NRC FORM 757
NRC MD 10.158
(3-2009)

U.S. NUCLEAR REGULATORY COMMISSION

NON-CONCURRENCE PROCESS

SECTION A - TO BE COMPLETED BY NON-CONCURRING INDIVIDUAL

TITLE OF DOCUMENT	ADAMS ACCESSION NO.
Revised models for adoption of TSTF-513, Revision 2, "Revise PWR Operability Requirem....	**ML101300134**
DOCUMENT SPONSOR	SPONSOR PHONE NO.
Robert Elliott/M Hamm	**301-415-1472**
NAME OF NON-CONCURRING INDIVIDUAL	PHONE NO.
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☐ DOCUMENT AUTHOR ☐ DOCUMENT CONTRIBUTOR ☐ DOCUMENT REVIEWER ☑ ON CONCURRENCE

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Senior Resident Inspector, Diablo Canyon	**Region IV**

REASONS FOR NON-CONCURRENCE

Summary

Incorporation of TSTF-513[1] into plant specific Technical Specifications would result in a significant reduction in the margin of safety at some reactor facilities. The proposed change would permit licensees to operate for periods up to seven days without the minimum reactor coolant system (RCS) leak detection capability assumed in the Leak-Before-Break (LBB) safety analysis.

Approval of TSTF-513 would also establish a new agency precedent by allowing licensees to credit Technical Specification required RCS leak detection equipment as "operable" when that equipment is not capable of performing the intended safety function as described in the plant safety analysis.

Current Requirements

Regulatory Guide 1.45[2] establishes the typical licensing basis commitment for RCS leak detection to meet General Design Criteria (GDC) 30, "Quality of Reactor Coolant Pressure Boundary." Regulatory Guide 1.45, Position C.5, established the requirement that containment atmospheric gaseous radiation monitors have the capability of detecting a one gallon per minute (gpm) leak when used for RCS leakage detection. Regulatory Guide 1.45 specifies that "realistic primary" coolant radioactivity source term be used when demonstrating gaseous monitor leak detection capability. The gaseous monitor is typically one of three RCS leak detection systems required by Technical Specification 3.4.15, "RCS Leakage Detection Instrumentation."[3] At Westinghouse PWRs, the specified safety function of these systems is to provide plant operators with an early indication of potential pressure boundary leakage between the 72 hour RCS inventory balance interval required by Technical Specification Surveillance 3.4.13, "RCS Operational Leakage."

The majority of US Westinghouse PWRs have also incorporated the LBB pipe fracture mechanics technology into the plant specific design bases.[4] The LBB technology provided the basis for reducing the number of RCS piping supports, resolution of Unresolved Safety Issue A-2, "Asymmetric Blowdown Loads on PWR Primary Systems," and GDC 4, "Environmental and Dynamic Effects Design Bases."[5] The LBB NRC review criterion specifies that licensees are required to maintain RCS leakage detection systems equivalent to Regulatory Guide 1.45 to use the LBB technology.[6] The LBB safety analysis requires licensees to maintain at least one RCS leak detection system with the capability of detecting a one gpm leak in four hours available at all times.[7] The integrity of this key safety requirement has been typically preserved by Technical Specification 3.4.15, "RCS Leakage Detection Instrumentation."[8] Technical Specification 3.4.15 currently prohibits continued reactor operation without at least one operable RCS leakage detection system.

☑ CONTINUED IN SECTION D

SIGNATURE	DATE
Michael Peck	*May 17, 2010*

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SECTION B - TO BE COMPLETED BY NON-CONCURRING INDIVIDUAL'S SUPERVISOR
(THIS SECTION SHOULD ONLY BE COMPLETED IF SUPERVISOR IS DIFFERENT THAN DOCUMENT SPONSOR.)

