NRC/NEI MEETING ON CONTROL ROOM HABITABILITY

UNITED STATES NUCLEAR REGULATORY COMMISSION

RICH BARRETT/MARK REINHART/JACK HAYES
PROBABILISTIC SAFETY ASSESSMENT BRANCH
JANUARY 13, 2000

Attachment 2

NRC OBJECTIVES

- ASSURE THAT GDC 19 IS MET

ASSURE GDC 19 IS MET CONSISTENT WITH LICENSING ANALYSES

ESTABLISH CONTROL ROOM HABITABILITY TO A QUALITY CONDITION SUCH THAT BASIC ASSUMPTIONS & ANALYSES ARE NO LONGER AN ISSUE IN LICENSING ACTIONS

WHAT IS REQUIRED?

- NRC REASSESS GDC 19 CRITERIA & CONTROL ROOM HABITABILITY REQUIREMENTS

LICENSEES REASSESS HOW THEY MEET GDC 19

VEHICLES FOR SUCCESS

1. NEI 99-03

2. NRC GENERIC COMMUNICATION

NRC/NEI Control Room Habitability Meeting
January 13, 2000

Agenda

Item	Topic	Responsible Party
1.	Opening Remarks	NRC/NEI
2.	Meeting Goals	NRC/NEI
3.	Scope and Purpose of NEI 99-03	NEI
4.	Framework of NEI 99-03	All
5	Identification of Issues Associated with the Framework	All
6	Identification of Subgroups • Scope & Function • Responsibilities • Method of Operation • Membership/Focal Points • Subgroups Required	All
7	Schedule	All
8	Meeting Logistics • Location • Duration • Format	All
9	Action Items	All
10	Next meeting schedules • Subgroups • TF/NRC	All
11	Adjourn	

FRAMEWORK OF NEI 99-03

SECTION	TOPICS	ASSIGNMENT
1. Introduction	Purpose History Scope Organization	
2. Regulatory Requirements & Guidance	GDC 19 Multi-plant Action Item TMI Action Item III.D.3.4 SRPs 2.2.1-2.2.3, 6.4, 6.5.1 NUREG-0737 Regulatory Guides 1.52, 1.78, 1.95 NUREG-4960	

SECTION	TOPICS	ASSIGNMENT
3. Control Room Habitability Issues	Unfiltered Inleakage TMI Action Item III.D.3.4 Remnants EOPs & NOPs ≠ As Operated As Built ≠ As Described Analyses not reflective of As-Built and/or As-Operated Other NUREG-4960 Issues DBA Scope	
4. Licensing Basis	TMI Action Item III.D.3.4 Amendment Submittals and NRC SEs UFSAR and FSAR Operating License SE	

SECTION	TOPICS	ASSIGNMENT
5. Control Room Habitability Performance Relative to Licensing Basis	Review of Normal and Emergency Operating Procedures Review of As-Built Control Room Envelope & Control Room Ventilation Systems	
6. Consistency of Control Room Habitability Assessment	Review Accident Analyses & Spectrum of Accidents Review licensing assumptions versus plant design, construction, and operating, test and surveillance procedures Review credit for mitigation features	
7. Identification of Plant-specific vulnerabilities to Control Room Habitability Issues	Unfiltered Inleakage LOCA Limited	

SECTION	TOPICS	ASSIGNMENT
8. Significance of Control room habitability		
9. Solutions to Control Room Habitability Problems	Sealing Control Room Envelope Revised Control Room Habitability Analysis Control Room Design Changes Procedural Changes Control Room Envelope Integrity Testing	

SECTION	TOPICS	ASSIGNMENT
10. Control Room Habitability Perpetuation Programs	Maintenance Sealing Operational Control Design Control Barrier Control Training Monitoring Technical Specifications	
11. References		
Appendices		
A. Regulatory Requirements & Guidance		
B. Description of Control Room Habitability Issues		

