NUCLEAR ENERGY INSTITUTE

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Mr. F. Mark Reinhart
Office of Nuclear Reactor Regulation
Probabilistic Safety Assessment Branch
U. S. Nuclear Regulatory Commission
Mail Stop O10-H4
Washington, DC 20555-0001

Dear Mr. Reinhart:

On January 24, 2003, the NEI Control Room Habitability Task Force met with you to discuss the NRC staff's comments on a draft of Revision 1 to NEI 99-03, *Control Room Habitability Guidance*. At this meeting, we discussed your comments and identified tentative changes to the guidance. In addition, we obtained clarification on the NRC staff comments and provided additional clarification. As a result, we found the meeting very beneficial in reconciling various NRC staff and industry concerns.

Enclosure 1 contains the final version of Revision 1 to NEI 99-03. The second enclosure is a table summarizing the resolution of NRC comments. We are submitting the final guidance for NRC review and endorsement. We believe that the final document has improved clarity by relocating more details to informational appendices, better defining periodic inspection intervals and refining the control room habitability (CRH) program.

During the meeting, the NRC staff stated its intentions to develop and publish four regulatory guides in parallel with our efforts to revise NEI 99-03. As part of our closing remarks, we requested the NRC staff to reference Revision 1 of NEI 99-03 in its regulatory guides, rather than the earlier version published in June 2001. Referencing Revision 1 will provide improved regulatory guidance reflecting the technical positions discussed with the NRC staff over the last year.

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If you have questions concerning the enclosures, please contact me at 202-739-8080, am@nei.org, or Kurt Cozens at 202-739-8085, koc@nei.org.

Sincerely,

Alexander Marion

KOC/avw
Enclosures

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Revision 1

Control Room Habitability Guidance

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ACKNOWLEDGEMENTS

The Nuclear Energy Institute (NEI) Task Force on Control Room Habitability developed the *Control Room Habitability Guidance* document. We appreciate the task force members contributing to its development and the industry contributors who commented on it to improve the content and clarity.

EXECUTIVE SUMMARY

This document addresses control room habitability (CRH) issues identified by industry and the NRC based on experiences with operating plants. The goal of the document is to provide guidance to assist licensees in assuring that their control rooms satisfy the NRC regulations and licensee commitments associated with control room habitability. This document addresses issues related to:

- Licensing/design basis and operator dose analyses
- Design basis accident (DBA) analyses
- Hazardous chemical evaluation
- Control room unfiltered inleakage
- Reactor control during smoke events
- Control room emergency filtration system (CREFS) technical specifications.

The document describes the general process for assuring and maintaining control room habitability. The document is divided into three primary sections:

- Background
- Initial actions
- CRH program.

The *Background* section discusses basic CRH licensing and design basis information and summarizes the CRH issues addressed in this document.

The *Initial Actions* section provides guidance, including recommended actions, on assembling the CRH licensing basis and assessing if a CRH issue is applicable to a specific plant. If deficiencies are identified, guidance for corrective actions consistent with the plant corrective action program is provided.

The *CRH Program* section describes a licensee-controlled program for managing CRH. The program recommends performance of periodic retesting of control room envelope (CRE) inleakage and periodic reassessment of the hazardous chemical program.

In addition, the document recognizes that training is an important element of a licensee CRH program.

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INFORMATIONAL APPENDICES

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document addresses Control Room Habitability (CRH) issues identified by the NRC and licensees based on experiences with operating plants. The goal of this document is to provide guidance to assist licensees in assuring that their control rooms satisfy the NRC regulations and licensee commitments associated with the following aspects of control room habitability. This document addresses:

- Licensing/design basis and operator dose analyses
- Design basis accident (DBA) analyses
- Hazardous chemical evaluation
- Control room unfiltered inleakage
- Impact of smoke events on reactor control
- Control room emergency filtration system (CREFS) technical specifications

1.2 DOCUMENT ORGANIZATION

The main body of the document describes the general process for assuring and maintaining control room habitability. Appendices are cited to provide in-depth guidance and other useful information.

The main body of the document is divided into three parts:

- Background
- Initial actions
- CRH program.

Section 2, *Background*, discusses basic CRH licensing and design basis information and summarizes the CRH issues addressed in this document.

Section 3, *Initial Actions*, provides guidance, including recommended actions, on assembling the CRH licensing basis and assessing if a CRH issue is applicable to a specific plant. If deficiencies are identified, guidance for corrective actions consistent with the plant corrective action program is provided.

Section 4, *CRH Program*, defines a licensee-controlled program for managing CRH. The recommended program defines periodic retesting of control room envelope (CRE) inleakage and periodic reassessment of the hazardous chemical program.

Section 5, *Training*, recognizes the importance of having appropriate training as part of the program to manage control room habitability.

This document contains two sets of appendices. The first set is the technical appendices that describe special topics, which include smoke evaluation, compensatory measures, the system assessment, the testing program, and the CRE boundary control program. These technical appendices are identified with a single letter nomenclature, such as Appendix A. The second set of appendices are for information only, which address subjects such as licensing basis history, regulatory documents associated with control room habitability, and other associated information that could be of value to licensees. The informational appendices are identified with a double letter nomenclature, such as Appendix AA.

2 BACKGROUND

2.1 INTRODUCTION

This section identifies documents containing regulatory requirements and guidance related to CRH. It also discusses the CRH issues identified by industry and the NRC and addressed by this document.

In this document, the control room envelope (CRE) encompasses the control room (CR) and other rooms and areas within the confines of the control room boundary (CRB). The CRB consists of the physical barriers (e.g., ducts, dampers, floors, ceilings, walls, doors) that separate the CRE from other plant areas. Control room envelope integrity is the condition whereby the control room habitability systems (CRHS) are functioning to provide a habitable environment for operators under normal and accident conditions to ensure the public is protected. The CRHS are the plant systems that help ensure CRE integrity, including the control room emergency filtration system (CREFS) and the control room heating, ventilating and air-conditioning (CR HVAC) systems.

2.2 CRH REGULATORY REQUIREMENTS

Appendix AA provides a brief history of the development of the NRC control room regulations and guidance. Appendix BB provides a listing of the NRC regulations and other NRC documents related to CRH.

2.3 CRH ISSUES

The following topics have been identified as areas of concerns for CRH:

- Licensing/design basis and operator dose analyses
- Design basis accident (DBA) analyses
- Hazardous chemical evaluation
- Control room unfiltered inleakage
- Impact of smoke events on reactor control
- Control room emergency filtration system (CREFS) technical specifications.

The following subsections summarize CRH issues addressed in this document. Section 3.2 provides specific guidance on assessing applicability of each CRH issue for a particular plant and defines actions for applicable issues.

2.3.1 LICENSING / DESIGN BASIS AND OPERATOR DOSE ANALYSES

During review of license amendments, licensees and the NRC have observed that some licensees have introduced inconsistencies between the plant's licensing basis and the as-built plant. Differences between the description of the control room envelope, the HVAC systems controlling the airflow within the envelope and in adjacent spaces[1], and the as-built condition of the plant have been identified and documented. Modifications to systems or the CRB may have inadvertently changed the CRE or its behavior. In addition, maintenance or operation activities may have resulted in repositioned dampers that could influence the system response or associated CRB integrity.

In addition, the design analyses used to determine the operator exposure to a radiological event include several input values that are based on system design parameters and assumed system operation. Licensees and the NRC have observed that some systems may have been operated differently from the assumptions or values used in the analyses. The analyses associated with power up-rates, steam generator replacement and alternate repair criteria for steam generator tubing are examples of that could affect the results of a licensee's CRH analysis.

Section 3.2.1 provides specific guidance.

2.3.2 DESIGN BASIS ACCIDENT (DBA) ANALYSES

Each plant is required to analyze the limiting design basis accident relating to CRH within the scope of its licensing basis. Generally, licensees and the NRC have assumed that large break loss-of-coolant accident (LBLOCA) was the limiting DBA for CRH. Reanalysis for some plants has shown that other licensing basis accidents can result in a more limiting dose to the operator. This may occur if, for example, timing and release locations of radioactivity release are more adverse than is currently assumed in the CRH analysis.

Section 3.2.2 provides specific guidance.

2.3.3 HAZARDOUS CHEMICAL EVALUATION

Control rooms are typically evaluated to assure that they can manage a hazardous chemical event consistent with NRC guidance contained in Revisions 0 of Regulatory Guides 1.78 and 1.95. Regulatory Guide 1.78, Revision 1 combines Revisions 0 of Regulatory Guides 1.78 and 1.95 and provides additional guidance. Some licensees may not have reassessed the plant's hazardous chemical evaluation since the early 1980s when it was provided in response to Three

[1] The conditions that exist in the areas adjacent to the CRE influence the performance of the CRHS. Although systems in adjacent areas might not be expected to operate during an emergency, during a loss of off-site power or with a single failure, inleakage may be increased if they do operate. Potential interactions between the CRHS and adjacent areas that may increase the transfer of contaminants into the control room should be identified. These interactions may be caused by ventilation systems that supply or exhaust air from areas adjacent to the control room, are located in areas adjacent to the control room or have ductwork that traverses the control room or areas adjacent to the control room.

Mile Island (TMI) NUREG-0737, item III.D.3.4. If the control room inleakage is greater than that assumed, or if hazardous chemical sources have changed over time, the existing hazardous chemical evaluation should be reassessed.

Section 3.2.3 provides specific guidance.

2.3.4 CONTROL ROOM INLEAKAGE

Tracer gas tests have been conducted at numerous nuclear power plant control rooms to determine the total amount of air inleakage (filtered and unfiltered). Essentially all the test results showed that the measured inleakage was greater than the amount assumed in CRH design basis analyses. In some cases, the difference was significant. This is a concern because control room inleakage values are used in the evaluation of both radiological and hazardous chemical events.

2.3.4.1 Radiological Considerations

The unfiltered inleakage rate is one of several input values used in the analyses that determine operator doses. The term unfiltered refers to potentially contaminated air entering the control room envelope that does not pass through an appropriate filtration device. With greater unfiltered inleakage, the fission product removal credited in the accident analyses may be inaccurate and non-conservative, and the control room personnel could be exposed to a larger dose than previously analyzed.

An increase in the rate of filtered inleakage may also increase the dose to the control room personnel. This will depend upon features such as system lineup, location of inleakage, mode of operation and timing of the event.

2.3.4.2 Hazardous Chemical Considerations

Inleakage is also a concern for hazardous chemical events. Increased inleakage may invalidate the conclusions of previous hazardous chemical analyses. The plant alignment used to determine the amount of inleakage for the hazardous chemical analysis might be different from that used for a radiological event. A typical control room response to a radiological event is to isolate and pressurize, whereas a typical response to a hazardous chemical event is to isolate only. This creates different system configurations and different surface areas subject to inleakage.

Section 3.2.4 provides specific guidance to address control room inleakage greater than assumed in operator dose analysis.

2.3.5 SMOKE EVALUATION

The original designs of many control rooms assumed that the primary source of inleakage was due to personnel ingress and egress thorough entrance doors. Recent CRH inleakage test results indicate that the original assumptions may not be correct and inleakage is likely to be greater than initially assumed. Therefore, licensees need to assure that, in the event of an internal or external smoke event, the reactor can be controlled from either the control room or an alternate shutdown panel. This may require additional assessment when the alternate shutdown panel is located within the control room envelope.

Section 3.2.5 and Appendix A provide specific guidance.

2.3.6 EXISTING TECHNICAL SPECIFICATIONS

The Standardized Technical Specifications have a control room emergency filtration system (CREFS) surveillance requirement to verify that one train can maintain a positive pressure in the CRE relative to adjacent areas. The basis for this surveillance states that it "…verifies the integrity of the control room enclosure and the assumed inleakage rates ... to minimize unfiltered inleakage …." This surveillance requirement would not apply to non-pressurized control rooms.

Integrated inleakage testing at a number of plants with positive pressure control rooms demonstrated that the measured inleakage rates were greater than the inleakage rates originally assumed in the safety analyses. Although these licensees had satisfied their positive pressure surveillance acceptance criteria, the positive pressure surveillance did not verify the assumed inleakage rate as stated in their TS Bases. The NRC has concluded that this deficiency should be corrected because 10 CFR 50.36 requires technical specifications to be derived from the safety analyses. In addition, the NRC has suggested that correction of the technical specifications would be consistent with the NRC Administrative Letter 98–10, *Dispositioning of Technical Specifications That Are Insufficient To Assure Plant Safety*, which describes the NRC's expectation that licensees correct technical specifications that are found to ''contain non-conservative values or specify incorrect actions.''

Section 3.2.6 provides specific guidance.

3 INITIAL ACTIONS

Licensees implementing the guidance of this document should perform the one-time actions addressed in this section:

- Assemble the licensing and design bases and analyses,
- Assess the applicability of the CRH issues identified in Section 2 and
- Identify actions to address those CRH issues that are applicable to the plant.

3.1 CRH LICENSING AND DESIGN BASES AND ANALYSES

Prior to determining the applicability of the CRH issues discussed in Section 3.2, licensees should assemble and document the CRH licensing and design bases and relevant analyses. The following subparagraphs provide some items that licensees should consider as they assemble and document this information.

If the licensee has previously assembled and documented its CRH licensing and design basis and analyses, the Section 3.1 actions may be omitted.

3.1.1 ASSEMBLE LICENSING AND DESIGN BASES

- The NRC-approved licensing bases of a plant are likely to have changed over time. Changes to the licensing basis contained in the operating license (OL) may have occurred because of plant modifications, response to NRC questions, or in response to TMI Action Item III.D.3.4.

- Prior to the issuance of the General Design Criteria (GDC), the NRC published for comment the proposed GDCs (sometimes called Principal Design Criteria), including one that addressed CRH. Typically, plants that received their construction permits or OLs prior to issuance of the GDCs have as part of their licensing basis these proposed GDCs. or something else similar,

- Appendices AA and BB provide a description of the licensing basis history and regulatory documents associated with CRH. Licensees may want to consider the content of these appendices when assembling the licensing and design bases.

- Regulatory Guide (RG) 1.186, Guidance and Examples of Identifying 10 CFR 50.2 Design Bases, endorses Appendix B of NEI 97-04, Revision 1, Design Basis Program Guidelines. These documents provide guidelines for identifying design basis information. Even though design basis information is a subset of the licensing basis, licensees may find the process identified in RG 1.186 useful when assembling the plant's licensing basis.

3.1.2 ASSEMBLING THE CRH ANALYSES

An important part of a control room design basis is the CRH analysis. This analysis is typically performed during initial plant design to determine operator exposure to the hazards produced by DBAs. For most plants, a CRH analysis will not be available as a stand-alone document. Rather, it must be assembled from its component parts. These parts should be found as written design basis documentation and licensing commitments. The following types of information should be reviewed to assemble the CRH analyses:

- Design basis accident analyses within the plant's licensing basis. Licensees should have a thorough understanding of the design basis accidents analyzed for CRH and should know the analysis results (such as radiological consequences) to ensure that the most limiting accident is identified.
- Specific performance requirements for components that provide a radiological, hazardous chemical or smoke mitigation function along with component performance data.
- Analysis input values, such as the amount of unfiltered inleakage or control room volume, their bases and source documents. For example, inputs such as occupancy factors may have been adopted from the Standard Review Plan.
- All modes of control room ventilation system operation and system alignments necessary to mitigate radiological, hazardous chemical and smoke events.
- All modes of adjacent area ventilation system operation and system alignments that may affect CRH function. This would include ductwork traversing the CRE.
- The design basis documents for controlling the performance of components important to CRH should be identified and reviewed to ensure consistency. Such documents may include:
  - Design specifications
  - Piping and instrumentation diagrams (P&ID)
  - Logic diagrams
  - Wiring diagrams
  - Performance test acceptance criteria.
- Technical Specification performance limits and surveillance requirements for credited components.
- Commitments and other requirements regarding operation of the control room envelope that may be identified in such documents as the licensee's Updated Final Safety Analysis Report (UFSAR), Design Basis Documents (DBD), Design Criteria Manuals or Memoranda, operating procedures, or surveillance test procedures.
- License submittals that may affect CRH such as steam generator replacement, steam generator alternate repair criteria and power uprates.

3.1.3 DOCUMENTATION

If the licensee already has a plant process developed for documenting the CRH licensing basis, the licensee should ensure that all appropriate CRH related information has been recorded. Otherwise, a process should be developed. The CRH licensing basis identification process should include means to identify, retain and update these items.

The process should ensure that all source documentation is reviewed. When licensing basis information is identified, it should be captured and accurately referenced to allow subsequent retrieval in its original context to facilitate review and verification if necessary.

3.2 EVALUATING CRH ISSUES

This section provides guidance for evaluating the plant specific applicability of the areas of concern introduced in Section 2.

This section recommends actions to address the applicable issues. Perform activities of Sections 3.2.1 though 3.2.3 in sequence prior to performing activities of Sections 3.2.4 through 3.2.6.

3.2.1 LICENSING / DESIGN BASIS AND OPERATOR DOSE ANALYSES

3.2.1.1 Applicability

Compare the control room (CR) system configuration, operation and maintenance practices to assure that they agree with the licensing and design bases.

This comparison is needed because new procedures and methods of operation, maintenance and testing may have been developed and revised during the years of plant operation. The effects of adjacent area ventilation systems should be considered. Systems may be operated differently from the assumptions or values used in analyses that determined operator exposure from radiological or hazardous chemical events.

The following subparagraphs provide guidance on performing this comparison.

3.2.1.1.1 As-Built Plant

Review the as-built configuration of the control room envelope and ventilation systems to ensure that the construction and configuration satisfy the design and licensing bases. The effects of adjacent area ventilation systems should be considered. As a minimum, include:

- Review plant drawings to ensure that the design provides the desired CR isolation function and supports the DBA analysis assumptions.

- For example, confirm that assumed automatic response functions such as isolation and pressurization have been implemented.
- Review component specifications to ensure that the licensing and design bases are consistent with current design. For example:
  - Do fans provide the required flow rates?
  - Do dampers provide the design leak tightness?
  - Are duct design requirements consistent with leakage assumptions?
- Perform a system walkdown to ensure that the actual field configuration agrees with the plant drawings/design.
- Compare the control room envelope assumed for inleakage evaluations to that identified in plant documents or surveillance procedures to ensure the identified boundaries are accurate.

3.2.1.1.2 Analyses

Review the CRH analyses to assure that they are consistent with the licensing basis, current control room envelope and the HVAC procedures and configuration. Verify the following:

- System lineups, including adjacent area systems, assumed in the CRH analyses agree with the current procedures.
- Assumptions in the CRH analyses are appropriate in light of current operations and configurations.

3.2.1.1.3 Operating Procedures Different than Licensing Basis

A. Normal and Emergency Operating Procedures

Review the plant operating procedures to ensure that the licensing and design bases are maintained. This includes review of procedures for both normal and emergency (off-normal) conditions, which should account for potential impacts of adjacent area systems. This should ensure as a minimum that:

- Normal operating procedures align the system to establish the proper flow paths. Damper settings are correct to establish the necessary flow rates and isolation capability.
- Emergency operating procedures (EOPs) do not invalidate the licensing and design bases while attempting to restore area cooling in certain situations.
- EOPs place the control room ventilation system in the correct configuration for the existing plant condition. For example, the proper configuration may be recirculation for a hazardous chemical event, pressurization for a radiological release or a combination of both.

B. CR Ventilation Systems and CRE Testing Procedures

Review testing procedures to assure the following:

- The procedures adequately demonstrate the operability of the intended components.
- Test configuration and test conditions reflect those expected under accident conditions.
- The procedures ensure that the envelope is not inadvertently breached or otherwise made inoperable during the test.
- The system is properly realigned after completion of the test.
- Post-maintenance testing is sufficient to ensure that the system is functional and properly configured before being returned to an operable state.

C. Maintenance Practices and Procedures

Assess maintenance practices and procedures to assure that they maintain CRE integrity or assure required system operability. For example:

- Maintenance planning should evaluate the required operability of control room ventilation components for the expected plant-operating modes.
- Maintenance practices affecting structures should ensure that the CRB would not be inadvertently breached.
- Maintenance activities of ventilation systems in areas adjacent to the control room should be evaluated for their effect on the inleakage values for the CRE.
- Maintenance procedures for these system components should address CR integrity requirements. Procedures should note that removal of inspection plates or opening access doors might constitute a breach of the CRE.
- Breach control programs and procedures designed to seal, maintain and inspect the integrity of the CRE should be in sufficient detail to examine all likely sources of control room inleakage. Easily damaged components, such as door seals, should receive increased scrutiny.

D. Plant Modification Procedures

Evaluate the design control procedures to ensure that changes that may have a direct or indirect impact on CRH are properly evaluated. Design change procedures should evaluate the effect of the modification on the CRE integrity. Ensure these items are addressed:

- Direct modification of the ventilation system could change the system's performance characteristics.
- Modification of ventilation systems in areas adjacent to the control room could affect the inleakage values for the control room envelope.

- Electrical work such as installing new conduit or pulling cable could create new inleakage paths.
- Installing or modifying floor or equipment drains could create new or altered inleakage paths.

3.2.1.2 Recommended Action

If discrepancies are identified, take corrective actions in accordance with the plant's corrective action program as described in Section 3.3.

3.2.2 DESIGN BASIS ACCIDENT (DBA) ANALYSES

3.2.2.1 Applicability

The LBLOCA DBA is generally assumed by licensees to be the bounding accident for control room habitability dose analyses and has been used to assess the adequacy of the CRH design. However, recent assessments have identified instances where the LBLOCA DBA was not the limiting CRH event.

Determine if the limiting DBA has been used to assure the adequacy of the CRH design. This assessment is to include as a minimum those DBAs in the plant's current licensing basis (CLB). If the licensee plans to implement DG-1113 (when issued) or RG 1.183 to perform the analyses, the guidance contained in these regulatory guides or in the associated regulations must be followed to determine the limiting DBA for CRH, unless the licensee takes exceptions to the regulatory guide.

The limiting CRH assessment is to consider the impact of different plant configurations, responses or atmospheric dispersion from other accidents, including accidents at adjacent units within the licensing basis, on the radiological consequences to the reactor operators. Changes to plant design or operations must be evaluated or analyzed over the spectrum of the plant licensing basis events to determine the CRH response.

Factors that may influence the limiting CRH DBA include:

- For accidents where the CRH features are actuated by containment isolation or safety injection (SI) signals, there is little or no actuation delay. Typically, control room isolation is activated by engineered safety feature signals such as containment high pressure or safety injection, or radiation monitors, or both. Where the CRH features are actuated by radiation monitor alarm signals, there may be a time delay to achieve control room isolation. Manual actuation of equipment may impose additional delays. In such cases, contaminated air may enter the control room during such delays.

- Radiation monitor configuration may affect the ability to actuate the CRH features in a timely manner.

- Differences in source terms for the different postulated accidents can have a significant impact on monitor response.

- Radiological release locations can dictate which analyzed accident is limiting. Some considerations are:

  - The distance between the control room intake and release points may be different for each postulated accident.
  - Release points for some accidents may be in a direction frequently downwind of the control room intake, while those for other accidents may be in a direction frequently upwind.
  - A ground-level release associated with a non-LOCA event may be more limiting than the elevated release associated with a LOCA at units with a secondary containment or enclosure building.

- For plants with approved alternate repair criteria (ARC) for steam generators, the main steam line break accident may be the limiting accident for CRH, especially if the licensee has maximized the postulated control room operator dose in order to maximize the number of tubes to which the ARC is applied.

- Adjacent unit accidents:

  - A special case of limiting DBA could result from an accident release from an adjacent unit that does not share a common control room. The release point, atmospheric dispersion and postulated source term for the adjacent unit should be reviewed to assess the impact on an operating unit. This potential limiting DBA must be considered if it is within the licensing basis of the plant evaluating its control room, or if the methodology in RG-1.183 or DG-1113 (when issued) is used. In other words, the recent regulatory guidance contains the NRC position that evaluation of impacts from adjacent units should be part of every licensing basis.

  - If there are adjacent units with separate control rooms, then an accident in one unit should not prevent the safe shutdown of the adjacent unit. Atmospheric transport mechanisms between the accident unit and the HVAC intakes to the operating unit control room should be reviewed for impact on CRH.

3.2.2.2 Recommended Action

If a new limiting DBA for CRH is identified, take corrective action in accordance with the plant's corrective action program as described in Section 3.3.

3.2.3 HAZARDOUS CHEMICAL EVALUATION

3.2.3.1 Applicability

The sources of hazardous chemicals may have changed over time, and the existing evaluation may not account for the current hazardous chemical threats near the plant.

Assess if the sources of hazardous chemicals have changed sufficiently to require revising the plant's hazardous chemical evaluation.

3.2.3.2 Recommended Action

Update the hazardous chemical evaluation in accordance with the plant's licensing basis. The current revisions of Regulatory Guides 1.78 and 1.95 or the revisions cited in the CLB may be used to perform these assessments. Appendix DD provides information beyond that contained in Regulatory Guide 1.78 in the areas of specifying toxicity limits, identifying sources of on-site and off-site hazardous materials, determining hazardous chemical release characteristics and applying updated atmospheric dispersion modeling techniques.

3.2.4 CONTROL ROOM INLEAKAGE

3.2.4.1 Applicability

Unfiltered and filtered air inleakage values are assumptions used in radiological and hazardous chemical evaluations. Inleakage tracer gas tests have been conducted at numerous nuclear plant control rooms to determine the total amount of air inleakage. Most tests indicated that the actual measured inleakage exceeded the value(s) originally assumed in the accident analyses. This is applicable to all plants.

3.2.4.2 Recommended Action

Some plants have already performed an integrated inleakage test. These plants have resolved or are in the process of resolving any discrepancies between measured inleakage and the inleakage value assumed in their accident analyses. For those plants that have not conducted an integrated inleakage test, perform a baseline test per Section 4.2 to determine numerical values for control room inleakage that can be compared to the accident analyses assumptions. These values should represent inleakage occurring with the control room emergency systems filtration in accident configurations.

3.2.5 REACTOR CONTROL DURING SMOKE EVENTS

3.2.5.1 Applicability

The presence of smoke in the control room originating from internal or external events may challenge an operator's ability to control the reactor. This is applicable to all plants.

3.2.5.2 Recommended Action

Since no regulatory limit exists on the amount of smoke allowed in the control room, the ability to manage smoke infiltration is assessed qualitatively. Guidance for performing qualitative evaluation of smoke management capabilities is contained in Appendix A. The evaluation should consider smoke events generated either internal or external to the control room. The assessment is to assure that the plant operators will be capable of controlling the reactor during such smoke events. Reactor control may be accomplished from either the control room or the alternate shut down panel.

If inconsistencies are identified, take action in accordance with the plant's corrective action program as described in Section 3.3.

3.2.6 ADEQUACY OF EXISTING CREFS TECHNICAL SPECIFICATIONS

3.2.6.1 Applicability

If a licensee has a surveillance requirement to verify operability of the pressurization system by demonstrating a differential pressure between the CRE and adjacent areas, determine if there is an inconsistency between the technical specification surveillance requirement, its TS bases and the safety analyses for the CREFS.

3.2.6.2 Recommended Action

Verify the design basis for pressurizing the control room envelope as described in the plant's safety analyses.

If an inconsistency exists, several options are available. One option is to adopt the new Standard Technical Specification for control room emergency filtration system (CREFS) being developed by the Technical Specification Task Force (TSTF), which includes a new surveillance and administrative program for control room integrity. The new Standard TS program is based on the guidance presented in Section 4. Another option is to revise the technical specification bases using 10 CFR 50.59 to be consistent with the safety analyses design basis and adopt a control room integrity program in accordance with the program described in Section 4.