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ORGANIZATION
Projects Branch B, Division of Reactor Projects, RIV

COMMENTS FOR THE DOCUMENT SPONSOR TO CONSIDER

☐ I HAVE NO COMMENTS

☒ I HAVE THE FOLLOWING COMMENTS

I SUPPORT DR. PECK'S USE OF THE NONCONCURRENCE PROCESS, AND I AGREE THAT THE PROPOSED TS CHANGE SHOULD BE REQUIRED TO DOCUMENT HOW IT IS CONSISTENT WITH THE LBB SAFETY ANALYSIS, OR OTHERWISE PROVIDE THE TECHNICAL BASIS FOR ACCEPTABLE RISK.

☐ CONTINUED IN SECTION D

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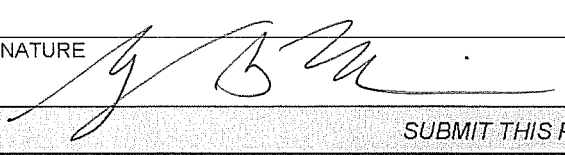	5/24/10

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SECTION C - TO BE COMPLETED BY DOCUMENT SPONSOR

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ACTIONS TAKEN TO ADDRESS NON-CONCURRENCE (This section should be revised, as necessary, to reflect the final outcome of the non-concurrence process, including a complete discussion of how individual concerns were addressed.)

See The Continuation Pages for Section C

☑ CONTINUED IN SECTION D

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NON-CONCURRING INDIVIDUAL *(To be completed by document sponsor* when process is complete, i.e., after document is signed):

- ☐ CONCURS
- ☐ NON-CONCURS
- ☐ WITHDRAWS NON-CONCURRENCE (i.e., discontinues process)
- ☐ WANTS NCP FORM PUBLIC
- ☐ WANTS NCP FORM NON-PUBLIC

Past Containment Gaseous Radiation Monitor Operability Issues

In 2003, the NRC identified that gaseous radiation monitors used for RCS leakage detection at the Byron and Braidwood plants were not capable of performing the specified safety function.[9] The Agency concluded that between 223 and 839 hours would be needed before these gas monitors could detect a one gpm RCS leak using a "realistic" primary coolant radioactivity source term. In 2003, the NRC also concluded that the Callaway gaseous monitor was inoperable because greater than 500 hours were needed before the detector could detect a one gpm leak at current RCS activity levels.[10] The NRC subsequently identified that the gaseous monitors at Wolf Creek,[11] Diablo Canyon,[12] and Mcguire [13]were also inoperable. In each of these cases, the NRC concluded that the gaseous monitors were inoperable for Technical Specification 3.4.15 compliance because the leak detectors were not capable of detecting a RCS leak in a reasonable period of time, consistent with either the plant licensing basis or safety analysis. The inspectors found the gaseous monitor design response and sensitivity was based on an assumed RCS source term equivalent to about 0.1 percent failed nuclear fuel. This assumed RCS source term was several orders of magnitude greater than "realistic" coolant radioactivity specified by Regulatory Guide 1.45. The NRC inspectors concluded that none of these reactors had ever operated with the RCS source term assumed in the monitor design and that current performance standards would likely result in a reactor shutdown long before 0.1 percent fuel failure would occur. Applying NRC operability guidance,[14] agency inspectors concluded that monitors were inoperably because they were not able to function as a creditable leak detectors at current RCS conditions. Inspectors also concluded that the high RCS source terms specified in the design and FSARs were a condition required for operability because these conditions were explicitly relied upon by licensees to demonstrate RCS leak detection function.

In 2005, the NRC issued Information Notice 2005-24[15] to alert licensees that the RCS activity assumed in the containment radiation atmospheric monitor design calculations may be non-conservative. The agency concluded that individual gaseous monitor response and sensitivity were dependant on plant specific factors, including placement of detector inlet in relation to RCS piping, RCS source term, if argon injection was used, containment size, containment ventilation flow and distribution (mixing). Information Notice 2005-24 also reinforced the fact that atmospheric monitor operability was dependant on the capability of the monitor to perform the specified safety function to detect a RCS leak.