C. Licensing Basis History		
D. DBA Radiological Design Pararneter		
E. Control Room Habitability Analysis Conservatism		
F. Sample Calculations		
G. Atmospheric Dispersion		

H. Toxic Gas & Smoke Assessments		
I. Tracer Gas Testing Guidance		
J. Control Room Envelope Sealing Program		
K. Technical Specification		

PROPOSED AGENDA
CONTROL ROOM HABITABILITY
NRC/NEI MEETING
JANUARY 13, 2000

ITEM	TOPIC	RESPONSIBLE PARTY
1.	Opening Remarks	NRC/NEI
2.	Discussion of Meeting Goals	All
3.	Scope and Purpose of NEI 99-03	All
4.	Identification of Major Topics	NRC/NEI
5.	Contents of NEI 99-03 • Assessment Process • TF proposed revisions to NRC outline	NEI
6.	Definition of subgroups • Prior examples of collaborative NRC/industry efforts • Scope/Function/Responsibilities • Method of operation • Membership/Co-Chairs (NRC/TF)	All
7.	Program Schedule	All
8.	Next meeting • Subgroups • TF/NRC	All
9.	Review of Action Items	NRC/NEI
10.	Adjourn	

Attachment 4

Proposed Meeting Goals

- Reach agreement on the scope and purpose of NEI 99-03
- Reach agreement on an outline for NEI 99-03
- Define all technical and licensing topics
- Reach agreement on subgroup identities, function and method of operations
- Reach agreement on program and meeting schedules

Purpose and Scope of NEI 99-03

PURPOSE

This document provides guidance on how to demonstrate adequate protection of control room operators against the effects of ~~accidental~~ releases of toxic gases and radioactivity.

SCOPE

Each licensee has an approved licensing basis that describes the habitability of the control room envelope and addresses the features that protect the operator from the ~~accidental~~ releases of toxic gases or radioactivity. This document provides guidance for demonstrating the licensing and design bases ~~assumptions~~ associated with control room habitability (CRH) are satisfied in the design and operation of the facility. CRH, as discussed within this document, is the term describing the features assuring operators are adequately protected from a postulated toxic gas release or radioactivity from a postulated design basis accident.

The document:

a) Identifies the basis for control room habitability requirements,
b) Describes the review process to assess control room habitability and determine the significance of any discrepancies,
c) Provides options to address identified issues and discrepancies, and
d) Describes processes that might be used to monitor compliance with control room habitability requirements.

NEI CRH TF Systems Subgroup

A. CR Inleakage

I. Establish a consistent definition for CR envelope - The definition of CR envelope is defined specifically for each plant in its licensing/design basis. However, the document will provide items typically included in the control room envelope.

II. CR Vulnerability -
This document will provide a methodology to assess the specific plant vulnerability to inleakage. It will include the existing NEI 99-03 information and additional information provided by subgroup member experience along with plant experience from plants that have performed leakage testing.

Areas where a plant may be vulnerable:

1. Doors and door seals - Doors and seals should be periodically inspected and replaced as needed to assure minimum leakage passes that barrier.
2. Isolation dampers and damper seals - Dampers and seals should be periodically inspected and seals replaced as needed. Dampers should be cycled periodically to verify operability for proper opening and closing.
3. Electrical/conduit penetrations and seals - Seals should be periodically inspected and replaced as needed.
4. Adjacent spaces at higher pressures - Spaces adjacent to the control room, if at a higher pressure than the control room, can be sources of inleakage. The space pressure should be controlled, if possible, to be less than the control room pressure. However, other means may also be available to control inleakage from an adjacent space such as reducing the area common to control room and the adjacent space or providing tighter seals.
5. Ducting passing through the control room - Ducting passing through the control room should be sealed to minimize leakage or isolated as necessary.
6. Ducting and equipment that serves the control room located outside the control room boundary - Ducting and equipment should be sealed such that leakage is minimized.
7. Procedural controls on boundary integrity - Controls should be in place to identify and track breaches to the control room boundary. The controls should include verification that the breach was closed and the boundary returned to an acceptable leak tight condition.