The first option requires a License Amendment for the Technical Specification change. The advantage is that the TSTF TS will be endorsed by the NRC and may offer some additional operational flexibility to the licensee. The second option should be simpler to implement. However, the licensee will need to assure and demonstrate the consistency between the TS, the revised TS bases, the administrative programs and the licensing analysis assumptions is accurate and sufficiently robust to assure control of the licensing basis. In either case, licensees need to perform a baseline test and to periodically assess and retest the control room envelope for inleakage. Section 4 discusses this testing and assessment guidance.

3.3 DISPOSITIONING AND MANAGING DISCREPANCIES

The process requires that conditions adverse to quality must be promptly identified and corrected in accordance with 10 CFR Part 50, Appendix B, Criterion XVI, consistent with each licensee's Corrective Action Program. Guidance for identifying and resolving degraded and nonconforming conditions is provided by Generic Letter (GL) 91-18, Revision 1, *Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Nonconforming Conditions*. Reportability criteria are specified by 10 CFR 50.72, *Immediate notification requirements for operating nuclear power reactors* and 10 CFR 50.73, *Licensee event reporting system*.

In addition, if changes are required, the criteria of 10 CFR 50.59, *Changes, Tests and Experiments*, may apply.

Appendix FF provides additional information.

4 CRH PROGRAM

4.1 PURPOSE AND SCOPE

This section defines the Control Room Habitability (CRH) Program, which is comprised of a one-time baseline control room inleakage test, followed by periodic inleakage assessment and retest activities. This program assures that CRH is maintained in accordance with NRC regulations and licensee commitments.

4.2 BASELINE CR INLEAKAGE TEST

4.2.1 PREPARATION FOR BASELINE TEST

Perform a system assessment per Appendix C, prior to performing a baseline test.

The system assessment includes a walkdown to identify (1) discrepancies in the envelope, and (2) components vulnerable to inleakage. The system assessment should help to find potential inleakage paths that are candidates for pre-test maintenance or design modifications.

The licensee may choose to perform preconditioning maintenance to eliminate suspected inleakage paths immediately before performing the baseline test for inleakage. This preconditioning should represent either restoring a deficiency to its design basis condition or a permanent design change.

The control room envelope (CRE) encompasses the control room and other rooms and areas within the confines of the control room boundary (CRB). The CRB consists of the physical barriers (e.g., ducts, dampers, floors, ceilings, walls, doors) that separate the CRE from other plant areas.

4.2.2 BASELINE TEST PERFORMANCE

Perform a baseline test to determine the value of control room inleakage for use in control room habitability analyses. Appendix D describes acceptable test methods and the scope of their application.

4.2.3 USE OF BASELINE TEST RESULTS

Compare the measured baseline inleakage value(s) to those used in the CRH radiological and hazardous chemical analyses. An acceptable result is when measured inleakage values are less than or equal to the analysis input. Appendix D, Section 4.4.3, provides additional guidance. If the measured inleakage value is greater than the analysis input, the licensee must take corrective actions as discussed in Section 3.3.

Section 4.3.1, *Administrative Controls* should be implemented following completion of the baseline test and any resulting corrective actions. These controls will be used as part of the periodic CRH assessment discussed in Section 4.3.2.

4.3 CRE INTEGRITY PROGRAM[2]

A CRE integrity program is to be implemented following performance of a baseline test. Figure 1 illustrates the CRH program.

Licensees that have already performed a test to measure inleakage will need to determine the point at which to enter the CRH program illustrated in Figure 1. The first step is to assure that the administrative controls described in Section 4.3.1 are implemented. The licensee should then assure that the inleakage testing meets the intent of the baseline test for the CRH program as described in Section 4.2 and Appendix D.

- If the test was performed, more than 3½ years prior to implementation of NEI 99-03, then conduct a baseline test per Section 4.2 or a retest per Section 4.3.3,
- If the test was performed within 3½ years of NEI 99-03 implementation, then conduct an assessment per Section 4.3.2. The assessment must be complete within four years of the completion of the inleakage test.

4.3.1 ADMINISTRATIVE CONTROLS

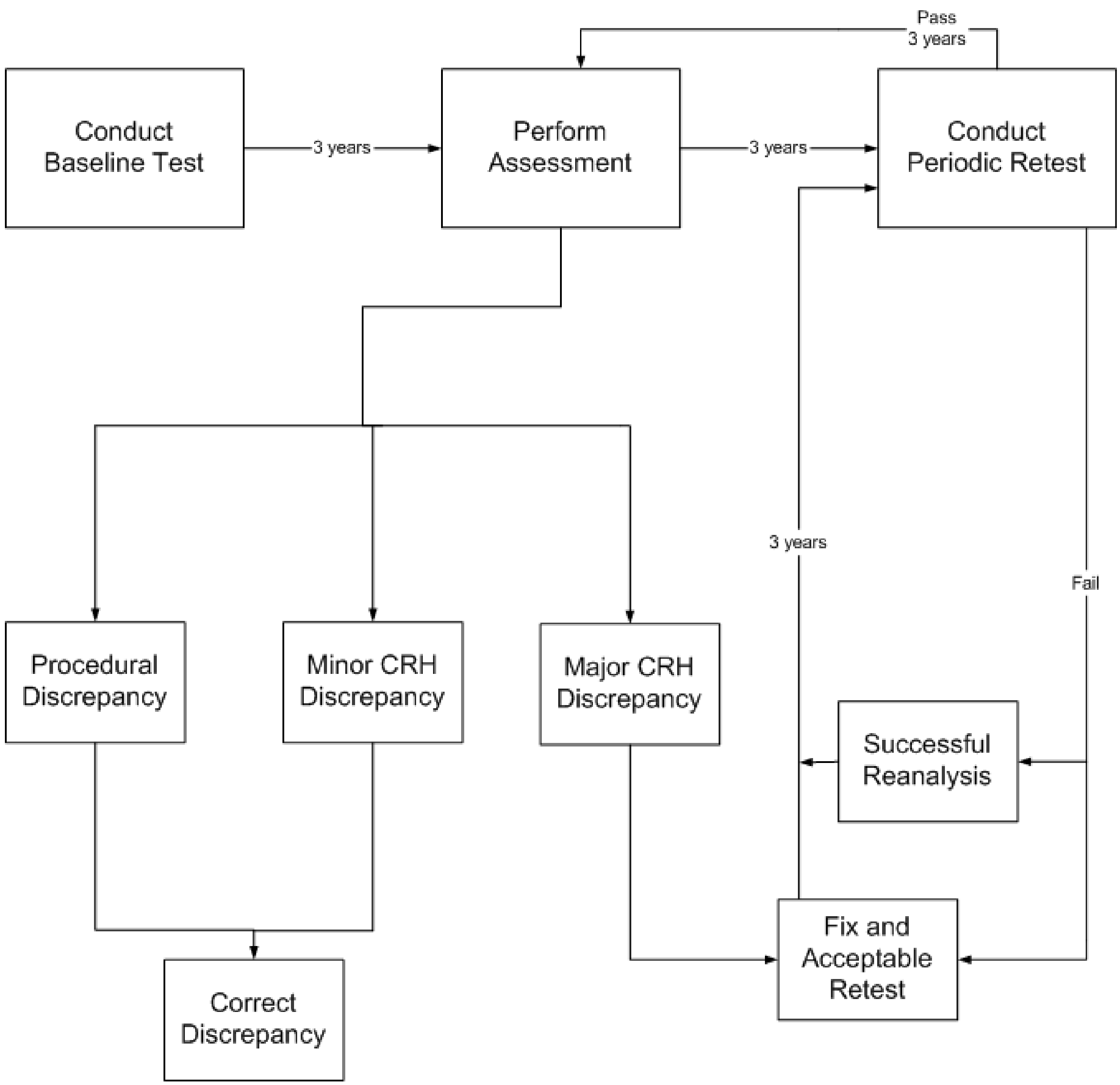
The following administrative controls should be established.

4.3.1.1 CRE Boundary/Breach Control

Establish a control room envelope boundary control program. Appendix E contains the guidance for establishing these controls, if they do not already exist at the plant. This is necessary to assure that boundary breaches are recognized, that uncontrolled breaches to the CRE do not occur and that known breaches do not result in an unanalyzed condition.

[2] The time periods listed in this CRE integrity program are considered nominal and a margin of +/- six (6) months is considered acceptable.

Figure 1
CRH Program



4.3.1.2 Procedure Control

Review plant procedures to assure that potential CR integrity issues are recognized and appropriately considered when generating or revising procedures. In addition, appropriate post-procedure change testing may be necessary to ensure that safety analyses assumptions remain valid. If it is determined that inleakage testing is necessary, the test should be performed in accordance with Appendix D. If guidance for issuing procedures that considers CR integrity is not currently in place, it should be implemented.

4.3.1.3 Hazardous Chemical Control

Review the existing chemical controls program and licensee commitments to ensure that the impact of potential release of on-site chemicals to the control room is assessed. See Appendix DD for addition information.

Guidance contained in RG 1.78 and/or RG 1.95 may be part of the licensee commitments. It is recommended the controls also provide guidance regarding acceptable quantities, locations or container sizes for chemicals approved for use on-site.

Licensees should conduct periodic surveys of stationary and mobile sources of hazardous chemicals in the vicinity of their sites to identify potential off-site sources of hazardous chemical releases to the control room. The frequency of these surveys should be commensurate with the likelihood that these sources will change. Licensees should consider establishing arrangements with nearby industrial facilities with stationary sources and with those companies or agencies controlling mobile sources to receive notification of changes in chemical inventories that would be reported to public officials under Superfund Amendments and Reauthorization Act, Title III.

4.3.1.4 Design Change Control

Review the design change control process to ensure that the CRE integrity issues listed in Section 2.3 are addressed for both permanent and temporary modifications. In addition, appropriate post-modification testing should ensure that safety analyses assumptions remain valid. This testing should be commensurate with the scope of repairs and modifications made. The test should be performed in accordance with Appendix D if it is determined that inleakage testing is necessary. The CR HVAC system engineer should be familiar with habitability issues and review each related modification package for impact on CRH.

4.3.1.5 Safety Analyses Control

The design change process typically ensures that the associated safety analysis is reviewed and revised. However, safety analysis calculations may be revised for purposes other than a design change. Therefore, ensure that the calculation control procedure has a requirement to review revisions of safety analysis calculations for impacts on control room integrity.

Examples of changes in assumptions that can affect CRH are:

- inleakage values
- release location, quantity or type
- system isolation characteristics
- accident event sequence and progression
- operator actions and timing.

4.3.1.6 Maintenance Control

Review the plant maintenance control process to ensure controls are in place addressing CR integrity issues. Preconditioning as defined in Section 4.2.1 is not acceptable for periodic retests (i.e., performing maintenance or correcting known deficiencies just prior to a test in order to pass a test). However, performing a routine, scheduled maintenance task is not preconditioning.

An example is periodic maintenance on degradable items (e.g., replacing or repairing door seals or damper seals) to ensure that CRE integrity will be maintained. Appendix CC provides additional information on areas where periodic maintenance should be developed.

4.3.2 PERIODIC CRH ASSESSMENT

4.3.2.1 Periodic CRH Assessment Process

A periodic assessment should be performed to assure that the plant maintains the CRH licensing and design bases. This would involve assessing configuration controls, performing walkdowns and reviewing operating and maintenance procedures. It is intended that this assessment be performed by a team of individuals, with industry peer participation, as appropriate.

The assessment plan should include a review of the administrative controls and their effectiveness, as described in Section 4.3.1. Use the following guidance when developing the assessment plan:

a) **CRE Boundary Control -** Review CRE boundary controls to ensure that CRE boundary breaches have been controlled since the previous assessment (see Appendix E for guidance).
b) **Procedure Control** - Review applicable procedure revisions to ensure that CRH issues were considered when revising procedures since the previous assessment.
c) **Hazardous Chemical Control -** Review hazardous chemical controls to ensure that new chemicals brought on-site were reviewed in accordance with the hazardous chemical control program and were considered for impact of a potential release on CRH. The monitoring program for off-site sources of hazardous chemicals should be evaluated against licensee control programs and commitments. As a minimum, off-site sources should be reassessed to assure that any changes in off-site chemical hazards were identified.
d) **Design Change Control -** Review design change controls to ensure that CRH issues (and/or new inleakage vulnerabilities) were considered when issuing design changes since the previous assessment
e) **Safety Analysis Control -** Review safety analysis controls to ensure that CRH issues were considered when safety analyses were issued as part of a design change (either temporary or permanent) or revised for other purposes since the previous assessment.
f) **Maintenance Control** - Review maintenance controls to ensure that CRH issues were considered during the performance of applicable maintenance since the previous assessment. Review maintenance controls to ensure that required periodic maintenance of the control room boundary was performed since the previous assessment.

Walkdowns of the control room boundary are necessary to assure that it is in accordance with plant drawings (see Appendix C for guidance) and that new inleakage vulnerabilities have not been introduced. Review test performance results (results from all post maintenance, post-modification, and surveillance testing) on the appropriate control room systems and adjacent areas systems to ensure system performance has not degraded since the previous test/assessment. Additional tasks that can be included in the review are:

- Confirmation of differential pressure margin for pressurized control rooms between the CRE and adjacent spaces. If the differential pressure margin has changed since the last test, further assessment and corrective actions may be required.
- Examination of industry operating experience to confirm applicability.

4.3.2.2 Periodic CRH Assessment Schedule

Perform a periodic CRH assessment three years following:

- Completion of the Section 4.2 baseline test, or
- Any subsequent successful periodic CRE inleakage retest.

4.3.2.3 Evaluation of CRH Assessment Findings

Ensure that findings and areas for improvement that result are entered, as appropriate, into the plant corrective action program.

- If no discrepancies are found, perform a retest per Appendix D in three years.

- If discrepancies are found, determine if the discrepancies are procedural, minor or major. If necessary, notify the NRC in accordance with any applicable regulations or the plant technical specification.

  - If the discrepancy is procedural or minor correct the discrepancy per the plant's corrective action program (Section 3.3) and perform a periodic retest per Appendix D three years after this assessment.

  - If the discrepancy is major, fix the discrepancy per the plant corrective action program (Section 3.3) and retest the CRE inleakage per Appendix D. Perform a periodic retest three years after this successful retest.

4.3.3 PERIODIC CRH RETEST

4.3.3.1 Periodic CRH Retest Process

Perform a periodic retest for CRE inleakage in accordance with Appendix D. Preconditioning as defined in Section 4.2.1 is not acceptable for periodic retests. However, maintenance performed as part of the standard operation of the plant is not considered preconditioning. Licensees should not schedule other maintenance immediately before a scheduled periodic test. Such a practice would detract from the objective of the periodic test to determine system maintainability and reliability.

4.3.3.2 Periodic CRH Retest Schedule

As shown in Figure 1, a periodic retest for CRE inleakage is performed three years following either a:

- Successful periodic assessment or
- Retest resulting from a previous test failure or major assessment failure.

4.3.3.3 Evaluation of CRH Retest Findings

Review the periodic retest results. Acceptable results exist if the nominal measured inleakage values are less than or equal to the analysis input values.

- If the results pass, perform a reassessment three years from this test per Section 4.3.2.
- If the results fail, implement one of the following courses of action, in addition to meeting requirements of the corrective action program as described in Section 3.3:
  - Demonstrate conformance with the plant licensing basis using reanalysis and perform a periodic retest three years from this test, or
  - Fix the discrepancy and retest the CRE inleakage per Appendix D; then perform a periodic retest three years from this test.

4.3.4 PERFORMANCE BASED TEST AND ASSESSMENT FREQUENCY

The interval for the reassessment and retest process is specified as three years. It may be appropriate for licensees to adjust the period between assessments and tests, after industry and licensees develop an experience base regarding testing and assessment. A licensee may elect to justify increasing the intervals between future assessments or tests based on satisfactory test performance. Changes to test and assessment frequencies may require NRC approval if they were previously reviewed and approved by the NRC staff. If testing or assessments experience is unsatisfactory, a licensee should consider decreasing the intervals between future assessments or tests based on test performance as part of the Corrective Action Program response.

5 TRAINING

Perform a training needs analysis to assess the level of understanding of operations, maintenance and engineering personnel with respect to the CRE integrity program and issues that influence control room habitability. Prepare appropriate training modules and schedules and perform periodic training. The information contained in this document along with plant specific information provides a good basis to develop these training modules.

6 REFERENCES

1. NEI, "Design Bases Program Guidelines," NEI 97-04, Revision 1, Nuclear Energy Institute, February 2001

2. USNRC, "Clarification of TMI Action Item Requirements," NUREG 0737, U.S. Nuclear Regulatory Commission, November 1980.

3. USNRC, "A Prioritization of Generic Safety Issues," NUREG 0933, U.S. Nuclear Regulatory Commission, June 2000.

4. USNRC, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Regulatory Guide 1.78, U.S. Nuclear Regulatory Commission, June 1974.

5. USNRC, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Regulatory Guide 1.78, Revision 1, U.S. Nuclear Regulatory Commission, December 2001.

6. USNRC, "Protection of Nuclear Power Plant Control Room Operators Against an Accidental Chlorine Release," Regulatory Guide 1.95, U.S. Nuclear Regulatory Commission, January 1977.

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10. USNRC, "Resolution of Degraded and Nonconforming Conditions," NRC Inspection Manual, Part 9900: Technical Guidance, U.S. Nuclear Regulatory Commission.

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APPENDIX A

SMOKE EVALUATION

1. PURPOSE/SCOPE

This appendix provides a qualitative assessment tool for managing the smoke in the control room. The guidance ensures that the operator maintains an ability to safely shut down the plant during a smoke event originating inside or outside the control room.

2. ASSESSMENT

Perform an assessment to assure that the operator has the capability to safely shut down the plant from either the control room or the alternate shutdown locations during a single credible smoke event originating either inside or outside of the control room. A design basis event does not need to be assumed simultaneous with the smoke event. Consider the following items:

- Verify that a single credible smoke event does not simultaneously result in contamination of the control room and alternate shutdown locations such that reactor control cannot be maintained from one of the locations.
- Verify that a credible smoke event does not exist that could affect control room habitability while simultaneously blocking the normal egress path to the alternate shutdown panels or controls. Otherwise, verify that an alternate egress path exists and that it is addressed in plant procedures.
- Verify that sufficient procedural guidance exists to mitigate credible smoke events. Smoke-response-procedures should contain provisions to manually align ventilation systems to exhaust smoke away from the control room and alternate shutdown panel when practical.
- Verify that a sufficient number of control room operators per shift are qualified in the use of self-contained breathing apparatus (SCBA) if SCBAs are credited for success.
- Verify that the appropriate SCBA and smoke removal equipment are available and properly staged if credited for success.
- Verify that initial and continuing training is performed to ensure familiarity with the success paths credited in a licensee's response to smoke events.
- The condition should be entered into the plant's corrective action process for appropriate resolution if the assessment determines that a potential situation exists where a success path is not assured.

3. CONTINGENCY LOGIC EVALUATION

The steps below outline possible success paths to ensure safe shutdown capability is maintained during a smoke event. These paths should provide confidence that a smoke event can be mitigated.

- Should an excessive amount of smoke infiltrate the control room envelope, the operators may isolate the ventilation system if the outside air intake is the primary entry point of the smoke. Efforts should then be taken to clear the smoke using either an installed smoke removal system or portable blowers. A short-term limited use of SCBAs may be expected in this situation. The ability to clear the smoke in a reasonable period would be considered a success path.
- If smoke removal is not a success path in the short term, then assess if the smoke would have a detrimental effect on the operator's ability to control the plant. Consideration should be given to evacuate to the alternate shutdown panel(s) or controls. This decision would be based on the severity of the situation and the availability of a safe egress path to the alternate shutdown panel(s).
- If the alternate shutdown panel(s) or controls are also contaminated with smoke, it may be advantageous to remain in the control room using SCBAs until smoke can be cleared from one of the locations.
- If the decision is made to evacuate the control room, choose a primary or an alternate path to the alternate shutdown panels or controls that are least affected by the event. It may be necessary to use SCBA while transiting to the alternate shutdown panels or controls.

APPENDIX B

COMPENSATORY MEASURES ALLOWABLE ON AN INTERIM BASIS

1. PURPOSE/SCOPE

Licensees may need to implement compensatory measures as part of the plant's corrective action program. This appendix identifies two actions that may be considered for use as compensatory measures in the event of unacceptable radiological dose consequences. These actions are the use of self-contained breathing apparatus (SCBA) and the use of potassium iodide (KI) tablets. Other plant specific compensatory actions may be appropriate. The use of any compensatory measure will require a plant specific evaluation to justify its use.

The use of SCBA and KI is acceptable for addressing unacceptable radiological release consequences in the interim situation until the licensee corrects the control room envelope integrity issue. However, use of SCBA or KI in the mitigation of situations where inleakage does not meet design basis limits is not acceptable as a permanent solution. 10 CFR 20.1701 states that engineering/process controls shall be used to the extent practical. If not practical, then 10 CFR 20.1702 methods should be used. Therefore, the use of SCBAs should be a last resort. The length of time for which credit is allowable should be determined on a case-by-case basis. If credit is currently part of the licensing basis, special considerations may be necessary.

The use of SCBA to mitigate adverse on-site or off-site hazardous chemical release consequences is allowed by Regulatory Guide 1.78, Revisions 0 and 1 and Regulatory Guide 1.95. The approved use of SCBA under these circumstances is not considered a compensatory measure. In addition, plant modifications such as the installation of local hazardous chemical monitors should be considered in the event of unacceptable hazardous chemical release consequences. Temporary removal or relocation of an onsite hazardous chemical source should be evaluated as part of any plant maintenance or modification actions. Additional guidance is provided in Regulatory Guide 1.78.

As described in Appendix A, compensatory measures that should be considered to respond to smoke events include the use of SCBA, as well as the use of pre-staged portable exhaust fans to remove smoke from the control room or alternate shutdown panels or controls areas. Compensatory actions are to be developed to the extent necessary to assure that the requirements of 10 CFR 50, Appendix A, GDC 19 are met. As for the case of response to radiological releases, the use of any compensatory measure will require a plant specific evaluation to justify its use.

2. SELF-CONTAINED BREATHING APPARATUS

Credit for the use of SCBAs as a compensatory measure is allowed provided an approved respiratory protection program is in effect. An approved respiratory protection program utilizing SCBAs can allow for inhalation dose protection factor values between 100 to 10,000 (see 10 CFR Part 20, Subpart H and Appendix A.) In addition to the requirements of 10 CFR 20 Subpart H, the following are key considerations for crediting SCBA use in support of control room habitability assessments.

2.1 Approved Respiratory Protection Program

2.1.1. Confirm the use of an approved respiratory protection program in accordance with 10 CFR Part 20, Appendix C, Regulatory Guide 8.15, Rev. 1, *Acceptable Programs for Respiratory Protection* and NUREG-0041, Rev. 1, *Manual of Respiration, Protection Against Airborne Radioactive Materials*.

- Maintaining an adequate respiratory protection program is vital to workers' safety and, thus, to their ability to respond in a timely fashion to emergencies.
- Plant operators and emergency response workers can face not only radiological airborne hazards but, in many cases, are challenged by unknown and potentially immediately dangerous to life and health (IDLH) conditions. Therefore, non-radiological hazards should also be considered.

2.1.2. Plans for dealing with emergencies should include consideration of:

- Postulated duration of SCBA use
- Quantities and kinds of materials against which protection must be provided
- Physical characteristics of the hazardous area
- Access requirements
- Numbers of people and technical skills needed
- Amounts, types and locations of equipment necessary
- Need for and availability of backup/replacement supplies for use in emergencies
- Enhancement of communications
- Capability of control room facilities to accommodate operators working with SCBA
- Visual impairment.

2.2 Training and Qualify Sufficient Operators for SCBA Use

The licensee should ensure there will always be sufficient numbers of control room operators on shift that are qualified for SCBA use.

Since SCBA use is expected to be infrequent, there should be adequate periodic, hands-on training and practice with donning and wearing SCBA including communication techniques and vision impairment during SCBA use.

Perform simulator crew training accident scenarios with operators in SCBAs, if SCBA units would be used as an interim compensatory measure for radiological events for more than 180 days with the plant in Mode 1. These scenarios should represent design basis accident response actions, including a bottle changeout, and simulate a watch turnover.

Additionally, operators should be trained and practiced to change out air cylinders and know where spare charged air cylinders are stored for emergency use.

Effective program oversight and controls should be in place for tracking and maintaining operators' required periodic retraining and SCBA fit testing.

2.3 Adequate Supplies of Equipment

Sufficient dedicated, surveyed and inventoried equipment with various size face pieces should be available for use by control room operators at all times.

A sufficient number of support personnel should be assigned to transport and replenish supplies for the duration of the need for SCBA.

2.4 Corrective Lenses for SCBA Users

All those requiring vision correction should use contact lenses or approved spectacle adapters in accordance with 10 CFR Part 20.1702(e),

A lack of required vision correction could hamper the control room operator's performance of licensed duties, including timely and effective response to emergencies.

Corrective lenses with temple bars interfering with the sealing surface of any respirator facepiece shall not be worn while using such equipment.

Semi-permeable prescription contact lenses may be worn if their use has been satisfactorily demonstrated.

Hard contact lenses should not be worn with full-facepiece respirators. Hard contact lenses present a distinct hazard to the individual due to the possibility of the lenses slipping because of pressure on the outside corners of the eye from a full-face mask or a speck of dirt getting under them while the respirator is being worn.

2.5 Respirator Fit

Persons using tight fitting (facepiece) respirators should not have any facial features that interfere with the sealing surfaces of the respirator. The required minimum staffing of control room operators qualified in SCBA use should be clean-shaven.

2.6 Method(s) To Refill SCBA Air Cylinders

This includes proper location of air compressor intakes (e.g., not downwind from release points).

When a compressor is used, it should be properly monitored and attended to ensure that the air intake remains in an uncontaminated atmosphere.

The impact of loss of off-site power should be factored into electric power sources to support refill methods.

2.7 Relief From Respirator

Provisions should be considered for operators wearing SCBA to leave the area if necessary.

2.8 Monitoring Program

An appropriate air sampling program should be implemented to monitor control room airborne radioactivity levels to determine individual exposure levels based on stay times, protection factors and respirator usage.

Protection factors apply only in a respiratory protection program that meets the requirements of 10 CFR Part 20.

- These protection factors are applicable to radiological, oxygen deficiency, hazardous chemical and smoke hazards and may not be appropriate for hazards that involve skin adsorption.
- Prompt emergency response does not lend itself to prework assessment of airborne hazards. In emergency situations, for example, it is illogical to take a "no-protection" assumption for entry into IDLH areas of unknown hazards.

3. POTASSIUM IODIDE

Certain forms of iodine help the thyroid gland work correctly. Most people consume the iodine their thyroid needs from foods such as iodized salt and fish. However, the thyroid can hold or store only a certain amount of iodine. In the event of a nuclear accident involving the release of large amounts of radioiodines, significant uptake of radioiodines by the thyroid could occur from inhalation and ingestion. The basis for using KI to limit thyroid dose is that administration of stable iodide as a prophylaxis can prevent thyroidal uptake of radioiodines, and thus reduce post-accident radiation dose to the thyroid.

KI is an effective thyroid-blocking agent when administered immediately before or after an exposure to radioactive iodine (that is, within one to two hours). If KI is administered more than four hours after an acute inhalation or ingestion of radioiodine, then its effectiveness as thyroid-blocking agent is substantially reduced. The prompt administration of KI in the event of a nuclear accident is critical to its effectiveness as a protective measure. Credit may be taken for a factor of 10 reduction in thyroid dose due to the administration of KI. Plant procedures should be in place to ensure KI can be administered to control room operators (and to oncoming shifts) soon after the start of an event where radioiodine has been released or could be released.

3.1 Considerations for Crediting KI

Although KI is a non-prescription medication, the licensee's internal policies on administering medications to employees should be reviewed and followed as required.

Personnel who are candidates for receiving KI must be screened for possible allergic reactions to iodine. Shift personnel who are allergic to KI may need to be temporarily reassigned, or provisions made for relieving them from duty in the event of a radioiodine release.