Changes Provided by TSTF-513

TSTF-513 provides two changes that would result in a significant reduction in the margin of safety for some reactor facilities. First, TSTF-513 includes a "clarification" to the Basis of Technical Specification 3.4.15"

> *"However, the gaseous or particulate containment atmosphere radioactivity monitor is OPERABLE when it is capable of detecting a 1 gpm increase in unidentified LEAKAGE within 1 hour given an RCS activity equivalent of that assumed in the design calculations for the monitors."*

This statement would allow licensees to credit atmospheric radiation monitors as operable RCS leak detectors independent of the capability of these components to detect an actual RCS leak. TSTF-513 would allow some PWRs (including Byron, Braidwood, Callaway, Wolf Creek, Diablo Canyon, & McGuire) to operate with a Technical Specification "operable" leak detector that would likely never have the necessary RCS source term to be functional.

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Proposed TSTF-513 would result in a significant reduction in the margin of safety at some reactor facilities because the change would reduce the minimum required functional RCS leak detection capability from one to none. TSTF-513 provides a new limiting condition for operation, "Condition D." This condition allows reactor operation for up to seven days with only the gaseous monitor. Given that the Basis "clarification" would no longer require the gaseous monitor to be capable of detecting a RCS leak to be "operable," this Condition would effectively permit continued reactor operation for seven days (at some facilities) without any RCS leak detection capability. Reactor operation without at least one RCS leak detection system (with a one gpm within four hour capability) would place the plant outside the bounds of the NRC LBB safety analysis assumstions.[16]

Approval of TSTF-513 would also establish a new agency precedent by permitting licensees to credit nonfunctional equipment as "operable." This position is contrary to current agency operability guidance.[17] This guidance specifies that:

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

TSTF-513 Failed to Provide Adequate Technical Justification for the Use of Containment Atmosphere Grab Samples for RCS Leak Detection

TSTF-513 justified the seven day Limiting Condition for Operation D, in part, by requiring licensees to analyze containment atmosphere grab samples once every 12 hours. Use of atmosphere grab samples is not an NRC approved method for RCS leak detection[18] and the TSTF did not provide an adequate technical justification that grab samples were effective for RCS leakage detection.

Containment grab samples are typically taken from the upper containment deck. The critical piping affected by the LBB analysis is remotely located in the lower containment, within the confines of the biological shield and crane walls. For RCS grab samples to be effective to identify RCS leakage, the coolant source term and leak rate must be sufficient to raise gaseous or particulate radiation levels above minimum detection limits at the location the grab sample is taken.

For gaseous grab samples, licensees typically fill a four liter sample bottle by a mechanical air pump. Xe^{133} is a typical dominant RCS gaseous nuclide. RCS Xe^{133} concentrations are often less than $7x10^{-4}$ µCi/ml. A 60 gallon leak (one gpm over an hour) would release about $2.2x10^{5}$ ml (or 160 µCi) into containment from the RCS. Given a large, dry PWR containment has about $2.5x10^{6}$ Ft^3 ($7.1 x10^{10}$ ml) free space, the resulting increase in Xe^{133} in the containment atmosphere would be about $2.21x10^{-9}$ µCi/ml, assuming instantaneous containment air mixing. This Xe^{133} value is lower than the $1x10^{-8}$ µCi/ml level of detection use for analyzing grab samples.[19] Actual expected radionuclide concentrations at the upper containment deck could be significantly less due to mixing resident time in the containment:

$$[N_{\text{sample point}}]/dt = d[N_{\text{leak}}]/dt \,/\, [_{\text{Containment Volume}}] * d\,[_{\text{mixing}}]/dt$$

Where N is radionuclide concentration, dt is time differential and $d[_{\text{mixing}}]/dt$ corresponds to the time depend diffusion/forced convection of the RCS leak location to sample point.

Given that containment coolers circulate about 110,000 scfm, about a third radionuclide concentration would be seen at the upper containment deck after one hour when compared to the instantaneous mixing case (depending on plant specific parameters).