8. Determination of a value for potential inleakage - Determination of a potential leakage value is time consuming and involves evaluating the entire boundary. This document will not determine such a value but will provide one or more methodologies that may be used in establishing such a value. This value could then be used for planning or determining future actions assuring control room boundary integrity.
9. General construction of pressure boundary - The construction of the control room boundary should be such that it can perform (i.e., not leak) at the required analysis values. It should be shown that the boundary can meet this requirement.

III. Methods to Determine Inleakage -

The NEI 99-03 document will provide methods available to measure and quantify control room inleakage.

Areas included:

1. Use of tracer gas to measure leakage - This is one acceptable means to demonstrate leaks, other alternative methods may be available.
2. Preparation for tracer gas tests - Industry experience in performing a test to determine (or verify) an inleakage value is invaluable in order to perform an adequate test. Providing this experience to those that have not previously performed this testing minimizes the potential for performing an invalid test and further assures that the correct inleakage value has been measured.
3. Other methods possible to measure leakage - Alternate testing possibly combined with inspections and/or analysis may be an acceptable means for establishing/measuring inleakage.
4. Comparison of calculated value versus measured value - Plants that have established calculated inleakage values and have tested to verify the inleakage coincides with the calculated value (with appropriate margin); may not need to retest the control room boundary. These plants may simply evaluate the condition of the boundary, within the guidelines of the calculation, and make a determination of the acceptability of the boundary.

IV. Periodic Demonstration and/or Verification of Envelope Integrity as Defined in the Design Basis -

The NEI 99-03 document will provide guidance on follow-up activities to assure control room envelope integrity is maintained.

Items of consideration in determination of need for periodic demonstration and/or verification of envelope integrity (individual items or various combinations of the items may be used in place of a periodic inleakage test)

1. Current Surveillance and/or other testing being performed - Initial inleakage testing should be compared to existing testing of the control room boundary. If it can be shown that the existing testing correlates to the initial inleakage test then additional periodic demonstration and/or verification of envelope integrity, other than current existing testing, may not be necessary.
2. Adequacy of initial inleakage determination - The initial inleakage determination should be performed for the configuration corresponding to the plant specific analysis. Provided the plant has determined the correct inleakage value, then it may elect to use a combination of inspections, other tests, and administrative controls to ensure boundary integrity is maintained.
3. Adequacy of boundary control procedures - Administrative controls that properly control the boundary configuration combined with existing surveillance and/or other testing correlated to the initial inleakage test may be acceptable to assure that boundary integrity is maintained.
4. Existing or proposed periodic maintenance - Routine periodic maintenance performed on the boundary may preclude the need for periodic demonstration and/or verification of envelope integrity. The maintenance activities would be used to ensure seals are sustained in a manner that assures minimum inleakage.

B. Toxic Gas

NEI 99-03 will provide guidance for determination of inleakage values for CRH and maintenance of control room envelope integrity and will use the same approach as for CR inleakage (vulnerabilities, testing, periodic testing).

Items considered for toxic gas will be same as for CR Leakage with the exception that evaluations are to be performed for the system response to toxic gas and not for radiological releases. Toxic gas (including smoke external to the CR) is a site specific issue. CR system line-ups for toxic gas response may be different then for radiological events (including anticipated Operator actions). The document will describe the fundamental differences in the system response for a toxic gas event versus a radiological release. In addition the document will also include guidance for addressing the management of the plant to assure that new challenges are identified as they occur in the area of toxic gas.

C. Unfiltered Inleakage Assumptions

Unfiltered Inleakage Assumptions -
This is covered under A. CR Inleakage above.