Personnel who are identified as candidates to receive KI after an accident must be on an approved list. The approved list should be readily accessible so that prompt administration can be performed.

It is not mandatory for control room operators to take KI as a protective measure. Those who choose not to take KI should evacuate the control room and be replaced by another qualified operator.

Adequate supplies of KI must be available in the control room for control room operators. Provisions must be made for storing KI tablets properly, and for periodic replacement prior to the shelf life being exceeded. Adequate supplies should also be available to administer KI to relief personnel.

Plant procedures should be in place to direct administration of KI to control room personnel within two hours of a radioiodine release. Procedures should also be in place to administer KI to oncoming shifts as necessary if radioiodine releases continue.

Controls should be in place to determine if follow-up administration of KI is required. The decision to have follow-up administration of KI should be done in consultation with the licensee's company medical representative and the plant's emergency response organization.

4. REFERENCES AND SUPPORTING INFORMATION

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APPENDIX C

SYSTEM ASSESSMENT

1. PURPOSE

This appendix provides guidance on performing walkdowns and inspections of the control room envelope and associated ventilation systems to identify potential vulnerabilities to inleakage.

2. SCOPE

This system assessment should not be confused with the control room envelope (CRE) integrity assessment discussed in Section 4.3.2. This system assessment is a prerequisite for baseline testing.

This appendix provides the direction for:

- Identifying potential vulnerabilities to inleakage into the control room envelope
- Determining whether the system is configured and will align in a manner consistent with its licensing basis
- Identifying areas where maintenance activities should be directed
- Determining whether the CRE and adjacent area ventilation systems are performing in a manner consistent with their licensing and design bases.

This appendix does not provide guidance for minimizing inleakage vulnerabilities. Informational Appendix CC provides additional supporting information for minimizing vulnerabilities and sealing once the inleakage source is identified.

3. ASSESSMENT METHODOLOGY

3.1 Boundary

This section ensures the user has a good understanding of the boundaries for the control room envelope (CRE) and the ventilation system(s) by performing the following process:

3.1.1 Obtain copies of the drawings (e.g., flow, physical, or general arrangement, etc.) that show the CRE and surrounding areas, the control room heating, ventilating and air conditioning (CR HVAC) system(s), adjacent area HVAC systems and ventilation systems (that are not part of the CR HVAC) that traverse the control room envelope boundary.

3.1.2 Highlight the following on the drawings. This may require more than one set of drawings if the system response is different for different types of events:

- Boundaries of the CRE,
- Boundaries of the ventilation system(s) that serve the CRE,
- Portions of the ventilation system(s) that are physically located outside the boundary or perform a boundary isolation function (e.g., dampers). This should include system alignments for response to both radiological and hazardous chemical events and
- Non-ventilation system(s) that traverse the CRE boundary and adjacent area systems. Highlight and label on the drawings the routing of other ventilation systems that traverse the envelope.

3.2 Operating Configurations

The information identified in this section will be used in Section 4.2 of Appendix D to establish test alignments.

3.2.1 Operating Parameters

Establish the design performance parameters for the ventilation systems for the different challenges (radiological, hazardous chemical or smoke). These parameters include but are not limited to differential pressures, makeup and recirculation flow rates, duct static pressures and filter differential pressures.

The purpose of this activity is to identify portions of the CRE that are at lower pressure than the surrounding areas. Identify ductwork of non-CR HVAC systems that traverse the envelope and are at a higher pressure than the envelope and to verify that the as built systems are consistent with controlled documents. If this was done earlier as part of the design bases review for other sections of this document, simply refer to that work.

3.2.2 Consider the Challenges

Consider all accident configurations of the CR HVAC and of the ventilation systems in adjacent areas during review of the pressures in the envelope and adjacent areas. Focus attention on the automatic and/or manual responses of the systems to different challenges examples: (LOCA, FHA, MSLB, SGTR, hazardous chemical or smoke). For example:

- A control room envelope could be pressurized during a radiological event and not pressurized during a hazardous chemical event.
- Operator actions taken per operating procedures during post-accident mitigation to realign ventilation systems can result in system alignments different than configurations due to automatic starting signals.
- The response of ventilation systems in adjacent areas can be different for a safety injection (SI) event versus a control room high radiation event (non-SI event).

3.2.3 LOOP Versus a Non-LOOP Event

Evaluate operating alignments in a manner that maximizes the dose to CR operator. Consider the following examples and guidance:

Ventilation system alignments serving the CRE and serving adjacent areas should consider the most limiting configurations. Consistent with the licensing basis for the facility, the user should consider a loss of off-site power (LOOP) coincident with the event. A LOOP is typically assumed to occur concurrent with an accident, but not with a hazardous chemical release.

Assuming a LOOP coincident-with-the-event may not provide the limiting condition for control room inleakage. For example, ventilation systems in adjacent spaces may continue to operate during a non-LOOP situation and result in a less favorable differential pressure condition across the CRB. If the assumption of a LOOP results in the CRE being positive to all adjacent spaces, it may be more conservative to assume a non-LOOP event. This would need to be examined within the analyses of the overall accident response.

3.2.4 Single Active Failure

Consider single active failures consistent with the licensing basis for the facility. Cases may exist where assuming all trains function as designed (i.e., no single failure occurs) could be more limiting from an inleakage perspective. For example:

- For a neutral pressure control room, operating both HVAC trains can result in an increased number of rooms within the CRE that have negative pressure relative to the adjacent areas.

- For a positive pressure control room, operating both pressurization systems can result in increased unfiltered inleakage if the fans are located outside the CRE.

3.2.5 Seasonal or Daily Changes

Consider alignments that may vary due to seasonal variation. The alignment of ventilation systems and the corresponding pressures in the adjacent compartments (from those alignments) can be affected by the time of year or the time of day. During different seasons or different times of the day, the ventilation systems serving these areas may be operated in different configurations depending on conditions such as outside air temperature. For example a PWR turbine building ventilation system adjacent to the CRE may be at a negative pressure with respect to the CRE for summer, but positive for winter operation.

3.3 Walkdown Performance

Perform a walkdown to determine potential leak locations. There are several methods available and some of these are described below. These methods do not provide quantitative methods for determining inleakage, but only aid the user in determining potential inleakage locations.

The walkdown should:

- Confirm that all components are configured in accordance with the design
- Confirm that all components can be configured in their accident modes
- Verify that the normally indicated system parameters in the various operating configurations are consistent with the design and licensing parameters
- Verify the proper operation of ventilation systems adjacent to the CRB for the various challenges.

Section 3.4 provides detailed discussion of the types of items to consider during these inspection activities.

3.3.1 Visual Examination

Perform a visual examination that consists of a thorough walkdown of both the inside and the outside of the CRB, where accessible, to determine the physical condition and identify any unwanted openings. This is important because numerous small openings can yield relatively high leakage rates. Specific areas to be visually inspected are identified in Section 3.4.

Tools such as smoke pencils can be helpful to determine if leakage exists. Smoke pencils should be used deliberately to distinguish between a leak and random air currents. ASTM E1186 (see Table D-1) provides additional information on how to use smoke pencils.

Outleakage may affect the ability of a positive pressure system to sufficiently pressurize the CRE. Outleakage requires additional makeup air to maintain the positive pressure; even though this air is usually filtered, it still affects radiological and hazardous chemical assessments. Outleakage is also important for a neutral pressure control room since the outleakage must be compensated by inleakage.

Easily accessible and large inleakage sources are most likely to be identified via walkdown.

3.4. Specific Inspection Areas

Determine specific inspection areas for identification of vulnerabilities. Table C-1 provides a list of items to consider when evaluating potential vulnerabilities to control room inleakage. Consider both unfiltered and filtered inleakage vulnerabilities. The items in the table are applicable to several different potential system and envelope configurations, but not all of these may be applicable to any given plant. Table C-1 is not to be considered an all-inclusive list but only as guidance for the types of potential vulnerabilities. It may be helpful to list the vulnerabilities by type (e.g., doors, dampers or structural joints) and rank them in order of importance or suspected leakage.

The following subparagraphs provide additional insight of the actions that plant personnel should consider when performing the Section 3 walkdowns and assessments described in Table C-1.

3.4.1 CR HVAC

For portions of ventilation systems located outside the CRE:

- CR ventilation systems that are located outside the CRE can experience inleakage if portions of these systems (e.g., return ducting) are at a negative pressure relative to the area(s) they pass through.
- Some ventilation ducting (e.g., commercial, pocket lock, non-seal welded or non-bolted connections) can be a source of potential leakage locations. Insulated ductwork can be difficult to inspect but can be a leakage source. If the ducting is a potential leakage source, the insulation may need to be removed to facilitate inspection.
- Air handling unit (AHU) housings can be a source of inleakage if they are not welded or their integrity is compromised. For example, the underside of the housing can be a location of corrosion due to moisture accumulation.

- AHU electrical and instrumentation penetrations can be a source of unfiltered inleakage.
- AHU and ventilation system doors, hatches or other entry points can be a source of unfiltered inleakage. Inspect such items as latches, sealing surfaces and seal compression.
- Fan shafts can be a source of inleakage if not sealed. This is due to the negative pressure at the fan shaft location.
- Loop seals and drains can be a source of inleakage.

For portions of ventilation systems located inside the CRE:

- Portions of pressurization ductwork upstream of the filter and within the CRE can be a potential source of inleakage. This portion of the system may operate at a higher pressure than the pressure in the envelope.
- Ducting that is isolated can be a source of unfiltered inleakage if the isolation dampers are not leak tight. Typically this is a concern if the ductwork interfaces with the suction side of a fan (e.g., recirculation or AHU).

3.4.2 Other Ventilation System Ducting Within the CRE

Ducting associated with other ventilation systems may be routed through the CRE. These can be a source of inleakage if the systems operate at a higher pressure than the pressure within the envelope. Control room pressure can influence the leakage from this ducting such that the lower the control room pressure, the more the duct leaks. In addition, in some cases, no pressure (e.g., isolation only for a hazardous chemical event) can influence the leakage from this ducting. As an alternative to duct sealing or replacement, it may be acceptable to change the operating mode of the subject ventilation system or secure it to ensure that it operates with a lower pressure than the envelope pressure. Isolating the ducting during post-accident mitigation does not exclude it from being a source of inleakage because damper leakage in isolated ductwork may provide a potential source of inleakage.

Excessive leakage from ducting routed through the CRE may assist in pressurizing the CRE. Sealing these leaks could result in reduced CRE pressure.

Ventilation ducting (e.g., commercial, pocket lock, non-seal welded or non-bolted connections) can be a potential leakage location. Seal welded ductwork should be visually inspected to ensure the integrity of the welds. Insulation may need to be removed from the ductwork to facilitate inspection to locate leaks.

3.4.3 CRE Boundary Penetrations

- Penetrations such as cables, conduits or small pipes can be a potential source of inleakage. To the extent practical, both the inside of the conduit and the conduit/wall penetration should be inspected to determine that seals are present and functional.
- Other items such as unsealed concrete anchors through block walls can be a leakage source at the interface.
- Ventilation equipment drains, system drains or floor drains commonly penetrate the CRB. To prevent leakage through these lines, check valves or loop seals should be installed. If used, verify that the check valve design is appropriate for its application and the loop seals are maintained to keep them filled.

3.4.4 Doors in Control Room Envelope Boundary

Door seals can be a potential significant source of inleakage. Experience has indicated that the door-to-door frame (sides and top of door) and the floor (bottom of door) can be significant leak locations. The inspection should not only ensure the integrity of the seals but also verify that the door is properly compressing the seals.

3.4.5 Ventilation System Dampers

CR HVAC isolation dampers that close to ensure the integrity of the system and the envelope during an event can be potential sources of inleakage if they do not seal properly or if they have degraded seals. On systems in which the difference between normal pressurization and accident pressurization modes is the position of a bypass damper around a filter bank (dampers used to divert flow), leakage through these bypass dampers constitutes unfiltered inleakage. Balancing dampers that establish a particular flow rate necessary for pressurization can have an impact if they are set in inappropriate positions.

Leakage can also occur through damper shafts or other associated sub-components that penetrate the ducting pressure boundary.

3.4.6 Other Non-HVAC Systems in the Envelope

Instrument air and/or service air systems can enter the envelope to provide air for functions such as damper controls or breathing air. The compressors for these systems may be located outside the envelope and provide a means of unfiltered inleakage if the components inside the envelope leak, or venting of air is part of the component operation.

Radiation monitors outside the envelope that draw samples from inside the control room, and radiation monitors inside the control room that draw samples from outside the envelope, can be a source of inleakage if the sample lines leak.

3.4.7 General Boundary Construction

Certain construction configurations or deficiencies are more susceptible to inleakage. For example, porous (non-filled) block walls can leak, where poured intact concrete walls should not leak significantly. Deficiencies such as cracks or inadequate sealing materials can be locations for inleakage. Deficient expansion joints can be a source of leakage.

Areas that are frequently overlooked are those that are not readily visible; e.g., above dropped ceilings, below raised floors, or against walls behind panels. These should be inspected to the extent practical. In some cases, it may be possible to verify the boundary by inspecting the other side.

3.4.8 System Flow Measurements

Airflow rates should be measured to ensure that the system flow rates are as expected for the various configurations. This document does not provide guidance on determining system flow rates. These measurements must be obtained from test results and compared with applicable limits to ensure that control room HVAC and interfacing systems are operating as designed. Ensure the tests were performed within an appropriate time frame and represent current system parameters.

An evaluation should be performed to ensure that the filter flow requirements in the emergency mode are not invalidated by inleakage. An example of this is a condition where a flow instrument is located upstream of the filter housing and recirculation fan and shaft inleakage exists.

Significant discrepancies in air flow rates (i.e., the sum of the individual flow rates does not equal the whole) need to be evaluated. These types of conditions indicate the possibility for leakage and unwanted airflow. Differences may also be due to the uncertainty of the measurements.

4. Documentation

Document the control room boundary, the modes of operation and the walkdown results, listing any inleakage vulnerabilities.

Document areas lacking seals and/or requiring refurbishment of seals. Document any deficiencies identified during the assessment in the licensee's corrective action program.

The documented information from this assessment is to be used in performing inleakage testing described in Appendix D.

Table C-1 DETERMINATION OF VULNERABILITY SUSCEPTIBILITY

System / Component[3]	Determining Inleakage Vulnerability
CRHVAC Operation (Section 3.2)	Determine the operating parameters and alignments of the systems.
CRHVAC Integrity (Section 3.4.1)	Determine if control room ducting and/or HVAC equipment located outside the envelope is at a negative pressure with respect to adjacent areas. This is applicable to both operating and non-operating equipment. If this condition exists then inleakage is possible. The following vulnerabilities may then exist: Ductwork including previous repairs with RTV sealant Bellows, flanged and flexible joints Equipment housings System penetrations such as chiller lines, electrical and instrumentation Accesses such as doors or hatches Fan shaft (AHU, recirculation fan, etc). Determine if portions of the pressurization ducting inside the envelope between the envelope boundary and the filter are operated at a higher pressure than the envelope pressure (for portions of the ductwork located inside the envelope). Determine if AHU fans have the potential to draw air from isolated ducting lines (i.e., damper leakage) that penetrate the envelope boundary.

[3] The Section references shown in this column refer to paragraphs in this appendix.

Table C-1 DETERMINATION OF VULNERABILITY SUSCEPTIBILITY	
System / Component[3]	**Determining Inleakage Vulnerability**
Other Ventilation System Ducting (Section 3.4.2)	If other system ducting is routed through the envelope: • Determine the post-accident pressure in the ducting relative to the pressure in the envelope (consider the effects of this ducting as a means of both inleakage and outleakage). Note: Excessive leakage from ducting routed through the CRE may assist in pressurizing the CRE. Sealing these leaks could result in reduced CRE pressure. After sealing, pressure in the control room should be rechecked to ensure that it meets design conditions. • If the ducting is isolated, consider the potential for damper leakage. • Determine the integrity of this ducting. Consider the items identified above under CR HVAC integrity.

Table C-1 DETERMINATION OF VULNERABILITY SUSCEPTIBILITY

System / Component[3]	Determining Inleakage Vulnerability
CRE Boundary Penetrations (Section 3.4.3)	Determine that wall, floor and ceiling penetrations (i.e., conduits, electrical cable trays, etc.) are sealed. Check for voids inside cable bundles that may be covered with cable coating or voids under the cable in the tray. Check for non-leak-tight flexible conduit or armored cables passing through penetration seals. Check seals inside the conduit and between the conduit and the wall. Check conduit connectors, couplings and terminations. Check caps on spare embedded sleeves. Determine that ventilation ducting penetrations and dampers are properly sealed. Check for space around fire damper sleeves. Note that space around fire dampers is necessary to allow damper expansion during a fire for proper damper functioning. Assure that the space is within requirements for expansion such that the fire damper retains its capability to function for a fire. Should the spaces need to be sealed consult fire damper standards (i.e., contact the manufacturer of the damper) to assure damper integrity is retained. Check for concrete anchors or other bolts through block walls that are not sealed. Determine that drains (floor or equipment) have loop seals or check that valves and abandoned drains are sealed. If used, verify that the check valve design is appropriate for this application. Determine if there are other types of penetrations that can provide potential leakage pathways.

Table C-1 DETERMINATION OF VULNERABILITY SUSCEPTIBILITY

System / Component[3]	Determining Inleakage Vulnerability
Doors in CRE Boundary (Section 3.4.4)	Determine that there are no defects in the doors. Determine that door seals (including sweeps) are not cracked, are not missing and have proper fit. Determine that doors are properly compressed or fitting against the door seals. Determine that door latches are functioning properly to maintain the door securely closed. Determine that doorframes are properly sealed.
Ventilation System Dampers (Section 3.4.5)	Determine that control room isolation damper seals are not cracked, are not missing seals and have proper fitting seals. Determine that control room isolation damper linkages are functioning properly to assure compression of the seals against the damper blade(s). Determine that damper shaft penetrations are properly sealed.
Other Non-HVAC Systems in the Envelope (Section 3.4.6)	Determine if there are instruments or service air lines that enter the envelope boundary and could provide potential unfiltered air sources due to leakage or operational venting of air operated components. Consider other equipment operations providing a mechanism for air inleakage such as radiation monitors that are located outside the envelope and draw a sample from within the envelope.

Table C-1 DETERMINATION OF VULNERABILITY SUSCEPTIBILITY

System / Component[3]	Determining Inleakage Vulnerability
General Boundary Construction (Section 3.4.7)	Determine that the general envelope boundary is in good condition, including: • Block walls – unsealed or unpainted, cracked or missing mortar • Metal deck – joints and ceiling interfaces with walls • Plaster or drywall – unsealed over armor plate • Steel/concrete interfaces – structural steel, doorframes • Concrete – cold joints, expansion joints, seismic gaps • Hidden or abandoned chases or spaces or joints hidden under carpet • Fireproofing - penetrating envelope or covering joints or penetrations.

APPENDIX D

TESTING PROGRAM

1. PURPOSE

This appendix provides guidance on preparing for and performing control room envelope (CRE) inleakage tests to demonstrate conformance to the plant licensing and design bases.
The CRE encompasses the control room and other rooms and areas within the confines of the control room boundary. The control room boundary (CRB) consists of the physical barriers (e.g., ducts, dampers, floors, ceilings, walls and doors) that separate the CRE from other plant areas.

2. SCOPE

This appendix focuses on conducting a test that will quantify inleakage into the CRE. The guidance includes the attributes of an acceptable test program, acceptable testing options, preparation for testing, performance of testing, and disposition of test results. This appendix is intended to aid plant personnel in the development of a plant specific testing procedure.

3. TEST ATTRIBUTES

The attributes of an acceptable test program are:

- The test must be comprehensive (see Section 3.1).
- Integrated system testing must be conducted with systems and components under conditions that bound their accident configuration lineups (see Section 3.2).
- Testing must be performed using an industry standard or a combination of standards. Table D-1 identifies examples of standards (see Section 3.3).

The following subparagraphs provide additional guidance on the attributes of an acceptable test program.

3.1. COMPREHENSIVE

A test is considered comprehensive if it quantifies all of the inleakage associated with a CRE. A comprehensive test program determines the total CRE inleakage for each challenge (e.g., hazardous chemical, and radiological) that may be encountered. Some plant designs may be such that the CR HVAC system(s) and associated components function in the same manner regardless of the challenges. In those cases, the results of one test may be able to identify the inleakage associated with the various challenges.

3.2. Configuration lineups

Test conditions are to bound the limiting conditions in the design basis.

Control room inleakage must be measured under conditions that support the licensee's accident analysis. When possible, perform tests with the envelope, its associated ventilation systems and adjacent ventilations systems aligned and functioning the way they would if a radiological or hazardous chemical event were to occur. If identical alignments cannot be met, justification must be given to ensure the results are conservative. This justification should include an evaluation to demonstrate with reasonable assurance that the measured inleakage is bounding for the licensing and design bases configuration that would exist during an accident. Alternatively, individual leakage sites may be tested with the ventilation systems in a non-accident alignment provided that the test conditions for the components are representative of the accident condition. For example, damper leakage may be tested in a static condition as long as the ambient temperature and pressure differential test condition bound the accident condition. This evaluation should be documented with the test results. The information identified in this section will be used in section 4.2 of this appendix to establish test alignments.

3.3. Industry Standard

Perform tests that demonstrate CRE integrity using a recognized industry standard. The industry standard must be relevant to the determination of inleakage for the specific application. See Table D-1 for examples and purposes of the standards.

4. Testing

This section provides guidance on test prerequisites, choosing the system mode of operation, choosing an appropriate test method, performing the test and dispositioning the test results.

4.1. Prerequisites to Testing

a) **Baseline Test only** - Perform an assessment of the CRB in accordance with Appendix C of this document.
b) **Baseline Test only -** Determine the areas that need sealing, refurbishment or repair, using the information from Appendix C, and perform the necessary work prior to performing the baseline test.
c) **Periodic Test only -** Perform walkdowns per Appendix C, Sections 3.3 and 3.4 (with the exception of Section 3.4.8).
d) Determine acceptance criteria for inleakage. The acceptance criterion will be developed using the configuration that results in the maximum consequences to the operator. This inleakage value may or may not be the maximum possible inleakage into the CRE (see also Section 4.2 of this appendix).
e) Develop contingency plans to address results that may challenge the operability of the control room ventilation system. Development of contingency plans should include calculations of

maximum allowable radiological inleakage, maximum **allowable** radiological inleakage for use in operability determinations, and maximum allowable hazardous chemical inleakage. In evaluating the consequences of operable, but degraded conditions, the use of analyses features approved in NRC regulatory guides that are not part of the current licensing basis may be justifiable. The features need to be applicable to the plant. If permanent credit is taken for these features, they will need to become part of the facility's licensing basis using applicable regulatory change processes. Contingency plans may include interim compensatory measures. (See Appendix B).

f) Align HVAC systems (including adjacent spaces HVAC systems) consistent with the design basis. For individual component leak tests, the conditions across the test boundary must bound the design basis.
g) Consider the impact of other plant activities on the test, and of the test on other plant activities. An example of this is that CRB ingress and egress may need to be limited during the test.

Note: Plants that use outside air for pressurizing their control rooms, and have Technical Specifications addressing pressurizing air, must continue to verify that the amount of pressurizing air is within acceptable limits.

4.2. DETERMINE SYSTEM MODE OF OPERATION FOR TESTING

a) Establish the mode of operation (i.e., CRHS alignment) for testing using the guidance contained in Section 3.2 above. This must match, to the extent practical, with the alignment evaluated in the design basis analysis. If it is not possible to establish this alignment, an alternative lineup may be used provided that it is conservative and documented.
b) Perform testing, with a sufficient number of different system modes of operation, to verify the adequacy of the system for all design basis events. If the plant can show that one test configuration encompasses all operational configurations (i.e., the mode being tested will yield the highest inleakage value and this value can support all applicable analysis) then multiple tests are not required. For a plant designed for positive pressure to radiation accidents, but neutral for hazardous chemical events, two separate tests should be considered. This is because the leakage across the CRB in the neutral configuration can be either in or out of the CRE depending on the direction of the differential pressure. One test could be acceptable if it can be designed to show the maximum possible leakage in both the positive and neutral configurations.
c) Since some plants have different alignments for radiological and hazardous chemical challenges, multiple inleakage tests may be required (i.e., one for a hazardous chemical event and one for a radiological event). The acceptance criteria for each test should correspond to the inleakage that results in the maximum consequence to the operator for the particular event being tested. Two common modes of operation are pressurization (isolation with pressurization) and isolation (isolation without pressurization). The pressurization mode is generally for protection from radiological events and the isolation mode is generally for protection from hazardous chemical events. However, this varies

among plants and each licensee should carefully determine the possible system alignments that need to be tested. For example, if the plant has a hazardous chemical event that results in a required isolation of the control room, the system should be tested in the isolated mode.

d) The conditions that exist in the areas adjacent to the CRE influence the performance of the CRHS. Although systems in adjacent areas might not be expected to operate during an emergency, during a loss of off-site power, or with a single failure, inleakage may be increased if they do operate. Potential interactions between the CRHS and adjacent areas that may increase the transfer of contaminants into the control room should be identified. These interactions may be caused by ventilation systems that supply or exhaust air from areas adjacent to the control room, are located in areas adjacent to the control room, or have ductwork that traverses the control room or areas adjacent to the control room.
e) Effects of the environment on the test results should be considered. Performing the test to minimize environmental influence is recommended. The test instruction should contain guidance on environmental effects. For example, the test should not be performed if there is a strong consistent wind (>15 mph) and the CRE is significantly exposed to the outside environment. The lower the wind speed, the more accurate the test results. In addition, the test should consider seasonal and daily temperature differences and their impact on pressure differential.
f) Document the system modes for testing and the basis for the system mode tested.

4.3. DETERMINE METHOD OF TESTING

Document the type of testing to be performed and the basis for the test chosen. Sections 4.3.1, 4.3.2 and 4.3.3 provide additional information on two acceptable methods of testing as well as guidance criteria for an alternative test method. The applicability, capability, and cost of each test method depend upon the plant design. The evaluation steps in order of importance and process are:

- Justify the applicability of the test method to the plant design by examining test features and requirements, including test benchmarking and correlation, as described in this section.
- Assess the ability of the test to deliver accurate nominal inleakage results, where uncertainties are minimized and the magnitude and sources of uncertainty are understood.
- If applicable, perform a cost comparison of test methods found suitable in the evaluations above. A comprehensive evaluation would include site personnel, site equipment, and vendor costs. Analysis and licensing costs may also be a consideration.

4.3.1. INTEGRATED TRACER GAS TEST METHOD BACKGROUND INFORMATION

This test method is described in standard ASTM E741,"Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution." It is applicable to all control room designs and will provide the total inleakage value. This test method determines total inleakage by one of three techniques concentration decay, constant injection and constant concentration. Depending upon the technique, this involves the measurement of makeup flow to the CRE, the concentration of the tracer gas in the control room envelope, and the injection rate of the tracer gas.

The concentration decay method has generally proven the most effective method for the system mode that relies on isolation without pressurized makeup air. The constant injection technique has generally proven the most effective method for the system mode that relies on pressurized makeup air. This test method uses the measurement of tracer gas dilution to determine the air change within the CRE. The measurement of the concentration, and sometimes the volume rate of the tracer gas that is injected into the CRE, allows calculation of the volume rate of outgoing air from the CRE. The inleakage can be inferred from these measurements. A combination of these test methods may be applied to test a given control room configuration.

ASTM E741 provides a description of the limitations associated with the tracer gas test. It also identifies the knowledge and expertise requirements of individuals performing this test method. Vendors have traditionally taken exceptions to the standard in developing their own testing protocols. Informational Appendix EE provides a listing of these exceptions to ASTM E741.