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For particulate grab samples, licensees typically count a filter after passing about 30 ft^3 of the containment atmosphere. A major contributor to RCS particulate concentration is Co^{58} or Cs^{138}. A typical RCS concentration for Co^{58} or Cs^{138} is about $2x10^{-3}$ µCi/ml. Applying the same approach used for the gaseous grab sample, 60 gallons of RCS would result in about $6.3x10^{-9}$ µCi/ml in containment assuming instantaneous mixing. This Co^{58} value is also lower than the $1x10^{-8}$ µCi/ml level of detection used for grab samples.[20] Actual radionuclide particulate concentrations at the upper containment deck would also be less due to mixing resident time in the containment:

$$d[N_{sample\ point}]/dt = d[N_{leak}]/dt / [_{Containment\ Volume}] * d\ [_{mixing}]/dt - d[N_{plate\ out}]/dt$$

In addition to the transport terms, additional containment atmospheric particulates would be lost due to plate out on the cooler surfaces in the lower containment surfaces and in the containment cooling cooler coils.

Proposed Alternative

1. Recommend that the Agency not approve TSTF-513, Revision 2.

2. Recommend additional renegotiation with industry to:

   - Remove the "clarification" to Technical Specification 3.4.15 Basis which provides for crediting nonfunctional equipment as operable. Removal of this change would still permit the use of radiation monitors for RCS leak detection at those plants where this equipment remains functional given plant specific design features and RCS source terms.

   - Specify that atmospheric grab sample analysis results are required to be completed every four hours while operating in Condition D. This change would provide consistency with the LBB safety analysis.

   - Included provisions in the Technical Specification Basis to ensure licensees complete a plant specific analysis, including the applicable ranges of RCS source terms and containment design and equipment alignments and transport times, demonstrating containment atmospheric grab samples have the capability to detect a one gpm RCS leak within four hours.

   - Ensure the revised basis for Technical Specification 3.4.15 includes all applicable safety analysis (LBB).

3. Correct error on Attachment 1, page 1. Attachment 1 states:

   "New condition [D] Required Action require analyzing grab samples of the containment atmosphere or performing an RCS water inventory balance every 12 hours and restoring another monitor within 7 days."

   New Condition [D] does not require water inventory balance every 12 hours.

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4. IAEA-TECDOC-710, “Applicability of the leak before break concept Report of the IAEA Extrabudgetary Programme on the Safety of WWER-440 Model 230 Nuclear Power Plants,” Status report on a generic safety issue (www-pub.**iaea**.org/MTCD/publications/PDF/te_**710**_web.pdf)
5. NUREG-1061, Volume 3, “Report of the U.S. Nuclear Regulatory Commission Piping Review Committed, Evaluation of Potential for Pipe Breaks, November,” 1984
6. NUREG-0800, U.S. Nuclear Regulatory Commission Standard Review Plan, 3.6.3, “Leak-Before Break Evaluation Procedures,” Revision, 1
7. Generic Letter 84-04, “Safety Evaluation of Westinghouse Topical Reports Dealing with Elimination of Postulated Pipe Breaks In PWR Primary Main Loops”
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9. Letter to J.L. Skolds, Exelon Nuclear, February 20, 2003, from L. Raghavan, NRR, “Resolution of Allegation NRR-2002-A0022”
10. Callaway Plant - NRC Integrated Inspection Report 05000483/2003005,October 16, 2003 (ADAEMS ML032890770)
11. Wolf Creek Generating Station - NRC Integrated Inspection Report 05000482/2004004 November 9, 2004 (ADAMS ML0431402790)
12. Diablo Canyon Power Plant - NRC Integrated Inspection Report 05000275/2008004 AND 05000323/2008004 November 3, 2008, (ADAMS ML0830801130)
13. Mcguire Nuclear Station - NRC Integrated Inspection Report 05000369/2005002 And 05000370/2005002 And Independent Spent Fuel Storage Installation Inspection Report 0720038/20050001 (ADAMS ML051190140)
14. RIS 2005-20, Revision to NRC Inspection Manual Part 9900 Technical Guidance, “Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety”. Revision 1
15. NRC INFORMATION NOTICE 2005-24, “Nonconservatism in Leakage Detection Sensitivity,” August 3, 2005
16. Generic Letter 84-04, “Safety Evaluation of Westinghouse Topical Reports Dealing with Elimination of Postulated Pipe Breaks In PWR Primary Main Loops”
17. Ibid 13
18. Ibid 2, 3, & 5
19. Discussion with Diablo Canyon Chemistry Supervisor on May 13, 2010
20. Ibid 15