Analysis Working Group Summary of Technical Issues

The technical issues bearing on the demonstration of acceptable Control Room habitability include the following (reflecting both NRC and industry concerns):

Radiological Parameters and Assumptions Used in DBAs

1. Appropriate Levels of Conservatism in Assumptions and Analytical Approaches

- In general one must be certain that conservatisms and non-conservatisms have been appropriately recognized and balanced.
- One must establish an acceptable level of overall conservatism (e.g., a 95th percentile Control Room dose) and then examine all contributing factors to ensure that, at least approximately, that level of conservatism is being achieved but not greatly exceeded. This may be more important for Control Room analysis than for offsite dose analysis because of the greater number of steps involved in the Control Room dose analysis and, therefore, the greater potential for excessive conservatism.
- This issue applies in general to toxic gas and smoke intrusion into the Control Room as well as to radiological challenges. However, because the radiological challenges are more generic and universal, the radiological challenges should be treated in detail first.

2. Source Term-Specific Issues

- Pre-accident coolant activity levels should be based on an individual plant's operating data and trends of that data utilizing a statistical analysis.
- Spiking factors should recognize that, typically, the largest observed multipliers are found when the initial coolant activity is very low.
- Gap fractions for reactor transients with fuel damage and for fuel handling accidents are being re-examined as part of the comment process on DG-1081 - these comments should be factored into the Control Room habitability dose assessments.
- For fuel handling accidents, the relationship between burn-up and peaking factor should be taken into account when determining the gap activity in the damaged pins.

- Conservatism in assessing the number of failed pins in a fuel handling accident should be consistent with levels of conservatism in other aspects of the analysis.

3. Issues Related to In-Plant Transport and Release to Environment

- Containment leakage should be consistent with the expected containment pressure.

- Containment spray lambdas and mixing rates should take into account real phenomena like condensation on hygroscopic aerosols, convective mixing, and momentum transfer between spray droplets and the containment atmosphere.

- Suppression pool scrubbing credit should not be limited to BWR Mark III containments. Suppression pool scrubbing credit must account for the potential for suppression pool bypass and must use conservative (but not excessively conservative) flowrates from the drywell to the wetwell during core degradation.

- Credit for removal in secondary containment bypass pathways should be given.

- Mixing in secondary containments or other structures which can be assumed to remain intact post-accident should not be limited only to periods when negative pressures have been achieved or only when such mixing is achieved by mechanical means (i.e., by ventilation and exhaust systems).

- Partition coefficients for radioiodine should reflect iodine chemistry as understood in light of its principal form being that of a cesium salt. This recognition affects both the ultimate iodine DF inside containment and the partitioning of iodine from leaked reactor coolant outside containment (i.e., as an option to using the SRP's 10 percent iodine release assumption).

- The assumption that consideration of a passive failure (leading to a 50 gpm leak for one-half hour beginning at 24 hours following the start of the accident) is necessary only for those plants with potential leak points not being served by Safety-Related filtered exhaust systems is inconsistent and unnecessary. Such a failure is extremely unlikely and can likely be dismissed on probabilistic grounds in terms of impact on Control Room dose whether or not the area is served by Safety-Related ventilation.

- Small LOCAs would not be expected to exhibit the same core damage and fission product release timing as large LOCAs, and this fact should be considered when assessing the impact of manually-actuated containment sprays for such events. This is true for the special case of a rod ejection accident (REAs). REAs leading to fuel damage, as a special case of a small LOCA, are considered extremely unlikely and can likely be dismissed on probabilistic grounds in terms of impact on Control Room dose.

- Trapping of radioiodine in OTSGs should be considered.

- For fuel handling accidents, even those involving high burn-up fuel, substantial pool DFs for radioiodine and other fission products are expected and should be credited. Pool pH, the chemical form of the iodine released, and the presence of surrounding structures, with or without Safety-Related ventilation, should be considered when determining the fuel pool DF.

