactivity, and the drywell air cooler condensate flow rate are designed to detect leakage rates of 3.8 liters/min (1 gpm) within one hour, thus satisfying RG 1.45, Position C.5. A leakage rate-of-change alarm value of 8.33 liters/min (2.2 gpm) is used to account for normal operating plant evolutions, satisfying the intent of RG 1.45, Position C5.

The monitoring instrumentation of the drywell floor drain sump, the air particulate radioactivity, and the drywell air cooler condensate flow rate are classified safety-related, Seismic Category 1; and designed to operate during and following seismic events. The airborne particulate radioactivity monitor is designed to operate during an SSE event. Thus, RG 1.45, Position C6 is satisfied.

Each monitored leakage parameter is indicated in the main control room and activates an alarm on abnormal indication. Procedures are provided (see Subsection 5.2.6) to determine identified and unidentified leakage to establish whether the leakage rates are within the allowable Technical Specifications. Calibration of each leakage monitoring channel accounts for the necessary independent variables. This satisfies RG 1.45, Position C.7.

The monitoring instrumentation of the drywell floor drain sump, the air particulate radioactivity, and the drywell air cooler condensate flow rate are equipped with provisions to readily permit testing for operability and calibration during plant operation, thus satisfying RG 1.45, Position C.8.

Limiting conditions for identified and unidentified leakage and for the availability of various types of leakage detection instruments are established in the technical specifications. This satisfies Position C.9 of RG 1.45.

5.2.5.9 COL Information for Leak Detection Monitoring (COL 5.2-2-H)

The COL holder is responsible for the development of a procedure to convert different parameter indications for identified and unidentified leakage (examples: sump pump run time, sump level, condensate transfer rate, process chemistry/radioactivity) into common leak rate equivalents (volumetric or mass flow) and leak rate rate-of-change values. The monitored leakage equivalents provides information used by the plant operators to manage the leakage and establish whether the leakage rates are within the allowable Technical Specifications and determine the trend.

The COL holder is responsible for the development of with procedures for monitoring, recording, trending, determining the source(s) of leakage, and evaluating potential corrective action plans. An unidentified leakage rate-of-change alarm provides operators an early alert to initiate response actions prior to reaching the Technical Specifications limit.

5.2.6 COL Information

5.2-1-H Preservice and Inservice Inspection Program Plan

The COL holder is responsible for the development of the preservice and inservice inspection program plans that are based on the ASME Code, Section XI (Subsection 5.2.4.~~12~~11).

5.2-2-H Leak Detection Monitoring

The COL holder is responsible for the development of a procedure to convert different parameter indications for identified and unidentified leakage into common leak rate equivalents and leak rate rate-of-change values.

The COL holder is responsible for the development of procedures for monitoring, recording, trending, determining the source(s) of leakage, and evaluating potential corrective action plans. (Subsection 5.2.5.9).