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10 CFR 50.36 states that when a Limiting Condition for Operation of a nuclear reactor is not met, the licensee shall shut down to reactor or follow any remedial action permitted by the technical specifications until the condition can be met. In the case of TSTF-513, the agency is changing which remedial actions licensees are permitted to perform until the LCO can be met. This allows licensees time to repair equipment while preventing a thermal transient to the plant due to a required shut down. The TS revised by TSTF-513 do not change the requirement for all safety systems to be operable. Therefore, any licensee adopting TSTF-513 should still be able to mitigate any design basis accidents or transients even if the leakage detection equipment were to fail to detect a leak. .

The staff believes that the TS should be revised because RG 1.45, ,provides conflicting guidance on the operability requirements for the leak detection systems using airborne particulate or gaseous radiation. In addition to the requirement to be able to detect a one gpm within one hour, RG 1.45 also endorses the use of fuel failure estimates that are much higher than operating plants are experiencing today (i.e.,for use in determining the required instrument sensitivity). Specifically, the RG states that "The expected values used in the plant environmental report would be acceptable." This forms part of the licensing basis for plants committed to RG 1.45. The RG recommended capability to detect a one gpm leak is contingent on this assumption, which is specifically endorsed by the staff.

The staff recognizes that LBB analyses assume at least one method of leakage detection can detect a RCS leakage rate of 1 GPM in 4 hours. TS, on the other hand, are structured to allow plants time to restore inoperable equipment when a licensing basis assumption is not met, provided that the level of risk associated with the inoperabilty is low. TSTF-513 provides time for the restoration of the inoperable instrumentation because the risk is low, and the licensee will be required to take additional actions to minimize the impact on the margin of safety while the instruments are restored.

The staff notes that the TS bases restate the licensing basis. The licensing basis only required using the RCS radioactivity concentration assumed in the design calculations. We understand that the actual RCS radioactivity concentration is now much lower than originally assumed and this adversely affects how quickly the containment gaseous activity monitor would detect small RCS leaks. This is why TSTF-513 would require operators to take extra actions to monitor for RCS leaks when only the containment gaseous activity monitor is operable. While the gaseous monitors may have difficulty detecting small leaks, they are capable of detecting larger leaks (e.g., on the order of 5 gpm). As a result, we consider that they are still appropriate instruments to be retained in TS since they may detect a larger leak that goes undetected by the other leakage detection instruments.

Please see the responses to the Proposed Alternatives in the following pages.

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Response to Proposed Alternative #1:

Since receipt of Section A, a revised TSTF-513 has been proposed. TSTF-513, Revision 3 contains the main elements of Revision 2 and the staff believes that Revision 3 is acceptable. The ADAMS accession number for the Revised Models for Adoption of TSTF-513, Revision 3 is ML101870545.

The staff believes that it is the combination of all three diverse leakage detection sensors that provides the maximum potential for early detection of a leak. Some licensees in response to the gaseous radiation monitor concerns have obtained license amendments to remove the gaseous radiation monitors from their TS, reducing their leakage detection systems to two instruments. The staff does not believe this is the best way to address this problem as it reduces the licensee's capability to detect leaks. In addition, as previously stated, the changes require more frequent monitoring of other leakage detection methods when the containment atmosphere gaseous radioactivity monitor is the only operable RCS leakage detection instrument. The staff feels that the appropriate approach to address the issue is requiring operators to monitor other leakage detection methods more frequently to maximize the potential for early identification and detection of an RCS leak such that leak before break assumptions are maintained.

Furthermore, the staff believes that the safety function of this instrument is clarified by this TSTF. Specifically, the safety function of leakage detection is to provide operators with an early warning of potential degradation of the Reactor Coolant Pressure Boundary with sufficient time for the operators to take action and place the plant in a safe condition before a catastrophic failure occurs. The function of leakage detection is to provide defense in depth by allowing to operators to take action before an accident occurs, not to mitigate the accident. The TSTF clarifies the level of sensitivity required for the gaseous monitor. This approach is consistent with the way operability is currently evaluated.