ARCON96

<u>1. Percentile Dispersion</u>

- X/Qs calculated using ARCON96 (as well as those calculated using Murphy-Campe) should be considered acceptable. The use of 95th percentile values (for both Murphy-Campe and ARCON96) should be employed only when the release to the environment is approximately a mean value so as to yield approximately a 95th percentile dose.

<u>2. Mechanically Elevated and Mixed-Mode Releases</u>

- Mechanically elevated and mixed-mode releases should be considered, especially those involving high temperatures and near-sonic velocities, such as those from a PWR ADV.

<u>3. Use of Wind Tunnel Data to Complement (or As an Altenative to) ARCON96</u>

- Wind tunnel-developed X/Qs should be considered. If there are exceptions to the acceptability of wind tunnel-developed X/Qs, these exceptions should be explained so that they may be addressed.

Dose Assessment

1. Operator Exposure

- ICRP-30 dose conversion factors are acceptable.

- Occupancy factors determining the most-exposed operator should consider actual plant staffing plans and expectations, measured doses to individual operators, and movement to and from the Control Room.

2. Dose Limits to Control Room Operators Consistent with Protecting Public Health and Safety

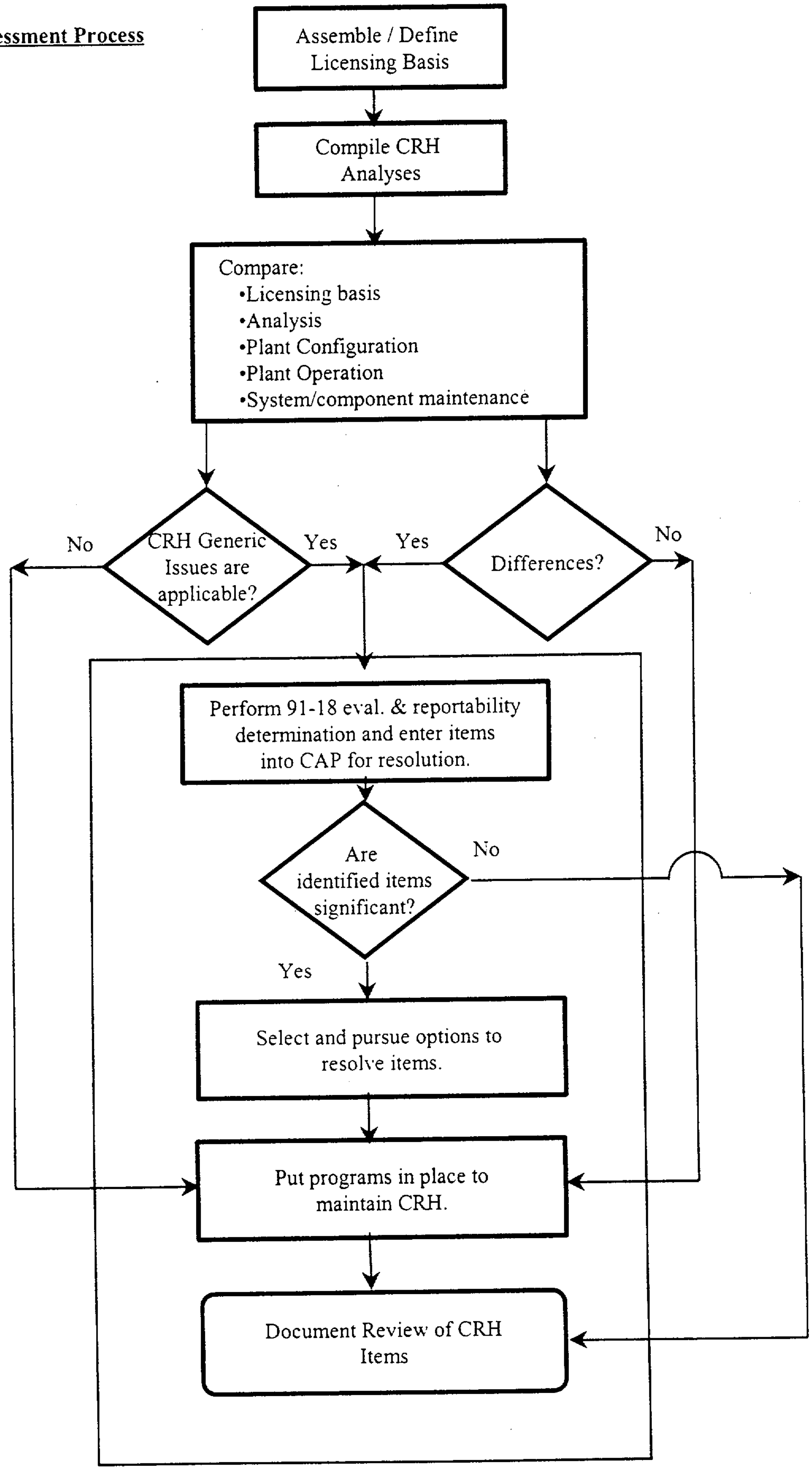
- Five rem whole body or the equivalent dose to any part of the body is the current dose limit for the most-exposed Control Room operator.