This test method will not distinguish whether the inleakage is filtered or unfiltered, the inleakage contribution of individual components, or the specific location of the leakage. For pressurized, low-leakage control rooms, the uncertainty in the test can be a significant percentage of the allowable inleakage, due to typical uncertainty in the pressurizing flow measurement. Consider also when performing a tracer gas test that:

- This test is dependent upon ensuring uniform tracer gas concentration throughout entire control room volume and upon appropriate sampling techniques. Multiple sampling may be advisable to improve the accuracy of the test results.
- ASTM E741 defines a zone by the air handling system serving it. Redundant air handlers serving the same area can still be treated as one zone. Multizone buildings are difficult to treat as single zones and meet the uniformity of tracer gas concentration required for this test method. If a control room is multizone it can still be tested using ASTM E741.
- Proper selection of the best measuring points for tracer gas test and injection points for tracer gas prior to test initiation is important to the success of this test method.
- Determination of the net volume of the control room envelope may also be important. This volume enters into the calculations of inleakage for the concentration decay test method. The more accurate the value, the more accurate the results of the tracer gas test.
- Where applicable, the ability to obtain accurate measurement of the pressurizing flow rate can have a significant impact on the uncertainty of the overall test results.

4.3.2. INTEGRATED COMPONENT TEST METHOD BACKGROUND INFORMATION

In the integrated component test method, the total inleakage value is established by summing all the results from the individual leakage location tests. This test method will distinguish whether the inleakage is filtered or unfiltered. The inleakage contribution of individual components will be identified. A limited number of inleakage tests using this method have been performed at facilities in the industry. In these cases, the uncertainty in the integrated component test results has been smaller than the uncertainty in the integrated tracer gas test results at these facilities.

For licensees to use the test, the initial inleakage test results must be correlated with the test results from the performance of an integrated test using the integrated tracer gas test method. The integrated component test method is considered correlated as long as the nominal inleakage value accounts for no less than 95 percent of the nominal inleakage test result from performance of the integrated tracer gas test method. Such a correlation will indicate that the inleakage from CR walls, ceiling and floor inleakage is small.

If licensees can benchmark their assessment method and design to a facility that has correlated the integrated component test method with the Integrated Tracer Gas Test Method, then the licensee can use the integrated component test method for baseline testing and any subsequent tests. Benchmarking a design, as used in this context, means that the facility design can be compared to a similar plant design that has already correlated the two test methods. Similar design implies that the design, construction and operation are sufficiently alike so as to assure comparable results between the two plants. Benchmarking the assessment method means that it was conducted in a systematic manner as described in Step 2 of this section. A peer reviewer from the benchmarked plant should be used to strengthen the assessment team and provide assurance of the implementation of a similar assessment per Appendix C. Although not required, a peer reviewer from the benchmarked plant is recommended to strengthen the assessment team and provide assurance of the implementation of a similar assessment method

Other aspects that should be understood prior to the performance of this test are:

- This test is dependent on the correct selection of components vulnerable to inleakage based on a systematic assessment performed in accordance with Appendix C.
- The identification and establishment of test pressures and airflow conditions to bound the limiting condition for an individual component may be difficult.

Control room design limits the selection of this test method. This test method is applicable only to positive pressure CRE designs. The prerequisite for an integrated component test is the need for the CRE to be maintained at positive pressure with respect to all adjacent spaces. The following are control room design features that should be evaluated when determining whether it is feasible to perform an integrated component test. All of these features improve the ability to correlate results to a tracer gas test and reduce the complexity of the test program and the analyses to derive results. However, these features are not prerequisites for the integrated component test method. These features are:

- A majority of control room HVAC equipment and ducting is located within the CRE.
- Minimal non-control room ventilation ducting or air system piping penetrates the CRE.

- Ventilation ducting located outside the CRE should be of a tight design (e.g., seam welded) and is in good material condition.
- A small number of vulnerable locations to inleakage exist.

This method requires three steps.

Step 1 - Performance of a comprehensive differential pressure test on the entire control room boundary. This verifies that the pressure inside the CRE is greater than the pressure in the outside adjacent areas. This test is dependent upon the premise that the CRE is at a positive pressure to all adjacent areas; however, testing must validate this premise. In this respect, the differential pressure measurements are critical. These differential pressure measurements are used to demonstrate that there is only outleakage across *the boundary walls, floors and roofs/ceilings. This includes the doors and all penetrations in the boundary*. Any component of the boundary that cannot be verified to have a positive differential pressure across the boundary must be tested for inleakage.

The comprehensive test of the control room boundary must include a sufficient number of test points on each side of the boundary so that the test points in aggregate represent the entire boundary that is credited in the test. If a test point represents an entire room, then the remote locations in the room should be checked to ensure that the test pressure represents the condition throughout the entire room. If not, additional test points will be required. For example, complicated room configurations with restrictions to air flow (panels, half walls, etc.) can result in pressure variations within the room. Each test result should be corrected, as necessary, to a standard set of environmental conditions.

The control room ventilation system should be in the limiting train pressurization mode of operation as discussed in Section 4.2 of this appendix. Elevation and temperature differences can also affect pressure differential and should be addressed. All areas adjacent to the boundary must be represented by a pressure measurement. Note that outleakage at least equal to the pressurization makeup flow is expected to exist across the entire boundary.

Should resealing of the CRE occur after the differential pressure measurements are made for the purpose of reducing unfiltered inleakage into the CRE, then an additional set of measurements are to be made. This is due to the likelihood that the eliminated leakage was assisting in pressurizing the CRE. The additional set of measurements must show that required pressure differentials are still being maintained.

Step 2 - Identification of vulnerable components to be tested. The Appendix C assessment identified any areas vulnerable to inleakage. Then using Appendix C and the differential pressure test, components are identified where the pressure inside the control room boundary is less than the pressure outside the boundary. Any components thus identified are determined to be vulnerable to inleakage and will require an individual leakage test. For the periodic test, perform reviews/walkdowns to assure that no new vulnerabilities have been created nor have existing vulnerabilities been removed. This review begins with the list of vulnerabilities identified (from Appendix C) for the baseline test.

Step 3 - Performance of leak tests on components vulnerable to leakage. Where the pressure inside the CRE cannot be verified to be greater than the pressure in the outside adjacent areas, these locations in the boundary must be individually leak tested. The final set of tests is the leakage tests for the individual components determined to be vulnerable to inleakage. These integrated component test methods should be performed using industry standards (see Table D-1 for examples). Any exceptions to the consensus standards should be noted. Although the control room ventilation system does not necessarily have to be in the limiting accident condition, the test pressure and flow conditions across the tested component should bound the accident condition. The effect of HVAC systems in adjacent areas under accident conditions must be addressed when establishing integrated component test method conditions. The sum of all the inleakage test results will represent the integrated control room inleakage value.

4.3.3. ALTERNATE TEST METHODS BACKGROUND INFORMATION

Licensees may propose alternate test methods. Alternate test methods must meet the following criteria:

- The method must identify or capture and test all potential inleakage pathways and produce an overall inleakage value for the entire CRE.
- The test must be performed in accordance with industry test standards such as those examples listed in Table D-1. Any exceptions to the consensus standards shall be noted.
- The testing must be conducted in a manner that reflects or bounds accident configuration leakage.
- An alternate test method will require correlation and/or benchmarking. See discussion of these items in relation to the integrated component test method in Section 4.3.2.

Licensees that propose to measure inleakage using an alternate test method will require a detailed description and justification of the proposed method to allow an NRC review to ascertain the acceptability of the test.

The documented information should include:
- summary of the test method
- description of the test apparatus and tolerances
- parameter specifications
- material requirements
- safety implications of the test (e.g., personnel safety, impact on plant operations and plant equipment)
- preparations before initiation of the test
- calibration of test equipment
- test procedure

- manner of calculating inleakage and associated error from the test results
- uncertainty (e.g., precision, accuracy) of test results obtained with the test method
- correlation and/or benchmarking results and evaluations.

Table D-1 identifies some methods that may be considered for development as an alternative test method. Note that a combination of methods may be necessary to produce an overall inleakage value for the entire envelope.

4.4. INLEAKAGE TESTING

Based on the determination made in Section 4.3, either Section 4.4.1 (integrated tracer gas test method) or 4.4.2 (integrated component test method) may be used. If an alternate test method is chosen, the utility should establish the testing guidance related to the alternate test.

4.4.1. THE INTEGRATED TRACER GAS TEST METHOD

The industry standard currently being used for a tracer gas test to determine inleakage is ASTM E741, *Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution*. It is beyond the scope of NEI 99-03 to provide a detailed procedure applying ASTM E741; however, general guidance is presented in preparing and conducting the test.

4.4.1.1. PRELIMINARY ACTIONS

Perform the following steps prior to performing a tracer gas test.

- Determine if the test is to be performed in house or by a contractor.
- Select the method of measurement that is appropriate for the CRE to be tested (examples: concentration decay, constant injection and constant concentration).
- Walkdown the CRE to select the best measuring points and injection points for tracer gas prior to test initiation. This should be conducted with a set of as-built drawings.
- Obtain material safety data sheets for the tracer gas for incorporation/approval by the site's material control program.
- Determine the net volume of the CRE, if needed. This volume enters into the calculations of inleakage for the concentration decay test method. The more accurate the value, the more accurate the results of the tracer gas test.
- Ensure that the test organization, contractor or licensee, is:
    - Familiar with this type of testing.
    - Has a 10 CFR 50 Appendix B quality assurance (QA) program and, if so, decide whose QA program will apply. Determine how the quality requirements for calibrated measuring and test equipment will be met.
    - Familiar with the plant configuration, the purpose of test and the control room HVAC mode to be tested prior to arrival on-site.

  * Reviews the CRE Boundary and CREFS configuration and operation (onsite) in detail to identify:
    a) test configuration(s)
    b) measured data required for habitability analysis
    c) CRE boundary and boundary condition walk-down
    d) CREFS configuration walkdown.
  * Verifies that test procedures are compatible with plant procedures (including, but not limited to):
    a) test equipment calibrations
    b) test personnel qualifications
    c) tracer gas test compatibility with plant chemical tracking program.
- Determine the minimum time needed to perform the test as provided in ASTM E741. This is a function of the method of measurement.
- Prepare plant specific test procedures in accordance with plant requirements. The test procedure should allow for using the contractor's actual tracer gas test methodology (if a contractor was selected). Consider the effects of the environment on the test results consistent with the plant design basis assumptions. The test instruction should contain this guidance on environmental effects. For an example: the test should not be performed if there is a strong consistent wind (>15 mph) and the CRE is exposed significantly to the outside environment. The lower the wind speed, the more accurate the test results. Consider including a requirement to limit door openings/closings during the test.
- Perform testing in accordance with plant procedures.
- Retest, if necessary, to achieve acceptable results and/or to understand inleakage vulnerabilities or testing uncertainties.

4.4.2. THE INTEGRATED COMPONENT TEST METHOD

4.4.2.1. COMPREHENSIVE DIFFERENTIAL PRESSURE MEASUREMENTS TEST

- Identify acceptance criteria for an acceptable positive pressure test. The acceptance criteria[4] are to be based on the design and, if applicable, Technical Specification required values. If a design or TS value does not exist then a) for adjacent spaces that are essentially outside atmosphere, a positive 0.125-inch water gauge pressure differential is recommended to allow for atmospheric variation; and b) for adjacent areas inside a building where conditions are more stable, a positive pressure differential of 0.05 inches water gauge[5] is sufficiently high to demonstrate assurance of pressurization. Adjustments for

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[4] Building spaces adjacent to the control room may be maintained as neutral, positive or negative with respect to the CRE during normal or accident conditions. Therefore, when making differential pressure measurements these conditions must be taken into account and acceptance criteria should be appropriately selected to address these pressures (should they exist).

Discussion: An adjacent space, by design, is normally maintained by its HVAC system at a certain (negative, neutral or positive) pressure. Accident analysis then requires the space to go to a different pressure (negative, neutral, or positive) for post accident operation. If the adjacent space HVAC cannot be placed in its accident lineup, when taking the differential pressure measurements, then the impact of the difference between normally maintained pressure and the accident pressure in the space must be addressed.

First example: The CRE has a design requirement to be able to maintain the differential pressure between the Turbine Building (TB) and CRE at 0.125 inches water gauge (WG) post accident. The TB is maintained at a negative 0.25 inches WG pressure with respect to the CRE during normal operation. The TB is designed to go to a neutral pressure during an accident condition, which assumes TB ventilation fails. The pressure differential between the CRE (with the CR HVAC operating in accident mode) and TB is measured (with the TB ventilation normally operating) and is determined to be 0.40 inches WG. Accounting for the negative pressure being maintained by the TB requires subtracting a value of 0.25 inches WG from the 0.40 measured. This would yield an anticipated accident pressure differential between the CRE and TB of 0.15 inches WG. This meets the requirement of 0.125 inches WG. Therefore, the measured pressure differential is acceptable. Note that if the differential pressure measured were 0.30 inches WG, then the acceptance criteria of 0.125 inches WG would not have been met and the integrated component test method could not be used. Additionally, this example also shows that the CRE can be maintained positive to the TB for all anticipated modes of operation of the TB HVAC.

Second example: The CRE has a design requirement to maintain the differential pressure between the Turbine Building (TB) and CRE at 0.125 inches WG post accident. The TB is maintained at a positive 0.25 inches WG pressure with respect to the CRE during normal operation. The TB is designed to go to a neutral pressure during an accident condition (assumes TB ventilation fails). The pressure differential between the CRE (with the CR HVAC operating in accident mode) and TB is measured (with the TB ventilation normally operating) and is determined to be 0.40 inches WG. Accounting for the positive pressure being maintained by the TB requires adding a value of 0.25 inches WG to the 0.40 measured. This would yield an anticipated accident pressure differential between the CRE and TB of 0.65 inches WG. This then meets the requirement of 0.125 inches WG. Therefore the measured pressure differential is acceptable. Additionally, this example also shows that the CRE can be maintained positive to the TB for all anticipated modes of operation of the TB HVAC.

[5] Background information on the values 0.125 inches WG and 0.05 inches WG: The value of 0.125 inches WG is based on the Standard Review Plan NUREG-0800 Section 6.4. The value 0.05 inches WG is based on current engineering practice in the cleanroom and healthcare industries and ASHRAE applications. In the April 2001 revision of Guidelines for Construction of Hospital and Health-Care Facilities, the American Institute of Architects

adjacent space pressures must be made as appropriate. The use of two precision instruments is recommended[6]. The adjacent measurements should be timed and corrections should be made for elevation differences and other environmental influences between different spaces.

- Perform a control room positive pressure test to determine if there are any adjacent areas that are at a higher pressure than the rooms within the CRE. The system mode of operation when the pressure measurements are taken must be consistent with the modes of operation defined in Section 4.2 of this appendix.

When measuring the differential pressure:

- Use drawings supplemented with walkdowns to identify all the control room areas and adjacent spaces to be measured.
- Measure the pressures in all areas adjacent to the envelope.
- Ensure hard to get areas, such as above dropped ceilings, below raised floors and behind false walls, are measured.
- Record and compare the pressures of the adjacent spaces to the areas inside the control room boundary to show the control room is at a positive pressure to all adjacent spaces. Document the portion of the boundary represented by each test point inside and outside the boundary.
- Monitor atmospheric pressure conditions while taking differential readings across the CRE boundary. Many instruments are very sensitive and changes, such as the passing of a weather front, can inject significant changes in data readings.
- If a licensing requirement exists that the CRE be at a positive pressure with respect to adjacent areas, and if it is discovered that adjacent area(s) are at a higher pressure than the pressure inside the CRE, then the licensee's corrective action program requires that actions be taken to reduce the pressure in the adjacent area(s). An integrated component test cannot be performed without maintaining a positive pressure differential with respect to all adjacent areas. Ventilation system operating configurations should be considered, as well as securing fans (if feasible) and providing pressure relief paths. If the system is rebalanced or in any way changed such that the differential pressure measurements are affected, then the test must be repeated per approved procedure.

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recommends a minimum of 0.01 inches WG ΔP (negative) for airborne infection isolation rooms, and a minimum of 0.01 inches WG ΔP (positive) for critical care areas, such as intensive care and surgical rooms. In Chapter 15 of the ASHRAE HVAC 2001 Applications Handbook, 0.05 inches WG is noted as a widely used standard for semiconductor cleanrooms, and pharmaceutical and biomanufacturing clean spaces. Selection of 0.05 inches WG as a pressure measurement is therefore adequate to meet the current practices of each organization, while also being high enough to be measured accurately.

[6] The preferable method is to measure with a differential pressure (d/p) gauge for accuracy considerations. If a d/p gauge is not available, measuring the pressures with a pressure gauge, barometer, or precision manometer is acceptable.

4.4.2.2. IDENTIFICATION OF VULNERABILITIES

- Identify all components vulnerable to inleakage from the assessment performed in Appendix C. This list will be used for all subsequent integrated component tests unless a new assessment is performed that identifies new vulnerabilities or deletes existing vulnerabilities, or design changes are made to change or reduce the vulnerabilities.
- Verify that each vulnerable component can be tested using a consensus standard.
- Any component that cannot be verified to have a positive differential pressure across the boundary must be tested for inleakage. Use the differential pressure measurements from Section 4.4.2.1 to make this determination. Each vulnerability (i.e., component) that was identified in Appendix C must be addressed. Record the components to be tested. Examples of components that could be tested individually are air-handling units, ductwork and isolation dampers.

4.4.2.3. INDIVIDUAL COMPONENT LEAK TESTS

A. SELECT TEST METHOD FOR THE COMPONENT

Perform the following steps prior to performing each test. Some of the more common standards for testing components are provided in Table D-1.

- determine that the test configuration will bound the limiting condition
- develop plant procedures for the individual components that will be tested
- determine if the site testing organization can perform each test or if contractor expertise will be required
- calibrate test equipment to the expected leakage rates.

B. PERFORM THE APPLICABLE TEST

- Perform each test as prescribed in 4.4.2.3.A.
- Record the leakage measurements made.
- Determine if the inleakage is filtered or unfiltered by a review of the leak path. Sum all the filtered and unfiltered leakage measurements. Include the pressurized makeup flow as filtered inleakage.

4.4.3. TEST RESULTS

- Document all test results including leakage measurements.
- Determine one value for total filtered and one value for the total unfiltered inleakage for each lineup tested.[7]

[7] Inleakage during ingress and egress should be added when evaluating the test results against acceptance criteria. An accepted assumption for this unfiltered inleakage contribution is 10 CFM. If a licensee uses less than 10 CFM, the basis for the exception should be justified and documented.

- Determine if the test results meet the acceptance criteria derived from the regulatory limits. Document how uncertainty was addressed in this determination. Current practice is to use the nominal value of the testing results in the radiological and hazardous chemical analyses when these nominal values are in a reasonable range and the variability in results, as represented by the uncertainty, is understood. The use of nominal test results, uncorrected for testing uncertainties, is valid provided that the test is performed in a quality manner that minimizes uncertainties and the magnitude and sources of uncertainty values are understood. For control rooms that demonstrate relatively low values of inleakage, in the range less than 100 cfm nominal, the disposition of the uncertainty in this manner is usually straightforward. The contributions to uncertainty are readily identified. For higher nominal inleakage values the identification of the sources of uncertainty and the justification for the magnitude of uncertainty will become more challenging. When the variability cannot be justified, an appropriate value to address this aspect of uncertainty should be added to the nominal value from the test. In general, the use of nominal values is further justified as an acceptable approach since conservative margins are routinely applied to other input parameters in these analyses, for example in the determination of chi/Q for radiological and hazardous chemical control room habitability analyses.
- If measured values are higher than acceptance criteria, compensatory measures may need to be taken to maintain the control room ventilation system operable until permanent resolution is achieved (See Appendix B for guidance). Inleakage values that result in doses greater than that currently reported in the UFSAR will require evaluation per the plant's corrective action program.
- If the integrated component test method is performed, document each differential pressure test point, the portion of boundary represented by the differential pressure measurements, and the measurement results.
- If the integrated component test method is performed, document the individual components tested and the measurement results.

TABLE D-1
TESTING OPTIONS

PURPOSE OF TEST	Standard Used to Develop Site Specific Procedure (Note 1)	DISCUSSION	Performed with systems in their accident configuration	Optimum Accuracy	Quantitative
Measurement of Inleakage Using a Tracer Gas	ASTM E741	This test method has been accepted by NRC and has been used for the majority of tests performed to date (Notes 2, 3)	Yes	$\pm$ 10 percent	Yes
Measurement of Inleakage Using A Component Test	ASTM E779 ASTM E741 ASTM E1827 ASTM E2029 ASME N510 ASME AG-1 10CFR50, App J, Type C LLRT method (Note 4)	These test methods are used to measure individual component leakages. They are used, as discussed in the text of this appendix, in conjunction with identification of vulnerabilities and pressure measurements to establish control room envelope inleakage. The text of this appendix discusses the integrated component test method that uses individual component tests for measuring component leakage. Note that in order to use an integrated component test method it must be correlated and benchmarked to an integrated tracer gas test (see section 3.3.2 of this appendix). Dampers may be tested by: • Direct Measurement Method of ASME N510 Standard; • Tracer Gas Technique using ASTM E 2029 Standard; • ANSI /ANS-56.8, “Containment System Leakage Testing Requirements”(Note 5) Ducting and housings may be tested by: • Direct Measurement Method of ASME N510 or • ASME AG-1. (Note 5)	Section by section	Test dependent	Yes
Detection of Leaks	ASTM E779 ASTM E1554 ASTM E1186	These test methods, though not discussed in the text of the appendix, are listed here for information. These test methods may prove useful in determining the location of leaks. These procedures can be used in addition to walkdowns, audible detection, and use of smoke pencils.	Not applicable	Not applicable	Not applicable

Notes:

1. Each listed standard provides the information necessary to develop a site-specific test to measure inleakage. Other methods may be acceptable if they are associated with a standard.

2. Optimal accuracy is generally for neutral pressure control rooms. Tracer gas testing is comprehensive for neutral pressure control rooms but requires flow measurements for positive pressure control rooms, which increases the overall uncertainty of the test result. If the actual unfiltered inleakage is small (<100 CFM) and the pressurizing airflow is relatively large (>1000 CFM), the uncertainty in the airflow measurement causes the accuracy of the tracer gas test to become very poor (30% - 60%). Using the parenthetical numbers as an example, an uncertainty of 10 percent in the airflow measurement yields an error band of at least +/-100 CFM. When this error is compared to the measured inleakage, the overall test uncertainty may approach (or exceed) 100 percent measured.
3. Testing developed by the Brookhaven National Laboratory using multiple tracer gases has the potential for conforming to an acceptable test. This method has the ability to discriminate and quantify leakage through different barriers.
4. The volume between closed isolation dampers installed in tandem can be pressurized and the volumetric flow required to maintain the test pressure measured as the leakage. One of the two dampers will be tested in the direction opposite the normal differential pressure condition. The results should be conservative since damper leakage in this direction should be greater than if it is tested in the normal differential pressure direction
5. Other methods may be acceptable if they are associated with a standard. The methods presented above are already accepted by the industry and the NRC for measuring leakage in ducts, housings and dampers.

APPENDIX E

CONTROL ROOM ENVELOPE BOUNDARY CONTROL PROGRAM

1. PURPOSE

This appendix provides guidance for controlling breaches of the control room envelope (CRE) and is to be used to develop plant specific procedures.

2. SCOPE

A boundary control program manages activities that breach the CRE such as:

- The creation of a new penetration in the CRE
- Opening of an existing penetration in the CRE
- Any activity that restricts the normal closure of a CRE door (including blocking a door)
- The removal of a CRE door/hatch from its design location
- The blockage or breach of a CRE ventilation duct
- Removal of or changes to structural components such that CRE boundary leak tightness may be affected
- Removal of fire, steam, high energy line break or flood barriers that also serve as the CRE boundary
- Any piping system breach (e.g., valves, pumps or pipes) that creates a flow path through the CRE boundary
- The removal or alteration of equipment and/or floor drain plugs from the CRE boundary, or dryout of loop seals in the CRE boundary

Normal use of doors, access panels or inspections plugs, for example, does not constitute a breach.

3. DISCUSSION

The physical CRE boundary is a fundamental element of CRE integrity. It is important to control the CRE boundary to ensure that the design is maintained such that the accident analyses and the design and licensing bases remain valid. In the event that planned maintenance, testing or plant conditions have potential to affect the CRE boundary, administrative control of the boundary should be procedurally maintained. This includes controlling openings in the boundary required for maintenance and modifications as well as preventing inadvertent openings. Assure that a program exists to:

- Evaluate the impact on the accident analyses when breaching the boundary
- Monitor active breaches
- Ensure preplanned responses are in place to close the breach in the event of hazardous chemical, radiological, or smoke challenges
- Ensure that the boundary is restored.

Baseline testing measures the actual CRE inleakage. This measured value is typically less than the maximum inleakage that can be calculated to satisfy regulatory limits. For a positive pressurized CRE the difference between these two values may represent margin that can be used to determine the maximum allowable size of a CRE breach to ensure that system operability is maintained. This cannot be done for a neutral pressure CRE. However, the inleakage margin may be used to control breaches as described in Section 4.2.2 below.

For pressurized CRE the breach size can affect the ability to maintain the minimum required differential pressure across the CRE boundary. If positive pressure cannot be maintained, this may result in greater inleakage. Additionally, the maximum pressurization airflow rate allowed by the accident analyses may be adversely affected.

4. PROCESS

4.1 Impact Evaluation

Evaluate the activity to be performed for the effect on control room habitability prior to breaching the CRE boundary. This evaluation should consider, as a minimum, the breach size and the ability to maintain the CRE integrity or rapidly restore the boundary. The impact on fire boundaries, tornado protection boundaries and security boundaries, for example, should also be considered when opening up a boundary.

4.2 Breach Size

4.2.1 Pressurized CRE

Evaluate the effect the breach has on inleakage margin, pressurization flow rate and required differential pressure across the boundary. Implement the following two steps:

- Determine the impact on the differential pressure across the boundary that will be breached under accident conditions.
- Calculate the maximum breach size using the allowable inleakage and differential pressure as input values to an appropriate orifice equation. If the anticipated breach size is less than the maximum breach size, the planned activity is allowed.

If the breach size adversely affects the accident analyses or system performance requirements, compensatory measures may be necessary. These compensatory measures may need a 10 CFR 50.59 evaluation.

If a breach is in an area known to have non-detrimental inleakage characteristics (i.e., the chi/Q for this location provides a large margin), a smaller degree of rigor may be used in the breach assessment/evaluation.

4.2.2 Neutral CRE

Evaluate the effect the breach has on inleakage margin considering any localized differential pressure across the boundary. Implement the following three steps:

- Determine the maximum breach size to identify the allowable inleakage based on the margin of the accident analyses.
- Determine the impact from the differential pressure across the boundary that will be breached under accident conditions.
- Calculate the maximum breach size using the allowable inleakage and differential pressure as input values to an appropriate orifice equation. If the anticipated breach size is less than the maximum breach size, the activity is allowed.

If the breach size adversely affects the accident analyses or system performance requirements, compensatory measures may be necessary. These compensatory measures may need a 10 CFR 50.59 evaluation.

If a breach is in an area known to have non-detrimental inleakage characteristics (i.e., the chi/Q for this location provides a large margin), a smaller degree of rigor may be used in the breach assessment/evaluation.

4.3 Ability To Rapidly Restore the Boundary

Breaches such as blocking doors open do not require evaluation if the breach can be quickly restored. To make use of this exception, a worker must be assigned whose primary responsibility is to shut the door at the onset of abnormal conditions. The assigned worker must be in communication with the control room.

4.4 Breach Monitoring

Establish programmatic controls to monitor the number of breaches and ensure that the sum effect of all the active breaches does not result in exceeding regulatory limits. This may be accomplished via a breach permit tracking system, differential pressure monitoring or controls on the number of work orders that affect control room habitability.

4.5 Boundary Restoration

The breach shall be verified closed when the barrier has been restored (e.g., qualified penetration seal installed) and work-related compensatory measures removed. All restoration activities should be documented.

5. REFERENCES

1. Crane Technical Paper #410; Twelfth Printing

2. R.R. Campbell, “Determination of a Consistent Approach to Calculating Breach Area”, NHUG Summer Meeting 2001, Boston, MA, August 2001

Informational Appendices

The following appendices (AA through GG) contain information that may be useful to licensees implementing the NEI 99-03 guidance.

APPENDIX AA

LICENSING BASIS HISTORY

This appendix provides an overview of the control room habitability regulatory and licensing history.

1. CR GENERAL DESIGN CRITERIA AND EARLY REGULATORY GUIDANCE

In February 1971, the Atomic Energy Commission published Appendix A, *General Design Criteria (GDC) for Nuclear Power Plants* to 10 CFR 50. 10 CFR 50.34(a)(3)(i), which requires an applicant for a construction permit to describe the preliminary design of the facility including the principal design criteria in a preliminary Safety Analysis Report (PSAR). This paragraph includes a reference to Appendix A as establishing the minimum requirements. Criterion 19 (GDC 19), *Control Room*, provides for a control room, alternative shutdown station(s) and habitability requirements. GDC 19, in part, requires:

> "*Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident*."

Between 1965 and 1971, the NRC worked on issuing the final version of the GDCs. The control room criterion was variously numbered as GDC 11, 13, 17 and finally, 19. There were several draft versions and much coordination between the Commission, the staff, and the Advisory Committee on Reactor Safeguards (ACRS). In June 1967, the Commission published a draft of the GDCs in the *Federal Register* for public comment and interim guidance. Applicants for construction permits and operating licenses during this period may have referenced it in their PSARs and FSARs. Many licensees were required to meet the draft GDC on control room habitability as a condition for receiving their construction permit and/or their operating license.

While the GDCs were under development, applicants proposed, and the staff approved, various criteria for the control room. As an example, at one plant the NRC approved the criterion of l0 percent of the 10 CFR Part 100, §100.11 dose guidelines.

In the early 1970's, K. Murphy and K. Campe presented a method for evaluating radiological events in the control room. Additional information can be found in a 1974 paper by Murphy and Campe[8]. In 1974 and 1975, NRC Regulatory Guides 1.78 and 1.95 were issued to provide direction on the protection of the control room operator from accidental releases of hazardous chemicals or chlorine gas respectively.

[8] K.G. Murphy and K.M. Campe*, "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19, In Proceeding of 13th AEC Air Cleaning Conference, San Francisco, CA, CONF-740807,* U.S. Atomic Energy Commission, 1974."

2. TMI EFFECT ON CRH CRITERIA

The NRC developed a number of proposed actions to be implemented on operating reactors and on plants under construction in response to the accident at Three Mile Island. These actions were presented in NUREG-0660, TMI-2 Action Plan. In October 1980, NUREG-0737, *Clarification of TMI Action Plan Requirements*, was published. NUREG-0737 contained all TMI-related items approved for implementation by the Commission as of October 31, 1980. The actions in NUREG-0737 were applicable to operating reactors and applicants for operating licenses. The letter that transmitted NUREG-0737 was addressed to all licensees of operating plants, and applicants for operating licenses and holders of construction permits. The letter in NUREG-0737 stated that the staff "…expected the requirements contained herein will be met." Pursuant to 10 CFR 50.54(f), operating reactor licensees were to confirm that the implementation dates in Enclosure 1 of NUREG-0737 would be met. If they could not, a revised date was to be provided along with a justification for the delay, a proposed revised date for completion and any planned safety actions during the interim.

The NRC issued the Standard Review Plan (NUREG-0800), Revision 1, in July 1981. The Standard Review Plan (SRP) provides standard regulatory acceptance guidance to the NRC for review and approval of Licensee Safety Analysis Reports. The SRP identified that the limiting design basis accident (DBA) for CRH is the loss of coolant accident. However, other DBAs were to be reviewed to determine whether they could be more limiting. Licensees were to provide assurance that the habitability systems will operate under all postulated conditions (DBA) to permit the control room operators to remain in the control room to take appropriate actions required by GDC 19. A schedule for completion of these modifications was required, where modifications were needed for compliance with CRH requirements. Some modifications and other CRH actions were deferred pending future resolution of certain regulatory issues such as the alternative source term (10 CFR 50.67).

In May 1982, Generic Letter 82-10 was issued that requested licensees to implement on a timely basis those TMI Action Items from NUREG-0737, which had not been addressed by Generic Letter 82-05. The Enclosure to Generic Letter 82-10 identified those items for which a schedule needed to be established or, if a schedule had been previously submitted, a reconfirmation of those schedule dates. TMI Action Item III.D.3.4, Control Room Habitability Requirements was in that Enclosure. In March 1983, the NRC issued an order to each reactor facility confirming licensee's commitment to post-TMI related issues. The order required each licensee to implement and maintain the specific items described in the Attachments to the Order in the manner described in the licensee's submittal noted in the Order.

Two classes of licensees were identified in item III.D.3.4.

- Licensees with control rooms that meet the guidance of the SRP needed only to describe their basis for determining that the guidelines were met.
- Licensees with control rooms that did not meet the guidelines of the SRP were required to analyze the control room exposures and submit the results.

3. CRH IN THE 1980'S

Two issues related to CRH were identified by the ACRS in the early 1980s. These issues, which are discussed in NUREG-0933, are:

- GSI B-66, *Control Room Infiltration Measurements*, which identified that a key parameter affecting control room habitability is the magnitude of control room air infiltration rates.
- GSI 83, *Control Room Habitability*, which identified that loss of control room habitability following an accidental release of external airborne hazardous chemical or radioactive material or smoke can impair or cause loss of the control room operators' capability to safely control the reactor.

The ACRS issued a letter to the Commission, on August 18, 1982, which identified a wide range of deficiencies in the maintenance and testing of engineered safety features designed to maintain control room habitability. These ACRS concerns encompassed both plant licensing review and operations and inspection activities.

In January 1983, the NRC responded to the ACRS concerns and recommended increased training of NRC and licensee personnel in inspection and testing of control room habitability systems. The staff also provided a profile of control room HVAC system component failures based on an analysis of Licensee Event Reports from 1977 through mid-1982. On April 28, 1983, Nuclear Reactor Regulation (NRR) and Office of Inspection & Enforcement (OIE) representatives met with the ACRS Subcommittee on Reactor Radiological Effects to discuss the staff response. Based on the accomplishments above, GSI B-66 was considered resolved.

In May 1983, the ACRS issued a letter to the Executive Director of Operations (EDO) that expressed continuing concerns about control room habitability and provided both general and specific comments and recommendations for further staff evaluation. This basically defined GSI 83. In July 1983, NRR transmitted to the EDO a joint NRR/OIE proposal for evaluating the ACRS comments and recommendations and the adequacy of the control room habitability licensing review process and criteria. In August 1983, the EDO indicated agreement with the proposal and directed NRR to coordinate with OIE and the NRC Regional Offices to complete the program and submit a report to the EDO by June 1, 1984. In September 1983, NRR established a Control Room Habitability Working Group and a Steering Group for conducting and guiding the proposed review. The Control Room Habitability Working Group was expected to identify any recommended actions that would correct significant deficiencies in control room habitability design, installation, test or maintenance.

Following issuance of NUREG/CR-4960, *Control Room Habitability Survey of Licensed Commercial Nuclear Power Generating Station*, it was recognized that the methodology used to evaluate control room habitability system design needed improvement. Accordingly, the NRC initiated activities to develop:

- improved methods for calculating control room dose and exposure levels
- improved meteorological models for use in control room habitability calculations and
- revised exposure limits to hazardous chemicals for control room operators.

The results of the improved methods were documented in NUREG/CR-5669 and NUREG/CR-6210. The HABIT Code was developed to provide an integrated code package for evaluating control room habitability. In 2000, the NRC issued a new regulation (10 CFR 50.67) allowing licensees to voluntarily request license amendments to revise their design basis to use alternate source term information in radiological consequence assessments, including those for control room habitability.

As recommended by the ACRS, the staff was expected to consider National Institution for Occupational Safety and Health recommendations for hazardous chemicals in its revision of Regulatory Guide 1.78.

4. EVOLUTION OF INDUSTRY ACTIVITIES

Numerous control rooms have used the tracer gas test to determine the amount of inleakage entering into the control room envelope. The NRC reported early testing results at a July 16, 1998, public meeting on control room habitability. The testing data indicated that actual inleakage was much greater than the amount assumed in control room habitability analyses. Licensees embarked on sealing programs, design improvements and/or revision to dose consequence analyses to ensure regulatory requirements were met.

NUREG/CP-0167, *Proceedings of the 25th DOE/NRC Nuclear Air Cleaning and Treatment Conference,* reported on control room envelope reconstitution efforts at one nuclear power plant, and control room air inleakage testing results at two nuclear power plants. Some of the conclusions from these reports were:

- Tracer gas testing was instrumental in definition and quantification of unfiltered leakage paths and represented documented measured inleakage rates. The constant injection tracer technique was considered the most useful method.
- Well-managed sealing efforts are instrumental for assuring control room integrity.
- Proper airflow balancing is essential to obtaining control room envelope and adjacent area HVAC system design basis.

Following the July 1998 public meeting with NEI, utility representatives and representatives from the Nuclear HVAC Users Group, the NRC agreed to work with the industry to resolve issues regarding control room habitability.

NEI agreed to take the lead. This document, NEI 99-03, presents the results of a joint industry and NRC effort to develop guidance to address CRH.

5. GDC-19 REVISION

In conjunction with the January 2000 issuance of the *Alternative Source Term* regulation, 10 CFR 50.67, GDC-19 was revised to allow licensees to use a dose criterion of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) when implementing an alternative source term. Regulatory Guide 1.183, *Alternative Radiological Source Terms For Evaluating Design Basis Accidents At Nuclear Power Reactors*, was issued in July 2000 to provide guidance on implementing an alternative source term.

APPENDIX BB

REGULATORY DOCUMENTS ASSOCIATED WITH CRH

1. SCOPE

This appendix lists the regulatory documents associated with designing, constructing, operating, and managing control room habitability.

2. REGULATORY REQUIREMENTS

General Design Criterion (GDC) 19 of Appendix A to 10 CFR Part 50 is the controlling requirement for control room habitability (CRH). Plants licensed or issued construction permits before 1971 may not be committed to GDC 19. The text of this criterion, as amended in December 1999 with the issuance of 10 CFR 50.67, is provided below:

Criterion 19 - Control room. *A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident.*

Equipment at appropriate locations outside the control room shall be provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

Applicants for and holders of construction permits and operating licenses under this part who apply on or after January 10, 1997, applicants for design certifications under part 52 of this chapter who apply on or after January 10, 1997, applicants for and holders of combined licenses under part 52 of this chapter who do not reference a standard design certification, or holders of operating licenses using an alternative source term under § 50.67, shall meet the requirements of this criterion, except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed 0.05 Sv (5 rem) total effective dose equivalent (TEDE) as defined in § 50.2 for the duration of the accident.

It is important to note that although GDC-19 provides a specific numeric criterion for only radiation doses. However, the scope of the GDC applies to other conditions that would prevent the requisite actions from being performed.

3. REGULATORY GUIDES

The control room is expected to be habitable following design basis events. The design basis events that establish the parameters for the design of control room features may vary from plant to plant. The Regulatory Guides listed below address various events and define some of the assumptions to be considered in the analysis and evaluation of each event.

- Regulatory Guide 1.3 - *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors*
- Regulatory Guide 1.4 - *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors*
- Regulatory Guide 1.5 - *Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors*
- Regulatory Guide 1.24 - *Assumptions Used for Evaluating the Potential Radiological Consequences of a Pressurized Water Reactor Radioactive Gas Storage Tank Failure*
- Regulatory Guide 1.25 - *Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors*
- Regulatory Guide 1.52 - *Design, Testing, and Maintenance Criteria for Postaccident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants*
- Regulatory Guide 1.77 - *Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors*
- Regulatory Guide 1.78 - *Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release*
- Regulatory Guide 1.95 - *Protection of Nuclear Power Plant Control Room Operators Against an Accidental Chlorine Release*
- Regulatory Guide 1.98 - *Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor*
- Regulatory Guide 1.145 - *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*
- Regulatory Guide 1.183 - *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors*

4. NUREGs

The technical reports listed below provide general information and results of research related to CRH.

- NUREG-0737 - *Clarification of TMI Action Plan Requirements*

As noted in Appendix AA, Generic Letter 82-10 required licensees to submit a report describing their efforts to address the TMI Action Plan Requirements and provide schedule commitments. The NRC issued orders confirming these commitments. The applicability of any NUREG-0737 item to a particular facility is dependent on the specific commitments made by the licensee.

NUREG-0737, Action Item III.D.3.4, *Control Room Habitability Requirements,* is one of the activities identified by the NRC after the Three Mile Island (TMI) accident. Each licensee and applicant was required to make a submittal addressing several questions regarding the design of their control room and habitability systems. Based on a review of these responses, the NRC typically documented the closeout of this TMI issue in a safety evaluation report (SER).

As a part of the CRH assessment effort, each utility should consider the response it provided to this issue, determine whether it still reflects the current design of the CRH features, and confirm that there is a SER closing out the issue for its plant.

For a few plants, the NRC issued SERs that allowed some control room habitability issues to remain open due to pending anticipated NRC actions. The NRC has permitted some plants to use temporary compensatory measures, such as the use of self-contained breathing apparatus or potassium iodide pills to mitigate radiological dose after an accident.

With the issuance of the accident source term rule, 10 CFR 50.67, the NRC encouraged licensees to comply with TMI Action Item III.D.3.4 without compensatory measures.

- NUREG-0800 - *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*

The Standard Review Plan (SRP) was developed to provide guidance primarily for the NRC performing reviews of license applications. It was intended to better assure the quality and consistency of the review effort. It also offered a means of communication for information about regulatory matters and the license process.

The SRP was originally issued in 1975 as NUREG-75/087. The SRP was revised in its entirety in 1981 and republished as NUREG-0800. The new revision outlined the requirements and acceptance criteria for each topic and incorporated new regulatory positions, including several derived since the Three Mile Island accident (see NUREG-0737, discussed above).

The SRP follows much the same outline as that for the Final Safety Analysis Report (at least for those plants that followed the standard format of Regulatory Guide 1.70). The key sections that relate to control room habitability include:

- Section 6.4 – *Control Room Habitability Systems*
- Section 9.4.1 – *Control Room Ventilation Systems*
- Section 11.3 – *Waste Gas System Failure and Liquid Tank Rupture Events*
- Chapter 15 sections – *Accident Analysis*

The SRP typically identified the applicable regulatory requirements, outlined the regulatory considerations and often provided acceptable values for analysis assumptions. The following excerpt from NUREG-0800, Section 6.4 is provided as an example:

> *The LOCA source terms determined from the EAB review in accordance with Appendix A to SRP Section 15.6.5 are routinely used to evaluate radiation levels external to the control room. …. Other DBAs [Design Basis Accidents] are reviewed to determine whether they might constitute a more severe hazard than the LOCA. If appropriate, an additional analysis is performed for the suspect DBAs.*

- NUREG-0933 - *A Prioritization of Generic Safety Issues*

NUREG-0933 presents the priority rankings for generic safety issues related to nuclear power plants. The purpose of these rankings is to assist in the timely and efficient allocation of NRC resources for the resolution of those safety issues that have a significant potential for reducing risk. Two issues related to CRH are Items GSI-B66 and GSI-83. These issues are considered to be resolved with no new requirements for licensees to implement.

- NUREG-1465 - *Accident Source Terms for Light Water Nuclear Power Plants*

In 1962, the U. S. Atomic Energy Commission published TID-14844 to specify the release of fission products from a postulated accident involving a substantial meltdown of the core. This source term was used by nearly all licensees to demonstrate compliance with the reactor siting criteria of 10 CFR 100 and has subsequently been used to estimate control room doses.

In 1995, the NRC published NUREG-1465 and provided more realistic estimates of the source term released from the core. This updated source term guidance was specifically applicable to future reactors. The Alternative Source Term Rule (10 CFR 50.67) was issued in December 1999 and provided for the implementation of the new source term insights of NUREG-1465 by currently licensed facilities. Regulatory Guide 1.183 provides a PWR and BWR alternative source term acceptable to the NRC and provides guidance regarding the attributes of an acceptable source term.

The NRC has also rebaselined a PWR and BWR using the NUREG-1465 source terms (SECY-98-154) and concluded the alternative source term need not be imposed on licensees because use of TID-14844 provides adequate protection of the public. The NRC concluded that voluntary application of the alternative source term by licensees of currently operating plants would be acceptable as an opportunity for burden reduction. Implementation must be approved by the NRC in an amendment to the plant's operating license.

While not directly associated with the CRH issue, the alternative source term does offer an improved basis for a larger control room inleakage value than initially assumed. The new source term, in conjunction with the regulation change to use a total effective dose equivalent acceptance criterion, may yield additional margin in calculated dose consequences for the postulated accidents in a plant's licensing basis.

- NUREG/CP-0167 - *25th DOE/NRC Nuclear Air Cleaning and Treatment Conference*

NUREG/CP-0167 contains papers presented at the conference without associated comments. Major topics included control room safeguards. For example, one session topic was "HVAC Systems for Control Rooms and Other Nuclear Facilities."

- NUREG/CR-4960 - *Control Room Habitability Survey of Licensed Commercial Nuclear Power Generating Station*

NUREG/CR-4960 presents the results of a survey of 12 plants regarding the design of their systems used for control room habitability. The survey was conducted from 1986 to 1988 and was published in September 1988. The observations may offer insights to licensees preparing to assess the integrity and effectiveness of their own control room envelope.

- NUREG/CR-6210 - *Computer Codes for Evaluation of Control Room Habitability (HABIT)*

NUREG/CR-6210 describes the HABIT package of computer codes designed to be used for the evaluation of control room habitability in the event of an accidental release of hazardous chemicals or radioactive materials.

HABIT is an integrated package of several programs that previously needed to be run separately and required considerable use intervention. Two of these modules, EXTRAN and CHEM, are used for estimating chemical exposures. EXTRAN determines the release rate of a chemical in the event of leaks or ruptures of liquid or gas tanks. It also uses a model that computes atmospheric dilution, including the effects of building wakes, to determine the chemical concentration arriving at the intake to the control room. CHEM models the dilution of the chemical by flows in the control room and determines the chemical exposure to control room personnel.

Regulatory Guide 1.78, Revision 1, *Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release,* endorses the use of EXTRAN to model the atmospheric transport of a released hazardous chemical as part of a licensee's hazardous chemical assessment. The use of EXTRAN as part of a hazardous chemical assessment is also discussed in Appendix DD.

- NUREG/CR-6331, Rev. 1 - *Atmospheric Relative Concentrations in Building Wakes (ARCON96)*

NUREG/CR-6331 describes the Atmospheric Relative Concentration in Building Wakes (ARCON96) computer code. ARCON96 is an atmospheric dispersion code intended for use in control room habitability assessments. The code uses hourly meteorological data and refined methods for estimating dispersion near buildings to calculate relative concentrations at control room air intakes that would be exceeded no more than 5 percent of the time. These concentrations are calculated for averaging periods ranging from one hour to 30 days in duration.

- NUREG/CR-6604 - *RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation*

NUREG/CR-6604, documents the RADTRAD computer code developed for the NRC to estimate transport and removal of radionuclides and dose at selected receptors. The code can be used to estimate releases using various source terms. Additionally, the code can account for a reduction in the quantity of radioactive material due to containment sprays, natural deposition, filters and other natural and engineered safety features.

5. INSPECTION AND ENFORCEMENT NOTICES (IEN) AND INFORMATION NOTICES (IN)

The following notices provide information regarding designs or events that had an identified impact on control room habitability.

- IEN 83-41 – *Actuation of Fire Suppression System Causing Inoperability of Safety-Related Equipment*
- IEN 83-62 – *Failure of Redundant Toxic Gas Detectors Positioned at Control Room Ventilation Air Intakes*

- IEN 83-69 – *Improperly Installed Fire Dampers at Nuclear Power Plants*
- IEN 86-76 – *Problems Noted in Control Room Emergency Ventilation Systems*
- IN 88-61 – *Control Room Habitability - Recent Reviews of Operating Experience*
- IN 89-44 – *Hydrogen Storage on the Roof of the Control Room*
- IN 91-56 – *Potential Radioactive Leakage to Tank Vented to Atmosphere*
- IN 92-18 – *Potential for Loss of Remote Shutdown Capability during a Control Room Fire*
- IN 92-32 – *Problems Identified with Emergency Ventilation Systems for Near-Site (within 10 Miles) Emergency Operations Facilities & Technical Support Centers*
- IN 93-06 – *Potential Bypass Leakage Paths Around Filters Installed in Ventilation Systems*
- IN 97-01 – *Improper Electrical Grounding Results in Simultaneous Fires in the Control Room and the Safe Shutdown Equipment Room*
- IN 97-79 – *Potential Inconsistency in the Assessment of the Radiological Consequences of a Main Steam Line Break Associated With the Implementation of Steam Generator Tube Alternate Repair Criteria*
- IN 97-82 – *Inadvertent Control Room Halon Actuation Due to a Camera Flash*
- IN 99-05 – *Inadvertent Discharge of Carbon Dioxide Fire Protection System and Gas Migration*

6. REGULATORY ISSUE SUMMARIES

- RIS 2001-09 – *Control of Hazard Barriers*
- RIS 2001-19 - *Deficiencies in the Documentation of Design Basis Radiological Analyses Submitted in Conjunction with License Amendment Requests*

7. GENERIC LETTERS

- GL 82-05 – *Post TMI Requirements*
- GL 82-10 – *Post-TMI Lessons Learned*
- GL 99-02 – *Laboratory Testing of Nuclear-Grade Activated Charcoal*

8. GENERIC ISSUES

Two issues related to CRH were identified by the ACRS in the early 1980s. These two generic safety issues (GSIs), which are discussed in NUREG-0933, are:

- GSI B-66, *Control Room Infiltration Measurements*, identifies that a key parameter affecting control room habitability is the magnitude of control room air infiltration rates. GSI B-66 was closed in 1983.

- GSI 83, *Control Room Habitability*, identifies that loss of control room habitability following an accidental release of external airborne hazardous chemical or radioactive material or smoke can impair or cause loss of the control room operators' capability to safely control the reactor. GSI 83 is still open.

APPENDIX CC

CRE MAINTENANCE AND SEALING

1. PURPOSE/SCOPE

The purpose of a control room envelope (CRE) sealing program is to monitor and maintain the pressure boundary penetrations in to the control room boundary such that the CRE habitability design and licensing bases are met and maintained.

2. CRE BARRIER CONTROL

Control of the CRE pressure boundary should be maintained at all times, Appendix E provides guidance on a breach program applicable to maintaining the CRE. In the event that planned maintenance work, testing or plant conditions will affect the CRE boundary, administrative control of the boundary should be procedurally maintained.

3. SEALING PROGRAM

A CRE assessment, as outlined in Appendix C, should consider the vulnerability of the envelope to leakage. The assessment should include a review of applicable building and system drawings and walkdowns. This information can then be used to identify all penetrations, prioritize them according to safety significance and develop a cost-effective sealing program. Such a program should include required inspection frequency, type of acceptable materials, and repair and test procedures. The method and frequency of inspection, repair or modification will depend on the type and safety significance of the seal.

The following is a list of typical penetrations and/or items that may have seals that would allow inleakage.

Abandoned pipe chases
Air handling unit (AHU) drains
AHU housing
Cable trays
Card readers
Conduits
Conduit penetrations
Control Room pressure boundary ducting outside CRE
CRE walls/ceilings/floors
Doors

Duct access panels
Duct expansion joints
Duct penetrations
Ducting traversing CRE and at higher pressure
Expansion joints or seismic gaps
Fan housing/shaft
Fire dampers
Filter housing/drains
Flanged joints
Gaps at building wall/floor/ceiling intersections
Gaps (required for fire damper thermal expansion) around fire dampers
Instrument air lines supplying CRE pneumatic components
Isolation dampers / shafts and gaps
Other instrument lines
Previous repairs with RTV sealant
Through bolts for hangers or equipment

Basic guidelines for inspection are detailed below. However, specific requirements will vary with parameters such as application, equipment vendor, or type of sealant. The term "approved," as used below, means that the material, component or technique has been approved by the plant engineering staff for the particular application.

3.1 Doors and Door Seals

The door should fit properly in the frame, with hinges securely attached. The door sweep should be in continuous contact with the floor or threshold for the entire width of the door. The gasket or seal should be an approved type, be free of cracks, and should form a contact seal around the entire perimeter of the door. The door and frame should be free of breaks or open holes. With the door closed, the seal should be compressed against the door at all points.

3.2 Dampers

Dampers, associated linkages and actuators should be inspected for proper movement throughout the entire range of travel. If applicable, response to actuation signals and required cycle time should be verified. Commensurate with the design and safety analysis requirements, seal tightness should be verified. Frames should be checked for dimensional stability and be structurally sound. Frame-to-wall gaps should be minimized and consistent with vendor and Underwriters Laboratory (UL) requirements. Damper gaskets or seals, if required, should be an approved type, be free of cracks and should form a contact seal around the entire perimeter of the damper or where installed. The damper and frame should be free of breaks or open holes. With the damper closed, the seal should be evenly compressed against the damper at all points.

3.3 Gaps

All walls and intersections of the CRE should be visually inspected for integrity. Deficiencies in original construction, building differential settlement and deterioration of sealing materials can result in significant but unnoticed openings in the CRE. Due to equipment, cabling and other interferences, these areas are difficult to inspect. Repairs should be made using approved sealants or grouts, in accordance with vendor instructions.

3.4 Ducting, Duct Penetrations, Expansion Joints

Welded ducting is preferable for CR HVAC ducting outside the CRE and for other ductwork running through the CRE. For other types, all seams and connections should be sealed with an approved sealant, such as room temperature vulcanization or hardcast, and tested for leak tightness (Snoop or pressure decay methods). Duct penetrations should also be sealed with an approved sealant or grout.

Expansion joints should be sealed and firmly clamped at each end, and should be free of cracks, holes and or tears. If replacement of the joint is necessary, old adhesive should be removed from the mating surfaces should be inspected for defects. The length and width of the joint should allow for at least a one-inch overlap at each end. If the duct is located outside, additional width should be included for slack, and the material should be rated for sun and weather exposure, or be covered with an approved coating.

3.5 Electrical Cables, Conduits, Cable Trays

All electrical conduits and cable trays penetrating the CRE should be sealed with an approved sealant. Sealing on the inside of the conduits is especially important due to the large potential flow areas that may not be readily apparent during a normal visual walkdown or inspection.

Close attention should be paid to the condition of penetrations. Typically, many wall and floor penetrations are sealed with silicone foam. Although the penetration may appear to be sealed, inleakage may still be occurring due to shrinkage of the foam, voids in the seal due to cable relaxation, voids between the cables in cable bundles, or improper cure of the foam. Delamination of material in wall seals is also possible.

Electrical conduits and cable trays provide a significant potential source of inleakage due to the large number of these components. Normal problem areas include unsealed conduits that terminate inside the CRE, intermediate connectors, junction boxes and panels, and non-leak-tight flexible conduit. Cable trays that are not filled completely by cable may leave voids that may have been overlooked during initial construction and sealing efforts.

3.6 Instrumentation or Air Tubing

All instrumentation or air tubing penetrating the CRE should be inspected for potential leak paths such as open valves in abandoned lines or insufficient seal around the tubing.

3.7 Air Handling Unit (AHU) / Fan Housings and Shafts

Inlet and outlet flanges should be sealed with approved sealants, or preferably continuously welded on both sides. Any fan housing drains should have plugs installed. AHU drain loop seals should be verified periodically. Separate sections of AHU housings should have individual drains. High quality or double gaskets (not sealants) should be used on cover plates and access doors. Bolts on cover plates and access doors should be spaced on three to four inch centers. Recommended shaft seals are stuffing box seals, lip seals or mechanical type seals. An arrangement using a neutral purge gas is also effective.

3.8 Plumbing Equipment

All plumbing-related equipment in the CRE should be checked for potential leak paths. Floors, restrooms, kitchens, showers and water fountains have drains. These drains must have traps and should be inspected regularly to verify they are filled. Abandoned traps and piping should be permanently closed or sealed.

4. Alternatives to Sealing

Degradation of the CRE can occur due to normal equipment wear or changes in operational practices. Therefore, supplements the sealing program should be considered.

- **Problem:** Major equipment (AHUs, filters, dampers, etc.) and long duct runs located outside the envelope significantly increase the potential for unfiltered inleakage, and the effort required to detect and measure the inleakage.
    - **Solution:** Permanently moving this equipment or ducting inside the envelope by expanding the boundary walls or flooring may be a cost-effective means of reducing this problem, assuming that there is a suitable new effective CRB.
- **Problem:** Airflow balance inside the CRE may produce unfavorable pressure differentials within separate spaces in the CRE, leading to potential positive pressure differentials relative to the outside or adjacent spaces.
    - **Solution:** Careful flow balance testing may be required to resolve this problem. Maintaining CRE internal doors open, adding door louvers to internal doors or

installing additional supply/return registers can improve pressure communication within the CRE to prevent this problem.

- The design and operation of ventilation systems serving adjacent spaces, safety-related as well as non safety-related, should be reviewed to prevent unfavorable CRE-adjacent space pressure differentials post accident.
  - This evaluation should consider scenarios both with and without off-site power.
  - From a CRE perspective, an accident without a loss of off-site power (LOOP) may actually be worse due to continued operation of non-safety ventilation systems in adjacent spaces. In some cases, modifications should be considered to shut off non-safety exhaust or supply fans in the event that a LOOP does not occur.

5. POST-MAINTENANCE ACTIVITIES

During the time interval between periodic assessments and/or testing, various maintenance or plant modification activities will occur that will affect either the control room envelope or the performance of the control room HVAC system. This may be preventive maintenance, corrective maintenance or implementation of modifications. It is important to perform a proper post-maintenance test (PMT) following these activities to ensure that the integrity of the CRE is maintained. The actual PMT may be a simple inspection to ensure that a gasketed surface has been sufficiently tightened to eliminate air gaps, or it may be a full inleakage test if a major modification has significantly changed the boundary of the CRE.

The following examples are provided to illustrate possible PMTs that may be used to ensure that CRE integrity is maintained:

- A PMT that is performed under guidance of other documents for a particular maintenance activity, such as ANSI-N510 for filter change out, should constitute a sufficient testing program.
- A pipe that penetrates the CRE has a flange mounted pressure transmitter that requires replacement. The flange has a bolted gasket connection that is fully accessible for inspection. An adequate PMT could be a visual inspection to ensure that proper gasket crush is achieved after the new transmitter is installed.
- A door seal requires replacing. The geometry of the gap between the door and the frame is such that a visual inspection is difficult to perform. An adequate PMT could be the use of a "smoke pencil" to verify that the door gasket has been properly installed to minimize leakage.
- A major modification has been performed to incorporate the CR HVAC equipment room into the CRE. A full inleakage test may be required to ensure that the new configuration still meets the inleakage assumptions used in the accident analyses.
- A modification has been performed on systems, structures and components outside the CRE that may affect CRE integrity. The complexity of the PMT would depend upon a careful evaluation of the modification and its potential impacts on CRE integrity.

A modification has been performed on systems, structures and components outside the CRE that may affect CRE integrity. The complexity of the PMT would depend upon the effect of the modification on CRE integrity.

APPENDIX DD

HAZARDOUS CHEMICAL ASSESSMENTS

This appendix provides information on performing an assessment of a hazardous chemical challenge to control room habitability.

1. SCOPE

This appendix applies to the release of hazardous chemicals from mobile or stationary sources, located either off-site or on-site.

2. HAZARDOUS CHEMICAL ASSESSMENT

The control room of a nuclear power plant should be appropriately protected from hazardous chemicals that may be discharged as a result of equipment failures, operator errors or events and conditions outside the control of the nuclear power plant. Potential sources of hazardous chemicals may be mobile or stationary and include storage tanks, pipelines, fire-fighting equipment, tank trucks, railroad cars and barges.

Guidance on hazard screening, risk evaluation, control room habitability evaluation, protection measures, and emergency planning is provided in Revision 1 to Regulatory Guide 1.78, *Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release* (Reference 1). This appendix provides information helpful in the areas of specifying toxicity limits, identifying sources of on-site and off-site hazardous materials, determining hazardous chemical release characteristics, and applying updated atmospheric dispersion modeling techniques.

2.1. IDENTIFYING HAZARDOUS MATERIALS

2.1.1. OFF-SITE

Two federal laws were developed to provide information regarding hazardous chemicals at industrial facilities. The EPA and state and local governments maintain these data. Much of the information is easily available on the Internet or from state and local governments who receive reports from facilities.

The U.S. Department of Transportation Research and Special Program Administration maintain a HAZMAT database. The Emergency Planning and Community Right-to-Know Act (EPCRA) and the Clean Air Act Risk Management Program (RMP) require facilities to report on hazardous chemicals they store or handle. Both provide for public access to the information on these chemicals. The two regional government agencies that receive the information are the Local Emergency Planning Committee (LEPC) and the State Emergency Response Commission (SERC). The information available from reporting facilities includes annual chemical inventories or lists of chemicals stored or handled, and accident data like worst-case release scenarios.

It is important to remember that only certain toxic chemical releases need to be considered. The number of facilities covered, for example, may be limited because only certain chemicals and threshold settings are required for reporting. In addition, the quantities for chemicals, if reported, are in broad ranges; it may not be possible to tell actual quantity. Therefore, a local resource (such as the fire department) is sometimes the best resource. Fire departments receive the same information as the LEPC but possess a broader knowledge of the community and smaller facilities.

Information on hazardous materials transported throughout the state via the highways can be obtained from the SERC or the state transportation department. The same agencies may have information on the transport of hazardous materials via railways. The railways should also be contacted directly. Information on the transportation of chemicals via rivers, the Great Lakes and coastal marine traffic can be obtained from the U.S. Coast Guard.

Internet sources of data on hazardous materials available at the time this appendix was written include the following:

LEPC/SERC contacts:
www.rtk.net/lepc

Toxic release information:
www.epa.gov/tri

Material Safety Data Sheets:
www.hazard.com

RMP data:
www.epa.gov/enviro

Right-to-Know data:
www.rtk.net or www.scorecard.org

2.1.2. ON-SITE

A facility's EPCRA and RMP reporting information is useful to determine the types and quantities of hazardous materials on-site. This information should be compiled with a site-wide "walk through" using as a checklist the list of EPCRA and RMP hazardous chemicals. The checklist should be compared against a recent chemical inventory, which can usually be supplied by a facility department like purchasing, chemistry or stores. The walk through should also emphasize identifying permanent or temporary use of bulk storage containers or tanks such as propane as well as storage of asphyxiates like nitrogen and carbon dioxide.

2.1.3. TOXIC LIMITS

The hazardous chemical toxicity limits presented in Regulatory Guide 1.78 are based on the IDLH exposure levels published by the National Institute for Occupational Safety and Health. Asphyxiating chemicals should also be considered, if they are stored on-site in significant quantities such that an accidental release could result in the displacement of a significant fraction of the control room air. According to OSHA Regulations, an oxygen deficient atmosphere (for permit-required confined spaces) is one containing less than 19.5 percent oxygen by volume (29 CFR 1910.146).

2.2. EVALUATING POTENTIAL ACCIDENTS

An existing hazardous chemical evaluation should be revised if:

- the assumed inleakage value is found to be non-conservative
- a new significant source of hazardous chemical is identified in the vicinity of the plant or
- the quantity of chemicals is greater than previously assumed.

For each chemical considered, the value of importance is the maximum concentration that can be tolerated for two minutes without inducing physical incapacitation (i.e., severe coughing, eye burn or severe skin irritation) of an average human. The NRC expects that two minutes is sufficient time for a control room operator to don a respirator and protective clothing.

If detailed calculations show that the two-minute toxicity limits will be exceeded in the control room for any time period for any given release scenario, compensating measures should be implemented.[9] As a minimum, a detection mechanism for each hazardous chemical release should be available. Such a system could include the installation of detectors or, if the buildup of the hazardous chemical in the control room is at a slow rate, human (i.e., smell) detection may be appropriate.[10] The detailed evaluation should demonstrate that if detection results in placing the control room in accident mode (i.e., automatic or manual closure of isolation dampers), the two-minute toxicity limits would not be exceeded. Otherwise, it would be expected that the control room operators would take protective measures (i.e., don protective equipment) within two minutes after detection to avoid prolonged exposure at the two-minute toxicity limit levels.

There are additional aspects beyond those discussed in Regulatory Guide 1.78 that should be considered when performing detailed evaluations of control room habitability, which are described below.

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[9] Compensating measures are not required for transportation-related accidents if it can be shown that the probability of occurrence of the initiating events leading to control room concentrations exceeding toxicity limits are less than 10^{-6} per year as discussed in Section 3.2 of Regulatory Guide 1.78.

[10] The American Industrial Hygiene Association has established odor thresholds for a number of toxic chemicals (Reference 2). Some of these data are presented in NUREG/CR-6624 (Reference 3).

2.2.1 RELEASE CHARACTERIZATION

The release characterization defines the physical state of the chemical as it leaves its containment and the manner in which it enters the atmosphere to form a vapor cloud. Since hazardous chemicals may be stored under pressure or under refrigeration, they can be emitted from a container as a liquid, a vapor or both, depending on the chemical's physical properties. For example, released liquids may form a vapor cloud through volatilization. A liquid can be volatized either completely or partially as it is released, forming a vapor cloud or a vapor and droplet mixture. Conversely, chemicals stored as a gas may partially or completely condense to form liquid droplets when released. Condensed vapor may fall to the ground to form a pool that, in turn, volatizes to the atmosphere.

2.2.2 ATMOSPHERIC DISPERSION

The NRC sponsored the development of a computer code system for evaluating control room habitability called HABIT (References 4 and 5). Two of the HABIT program modules, EXTRAN and CHEM, can be run in sequence to predict chemical concentration and exposures in the control room. The EXTRAN program computes atmospheric chemical concentrations associated with a release of a toxic chemical and the CHEM program use the results of EXTRAN to determine the associated chemical exposures in the control room.

In executing EXTRAN, the user should be aware of the following:

- EXTRAN does not calculate release rates and, as such, the user must calculate the release rate outside the model for the *maximum concentration-duration accident*.
- Regulatory Guide 1.78 suggests the atmospheric dilution factors to be used in the analysis should be that value which is exceeded only 5 percent of the time. Although EXTRAN uses a simple Gaussian dispersion model, the concentrations predicted by the model do not vary inversely with the wind speed because building wake correction is not a linear function of wind speed. In the case of evaporation, the highest emission rates are also related to high wind speeds. In addition, the building wake corrections are not particularly sensitive to atmospheric stability. Consequently, a range of meteorological conditions should be executed for determining the 5 percent atmospheric dilution factors.

Several references describing methodologies for calculating release characterizations (including release rates) include EPA's "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants" (Reference 6), "Risk Management Program Guidance for Off-site Consequence Analyses" (Reference 7) and "Guidance on the Application of Refined Dispersion Models to Hazardous/Toxic Air Pollutant Releases" (Reference 8). The latter reference also provides guidance on how to execute several dense gas atmospheric dispersion models that are generally available.

3. REFERENCES

1. USNRC, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Regulatory Guide 1.78, Revision 1, U.S. Nuclear Regulatory Commission, December 2001.

2. AIHA, "Odor Thresholds for Chemicals with Established Occupational Health Standards," American Industrial Hygiene Association (AIHA), 1989.

3. L. B. Sasser, et al., "Recommendations for Revision of Regulatory Guide 1.78," NUREG/CR-6624, Pacific Northwest National Laboratory, U.S. Nuclear Regulatory Commission, November 1999.

4. S.A. Stage, "Computer Codes for Evaluation of Control Room Habitability (HABIT)," NUREG/CR-6210, Pacific Northwest National Laboratory, Richland, Washington, U.S. Nuclear Regulatory Commission, June 1996.

5. J.V. Ramsdell and S. A. Stage, "Computer Codes for Evaluation of Control Room Habitability (HABIT V1.1)," NUREG/CR-6210, Supp. I, PNNL-10496, Pacific Northwest National Laboratory, Richland, Washington, U.S. Nuclear Regulatory Commission, November 1998.

6. USEPA, "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised)," EPA-454/R-92-024, U.S. Environmental Protection Agency, December 1992.

7. USEPA, "Risk Management Program Guidance for Off-site Consequence Analysis," EPA-550-B-99-009, U.S. Environmental Protection Agency, December 1992.

8. USEPA, "Guidance on the Application of Refined Dispersion Models to Hazardous/Toxic Air Pollutant Releases," EPA-454/R-93-002, U.S. Environmental Protection Agency, April 1993.

APPENDIX EE

ASTM E741 EXCEPTIONS

This appendix provides a listing of the exceptions to implementation of ASTM E741 traditionally taken by testing vendors. Based on existing practices, the following exceptions to the 2000 edition are recommended.

- These paragraphs may be totally excluded from implementation: 6.6.1, 6.6.2, 6.7, 6.7.1, 6.7.2, 8.5.4, 9.5.3, 9.5.4, 11.1.1, 12.3.2, 12.3.2.2, 13.2.1.2, 13.2.2, 13.4.2. Other editions are acceptable and may require similar exceptions.
- Use Sections 1 through 5 only to define the test method and the equipment to be used.
- In Section 8.5.3.1 a decay test using the regression method may be used to obtain confidence intervals as a part of the regression calculation,
- In Section 9.2.1 the standard is not typically used when there is a non-steady flow since such a test would only permit establishing bounds on the inleakage.
- Sections 9.2.3.1, 9.2.3.2, 9.2.3.3, 9.2.3.4 are not typically used, since makeup flow rate is typically used to estimate the anticipated concentration for an assumed tracer gas injection flow rate.
- Section 9.4.2 is not followed since a statistically significant number of samples are usually taken over one or two hours following the establishment of equilibrium.
- Sections 9.5.3.1, 9.5.3.2 calculations are not used since the vendor demonstrates that concentration in CRE is not changing before making measurements designed to calculate total inleakage.
- Section 10 is not used in total.
- Section 11.1 is not used to measure indoor and outdoor temperatures or wind speed and direction, unless there is a direct need for the information.
- Section 15 is not used in total.
- Section 16 is not used in total. The vendor's report is to present the theory, data analysis, sampling locations, operating conditions, procedures, quality assurance records for the particular plant work order, data, calculations, and references.
- Section 17 is not used in total. The information is useful, but most vendors performing the test are highly experienced in many industrial settings and are familiar with these cautions and conditions. Uncertainty analysis or precision analysis may use the ANSI PT 19.1 Standard to calculate the 95 percent confidence intervals. The ANSI PT 19.1 Standard is not listed in Table D-1 since it is unrelated to the actual leakage determination.

APPENDIX FF

DISPOSITIONING AND MANAGING CRH BASELINE TESTING OR PROGRAM DISCREPANCIES

1. PURPOSE

During the reviews, evaluations, and testing that will be performed to address these issues, conditions adverse to quality must be promptly identified and corrected in accordance with 10 CFR Part 50, Appendix B, Criterion XVI. Each licensee's Corrective Action Program accomplishes this. The primary guidance for identifying and resolving degraded and nonconforming conditions is provided by Generic Letter (GL) 91-18, Revision 1, *Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Nonconforming Conditions*. Reportability criteria are specified by 10 CFR 50.72, *Immediate notification requirements for operating nuclear power reactors* and 10 CFR 50.73, *Licensee event reporting system*.

In addition, if changes are required, the criteria included in 10 CFR 50.59, *Changes, tests and experiments*, may apply.

2. GENERIC LETTER 91-18

Generic Letter 91-18 informed licensees of the issuance of a revised section to Part 9900, *Technical Guidance of the NRC Inspection Manual*. The revised section was entitled *Resolution of Degraded and Nonconforming Conditions* and provides guidance to NRC inspectors and provides explicit insights on appropriate actions to take when a degraded or nonconforming condition exists. The document directs assessment of the following:

- operability determination
- justification for continued operation
- reasonable assurance of safety
- compensatory measures (if used).

This *Technical Guidance* describes three potential scenarios for addressing degraded and nonconforming conditions:

The licensee may restore the structure, system, or component (SSC) to the condition that is described in the licensing basis. For example, if the assumed control room inleakage is explicitly described in the UFSAR and an inleakage test reveals excessive inleakage, the licensee may take corrective action to repair various seals and openings to reduce the inleakage to within the UFSAR analyses input value(s). See Appendix CC for information on sealing.

- The licensee may accept a condition "As-Found" which results in a design basis different from that described in the UFSAR or may modify the plant design basis from the FSAR to a different condition than the "As-Found" condition. These second and third options are considered a change and would be subject to 10 CFR 50.59 and other applicable regulations. Modifying the control room envelope to enhance the leakage prevention characteristics of the system is an example of such a change. Another example would be revising the appropriate accident analyses to demonstrate the acceptability of increased inleakage.

- In addition, the licensee may take interim compensatory measures until the permanent corrective actions identified are implemented. These compensatory measures may be subject to 10 CFR 50.59.

3. Determining Operability and Reportability

If a degraded or nonconforming condition is identified, appropriate action must be taken to maintain the plant in a safe condition. Generic Letter 91-18 provides guidance to NRC inspectors regarding performance of operability determinations. Appendix D advises licensees to develop contingency plans and operability determination actions prior to performing inleakage tests. Such planning could include evaluation of the baseline testing acceptance criteria under different analysis options. A licensee may want to determine the maximum inleakage that can be accommodated:

- within the current licensing basis analysis and regulatory limits,
- within the current licensing basis analysis, but with the analysis improvements of DG-1111 (when issued)
- using the TID-14844 source term, but with the analysis improvements of DG-1111 (when issued) and DG-1113 (when issued)
- using the alternative source term (10 CFR 50.67 and Regulatory Guide 1.183), with or without the atmospheric dispersion improvements of DG-1111 (when issued).

The reportability evaluation ensures timely NRC notification of significant conditions or events relative to regulatory compliance. The corrective action process should ensure that an identified discrepancy is evaluated for potential reportability to the NRC under the requirements of 10 CFR 50.72 and 10 CFR 50.73.

The basis for operability and reportability, including evaluations and analyses, should be documented and retained for future use.

4. Methods Available to Address Degraded or Nonconforming Conditions

4.1 Compensatory Measures

Compensatory measures may be required in the short term to mitigate an identified discrepancy that may result in the plant being in an unanalyzed condition or outside its design or licensing basis. Compensatory measures must provide reasonable assurance of safety until final corrective actions are complete. Compensatory measures can consist of additional administrative or procedural controls, additional testing or inspection of system components, and additional protection provided to control room operators through the availability of self-contained breathing apparatus (SCBA) and/or potassium iodide (KI) tablets. Licensees must ensure that compensatory actions can be implemented under 10 CFR 50.59 or request prior NRC approval. Guidance regarding compensatory measures related to CRH is provided in Appendix B.

4.2 DOSE ANALYSIS REVISION OPTION

A revised dose analysis may be part of the short-term justification for continued operation or part of the long-term resolution of the nonconforming condition.

Revision of the analysis of record for the dose consequences to the control room operator may be an acceptable method for addressing a condition different from that described in the UFSAR and for meeting the requirements of the current licensing basis. Revision of the dose analysis of record may be desirable in combination with plant modifications to improve the margin to regulatory limits.

An option for consideration in the development of the final resolution of the degraded condition is to revise the licensing basis. An example of a new licensing basis would be the implementation of the Alternative Source Term methodology based on 10 CFR 50.67 and Regulatory Guide 1.183. A plant may also choose to use the guidance in DG-1111 (when issued) and DG-1113 (when issued) to revise their dose analysis.

An increase in previously calculated operator doses may require NRC review and approval in accordance with 10 CFR 50.59. In addition, some changes to the licensing basis (e.g., AST, or use of DG-1113, when issued) or analysis methodology (e.g., DG-1111, when issued) may also require prior NRC approval. Regulatory Guide 1.187 and NEI 96-07, *Guidelines for 10 CFR 50.59 Implementation*, provide additional guidance to address criteria for making these determinations.

A change, if justified, in an input parameter associated with the limiting accident may be made to yield acceptable results. NRC review and approval of the revised technical specification will be required if this parameter is part of the technical specification. Examples of these changes that could be considered are allowable values for reactor coolant activity levels, containment leak rate, or primary-to-secondary leak rates.

4.3 REPAIRING OR MODIFYING THE PLANT

The identified inleakage source may be corrected by a repair of the physical condition or by sealing the leak path.

In some instances, a plant modification may be desirable. Licensees may decide to modify their control room envelope boundary by:

- moving HVAC equipment within the CRE
- replacing ducts with seam-welded heavy construction material to eliminate ducting as a leakage source
- modifying system controls to change actuation signal timing
- securing non-emergency ventilation systems that contribute to inleakage during operation and pressurization
- modifying the system modes of operation.

Repair or modification may require a retest to ensure that they were successful in elimination of the excessive inleakage and provide appropriate validation of the assumed new inleakage value.

APPENDIX GG

GLOSSARY OF TERMS

1. PURPOSE

This appendix contains definitions applicable to control room habitability issues.

2. DEFINITIONS

AIR CHANGE FLOW (from ASTM E741): The total volume of air passing through the zone to and from the outdoors per unit of time.

AIR CHANGE RATE (from ASTM E741): The ratio of the total volume of air passing through the zone to and from the outdoors per unit of time to the volume of the zone.

BOUNDARY: A combination of walls, floor, roof, ducting, doors, penetrations and equipment that physically form the CRE.

BREACH: Any work activity or testing that creates or enlarges an opening through a barrier, which would allow the propagation of a hazard through the barrier. These include:

- modification (addition, removal or degradation) of a penetration seal or structural component
- core boring
- blocking open a door/hatch or damper
- modification (addition, removal, or degradation) of a door/hatch or damper

CONTROL ROOM ENVELOPE (CRE): The area within the confines of the control room boundary that contains the spaces that control room operators inhabit to control the plant for normal and accident conditions. This space is protected for normal operation, natural events, and accident conditions. The Standardized Technical Specifications use the term control room enclosure. The CRE term used in this document is synonymous with the term used in the Standardized Technical specifications.

CONTROL ROOM ENVELOPE (CRE) INTEGRITY: The condition wherein the control room habitability systems (CRHS) are functioning to ensure the protection of the control room operators in the CRE during normal and accident conditions.

CONTROL ROOM HABITABILITY SYSTEMS (CRHS): The plant systems that help ensure CRE integrity. This includes the control room emergency ventilation system (CREFS) and the control room heating, ventilating and air-conditioning (CR HVAC) systems. The CREFS could be a subset of the CR HVAC and is used in that context in this document. This also assumes the control room boundary (CR B) is intact. The CRB is the physical barrier that defines the CRE.

FILTERED INLEAKAGE: This is leakage that occurs at a location that allows contamination to be filtered prior to the air entering the habitability zone. An example is duct leakage on the suction side of a pressurization filter system where the duct is outside the control room envelope. Radionuclides are removed from this air prior to it entering the habitability zone. There is no filtering assumed for hazardous chemical events.

INOPERABLE BARRIER: A barrier that is inoperable such that it cannot fully perform its intended function.

INTEGRATED COMPONENT GAS TEST: A test method that provides the total inleakage value by summing the results from individual leakage location tests. The test method distinguishes between filtered and unfiltered inleakage, and identifies the inleakage contribution of individual components

INTEGRATED TRACER GAS TEST: A tracer gas test to determine total inleakage to the CRE. The tracer gas test is actually measuring the amount of air changing in the space (i.e., the air going out is being replaced by the air going in). This particular test does not locate leaks; it only provides a value for total inleakage.

LICENSING BASIS INLEAKAGE: This is the inleakage that is used in the plant design basis radiological analysis with design basis values of other plant parameters to calculate control room operator dose during a licensing basis accident.

MAXIMUM ALLOWABLE RADIOACTIVE CONTAMINATION INLEAKAGE: This is the maximum value that can be assumed in the current licensing basis analysis for inleakage of contaminated air. It is the calculated inleakage value in cfm that will result in the control room operators receiving the maximum allowable dose with design basis inputs of all other parameters to the plant radiological analysis.

MAXIMUM ALLOWABLE RADIOACTIVE CONTAMINATION INLEAKAGE FOR OPERABILITY DETERMINATION: This is the calculated inleakage value in cfm that will result in the control room operators receiving the maximum allowable dose with realistic but verifiable inputs of all other parameters to the plant radiological analysis. This value may take credit for compensatory measures allowed by GL 91-18.

MAXIMUM ALLOWABLE HAZARDOUS CHEMICAL INLEAKAGE: This is the maximum calculated inleakage of hazardous chemical that will result in the control room remaining habitable for the bounding hazardous chemical hazard evaluation.

PENETRATION: An opening in a CRE boundary wall, floor or ceiling, other than a door/hatch, which contains materials or mechanical devices that prevent the propagation of a hazard through the barrier. Some examples are:

- Penetration seals
- Structural material
- Dampers, such as fire or tornado barrier dampers

TRACER GAS (from ASTM E741): A gas that can be mixed with air in very small concentrations in order to study air movement.

UNFILTERED INLEAKAGE: This is leakage that occurs at a location in the habitability system that allows air to enter the control room envelope without any contaminants being removed at the point of entry. Examples of this are penetrations and dampers that are at a negative pressure with respect to potentially contaminated surroundings and located such that radionuclides are not removed prior to the inleakage entering the control room.

NEI DISPOSITION OF NRC COMMENTS ON NEI 99-03, REVISION 1 DRAFT (NOVEMBER 2002)

MAIN TEXT

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
1.	General	Instead of the term "Toxic Chemical" use "Hazardous Chemical" throughout the document.	Revise document	Implemented
2.	General	In some sections of the document there is extensive guidance provided on certain situations. For example, what constitutes systems outside the control room, acceptable test attributes, etc. Some common terms are used throughout the document. Usually, such terms are defined in the document. When the terms are used elsewhere within the document, instead of referring to the point of definition, attempts are made to paraphrase the definition within the text. When such paraphrasing is done, it is usually done in an incomplete manner such that the portions of the definition are excluded. This process confuses the reader and clouds the application of the document. For example, Footnote 4 of Appendix D provides a complete description of the systems to be considered in adjacent areas. Yet when referring to adjacent area ventilation systems, the systems referenced throughout the document are not as complete as Footnote 4.	Review the document for consistency, and provide cross-references to the more detailed descriptions.	Implemented The document has been revised to improve the clarity and consistency of definitions, terms, and descriptions, both in the general process description and the detailed Appendices. The text for the example provided has been restructured to improve the clarity of the message in Appendix D. The detailed note now appears in the main body Section 2.3.1
3.	General	Ultimately replace references to Draft Guides (DG) with references to issued Regulatory Guides.	If the RGs numbers are assigned in advance of publishing NEI 99-03, the DG citations will be replaced with the RG citations.	NEI 99-03 references the DGs, since the final RGs are not yet issued.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
4.	General	Throughout the document reference is made to radiological and toxic gas events. Such references need to be expanded to include radiological, hazardous chemical, and fire events.	Task Force believes that NEI 99-03 adequately addresses the need to evaluate the impact of smoke events. Concern about fire events is inappropriate – it is addressed in 10CFR50 Appendix R. The TF is will use the phrase "radiological, hazardous chemical, and smoke events", when appropriate.	Implemented
5.	General	Where does the user of NEI 99-03 go to determine the alignment (design information) of systems adjacent to the control room during integrity testing and how is the operation of these adjacent ventilation systems accounted for in the determination of the limiting condition?	The TF believes that the determination of the limiting condition is on a plant-specific basis, and that Appendices C and D provide the level of detail necessary to provide guidance.	No Action Required
6.	General	In the verification process when references are made to flow rates this should be combined with a determination of flow sources.	NRC desired verification of source of inleakage. This is not typically done as part of the inleakage test. However, it is something a plant may do to reduce inleakage. Implementation of a criteria to verify the source of inleakage is not necessary for the guidance document. If inleakage criteria are met, it is not necessary for the licensee to locate the source of unfiltered inleakage.	No Action Required
7.	General	Appendix AA and BB will not be reviewed.	AGREE. No review required.	No Action Required
8.	§1.1	Change the end of the initial paragraph as follows, ". . . associated with the following aspects of control room habitability:"	AGREE. Implement	Implemented
9.	§2.3.1	CR should be defined before its use.	Define CR when it is first used.	Implemented Now in Section 2.1
10.	§3.1	1st paragraph, last sentence, replace the words "may want to" with "should."	AGREE. Implement	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
11.	§3.1.1	NEI 97-04, Revision 1 is not fully endorsed by the NRC. Reference only Regulatory Guide 1.186 since it provides the NRC guidance endorsed.	The text will be revised to cite both RG 1.186 and NEI 97-04 as sources of guidelines for identifying design basis information. The revised text will note that RG 1.186 has endorsed NEI 97-04 Appendix B.	Implemented
12.	§3.1.2	Licensees should compare the design, configuration, maintenance and operation of their control room habitability systems (CRHSs) and the systems that are in adjacent areas and could interact with the control room envelope to their licensing and design bases to ensure consistency. The review of the configuration of the CRHSs should include the construction and the alignment of the systems and structures that make up the CRHSs. The CRH analyses assembled should include those systems that may impact control room habitability. These include ventilation systems that serve or traverse areas within the control room envelope or are located adjacent to the CRE.	After the fourth bullet add: • ?All modes of adjacent area ventilation system operation and system alignments that may affect CRH function. This would include duct work traversing the CRE.	Implemented
13.	§3.2.1.1	Replace the first sentence with: "Licensees should compare the design, configuration, maintenance and operation of their CRHSs and the systems that are in adjacent areas and could interact with the control room envelope to their licensing and design bases to ensure consistency."	Add the following sentence to the first paragraph: "The effects of adjacent area ventilation systems should be considered."	Implemented
14.	§3.2.1.1.1	Delete the example in the 3rd bullet. The existing example is not appropriate and could be misleading. A system walkdown is unlikely to determine air sources.	Delete the example from the third bullet.	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
15.	§3.2.1.1.3	Change the word “licensing” in the 1st bulleted sentence to “licensing and design bases.” Generally, acceptable, but the section seems weak. Words like “. . . establish the proper flow path,” and “. . . they do not adversely affect” are subjective and open ended. These words need to be strengthened so that the statements and guidance are definitive.	Change Section 3.2.1.1.3A second bullet to: “… do not invalidate the licensing and design bases while ….” Change the phrase “proper flow path” in the second bullet. The intent is to create a clear, concise, strong document. The text will be revised to make this section stronger.	Implemented Wording has been reviewed and strengthened to provide clearer, directive language with more pronounced recommendations on actions. Now, e.g., “ensure…align…proper flow path” provides clear direction to the intended users.
16.	§3.2.2.1	3rd paragraph, revise to read “. . . including accidents at adjacent units, on the radiological consequences to the reactor operators.” Also, in the 6th bullet, 1st paragraph, revise to read, “This potential limiting DBA must be considered.” In the 6th bullet, delete the second paragraph. Make conforming changes in any other applicable location.	NEI 99-03 Rev. 1 permits licensees to maintain their current licensing basis with respect to accidents at adjacent units. Should a licensee choose to implement the analysis techniques described in DG-1113 and RG 1.183, then the licensee will need to consider accidents at adjacent units.	Sentence added to clarify expectations for sites with adjacent units and separate control rooms. The bulleted test was augmented to state that licensing bases should require analyses of releases from adjacent units.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
17.	§3.2.3.2	The recommended action is to be performed one time. Regulatory Guide 1.78 encourages licensees to conduct periodic surveys of stationary and mobile sources of hazardous chemicals in the vicinity of their plant sites. The periodicity should be based on the number, size, and type of industrial and transportation activities in the vicinity of the plant and regional and local changes in uses of land. The staff recommends conducting a survey of the location, types, and quantities of the mobile and stationary hazardous chemical sources at least once every three years, or more frequently as applicable. The staff also recommends annual performance of an onsite survey of hazardous chemical sources.	Section 3.2.3.2 addresses the first (or baseline) hazardous chemical evaluation. Periodic reassessment is in Section 4.3. Section 4.3.1.3 specifically addresses the need to include a review of toxic chemical hazards.	NEI 99-03, Revision 1 recommends that licensees determine the licensing basis for periodic update of hazardous materials, assure that a process is in place to support the licensing basis, meet the intent of that process, and perform periodic reassessments on a interval not to exceed 6 years. Section 4.3.1.3 was augmented to provide direct guidance on considerations and methods a licensee should use to set review cycles and resources that are available that should be used to perform the reviews.
18.	§3.2.5.2	1st paragraph; add the following sentence: "Consideration should be given to the undesirable propagation of fire byproducts through the operation of fire suppressant or ventilation systems. Such propagation should not simultaneously impact habitability in the control room envelope and at the alternate shutdown panel."	The guidance assures that the control of the reactor can be achieved from one of these locations in a smoke event NEI 99-03 refers to the propagation of smoke.	The text was modified to state: "assure that the plant operators will be capable of controlling the reactor in such smoke events"

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
19.	§3.2.6.2	The bases of the Improved Standard Technical Specifications say that this SR demonstrates control room integrity with respect to unfiltered inleakage. The E741 integrated testing proves that it does not. Because 10 CFR 50.36 requires technical specifications to be derived from the safety analyses, the staff feels that the existing deficiency should be corrected. This correction is consistent with the NRC Administrative Letter 98-10, "Dispositioning Of Technical Specifications That Are Insufficient To Assure Plant Safety," which describes the staff's expectation that licensees correct technical specifications that are found to "contain non-conservative values or specify incorrect actions."	Sections 2.3.6 and 3.2.6 address the need to resolve any inadequacy of existing CREFS Technical Specifications. Section 2.3.6 and 3.2.6 were rewritten based on discussions with the NRC.	These sections were changed to clarify expectations that following the TSTF process to revise the CREVS TS. This is a simple straightforward process involving the NRC and industry. If another process was selected, there would be no such gains and licensee bears the demonstration of adequacy. The Task Force has worked hard to assure that the TSTF product would be a beneficial and effective solution.
20.	§3.3, 3.3.1-3.3.3, 3.3.4.1	Generic Letter 91-18 stands on its own. An interpretation of Generic Letter 91-18 within these sections and corresponding subsections will not be endorsed by the staff.	Move the examples to an informational appendix.	The guidance was modified so that the general description of expected licensee actions conforms to GL 91-18. Details were moved to Appendix FF with emphasis on the pre-test analyses that licensees should do to assess options. Specific guidance on use of realistic analyses was removed.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
21.	§3.3.4.2	Reference only Regulatory Guide 1.187 since it provides the NRC guidance endorsed.	RG 1.187 states that NEI 96-07 provides acceptable methods for compliance with 10CFR50.59. No change to Section 3.3.4.2 is necessary. RG 1.187 needs to be added as a NEI 99-03 reference.	Implemented The discussion is included in Informational Appendix FF rather than in the main text.
22.	§3.3.4.3	Securing a non-emergency ventilation system that contributes to inleakage during operation and pressurization is an acceptable method to correct a leakage problem if this securing is done by a plant modification. If the securing is done by a manual operator action, this is not acceptable. This comment also applies to Appendix C, §3.4.2.	Manual actions are acceptable in accordance with the existing licensing bases and NRC approved plant actions. This type of plant change may be performed in accordance with 10CFR50.59. NRC Information Notice 97-78 provides guidance on crediting operator actions in place of automatic actions.	No Action Required
23.	3.3.4.3, 4th bullet	Securing a non-emergency ventilation system that contributes to inleakage during operation and pressurization is an acceptable method to correct a leakage problem if this securing is done by a plant modification. If the securing is done by a <u>local</u> manual operator action, this is not acceptable. This comment also applies to Appendix C, §3.4.2.	Manual actions are acceptable in accordance with the existing licensing bases and NRC approved plant actions. This type of plant change may be performed in accordance with 10CFR50.59. NRC Information Notice 97-78 provides guidance on crediting operator actions in place of automatic actions.	No Action Required
24.	§4.2.1	With regard to preconditioning before a baseline test: (1) the preconditioning should represent either restoring a deficiency to its design basis condition or a permanent design change. Interim actions that will not become part of the ongoing control room integrity program are not acceptable. (2) There should be a warning that no preconditioning is acceptable for periodic tests.	Revise text to reflect the NRC comment on preconditioning.	Revised 4.3.1.6 (formerly section 4.3.4.6) to address preconditioning. Preconditioning has also been addressed elsewhere in NEI 99-03 consistent with the resolution of this comment.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
25.	§4.2.3	This text allows the use of nominal test results, uncorrected for test uncertainties. The staff believes that this is acceptable for low-leakage control rooms (e.g., nominal leakage less than 100 cubic feet per minute) provided that the test was performed in a quality manner than minimized uncertainties and that the sources of uncertainty values are understood. The substance of this comment should be applied throughout NEI 99-03.	Appendix D ensures that the testing is performed in a quality manner that minimizes uncertainties and that the sources of uncertainty values are understood. Appendix D Section 4.4.2.4 states that it is acceptable to use a nominal value in the analyses when the nominal values are in a reasonable range and the variability in results, as represented in the uncertainty, is understood. It should not be necessary to restrict the use of nominal values to only those cases where inleakage is < 100 cfm. However, justification must always be developed based on the overall testing results.	The guidance on test result evaluation was included in Appendix D. (See Comment D-44, D.4.4.3.) The text was amplified to state what the TF concluded from this NRC meeting and other staff interactions. Specifically, the text now states that nominal values can be used when justified, and that justification is generally straightforward when the overall inleakage is in a reasonable range (<100 cfm) and may become progressively more difficult if the measured nominal inleakage is at higher and higher values.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
26.	§4.3 & footnote 1	While some scheduling tolerance is acceptable, the specified value of +/- one year is excessive when applied to schedule intervals of three years or more. With schedule intervals of such length, a utility has sufficient flexibility to schedule the tests and get them performed without invoking an additional year. The staff believes that this tolerance should be reduced to no more than three months to provide for unscheduled outages that might occur as a scheduled test is due. This scheduling tolerance does not apply to every time interval in this section as stated in the footnote. It applies only to time intervals in the future and not those already past. For example, in the 3rd bullet, ". . . three years prior . . . " is 3.0 years prior, not four years as permitted by footnote 1. "...three years after . . . " can have a tolerance of no more than three months. The footnote and the position of the footnote reference at the title of Section 4.3, could create a situation in which an assessment might not be performed for five years after the last baseline. Licensees are allowed scheduling credit for a previous performed baseline test only if that test can be shown to satisfy the provisions of a baseline test as described in NEI 99-03, Appendix D, with the exceptions and clarifications to be provided for Appendix D.	The Standardized Technical Specifications allow a 25 percent scheduling tolerance. A 25 percent scheduling tolerance of 3 years is 9 months. The Task Force believes that the specified value of 6 months year is appropriate. The 3 and 6-year time frames were proposed by the NRC and adopted by the Task Force. The 6 months scheduling tolerance provides flexibility to accomplish the data collection task necessary to make a future performance-based testing frequency. The Task Force disagrees. A plant that has performed a test to measure inleakage prior to the issuance of guidance has met the intent of performing a baseline test. It is inappropriate to require these licensees to immediately perform a retest. To clarify this position, the Section 4.3 second paragraph should refer to "a test to measure inleakage" rather than "baseline test", and the accompanying three bullets delete the word baseline.	Implemented The Task Force has reconsidered each of these items on the basis of these comments and has developed an approach that should resolve all concerns discussed at the meeting. The original schedule tolerance was from standard TS practices of including +/- 25% (with roundup). In review +/- 6 months is a justifiable allowance for effective planning purposes. The process and intervals for entry into the program for licensees that have done previous testing has been fully revised to address the staff concerns. With these modifications it is justifiable to allow this same schedule allowance (+/- 6 months). Guidance is specified to assure that a licensee has met the intent of the administrative controls and test protocol in this document before a previous baseline test can be credited.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
27.	Figure 1 and §4.3.1 through 4.3.3	Figure 1 does not reflect the corresponding staff figure discussed at the workshops. As a consequence of expanding the logic for corrective actions flowing out of an assessment, the industry used the completion of the corrective actions that result from an assessment as the starting point for the three-year clock. This is reflected in the text (e.g., in §4.3.1, ". . . three years following completion of the Section 4.2 baseline test AND any corrective actions . . . "). The staff's position is that the time interval is to be taken as three years following the last successful performance of the action, whether it is a baseline test, assessment, or periodic test. Predicating the timing of the next action on the completion of a corrective action could forestall the next action for as long as it takes the item to work its way up the corrective action priority list. This is unacceptable.	It is inappropriate for the 3-year frequency to begin with the completion of corrective actions for minor deficiencies (without the need for retesting). The guidance states that 3-year frequency is to begin with the completion of the most recent assessment or retest. Figure 1 will be redrawn to delete the arrow from the "Correct Deficiency" box to the arrow exiting the periodic retest's "fix and retest" box. Figure 1 will be redrawn to show the line originating from the two "fix and retest" boxes and the "reanalyze" box to go directly into the "periodic retest" box, with the "(3 years)" note added to this redrawn line. Section 4.3.1 will be revised to reflect these changes.	Implemented, Figure 1 has been revised and simplified to represent the common intentions of the industry and the NRC.
28.	§4.3.3, 2nd bullet	Although the reference to the corrective action program is generally acceptable here, the staff expects that the corrective actions will be timely and continuous since the test failure indicates that the design basis may not be satisfied with regard to control room habitability. An operability determination and a reportability determination need to be made.	The guidance should include criteria on operability and reportability determinations. The next test should be within three years.	Implemented The section is now renumbered to section 4.3.3.3 and wording has been altered to clarify that the Corrective Action program must be entered and that a retest is needed after three years following the successful test.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
29.	§4.3.4.2	Make procedure control a required part of the program.	Agree.	Section renumbered to 4.3.1.2 so that the process steps follows the logic Figure 1. The paragraph wording was revised to be consistent.
30.	§4.3.4.3	This section relegates review of offsite toxic gases to the six-year assessment. The staff believes that facilities should be assessing the impact more frequently than every six years. The staff believes that such facilities would want to establish arrangements with those facilities to receive notification of changes in chemical inventories that would be reported to public officials under SARA III. This is not an onerous burden.	The six-year toxic chemical control assessment reviews the plant's existing chemical controls program and licensee commitments. The time interval between offsite hazardous chemical inventory assessments is addressed in a licensee's licensing basis. A six-year interval between offsite hazardous chemical assessments is adequate, unless a licensee's hazardous chemical licensing basis requires more frequent assessments.	This section is renumbered as 4.3.1.3. The test was revised to address the frequency of reviews consistent with the TF position. The response to Comment #17 provides additional clarification on full extent of modifications related to the hazardous chemical program assessment.
31.	§4.3.4.4	The staff believes that the CR HVAC engineer's recommendation needs to be expanded to system engineers involved with systems and structure identified during the system assessment as having a potential impact on control room habitability. The CR HVAC engineer needs to be familiar with habitability issue and review each related modification package for impact on CRH.	Section 5 ensures adequate training to allow the individual(s) responsible for CRH to be familiar with the potential impact of changes various plant systems and structure (including those of adjacent areas). Therefore, no text change is needed. The CR HVAC engineer should be familiar with habitability issue and review each related modification package for impact on CRH.	This discussion is now in Section 4.3.1.4. It now states that the CR HVAC system engineer should be familiar with habitability issues and review each related modification package for impact on CRH.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
32.	§4.3.4.7	Add a control to address fire.	Fire is addressed in Appendix R of 10 CFR Part 50. NEI 99-03 addresses smoke in Section 4.3.4.	No Action Required The administrative controls for smoke intrusion is now discussed in Section 4.3.1 (previously 4.3.4.).
33.	§4.3.5	Changes to test and assessment frequency, after sufficient experience, need to be proposed to the NRC staff.	Changes to test and assessment frequencies are at the licensee's discretion, unless previously reviewed and approved by the Staff. This paragraph is consistent with existing licensee commitment change processes.	The discussion is now in Section 4.3.4, which states that changes to test and assessment frequencies may require NRC approval if they were previously reviewed and approved by the NRC.
34.	Figure 1	This figure is different from that presented by the staff. Figure 1 does not provide a failure path for the retest following a repair or if re-analysis cannot relax the acceptance criteria. The staff expects that following a failed periodic retest, efforts to fix and retest will continue in a timely manner until a successful test is performed. The three-year interval to the next periodic retest starts upon obtaining a successful retest result.	Addressed in Resolution to Comment 27.	Implemented, Revised Figure 1

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
35.	§4.4.1	First paragraph, first sentence, revise to read, ". . . to assure that the plant maintains the. . . ." With the exception of item b, which requires the review of procedure revisions to ensure that control room issues were considered, the language requires a review of the individual process control. The staff expects that reviews of the various process controls will also evaluate the effectiveness of such controls. For example, in item f, rather than ". . . Review maintenance controls to ensure that CRH issues were considered . . ." The item should read, ". . . Review applicable maintenance work packages to ensure that CRH issues were considered . . ." The assessment plan should include the measurement of flow rates, performance of a flow balance, and the determination of air sources associated with those flow rates. Add subparagraph g to address fire.	Revise the first paragraph, first sentence, to read, "... to assure that the plant maintains the …." In the sub item lead-in sentences, change "controls" to "controls and their effectiveness". Assessments do not require new testing. A CRH assessment involves reviewing non-in-leakage test results generated during the preceding 3-year time interval. Fire is addressed by 10CFR50 Appendix R. This guidance document addresses smoke.	Implemented in Section 4.3.2.1. Implemented in Section 4.3.2.1. No Action Required No Action Required
36.	prior to §4.4.2	The cross-reference to Section 4.3.1 is subject to the comments above on that section	Agree	This section has been completely rewritten and renumbered as 4.3.2.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTION TAKEN
37.	§5	The staff believes that training is warranted.	The training needs analysis will identify the extent of training required	Section 5 on Training has been rewritten to provide clear guidance on expectations for a training needs analyses and training plan that will meet the specific needs of the licensee's program.

APPENDIX A

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
A-1		The appendix should evaluate for success (i.e., not having smoke in both the control room and the alternate shutdown panel). Plans for simultaneous contamination of both locations as allowed by bullet three under Section 3, Success path Logic results in a situation where GDC 19 is not met. If that condition arises, the situation warrants the issue being placed in the corrective action program. It also necessitates the implementation of compensatory actions. Since bullet three reflects failure to meet GDC 19, it is unacceptable and should be deleted.	Change the title of Section 3 to "Contingency Logic Evaluation", This will clarify that this section is providing guidance that may be beyond the design basis. The assessment in Section 2 will evaluate whether this is an issue. If it is an issue the licensee is to take corrective action, as appropriate. The contingency logic provides good practices in this "very unlikely event…"	Implemented No Action Required
		The staff recommends the following: 1) the title of section 3 be "Contingency Logic Evaluation," 2) the last bullet on page A-1 be made the last bullet in section 2, and 30 the first bullet under section 2 Assessment read, "Verify that a single credible fire event does not simultaneously result in the contamination of the control room and the alternate shutdown Panel such that reactor control cannot be maintained from one of the locations." For the latter case, distance and barriers may be insufficient to assure that the alternate shutdown panel and the control room are not simultaneously contaminated.	The second set of NRC recommendations improves the logic and clarity of the guidance and will be adopted. As noted above these changes also identify bullet 3 as a contingency alternative, so that it may be retained as appropriate guidance.	Implemented

APPENDIX B

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
B-1.	§4	References 5 and 6 need to be updated. The latest version of both the Regulatory Guides and the NUREG is Revision 1.	Cite both reference revisions.	Implemented
B-2.	General Issue	Compensatory measures for issues associated with smoke should be provided. Compensatory actions associated with hazardous chemicals need to be enhanced. Sufficient compensatory measures need to be performed to make sure that GDC 19 is met. The staff suggests providing additional compensatory measures such as temporary removal or relocation of the hazardous chemical source.	Agree. Add the principles expressed in the comment to the introductory paragraphs of Appendix B. The assignment and justification of compensatory measures for smoke and hazardous chemicals are plant-specific. Remind licensees of their obligation to assure that programs, including compensatory measures, fulfill the requirements of GDC-19.	Implemented

APPENDIX C

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
C-1.	§3.1.1 & 3.1.2	These sections need to address non-CREVs systems that do not traverse the boundary but can impact pressure differentials. These sections appear to be limited to ventilation systems. They also need to address penetrations to the CRE, such as cable trays, conduits, floor and equipment drains.	These issues are addressed in Section C.3.2.2 (last bullet). Section C.3.4 addresses Table C-1, which cites various boundary information items. These issues are addressed in Section C.3.4.3 and Table C-1. The Task Force believes that NEI 99-03 is sufficiently detailed.	No Action Required
C-2.	§3.2	This section calls for "justification" for deviations from the licensing basis configuration. This should be stronger, e.g.: If such deviations from the licensing and design bases alignments are needed, a sensitivity evaluation should be performed to demonstrate with reasonable assurance that the measured inleakage is bounding for the licensing and design bases configuration that would exist during an accident. This evaluation should be documented with the test results. Reference to §5.2 of Appendix D is in error.	Add the following sentence after the third sentence in Section D.3.2: "This justification should include an evaluation to demonstrate with reasonable assurance that the measured inleakage is bounding for the licensing and design bases configuration that would exist during an accident. This evaluation should be documented with the test results." Rewrite to reference Section D.4.2.	Implemented in Section D.3.2, "Configuration Lineups" so that it provides a direct connection to the expectations in the testing process. Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
C-3.	§3.2.1	The configuration of ventilation systems that serve areas external but adjacent to the CRE boundary can create pressure differentials that impact the CRE. While this section addresses external ventilation systems, it is with regard to those systems that traverse the boundary. An activity to identify the impacts of external ventilation systems on pressure differentials should be added. Add the following to the 1st sentence of the 2nd paragraph: "and to verify that the as built systems are consistent with controlled documents."	Section C.3.4.1 and C.3.2.2 address this issue. Section 3.2.1.1.1 of the main text already states this. Revise per the NRC comment, first paragraph.	The text has been clarified in these sections. Modified 3.2.1.1.1 in main text. No change to Appendix C 3.2.1
C-4.	§3.2.3	In the 2nd sentence of the 2nd paragraph the phrase " the user may consider" should read "the user should consider."	Revise as recommended.	Implemented
C-5.	§3.3, 1st bullet	This item should require confirmation that the components are constructed, operated, and maintained with the design basis. Also, it appears that a note should be added to this section to identify the limitations of walkdowns. For example, for some components they cannot be used to confirm that components are constructed or configured in accordance with their design, especially without testing.	In Section C.3.3, first bullet, change the word "constructed" to "configured". A walkdown cannot confirm all design and construction attributes in accordance with the design basis.	Implemented
C-6.	§3.4.2	It is important to note that leakage from components of this nature could be a source of unrecognized pressurization of the CRE that could adversely affect the results of pressurization tests.	In C.3.4.2 between the two paragraphs, add the following sentences: "Excessive leakage from ducting routed through the CRE may assist in pressurizing the CRE. Sealing these leaks could result in reduced CRE pressure."	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
C-7.	§3.4.5	This discussion is acceptable overall, but should not be limited to isolation dampers. On systems in which the difference between normal pressurization and accident pressurization modes is the position of a bypass damper around a filter bank (dampers used to divert flow), leakage through these bypass dampers constitutes unfiltered inleakage. Balancing dampers that establish a particular flow rate necessary for pressurization can have an impact if inappropriately set. It is also recommended that the paragraph in Section 3.4.5 of NEI 99-03, Rev. 0, page H-7 concerning the historical unreliability of louvered dampers be put back in this section.	Change Section C.3.4.5 title to: "Ventilation System Dampers" Add the following to the end of the first paragraph: "On systems in which the difference between normal pressurization and accident pressurization modes is the position of a bypass damper around a filter bank (dampers used to divert flow), leakage through these bypass dampers constitutes unfiltered inleakage. Balancing dampers that establish a particular flow rate necessary for pressurization can have an impact if they are set in inappropriate positions." It would be inappropriate for NEI 99-03 to define an acceptable design. The text as written is acceptable.	Implemented Implemented No Action Required
C-8.	§3.4.6	The discussion is acceptable overall. However, the discussion regarding radiation monitor sample lines should not be limited to monitors outside the CRE that draw samples inside the envelope. Some older plants have an operator selectable airborne sampler that allows the operator to select areas outside of the control room for sampling.	Revise the last sentence in Section C.3.4.6 to: "Radiation monitors outside the envelope that draw samples from inside the control room, and radiation monitors inside the control room that draw samples from outside the envelope, can be a source of inleakage if the sample lines leak."	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
C-9.	Table C-1	This table will need to be updated to reflect the clarifications identified above. Also, it is recommended that the previous text contained in NEI 99-03, Rev. 0, Table H-1, for Control Room Ventilation System Operation (Section 3.3.2) be retained in Table C-1.	Table C-1 will be revised to be consistent with the Section C changes. An inleakage test is performed to prove that the CR HVAC systems are performing their CRH design functions. This precludes the need to determine that ventilation systems are properly balanced, and the need to determine that ventilation system air flow rates and air sources are as expected.	Editorial changes to Table C-1 have been made to be consistent with the Appendix C text.
C-10.	Table C-1, page C-10	For the section on "Other Ventilation Systems (Section 3.4.2)"and in the column entitled "Determining Inleakage Vulnerability," replace the words, "Determine if other system ducting is routed through the envelope when the control room is isolated. If so:," with "If other system ducting is routed through the envelope:."	Modify as proposed.	Implemented

APPENDIX D

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-1.	General	In some cases, there is a reasonably complete discussion of a testing aspect. Subsequent sections may repeat excerpts from the fuller discussion, but omit important caveats, etc. It would be better if the subsequent sections referred to the fuller discussion. For example, Appendix D, §3.3 addresses the need to use recognized industry standards and that ". . . the industry standard must be relevant to the determination of inleakage for the specific application . . ." However, subsequent phrasing often simply refers to ". . . industry standard . . . " A similar situation exists with excerpts related to testing the limiting or bounding case without a cross-reference back to the full discussion in Appendix D, §4.1, §4.2.	The document will be reviewed to ensure consistency and will rely upon the details of Appendix D, as appropriate.	The document has been reviewed for consistency and changes made to various sections to ensure consistency and clarity in the guidance.
D-2.	General	The text is heavily biased against the tracer gas test, and the staff feels that the document does not adequately give a user the complete picture regarding the pros and cons of all methods. For example, there is a discussion regarding the potentially higher measurement uncertainty associated with tracer gas testing, but no mention of the inability of the component test method to detect unsuspected inleakage, or the dependence of the method on the quality of the self-assessment.	The Appendix D text will be made more balanced by modifying Section D.4.3.2 to reflect the strengths and weaknesses of integrated component testing. The rewrite will address the inability of the component test method to detect unsuspected inleakage, or the dependence of the method on the quality of the self-assessment.	Text has been reviewed and rewritten to remove any identified biases.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-3.	General	Sections of NEI 99-03 need to point to Appendix D. These include situations where changes in design or operating procedures impact control room envelope inleakage characteristics.	Section 4.3.1.2 addresses procedure control. Add the following after the first sentence: "In addition, appropriate post-procedure change testing may be necessary to ensure that safety analyses assumptions remain valid. If it is determined that inleakage testing is necessary, the test should be performed in accordance with Appendix D." Section 4.3.1.4 addresses design change control. Add the following after the third sentence: "This testing should be commensurate with the scope of repairs and modifications made. If it is determined that inleakage testing is necessary, the test should be performed in accordance with Appendix D."	Implemented Implemented
D-4.	General	Generic Letter 91-18 stands on its own. An interpretation of Generic Letter 91-18 within these sections and corresponding subsections will not be endorsed by the staff. For example see §4.1 d).	Details of examples will be moved to informational appendices.	Implemented. Details were moved to Appendix FF. See the response to Comment 20 on the same subject.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-5.	General	There needs to be a consistent treatment when the document either references the design or licensing bases. For example in Appendix D, §4.1, item e) the text refers to only the design bases. The staff suggests referencing both the licensing and design bases and that these documents remain consistent with one another or just the licensing bases since the design bases is a subset of the licensing bases.	Agree	Section 4.1 (e) was revised and other text has been reviewed and changes made.
D-6.	§3, second bullet, §4.2a, and §4.3.3, third bullet on the first list	When testing the CRE for its inleakage characteristic for a particular type of challenge, testing should be conducted with all ventilation systems (those within the CRE and those serving, traversing or located in areas adjacent to the CRE) performing in a manner consistent with the facility's licensing basis unless it is determined that such a testing mode would underestimate the inleakage characteristics for such a challenge. The cited sections refer to a bounding configuration.	The guidance will reviewed for clarity.	Sections were rewritten for clarity.
D-7.	§3.1	The staff would like to see this text be revised to include the provision that a comprehensive test be capable of reliably measuring and detecting unknown inleakage.	The guidance provided in NEI 99-03 has addressed this issue. No change to the text is necessary. Section D.4.3 provides the detailed guidance for the test methods that would be under consideration.	No Action Required
D-8.	§3.2, second	Delete text after the 1st sentence. This text belongs in the discussion regarding component testing.	This text is included for clarity and is not solely associated with component testing. The text will remain. Revise Section D.3.2 title to be: "Configuration Lineups"	No Action Required Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-9.	§4.1.b)	The staff agrees that this item is applicable to the baseline test. Since the item is a prerequisite, e.g., requirement, the disclaimer could be interpreted as a requirement for a baseline test and permissive for a periodic test. Thus, §4.1.b) should be expanded with something such as: Acceptable pre-conditioning represents either restoring a deficiency to its design basis condition or a permanent design change. Interim actions that will not become part of the ongoing control room integrity program are not acceptable. Such test pre-conditioning should not be performed for periodic tests since this would inappropriately mask integrity degradation that occurs between tests.	The text is clear that item D4.1.b does not apply to the periodic test – it is for Baseline Test Only.	No Action Required. Additionally preconditioning has been addressed elsewhere in the NEI 99-03 document.
D-10.	Footnote 3 on page D-2	Change the footnote to read, "An assessment of the control room boundary is essential if inleakage is going to be determined." See also the comment for §4.1.g).	Delete the footnote. It is unnecessary when the qualification is removed.	Implemented
D-11.	§4.1.g)	Add the following prerequisite for non Baseline tests: Perform an assessment of the control room boundary in accordance with Appendix C, §4.3.3 and §4.3.4.	No change needed. Section 4.1 addresses prerequisites to testing. There is no need to perform an assessment as a prerequisite to retesting. Assessments will be performed 3 years after a retest. However, following discussion with Staff it is apparent that additional improvements in the way of walkdowns prior to a periodic test can be made in this section.	Added new prerequisite to this section for performance of a walkdown for the periodic test.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-12.	Note before §4.2	Add: "All plants should verify system flow rates and sources."	During the January 2003 meeting, the NRC stated that sources of inleakage need to be identified. This is not necessary if the amount of unfiltered inleakage remains unchanged or decreases. If the flow increases then the plant's corrective action program will be entered and appropriate actions will be taken (an example could be reduction of inleakage or location of the source of the inleakage). This position is consistent with the response to comment C-9.	Flow rates are periodically verified and do not need to be verified here (it is considered an unnecessary burden). The periodic retest will identify sources (in this context unfiltered inleakage sources), if needed. No changes made as a result of this comment.
D-13.	§4.2 b)	Regarding the use of one test to represent the inleakage characteristic for all types of challenges. Add: "Although the CRE ventilation systems may be performing in a similar manner for the different challenges, the ventilation systems serving, traversing and located in adjacent areas may not perform in a similar manner and may impact the inleakage characteristics of the CRE."	This is addressed in Comment C-2. Changes are implemented in Section D.3.2.	Previously addressed in Comment C-2
D-14.	§4.2, last	The last sentence should be clarified.	Delete the last sentence of Section D.4.2 Additional editorial correction: In first sentence after bullet D.4.2.c, delete the word "licensees". .	Implemented The section has been reorganized for additional clarity. The footnote information has been integrated into the text.

Cmt #	Para. or Section	NRC Comment	NEI Disposition	Actions taken
D-15.	Footnote 4, page D-3	The footnote does a good job of defining the functions that ventilation systems in adjacent areas can be performing. It is a complete definition that should be used throughout the document. The staff believes this text belongs in the text rather than in a footnote.	Agree to review the document for consistency, and to provide cross-references to the more detailed descriptions. It may be possible that the main body of NEI 99-03 needs to refer the user to more detailed discussions in the Appendices.	Footnote moved to beginning of main text (section 2.3.1) to address adjacent spaces.
D-16.	Footnote 5, page D-3	In footnote 5, for a plant designed for two operating modes (pressurization mode during a radiological challenge, and a recirculating mode during a hazardous chemical challenge) two separate tests should not be a consideration. Rather they should be a requirement.	The need, or lack of need, for separate testing modes must be justified by the licensee.	Footnote moved to main text Appendix D, 4.2.b and wording clarified.
D-17.	§4.3, short	This short reference does not carry with it the necessary attributes identified in Appendix D, §3. Replace "Acceptable standards are listed in Table D-1" with "Section 3.1 to 3.3 of this document identifies attributes of acceptable test methods." The choice of test method should be based upon the method that will best identify inleakage and not the method that is most economical. Likewise, the consideration of uncertainty is focused on the uncertainty of test results but ignores the uncertainty of not identifying all of the inleakage. These considerations should be incorporated in the text. Add the following after the last sentence: "The selection of one test method over another may hinge upon the ability of a certain test to assure that all inleakage is measured."	Rewrite last sentence as: "Acceptable standards are addressed in Appendix D, Section 3." The description of the selection method is changed to reflect a comprehensive, site –specific evaluation process. Per Comment D-2, Appendix D is being revised to address the pros and cons of different testing methods. No additional changes are necessary.	Implemented Section 4.3 rewritten to address comment. Section 4.3 rewritten to address comment.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-18.	§4.3, short	The staff would like to see a provision requiring that the test documentation include a written justification for a conclusion that a particular test configuration bounds the accident configuration, e.g.: "If such deviations from the licensing bases alignments are needed, a sensitivity evaluation should be performed to demonstrate with reasonable assurance that the measured inleakage is bounding for the licensing bases configuration that would exist during an accident. This evaluation should be documented with the test results."	The comment is appropriate. The bases for testing should be documented. Text is being added to Appendix C per the response to Comment C2. Add the following: "This justification should include an evaluation to demonstrate with reasonable assurance that the measured inleakage is bounding for the licensing and design bases configuration that would exist during an accident. This evaluation should be documented with the test results."	Implemented
D-19.	§4.3.1	The discussion in this section is biased as it only provides negatives aspects of the testing method. The section should discuss the positive aspects of this method to present a balanced view.	The Appendix D text will be made more balanced by modifying Section D.4.3.2 to reflect the strengths and weaknesses of integrated component testing. The rewrite will address the inability of the component test method to detect unsuspected inleakage, or the dependence of the method on the quality of the self-assessment.	Text has been reviewed and rewritten to remove any identified biases.
D-20.	Footnote 6, page D-4	Footnote 6 is irrelevant to the purpose of this document. What has happened in the past is not indicative of what will happen in the future. There may be techniques that do not require exceptions. Therefore, delete the text addressing the exceptions.	The vendors which perform ASTM E741 testing have told industry that verbatim compliance with ASTM E741 is not possible, nor has it been done for testing completed to date.	The footnote was removed and placed in main text of Appendix D. The footnote was rewritten to refer to Appendix EE.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-21.	§4.3.1, second bullet	While it is true that multizone buildings are more difficult to test than single zones, most control room envelopes are single zone spaces. ASTM E741 defines a single zone. This should be reflected within the bullet.	The tracer gas testing vendors identified this limitation. This bullet exists to define a limitation that is applicable to those licensees with a multizone control room design.	Bullet reworded to provide more details regarding the situation described and is considered technically correct and unbiased by the TF.
D-22.	§4.3.1, third bullet	Opening normally closed doors, removing ceiling tiles, and using portable fans to assist in mixing are actions taken by testers to reduce the time before equilibrium is reached so that sampling may begin sooner. If these actions are not taken, the control room envelope will still reach equilibrium but it takes longer to perform the test. The above noted actions merely reduce the time at which the concentration within the CRE is in equilibrium so that testing may begin consistent with ASTM E741.	Delete the third bullet.	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-23.	§4.3.1, last bullet	To a large degree, this item is likely applicable to all testing methods and might be better in Appendix D, §4.2.	Delete the last bullet in Section 4.3.1 (previously Section 4.3.1.1) Add the following text as a new paragraph to the end of Appendix D, Section 4.2: "Effects of the environment on the test results should be considered. Performing the test to minimize environmental influence is recommended. The test instruction should contain guidance on environmental effects. For example, the test should not be performed if there is a strong consistent wind (> 15 mph) and the control room envelope is significantly exposed to the outside environment. The lower the wind speed, the more accurate the test results. In addition, the test should consider seasonal and daily temperature differences and their impact on pressure differential." In addition, remove the phrase "additional information" from the first paragraph following item c in Section D.4.2.	Implemented Implemented
D-24.	§4.3.1.1, E741 exceptions	This section should be deleted. See the comment for Appendix D, Footnote 6.	The tracer gas testing vendors identified these exceptions which are routinely used in testing performed to date. These exceptions remain in the document (non-mandatory appendix) so that licensees implementing the E741 test can properly plan and execute the testing.	Moved to Informational Appendix EE.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-25.	§4.3.2	During the workshops it was stated that those who did a component test would have their methods peer reviewed. This does not show up in appendix D §4.3.2. This should be added to this section.	The last sentence of the third paragraph in Section D4.3.2 will be revised to: "A peer reviewer from the benchmarked plant should be used to strengthen the assessment team and provide assurance of the implementation of a similar assessment per Appendix C."	Implemented
D-26.	§4.3.2, second bulleted list	The staff feels the following bullet should be added to the list: "Correlation between E741 and component tests indicates that control room envelope wall, ceiling and floor inleakage is minimal."	This NRC comment is addressed by the content of the second and third paragraphs of Section D.4.3.2, which states that the nominal inleakage value from integrated component testing accounts for no less than 95 percent of the nominal inleakage test result from the tracer gas testing. However, the TF agrees that this aspect of component testing is correct (i.e., inleakage is minimal).	Second paragraph of 4.3.2 was reworded to include NRC concept that leakage through these paths will be demonstrated to be small.
D-27.	§4.3.2, "Step 1", 3rd ¶	Reference to §5.2 should be a reference to §4.2. Also, "… temperature differences …" should read "…temperature, seasonal and daily temperature differences"	Reference will cite Section D.4.2. Seasonal and daily temperature differences are applicable to all test methods. This is addressed in Section D.4.2 with the note added per the resolution of Comment D-23. With this change per Comment D-23, no additional changes are needed to Section D.4.3.2.	Implemented Seasonal changes impact all types of testing and has been moved to Appendix D section 4.2.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-28.	§4.3.2, first	The discussion in this section is biased as it only provides positives aspects of the testing method. The section should discuss the negative aspects of this method to present a balanced view.	The Appendix D text will be made more balanced by modifying Section D.4.3.2 to reflect the strengths and weaknesses of integrated component testing. The rewrite will address the inability of the component test method to detect unsuspected inleakage, or the dependence of the method on the quality of the self-assessment.	Section 4.3.2 has been rewritten to address this comment and related comments.
D-29.	4.3.2, first ¶, second sent.	It is erroneous to state that a component test will identify the total inleakage of a CRE. Such a statement is true only if all of the leakage locations are identified and tested.	Revise the first sentence to read: "…the total inleakage value is established by summing the results from the individual leakage location tests." The second paragraph of Section 4.3.2 requires that the nominal inleakage value from integrated component testing accounts for no less than 95 percent of the nominal inleakage test result from the tracer gas testing.	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-30.	§4.3.2, third	To the criteria for similar design and operation, emphasize that this includes design and operation of spaces and ventilation systems external to the CRE. Also, the staff believes that each application of benchmarking is a change in methodology that must be approved by the NRC staff.	Step 1 of the integrated component test methodology requires establishing differential pressure measurements with respect to all adjacent areas. This minimizes the differences in design of adjacent areas. Submittal for NRC staff approval should only be required if the test was performed to support a license amendment. The staff's position is a misapplication of 10 CFR 50.59 process (departure from methods that generally apply to accident analysis methods described in a licensee's FSAR.) In addition, inleakage tests do not meet the definition of *tests or experiments not described in the FSAR* that are subject to 10 CFR 50.59.	Section Appendix D, 3.2 has been rewritten to address justification of configuration choices and this includes the adjacent spaces. No Action Required
D-31.	§4.3.2, first bulleted list	This bullet does not belong with the other two bullets. Since this aspect is also true for integrated tracer gas tests, yet it is not mentioned within the text of §4.3.1, it further reinforces the comment for §4.3.1. At least one facility has performed tracer gas tests for years with their plant staff. The staff therefore, believes the bullet should be deleted.	Delete the last bullet in the first set of bullets at the top of page D-7.	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-32.	§4.3.2, second bulleted list	The staff considers that the bullet items to be prerequisites that all need to be satisfied before a component test can be found appropriate.	Delete the first bullet from the second bulleted list. Replace the final sentence introducing the second bulleted list with the following: "The prerequisite for an integrated component test is the need for the CRE to be maintained at positive pressure with respect to all adjacent spaces. The following are control room design features that should be evaluated when determining whether it is feasible to perform an integrated component test. All of these features improve the ability to correlate results to a tracer gas test and reduce the complexity of the test program and the analyses to derive results. However, these features are not prerequisites for the integrated component test method." As an example, the second bullet is not true of PVNGS Unit 2, yet this licensee successfully correlated the results of an integrated component test to the results of a tracer gas test.	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-33.	§4.3.2, "Step 1," second	(1) Particular attention needs to be paid to rooms within the CRE that contain ventilation intake plenums, since these can create localized negative pressure differentials. (2) Similarly, particular attention needs to be paid to areas within the CRE that are opposite to areas exterior to the CRE and are subject to localized positive pressurization. (3) An evaluation should be performed to ascertain that the observed pressure differentials can be attributed to intentional filtered pressurization flow, and are not the result of unknown unfiltered inleakage.	The integrated component test methodology described in this guidance addresses concerns 1 and 2. The prerequisite for an integrated component test is the need for the CRE to be maintained at positive pressure with respect to all adjacent spaces. It is not necessary to perform additional evaluations with these pressure differential measurements.	No Action Required No Action Required
D-34.	§4.3.2, "Step 2"	The reference to Appendix C is potentially confusing since Appendix C applies to baseline testing and §4.4 of the text to periodic testing, but Appendix D applies to both. Consistent with the staffs comments for §4.1.g), the staff believes that sections of Appendix C should be performed each time a periodic test is performed.	Appendix C addresses an assessment of the system, not the baseline testing. Section 4.1 addresses prerequisites to testing. There is no need to perform an assessment as a prerequisite to retesting. However, it is good practice to perform reviews/walkdowns prior to testing and appendix C does provide guidance for those actions.	Appendix D, Sections 4.1 and 4.3.2 "step 2" have been revised to address this comment.
D-35.	§4.3.2, "Step 3",	Several sentences are incomplete excerpts from previous text and the omitted text is important. It would be better if these sentences referred back to the fuller discussion. For example: ". . . these integrated component test methods should be performed using industry standards . . ." §3.3 contains a caveat that ". . . the industry standard must be relevant to the determination of inleakage for the specific application . . ." This is an important caveat.	Review the document for consistency, and to provide cross-references to the more detailed descriptions.	Document has been reviewed for consistency and changes made where appropriate.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-36.	§4.3.3, overall	The text refers to ". . . licensees may propose . . . " The text, however, doesn't say to whom and whether they can implement it without prior staff review. The staff believes that each alternative test method is a change in methodology that must be approved by the NRC staff.	In Section D.4.3.3, it is expected that each licensee will provide sufficient justification for their use of an alternate test method with any submittal related to unfiltered inleakage testing. Revise the second paragraph from "allow a knowledgeable reviewer" to "allow an NRC staff review."	No Action Required Implemented
D-37.	§4.3.3, last bullet, first list	There appears to be a typo in the last bullet of the first bullet list -- there is no §5.3.2. My suspicion is that it meant to refer to §4.3.2. As such, the above comment on §4.3.2, 2nd paragraph applies equally here as well.	Reference Section D.4.3.2.	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-38.	§4.4.2.1, 1st bullet & Footnote 8	Based upon the following comments the staff believes the reference to 0.05 and 0.01 inches WG should be deleted from footnote 8. The staff also recommends replacing *"Use 0.125" WG or 0.05" WG if no other pressure differential is specified by design."* with *"Use 0.125" WG if no other pressure differential is specified by licensing basis."* The staff does not believe that the conclusion regarding more stable pressure differentials within adjacent areas as opposed to atmospheric variation can be supported. Internal pressure differentials can be created by solar heating or the response of moderating HVAC systems to temperature changes within the buildings. Accident conditions in adjacent areas, temperature or pressure caused by high energy line breaks, etc., are not likely modeled in the performance of the test. One pressure differential ought to be used. I think the uncertainty associated with these changes may be comparable if not greater to those in the environment, e.g., a high energy line break may increase pressure by 10's of psi in short periods; barometric pressure doesn't change at this rate. The description of reference 8, referring to the Guidelines for Construction of Hospital and Health Care Facilities by the American Institute of Architects and the ASHRAE HVAC 2001 Applications Handbook as the justification for the value of 0.05 inches WG is inappropriate. These guidelines and applications apply to rooms that do not have the multiple divisions within the zone nor the numerous ventilation systems which traverse, serve or are located in areas adjacent to the CRE which may affect the CRE pressure.	Rewrite section to improve clarity. Add information on how the guidance can be applied.	The footnote and bullet were reworded based on TF and NRC discussions. The footnote now discusses the background for the values plus provides examples to illustrate how values can be applied..

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-39.	§4.4.2.1, 2nd list	Sufficient guidance is not provided on the performance of the delta-P measurement and some of the guidance which is provided is erroneous.	Disagree. The guidance is detailed. The Task Force is unaware of any erroneous guidance.	No Action Required
		There is a need to know the location of ventilation systems which serve, traverse or are located in adjacent areas.	Appendix C recognizes the need to identify adjacent areas and ventilation systems that can impact CRH with unfiltered inleakage.	Adjacent spaces have been addressed.
		The guidance to measure the pressure relative to all adjacent areas is probably not specific enough.	The Task Force believes that the guidance is detailed and specific.	Adjacent spaces have been addressed.
		The areas which need to be measured probably are most readily identified by using a drawing in conjunction with a walkdown.	Revise the first bullet to begin: "Use drawings supplemented with walkdowns to identify all…."	Earlier comments addressed use of walkdowns and drawings (see resolution to comment D-11 for example).
		Areas where pressure measurements need to be made include those where a ventilation system is located, there is a change in boundary, or a change in ventilation systems which traverse or serve the area.	The second, third and last bullets require pressure differential measurements with respect to adjacent areas.	Adjacent spaces have been addressed.
		Pressures also need to be measured behind false walls.	Revise the third bullet to read: "… above dropped ceilings, below raised floors, and behind false walls are measured."	Implemented

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-40.	§4.4.2.1, last bullet, 2nd list	It is indicated that if an adjacent area is determined to be at a higher pressure than the CRE, then actions may be taken to reduce the pressure in the adjacent area. If that is the case and all systems are functioning in accordance with their licensing basis then a component test cannot be performed. §4.1, "Prerequisites to Testing," subparagraph e) called for the systems to be placed into their design basis configuration. §4.3, "Determine System Mode of Operation for Testing" also calls for design basis alignment or bounding equivalent, with deviations documented. The text in this bullet appears to allow the test personnel to modify the alignments on an ad hoc basis. This is unacceptable. The staff believes that it is common protocol that if a test cannot be completed without deviation of procedure, the test is terminated and necessary corrective actions completed and procedures changes are made and approvals are obtained prior to continuing with the test. If the design characteristics change then a new licensing basis needs to be initiated and a re-assessment of the applicability of a component test would be made. Simply re-configuring the control room or adjacent area ventilation systems is not the answer for it may introduce other consequences, e.g., less ventilation flow thereby affecting cooling and, in turn, equipment.	Revise the first sentence of the last bullet in the second bulleted list to read: "If a licensing requirement exists that the CRE be at a positive pressure with respect to adjacent areas, and if it is discovered that adjacent area(s) are at a higher pressure than the pressure inside the CRE, then the licensee's corrective action program requires that actions be taken to reduce the pressure in the adjacent area(s). An integrated component test cannot be performed without maintaining a positive pressure differential with respect to all adjacent areas." Change the last sentence of the bullet to read: "If the system is rebalanced or in any way changed such that the differential pressure measurements are affected, then the test must be repeated per approved procedure.	Implemented
D-41.	§4.4.2.3.A, Footnote 10	The reference to ANSI N510-1989 as N510 should be deleted in this footnote. It is no longer an ANSI Standard but has been replaced by ASME N510. A more appropriate and accurate test is ASTM E2029-99.	Change from "ANSI" to "ASME". Add ASTM E2029-99.	Implemented.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-42.	§4.4.2.3.B	The document does not state how many components need to be tested to account for the identified leakage. The document should state that a sufficient number of components need to be tested to assure that 95% of the leakage identified through the E741 test is accounted for.	As stated in Section D.4.2.2 (at the top of page D-12), all components identified in the Appendix C vulnerability assessment shall be tested.	No Action Required
D-43.	Footnote 11	Clarify this footnote. Flow measurements are acceptable in lieu of what? Does it allow no testing? Is it a statement that the uncertainty is included only when a large amount of unfiltered inleakage can be tolerated?	Delete footnote 11.	Implemented
D-44.	§4.4.2.4	This material is applicable to the tracer gas test as well, and the section should be renumbered as §4.4.3 or §4.5. This section is generically applicable to any testing method and should not be located only within the component test method section. This text allows the use of nominal test results, uncorrected for test uncertainties. The staff believes that this is acceptable for low-leakage control rooms (e.g., nominal leakage less than 100 cfm) provided that the test was performed in a quality manner that minimized uncertainties and that the sources of uncertainty are understood.	Change paragraph numbering from 4.4.2.4 to 4.4.3. The guidance provided in NEI 99-03 Appendix D will be reviewed to ensure that the testing is performed in a quality manner that minimizes uncertainties and that the sources of uncertainty values are understood. Choosing 100 cfm as the cutoff point should not be necessary.	Implemented The response to this issue is described in detail where it first appeared in Comment 25. The description and discussion on the appropriate use of nominal test result values has been expanded and is now addressed in renumbered section 4.4.3 along with uncertainties.

CMT #	PARA. OR SECTION	NRC COMMENT	NEI DISPOSITION	ACTIONS TAKEN
D-45.	Table D-1, footnotes	There are several unqualified references to "standards." These references omit the caveat included in §3.3, i.e., "The industry standard must be relevant to the determination of inleakage for the specific application."	Table D-1 will be reviewed for consistency with the document text. Change "ANSI N510" to ASME N510".	The document was reviewed and changes were made to assure that standards used are appropriate. Changes were made where needed in the text and Table D-1. Resolution to comment D-1 also addresses this issue. Implemented
D-46.	Table D-1, page D-14	Suggest deleting AG-1 and N510 from Table D-1 as it provides testing guidance that is inconsistent with the testing attributes of §3 of Appendix D.	AG-1 and N510 are documents that do provide component testing information.	No Action Required
D-47.	Table D-2, Electr. conduits	There is no technical basis for excluding conduits. Also, this item should be expanded to address cable trays. In the Discussion Section of Table D-2, for several vulnerabilities the discussion states that the positive pressure measurements of the CRE will show that this vulnerability would not exhibit inleakage as the leakage would be out of the CRE. This assumption is only true if a correlation has been performed using E741. Such a correlation would be required to demonstrate that the walls, floors and ceilings are not a source of inleakage (pressurization flow) since the positive delta-P may originate from air inleakage sources which are unidentified. Consequently, the delta-P measurement is only beneficial if you know the sources of pressurization flow.	Table D-2 will be deleted, including its referencing within the text.	Table D-2 deleted

APPENDIX E

Cmt #	Para. or Section	Comment	Disposition	Actions taken
E-1.	§2., third bullet	Add: "(including blocking a door)."	Agree	Implemented.
E-2.	§3., first ¶, second sentence	Since smoke challenges are not considered in the accident analysis, the sentence should state: "It is important to control the CRE boundary to ensure that the design is maintained such that the accident analyses, and the design and licensing bases remain valid."	Agree. Disposition consistent with Comment D-5.	Implemented
E-3.	§3.	The staff does not endorse the method of equating a breach size to an inleakage flow rate. The staff endorses the method of breach control contained in TSTF-287, which allows the control room boundary to be opened intermittently under administrative controls. For entry and exit through doors the administrative control of the opening is performed by the persons entering or exiting the area. For other openings, these controls consist of stationing a dedicated individual at the opening who is in continuous communication with the control room. This individual will have a method to rapidly close the opening when a need for control room isolation is indicated.	Industry was polled about the use of an orifice equation for calculating a breach opening is commonly used and well understood. Greater than 90% of the utilities currently use this technique to allow breaches. The technique of using an orifice equation is technically sound and well documented in the two references added to Appendix E. No changes to the guidance are necessary.	Added references to Appendix E
E-4.	§3.,page E-2, first bullet	The staff recommends changing this bullet to state: "Ensure preplanned responses to close the breach in the event of hazardous chemical, radiological or smoke challenges are in place."	Agree	Implemented

Cmt #	Para. or Section	Comment	Disposition	Actions taken
E-5.	§4.4, first ¶, last sentence	The staff believes that differential pressure monitoring is not a good method of breach control since, during the event of radiological or smoke challenges normal differential pressures may not apply. Normally operational systems may shut down or non-operating systems may be turned on, thus affecting the differential pressures used for monitoring the breach.	Breach monitoring using differential pressure method requires action statements should the pressure change. No change to the text is needed.	No Action Required
E-6.	§4.2.1, §4.2.2	Consistent with TSTF-287, any breech activity should incorporate compensatory actions.	The TSTF-287 has not been implemented by every utility. As was stated in disposition of comment E-3 above, this technique of breaching (orifice equation) is common in the industry. As long as the breach size is clearly understood and inleakage remains below limits then no compensatory measures are needed. However, compensatory measure are still considered with this technique. This is noted in the existing paragraph following the bullets, " If the breach size adversely affects the accident analyses or system performance requirements, compensatory measures may be necessary. These compensatory measures may need a 10 CFR 50.59 evaluation."	No Action Required
E-7.	§4.2.2, last	The staff believes this ¶ is applicable to §4.2.1 and should also be placed in §4.2.1.	Agree. The paragraph text will be added to 4.2.1.	Implemented