Because many factors can affect leakage detection capabilities, the TS are configured to require multiple diverse means of leakage detection. This allows the capabilities of the sensors to be combined to provide the best detection capability and the greatest defense in depth. The staff notes that the specified safety function of these monitors is not based on the detection of a specific leak size. Rather it is to warn the operators of RCPB degradation. The specific requirement to detect a one gpm leak within one or four hours has no mechanistic tie to safety. There is no accident or transient scenario that requires a one gpm leak be detected within four hours in order to achieve successful mitigation of the accident. The situation in which the gas monitor is the only operable monitor is a very rare occurrence. And, leakage detection is a defense in depth capability which does not mitigate any accident or transient. All safety systems will still be required to be operable, and will still be able to mitigate any design basis accidents or transients. In addition, heightened awareness and additional Required Actions in the TS combined with the reduced CT minimize any reduction in the margin of safety while operating with only the gaseous monitor operable.

The staff notes that the current STS would allow 30 days of operation with only the gaseous monitor operable. TSTF-513 revises the CT to 7 days, and requires additional actions. Essentially, this change recognizes the reduction in detection capability when the other two instruments used for RCS leakage detection are inoperable, and would account for this by modifying the Required Actions to provide additional actions and a reduced CT when the Gas Monitor is the only Required instrument operable. The gas monitor is not being "credited" towards any relaxation of requirements.

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Response to Proposed Alternative #2:

The staff believes that the proposed changes to the TS Bases should be retained because they are necessary to prevent continued confusion. The changes revise the language regarding equipment operability. These revisions clarify when the equipment can be considered operable and are acceptable because they define, consistent with the design basis of the facility, the minimum set of diverse instruments that must be operable, the plant parameters monitored by the instrumentation, the design sensitivity of the leakage detection instruments, and factors that affect the operational sensitivity of the instrument. In addition, the TS are modified to provide Required Actions and a reduced CT which the staff believes are acceptable when the gaseous monitor is the only operable leakage detection instrument.

Increasing grab sample frequency would add no value to the Required Actions and may distract operators. Requiring the grab samples is done specifically because it is recognized that a 1 GPM leak may not be recognized in 1hour.

Containment grab samples have long been identified as an acceptable measure to compensate for inoperable containment atmosphere radioactivity monitors. The measure has been identified in the associated improved standard technical specification since its inception in 1993. As noted above, 10 CFR 50.36 states that when an LCO is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. Revision 3 to Section 16.0, "Technical Specifications,"of the Standard Review Plan (NUREG-0800), states that plant specific Technical Specifications satisfy 10 CFR 50.36 and are acceptable if the specifications are consistent with the regulatory guidance of the improved standard technical specifications and present plant -specific values for parameters at the indicated level of detail. Therefore, the periodic monitoring of containment grab samples is an NRC approved remedial action to compensate for short-term inoperability of a permanent containment atmosphere radioactivity monitor.

From a technical perspective, both the permanent containment atmosphere radioactivity monitors and the periodic monitoring of containment atmosphere grab samples are subject to factors that degrade their sensitivity to reactor coolant system leakage. As discussed in RG 1.45, reactor coolant system activity, detector sensitivity, detector response time, transport time, and other factors (e.g., containment atmospheric dilution, holdup, and decay) affect the overall sensitivity to leakage. The physical processes used to measure containment atmosphere radioactivity are similar for both the permanent detectors and the grab samples. The particulate monitors draw a sample volume of the containment atmosphere through a filter medium and measure the collected particulate radioactivity. The gaseous monitors measure radioactivity in a defined volume of the containment atmosphere. The principal difference between detectors is the continuous monitoring capability of the permanently installed monitors as opposed to the periodic nature of the grab sample monitoring. Therefore, with appropriate controls, the grab samples constitute an effective remedial measure to detect reactor coolant leakage.

Response to Proposed Alternative #3:

The editorial error has been corrected.