- TEDE is an appropriate dose measure if all potentially dose-significant radionuclides are included in the dose analysis.

- If thyroid dose is used as the dose measure, then 50 rem or greater thyroid is more closely equivalent to five rem whole body than is the 30 rem thyroid from the SRP.

This summary is intended to provide a starting point for discussions with an NRC working group regarding the appropriate level of conservatism to be included in a Control Room radiological dose analysis as well as the appropriate methods and assumptions one would employ to be consistent with that level of conservatism. This discussion can then be extended to toxic gas and smoke intrusion, the completeness of the scope of accidents which should be considered in a Control Room habitability assessment, and the need for further assurance that the analysis input assumptions are correct.

CRH Assessment Process



Section/Topics

1) Introduction

- a) Purpose
- b) History
- c) Scope
- d) Organization

2) Regulatory Requirements and Guidance for Control Room Habitability

- a) GDC 19
- b) TMI Action Item III.D.3.4
- c) SRPs 2.2.1-2.2.3, 6.4, 6.5.1
- d) Regulatory Guides 1.52, 1.78, 1.95

3) Generic Issues Associated with Control Room Habitability

- a) Unfiltered In-leakage
- b) As Described In UFSAR is not the same as As-Built
- c) Analyses do not reflect As-Built, As-Operated
- d) DBA Scope

4) Determine Licensing Basis for CRH

- a) TMI Action Item III.D.3.4 response
- b) Recent Amendment Submittals and Associated NRC SEs
- c) UFSAR and FSAR
- d) Operating License SE

5) Compare existing plant configuration and operations with licensing bases for CRH.

- a) Review Normal and Emergency Operating Procedures affecting CRH
- b) Review As-Built Control Room Envelope and Control Room Ventilation Systems

6) Compare the Control Room Habitability Analyses with the Licensing Bases and Plant Configuration / Operation

- a) Determine consistency between the assumptions and plant design, construction and operating, test, and surveillance procedures.
- b) Determine credit assumed for mitigation features.
- c) Evaluate the consistency between CRH and the licensing basis

7) Identify plant specific vulnerabilities to Control Room Habitability Issues (Item 2)

8) Evaluate the significance of all identified issues (items 5 through 7) law corrective action program.

9) Potential options to address Control Room Habitability Issues

- a) Existing CRE Maintenance Program
- b) Sealing Control Room Envelope
- c) Perform a new Control Room Habitability Analysis (dispersion coefficients, alt source terms, limiting accident, etc)
- d) Control Room Design Changes / Procedure Changes
- e) Perform Test of Control Room Envelope Integrity

10) Potential and Existing Programs for Maintenance of Control Room Habitability

- a) Maintenance Programs (sealing)
- b) Design and Operational Control Programs (barrier control)
- c) Training in Control Room Habitability Issues
- d) Periodic Monitoring to identify CRH degradation.

11) References

Appendix A – Regulatory Guidance and Requirements

Appendix B – Generic Issues

Appendix C – Licensing Basis History

Appendix - DBA Radiological Design Parameters

Appendix - CRH Analysis Assumption Conservatisms

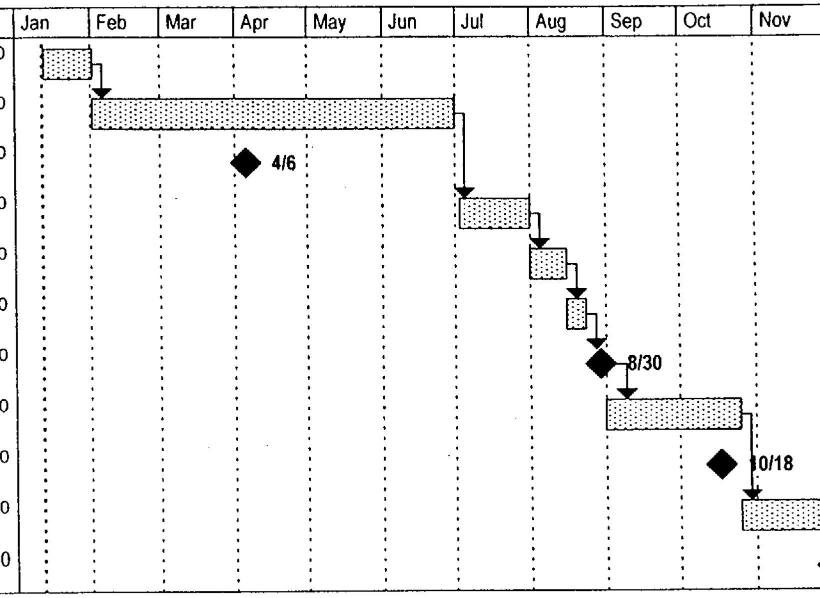
Appendix - Sample Calculations

Appendix - Atmospheric Dispersion

Proposed Subgroups

- **Systems Subgroup**
  - Responsible for addressing technical issues dealing with plant design, operation, and testing.
- **Analysis Subgroup**
  - Responsible for addressing technical issues related to radiological assessment, meteorology, and accident analysis.
- **Design Basis / Licensing Subgroup**
  - Responsible for addressing licensing issues and revising NEI 99-03, as required.

ID	Task Name	Duration	Start	Finish
1	Define issues and protocol for NRC/NEI interactions	14 days	Thu 1/13/00	Tue 2/1/00
2	Subgroup meetings to resolve issues and draft sections of NEI 99-03	108 days	Wed 2/2/00	Fri 6/30/00
3	Determine if adequate progress is being made to continue	0 days	Thu 4/6/00	Thu 4/6/00
4	Design Basis Subgroup Assembles Revised NEI 99-03	21 days	Mon 7/3/00	Mon 7/31/00
5	CRTF reviews and comments on Revised NEI 99-03	11 days	Tue 8/1/00	Tue 8/15/00
6	NEI incorporates appropriate comments from CRH TF	6 days	Wed 8/16/00	Wed 8/23/00
7	CRH TF Meeting to review revised documents	0 days	Wed 8/30/00	Wed 8/30/00
8	Industry reviews revised NEI 99-03 and provides comments to NEI	39 days	Fri 9/1/00	Wed 10/25/00
9	Possible Industry Workshop	0 days	Wed 10/18/00	Wed 10/18/00
10	CRH TF reviews industry comments and revises NEI 99-03	27 days	Thu 10/26/00	Fri 12/1/00
11	Submit Revised NEI 99-03 to the NRC for formal review	0 days	Fri 12/1/00	Fri 12/1/00



Project: CRH (NEI 99-03) Schedule Pr
Date: Wed 1/12/00

Task | Split | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Split | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary