UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 23, 2000

MEMORANDUM TO: Cynthia A. Carpenter, Chief
Generic Issues, Environmental, Financial
and Rulemaking Branch
Division of Regulatory Improvements Programs, NRR

FROM: Joseph L. Birmingham, Project Manager
Generic Issues, Environmental, Financial
and Rulemaking Branch
Division of Regulatory Improvements Programs, NRR

SUBJECT: SUMMARY OF FEBRUARY 1-2, 2000, MEETING WITH THE NUCLEAR ENERGY INSTITUTE (NEI) REGARDING CONTROL ROOM HABITABILITY AND NEI 99-03

On February 1-2, 2000, representatives of the Nuclear Energy Institute (NEI) Control Room Habitability Task Force met with representatives of the Nuclear Regulatory Commission (NRC) at the NRC's offices in Rockville, Maryland. Attachment 1 provides a list of attendees.

Introductory remarks were made by Kurt Cozens of NEI and Mark Reinhart of the NRC. Agreement was reached on the structure and the protocol for the two days of meetings. Following the introductory remarks, the attendees divided into three subgroups for discussion. These subgroups were structured to cover issues associated with control room analyses, design & licensing bases and ventilation systems. Industry Chairmen for the Subgroups were John Cotton - Analysis, John Duffy - Design Basis/Licensing, and Bob Campbell - Systems. The NRC liaisons in these areas were Mark Blumberg, Steve La Vie and Harold Walker, respectively. Attachments 2-4 are copies of the NEI agendas for the Analyses, Design Basis/Licensing and Systems Subgroup meetings, respectively. Attachments 5-6 present a summary of Systems Subgroup and the Analyses Subgroup meetings, respectively, as prepared by the NEI Control Room Habitability Task Force Subgroup Chairmen. Attachment 7 is a summary of the Design Basis/Licensing Subgroup meeting and was prepared by the NRC liaison.

During the two day meeting the NRC provided the drafts of documents that would provide guidance on the use of the ARCON96 atmospheric dispersion computer program and that detail NRC expectations regarding licensee's accident analyses. These two documents are provided as Attachments 8 and 9 respectively. Within the Design Basis/Licensing Subgroup meeting, a figure outlining the Control Room Habitability Assessment Process was also distributed. This figure is included as Attachment 10.

Project No. 689
Attachments: As stated
cc w/att: See list

During the two day meeting the NRC provided the drafts of documents that would provide guidance on the use of the ARCON96 atmospheric dispersion computer program and that detail NRC expectations regarding licensee's accident analyses. These two documents are provided as Attachments 8 and 9 respectively. Within the Design Basis/Licensing Subgroup meeting, a figure outlining the Control Room Habitability Assessment Process was also distributed. This figure is included as Attachment 10.

Project No. 689
Attachments: As stated
cc w/att: See list

DISTRIBUTION: See list
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Attachment 1

List of Attendees
NRC/NEI Meeting on NEI 99-03
February 1-2, 2000

Name	Organization
John Hayes	NRR/DSSA/SPSB
Nick Trikouros	GPU Nuclear
Jim Metcalf	Polestar Applied Technology
Gopal Pacci	Nucore Consulting
Lenny Azzarello	Duke Energy - Oconee
Kurt Cozens	NEI
David Black	Wisconsin Electric
Ken Taplett	STPNOC
Robert Burley	Duke Power
Robert Campbell	TVA Corporate
Mark Blumberg	NRR/DSSA/SPSB
Steve LaVie	NRR/DSSA/SPSB
Jason Schaperow	NRC/RES
Leta Brown	NRR/DSSA/SPSB
Steve Leonard	Niagara Mohawk
Steve Thomas	NSP
John Wynn	BGE
Jerry Buford	Entergy
Jerry Gryczkowski	BGE
Bernie Jwaszewski	Vermont Yankee
David Distel	PECO Nulcear
Everett Whitaker	TVA
John W. Cotton	Entergy
John Duffy	PSE&G
Mike Ruby	Rochester Gas & Electric
Thomas Mscisz	PECO/AmerGen

List of Attendees (Cont.)
NRC/NEI Meeting on NEI 99-03
February 1-2, 2000

Mark Salley	NRR/DSSA/SPLB
Mark Reinhart	NRR/DSSA/SPSB
Kris Parczewski	NRC/DE/EMCB
Jerry Kloecker	VA Power
Norman Wolfhope	VA Power
Syed Ahmed	VA Power

PROPOSED AGENDA
ANALYSES SUB GROUP MEETING

1. Introductions

2. Discussion of Meeting Goals

3. Discussion of what product of Analyses Subgroup will be :
   a. Review draft outline of NEI 99-03
   b. Discuss what form these Appendices will take
   c. Discuss anticipated direction/approach of NEI 99-03

4. Appropriate Levels of Conservatism in Assumptions and Analytical Approaches
   - Task Force paper
   - NRC feedback
   - Discussion
   - How is this to be used in 99-03?
   - Outline plans for this issue

5. Meteorological Issues
   ARCON96, Murphy Campe etc.
   - NRC Guidance document concerning ARCON96 (to be supplied by NRC)\
   - Assess Resource and Expertise needs
   - What is appropriate level of guidance to give within NEI 99-03 on X/Qs?
   - Outline plans for this issue

6. Breakout Groups
   - Establish participants and logistics
   - Agenda for Breakout Groups Attached

7. Brief by Breakout Groups

8. Summary/review of meeting and action items

Attachment 2

Issues Associated with Different Topics

Radiological Dose Assessment

Dose Assessment

TEDE an appropriate dose measure if all significant isotopes considered
50 Rem (or greater) to thyroid is better than SRP 30 Rem thyroid
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.

Radiological Parameters and Assumptions Used in DBA's

A. Source Term Specific Issues

Iodine Spiking : magnitude, initial conditions, duration
GAP Fractions for Transients with fuel damage or for fuel handling accidents
Relationship between burn-up and peaking factor for determining the gap activity
Conservatism in assessing number of damaged pins in FHA

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

Containment leakrates consistent with expected containment pressure
Containment spray lambdas and mixing rates
Suppression Pool Scrubbing credit
Credit for removal in secondary containment bypass pathways
Mixing in Secondary containments
Partition coefficients for iodine (DF in containment, partitioning in ESF leakage)
50 gpm passive failure assumption
SBLOCA fuel damage and timing should be considered when evaluating manual spray actuation
Is Control Rod Ejection Accident an appropriate accident
Trapping of radioiodine in OTSGs
FHA pool DFs

Guidance for Justified Continued Operation Determinations

Balanced consideration of conservatisms and non-conservatisms necessary (both in Regulatory Guidance and Plant Design and Assessment)

Atmospheric Dispersion

- NRC Guidance document concerning ARCON96 (to be supplied by NRC)\
- What is appropriate level of guidance to give within NEI 99-03 on X/Qs?

- Use of wind tunnel data to complement (or alternative to) ARCON96, Murphy-Campe
- There are many issues associated with assessing X/Q's for the various release paths : Reactor Building leakage, ADVs, MSSV's, fuel handling ventilation exhaust stacks, penetration room exhaust stacks. (Mechanically Elevated Releases, Mixed Mode Releases)
- Restrictions/requirements for meteorological data to be used for ARCON96 or other methodologies
- Amount of data, format of data, TS requirements on Meteorological Tower

- What method to use for puff releases (FHA, toxic gas)

PROPOSED AGENDA
CONTROL ROOM HABITABILITY
NRC/NEI MEETING
DESIGN BASIS/LICENSING SUBGROUP
FEBRUARY 1 - 2, 2000

Purpose: Initiate discussion on control room habitability design basis and licensing basis issues at nuclear power plants

Desired Outcomes:

- Agree on the purpose & scope of the tool for NEI 99-03
- Agree on the outline or framework of NEI 99-03
- Concur on subgroup responsibilities
- Establish NEI 99-03 criteria for addressing:
  - Toxic gas & smoke generic issues
  - Determining the generic nature of the adequacy of existing accident analyses
  - Determining the generic nature of the TMI Action Item III.D.3.4
  - Need for additional generic guidance in plant technical specifications

Attachment 3

AGENDA

FEBRUARY 1

9:30 a.m. – 4:30 p.m.

ITEM	TOPIC	Responsible Party
	Welcome and Opening remarks	NRC Liaison /TF chair
	Agree on NEI 99-03 Purpose & Scope • Define future actions and schedule	All
	Agree on NEI 99-03 Outline • Determine action plan Define future actions and schedule	All
	Determine Subgroup responsibilities • Define future actions and schedule	All
→	Define NRC's concern regarding toxic gas and smoke relative to NEI 99-03 • Define future actions and schedule	All
	Review action items	All
	Adjust second day agenda, as appropriate	NRC Liaison /TF chair

FEBRUARY 2

8:30 a.m. -- 3:30 p.m.

ITEM	TOPIC	Responsible Party
	Review first day's results	NRC Liaison /TF chair
→	Determine if inadequate accident analyses is a generic issue that should be in the scope of NEI 99-03 • Define future actions and schedule	All
→	Determine if TMI Action Item III.D.3.4 is a generic issue that should be included in NEI 99-03 • Define future actions and schedule	All
→	Define need/benefit of defining generic Technical Specification section for NEI 99-03 • Define future actions and schedule	All
	New Business	All
	Define topics for next NEI/NRC Subgroup meeting (February 29 & March 1) • Define future actions and schedule	All
	Review action items	NRC Liaison /TF chair
	Adjourn to full NRC/TF meeting	All

February 1, 2000
NEI TF on CRH (with NRC participation)
Proposed Agenda - Meeting 1
Two Day Meeting w/NRC (2/1-2)
One Day Meeting w/NEI TF (2/3)
Systems Subgroup

Item	Topic (for meeting w/NRC)
1	Introductions - Items to consider is background, experience with CRH issues, brief summary of the plant each of us represents, why we are on the task force, etc.
2	Logistics of Meetings - #1
3	Review of Systems Subgroup Scope/Responsibility - #2
4	Identification of Systems issues/concerns (Existing meeting notes provided a listing of items to be discussed; 59 items) Review existing issues/concerns - #2 Identify any new issues/concerns - #2
5	Identification of Toxic gas/smoke issues/concerns (Existing meeting notes provided a listing of items to be discussed; 8 items) Review existing issues/concerns - #2 Identify any new issues/concerns - #2
6	Determination if toxic gas/smoke should be within Systems Subgroup
7	Discussion of Tracer Gas Testing and Alternatives
8	Action items and assignments
9	Future meeting goals and schedule

What we will do to foster a team atmosphere and the needed ground rules to ensure a team atmosphere. Example, ensure that we can communicate with the NRC directly via E-Mail, phone calls, etc. It is very important that everyone comes into the meetings with an open mind.

Within the Scope of NEI 99-03, what are the issues that we are trying to resolve. This also implies clearly defining the issue/concern. For example, we need to try and nail down what the toxic gas concerns are. This is also to include identifying differences between NRC/Industry views on each issue/concern. See attached listing of issues previously identified)

Issues Previously Identified

Identification of Systems issues/concerns

Verification of control room and control room ventilation system design and operation relative to the licensing basis.

With regard to the Staff's recommendation that requirements for periodic demonstration of control room envelope integrity be incorporated into technical specifications (TS), industry does not consider this necessary. (In a November 18, 1998 letter to NEI, NRC had reiterated its belief that periodic tracer gas tests would provide a valuable tool for assessing control room integrity.)

If the study indicates the licensing limits are being approached, extra maintenance should be performed, such as sealing around ducts, vents, etc. As a last resort, if the study indicates a reasonable possibility that the licensing limits will be exceeded, then consideration should be given to conducting a tracer gas test (ASTM E741) to establish the actual inleakage.

Does the NEI document provide guidance on how to fit the test results to a licensee's plant-specific situation? For example, if you follow the recommended maintenance practices, etc., you do not have to proceed to the ultimate step of performing the test? Following more discussion along these lines, Barrett finally suggested that perhaps the industry had collected more substantive data than seemed apparent by looking at the slide. Reinhart admitted to still being confused since the nine plants who did the test had all passed the TS operability requirements, etc., yet all failed the tracer gas test; therefore, there seems to be a disconnect between what the TS say versus what the integrity of the control room really is.

Another item to consider is to include the potential for misadjusting flow dampers that end up affecting control room pressure.

Changes agreed to were that the systems subgroup would not provide a 'definition' of CRH but a 'description' of CRH (suggested by Jack Hayes).

The guidance should include an improved description of ventilation system configurations, operational modes and susceptibility to inleakage.

Guidance must be provided on how licensees will initially and periodically demonstrate control room integrity for toxic gas and radiological events.

The NRC staff acknowledged that methods other than tracer gas testing could be used to demonstrate acceptable control room habitability. However, at this time the staff is unaware of an acceptable alternative. The burden will be on industry to demonstrate the adequacy of alternative methods.

Examine plant specific vulnerabilities based on system configurations and past operating experience, including tracer gas tests.

Make sensible choices regarding which plants need to do periodic control room assessments and identify an appropriate evaluation method, tracer gas or another appropriate alternative, to demonstrate conformance to the regulatory criteria.

In their introductory remarks the staff commented that we first need to set an appropriate level of safety for control room habitability and that the industry then needs to provide an appropriate way to demonstrate that they meet that level of safety. In all cases, it must be clear to the public that protection of the control room operators is both important and required.

Industry indicated that their re-assessment of NEI 99-03 had determined that they believed that the document should identify the vulnerability of a plant design to inleakage and then, based upon the facility's dose assessment, determine how much inleakage can be tolerated and still meet the licensing basis. Based upon those two considerations, a choice would be made as to the manner of demonstrating integrity. The staff responded to this proposal by indicating that, while feasible, it is imperative that licensees have reviewed the spectrum of accidents to assure that they have determined that limiting conditions have been addressed and that the analyses, which have been performed, reflect plant design, operation and configuration. In addition, licensees' assessments need to incorporate the lessons learned from the tracer gas tests.

Look at plant-specific vulnerabilities based on past operational experience, including tracer gas testing.

Make sensible choices regarding which plants need to do periodic tracer gas testing and which ones can do less

Information needs to be as complete as possible. Control room envelope sometimes includes cable spreading room, computer rooms, mechanical equipment rooms and the TSC.

Table 2.1.1.1 needs to be reviewed to assure that it includes the correct data.

There needs to be a basis for the statement that the data from Table 2.1.1.1 is justification for a screening process to determine the adequacy of plant specific surveillances and control room envelope integrity control and sealing programs. How many of the plants in the Table have been operating for a refueling cycle and have retested their control room to determine degradation with time?

Figure 2.1.1-1 only identifies leakage associated with ventilation systems. It ignores inleakage associated with penetrations, ductwork passing through the control room envelop, the boundary itself, and doors. Figure is not typical of most systems relative to ESF filter fan location. Change in location changes susceptibility to inleakage.

Figure 2.1.1-2 is not typical as noted in the item above and contains some errors.

Challenges associated with smoke and fire suppressants have been ignored. They need to be addressed.

It appears that the document ignores the fact that 20% of the industry has tested their control rooms and none have met their licensing basis.

If you have a control room envelope susceptible to inleakage how do you define an appropriate value for inleakage without testing. (2.3.1.1c.)

Table 2.3.1.1-1 ignores sealing of AHUs. Gives too much credit for visual inspections and smoke tubes. Only gross leakage results in audible leaks.

Depiction of control room emergency ventilation systems does not represent most of the operating systems in the US. Most of the fans associated with ESF filter systems are located downstream of the filter unit rather than upstream. Consequently, a common source of unfiltered inleakage has been overlooked. In addition, even if the fans were located upstream of the filter unit you may still have inleakage pathways if you have ductwork with such a system is located outside the envelope and is at a lower pressure than the air in that room.

The statement is made that for those ESF systems which are located entirely within the control room envelope "there are no potentially adverse leakage paths." This statement is not true if either of the following situation exists and it may not be applicable to other situations. If you have ductwork which passes through the room associated with the ESF equipment and this ductwork conveys air from an area outside the control room and is at a higher pressure than the air in this room, then that air will leak from the ductwork into the room and can be conveyed by the ventilation system. The second case occurs if you have a part of the control room envelope which is at a lower pressure than the surrounding contaminated area. Outside leakage will occur into that area and will be conveyed to the remainder of the control room envelope via the ventilation system.

There are certain axioms that are put forth as truths which are not. One example is that a pressurization test is a demonstration of control room envelope integrity. It is not. It is a demonstration that the source of the air was outside the envelope. Another is that the increase or decrease in pressurization flow is not an indication of either a loss or a improvement in control room envelope integrity. Document must be judicious with respect to its statements.

It does not appear that AG-1 contains the guidance for verification of ductwork or envelope integrity implied by C.2.1.3. Tests performed in AG-1 are not on a dynamic system which exists during control room ventilation system operation. Such guidance has yet to be developed.

Table C.2.3.1-1 should incorporate the following: item 1 should indicate with respect to adjacent areas.; Item 2 has no bases and should be eliminated.; On Item 3, you can have large volume AHU fans which continue to operate during an emergency and which can draw air from isolated duct lines. In addition, one might have to be concerned about an isolated ductwork being a conveyance vehicle for unfiltered inleakage due to natural convection.

Presence of Item 4 does not guarantee whether you are susceptible to unfiltered inleakage if you have not made a measurement to determine potential sources to begin with. It is a way to minimize inleakage once you have identified the potential sources.

Question for Item 5 should be, "Are areas adjacent to the control room envelope at a higher pressure than the control room envelope?"

Point of Item 6 is not understood. If the area adjacent to the control room envelope is at a negative pressure relative to the control room envelope, how is inleakage going to be a problem?

Item 8 should not exclude seam-welded ductwork. If a fan is also located outside the envelope, the fact that the ductwork is seam-welded may not eliminate inleakage.

Whether your existing dose assessment reflects the most limiting accident is no indication of the susceptibility of the control room envelope to inleakage.

Table has excluded such potential sources as wall penetrations, isolated ductwork with high volume air handling units, systems with single isolation dampers and/or louvered isolation dampers.

Statement which follows Table C.2.3.1-1 indicates that the answers to the questions in the Table are the basis for determining whether a tracer gas is required. That doesn't seem to fit based upon the title of the Table.

There is no basis for assuming unfiltered inleakage is 335 cfm or that infiltration is 500 cfm based upon having a control room envelope integrity control and sealing program unless there is some testing to determine what the inleakage even is. These values were determined after control room envelope integrity was determined, sources of inleakage identified and the control room envelope sealed. It should be noted that for some licensees, assumption of the above values would result in consequences which would be unacceptable relative to GDC 19.

Derivation of the numbers for unfiltered inleakage and infiltration is questionable. It appears that a number of those facilities with large values for inleakage were excluded. An example is Plant A in Table 2.1.1.1. It was indicated that this source was excluded because it had not done sealing. It has done some sealing and it has assumed a value of 3000 cfm. It will be retesting its control room by the end of the year. Plant J replaced their control room ventilation ductwork because it was rusted out. It was retested. Plant L was excluded because it did not perform a sealing program prior to testing.

Look at plant-specific vulnerabilities based on past operational experience, including tracer gas testing.

There is a concern by the staff that licensees will utilize the conservative factors without recognizing whether such conservatism may even apply to their application.

Licensees need to utilize the information in this Chapter with discretion. It cannot be presumed because their analyses include the particular parameter that their calculations are conservative by the factors given

Description of control room envelope integrity,

EOPs & NOPs ≠ As Operated

Review of As-Built Control Room Envelope & Control Room Ventilation Systems

Sealing Control Room Envelope

Revised Control Room Habitability Analysis

Control Room Design Changes

Procedural Changes

Control Room Envelope Integrity Testing

Maintenance

Sealing

Operational Control
Design Control
Barrier Control
Training
Monitoring
As Built ≠ As Described
Analyses not reflective of As-Built and/or As-Operated
Other NUREG-4960 Issues

Identification of Toxic gas/smoke issues/concerns

For toxic gas exposure, conservatisms are estimated to be approximately 1 order in magnitude. NEI has concluded that the identified issues are not near-term safety concerns.

The Staff questioned the conclusion that, for toxic gas, you can continue to operate the plant. Blumberg asked if non-conservatisms had been reviewed, e.g., timing -an instantaneous release equals zero. Industry representatives countered that frequently something that appears to be non-conservative actually turns out to be conservative. In fact, the more complex the safety assessment, the greater the total conservatism because conservatism is introduced at each step in the process.

The staff believes that a greater emphasis in terms of resources and effort must be put into the control room habitability aspects of toxic gas and smoke challenges. The staff believes that these two challenges have the potential for the most immediate impact upon operations with the most serious ramifications on public health and safety. These two areas should not be an after-thought. We would suggest that special emphasis be placed in these areas.

To date no licensee has been afforded credit for toxic gas removal through the use of charcoal or some other type of adsorber. Inference in item 9 of C.1.3 is incorrect. Mass flow balancing during startup testing is not a means of measuring inleakage if the mass which you are measuring is the mass in the various control room ventilation ductwork. You have to consider control room envelope inleakage as well as inleakage from ductwork not associated with the control room ventilation systems. (C.2.1)

Further explanation needs to be provided on Item 7 as to how the presence of a toxic gas control program and/or a toxic gas isolation triggered by a toxic gas monitor defines a control room envelope as not being susceptible to unfiltered inleakage.

Most control rooms which have performed tracer gas tests to determine control room envelope integrity have not tested in the toxic gas mode. There is a need for this.

SRP guidance for toxic gas challenges is incomplete. Missing is SRP sections 2.2.1-2.2.3.

No regulatory guidance on toxic gases in Section A.2 yet in appears in Section A.3. Similar examples exist for radiological accident guidance.

Attachment 5

NEI CONTROL ROOM HABITABILITY TF (With NRC participation)
Systems Subgroup Meeting
February/1-2/2000
NRC Offices (Rockville)

Attendees
Robert Campbell, TVA
John Segala, NRC
Jerry Kloecker, Virginia Power
Harold Walker, NRC
Janak Raval, NRC
Mark Henry Sally, NRC (pt)
Khris Parczewski, NRC (pt)
Jack Hayes, NRC (pt)
Steve Thomas, Northern States Power
Robert Burley, Duke
John Wynn, Baltimore Gas and Electric
Bernie Jwaszewski, Vermont Yankee
Kurt Cozens, NEI
Mark Reinhart, NRC (pt)

Minutes

Introductions of the attendees were made. Jack Hayes provided a background on control room habitability issues and the major topics concerning habitability. Logistics of the meetings were discussed and it was emphasized that the meetings are to be open with a free exchange of information. It was also emphasized that issues concerning the systems portions of habitability were to be brought to the table and addressed. It is unacceptable to hold back issues if they are known. The systems portion of NEI 99-03 is to contain the right information to address control room system problems/topics/concerns. The list of items already identified were then reviewed (by both NRC and Industry - with both agreeing on category) and placed in the following categories. The subgroup agenda contained the list of items.

All items/topics were sorted by categories. The categories which were developed are noted below. The categories were then reviewed with respect to resources needed to resolve the topics with the rankings classified as low, medium, or high.

Scope (medium)
Testing (high)
Maintenance (low)
Operation/ configuration control (medium)
Vulnerabilities (high)
Smoke (medium)
Training (low)
Toxic Gas ((medium)

Items deleted

Other groups will handle/address the following topics: 40, 41, 46, 58 ***(Refer to the Systems Group Agenda to associate a topic with the number)***

NUREG CONTROL ROOM/3786 and NUREG CONTROL ROOM/4960 were discussed to determine if issues were contained with the NUREGs that the systems Subgroup need to address.

There is an analysis side and a systems side to the issues of toxic gas and smoke. The systems subgroup will needs to be looking at the systems and its response to the toxic gas. The smoke issue will require further discussion as to whether it is a control room habitability issue or a fire protection issue. Mark Sally, NRC, made a presentation on smoke and fire protection. Some highlights of the presentation included information on opening and closing of doors and the CFM associated with such operations may be found in NFPA documents. The subgroup will review the NFPA documents. Fire sealed penetrations may not be leak tight.

The document ISO/DIS 14644 - clean rooms standard made provide information on how other industries test areas similar to control rooms. This document will be reviewed by the subgroup.

Tracer gas testing and alternatives

A specific example of the control room testing was discussed to illustrate problems with control room boundary testing. A schematic of the example system was drawn and specifics of the testing described. One alternative discussed centered around the concept that the control room boundary may be broken into smaller volumes and each volume tested separately. It was noted there are three types of testing to measure leakage: tracer gas, flow measurement with pressurization, and pressure decay. The tracer gas, pressure decay, and flow tests can be performed at either a positive pressure or negative pressure.

There will have to be positive proof using a qualified test that performing a positive pressure test on the control room boundary is an acceptable means of showing that inleakage is not a concern.

Another discussion item is the pressure gradient of the plant. Pressure gradients and wind conditions may also have to be explained. Additionally the opening and closing of doors can affect the testing of the control room and the value measured for control room inleakage

The subgroup needs to explore the limits of tracer gas and have its limits discussed (error at low values) plus capability of the test and applicability of the test. There needs to be a critical look at the ASTM E741 document and then see if it is being applied properly.

Attachment 6

Summary of NEI Control Room Habitability Analysis Sub-Group Meeting

Tuesday February 1, 2000

- Appendices envisioned as an outline of accident analyses
- Identify accidents
- Breakdown into individual parameters as before
- Discuss each parameter as far as realistic values (for JCO) and acceptable values for safety analyses for design bases purposes.
- Realistic values should address conservatisms and non-conservatisms.
-
- Paper on Acceptable Level of Conservatism
  Discussed paper by Jim Metcalf that 90 percentile dose is achieved through use of mean source term and mean in plant transport values, if a 95 percentile X/Q is used. NRC staff statisticians said to disagree with approach. They feel only valid for cases where all values have centrally located mean. Much work would be required to come to full agreement with this issue. A more rigorous source term to dose Monte Carlo analysis would be required to support this strategy.

- Discussion on ARCON96
  Discussion of use of wind tunnel data to adjust X/Qs
  Discussion of considering Atmospheric Dump Valves and Main Steam Safety Valves, as elevated releases

- NRC Comments about Technical Issues list
  NRC feels that easiest issues are those which have been worked on for alternate source term which don't rely too exclusively on the new chemical forms inherent in the new source term. Suggests that DG-1081 be reviewed for possible applications of this approach.

  Issues NRC feels are more likely to be resolved:
  a. DG-1081 approach on determining fuel damage via enthalpy vs. DNBR should offer relief for plants on seized rotor and possibly MSLB accidents.
  b. NRC willing to raise thyroid limit to 50 Rem for TID. TEDE may be used in conjunction with new source term. To use TEDE with TID source term would require rulemaking
  c. ICRP30 DCFs are acceptable to Staff
  d. ARCON96 is acceptable within constraints defined in recent NRC guidance document
  e. NRC open to considering removal of requirement to take passive failure 24 hours after a LOCA (50 gpm seal leak for 30 minutes)

A discussion of initial responses by staff to list of technical issues submitted by task force

1. Fuel handling accident issues: Many issues have been wrestled with concerning burnup beyond Regulatory Guide 1.25 limitations. NUREG-5009 assumptions about gap fractions as a function of burnup are being revisited, so consider these assumptions as under revision. NRC staff not in agreement that relationship between radial peaking factor and burnup provides margin, that the available margin on this and other issues has been used up to justify extended burnup. Industry and NRC agree to detail these issues more.

2. Staff does not agree that dose is more universal than toxic gas.

3. Containment leak rates as a function of expected versus design pressure: may require demonstration. Test leak rate at different pressures. Some leaks may get worse at lower pressures, and tend to seal at higher pressures.

4. Spray lambdas: Staff feels that its important to not apply insights based on chemistry of new source term to TID-14844. If you want benefit of cesium iodide, pursue it through alternate source term.

Wednesday February 2, 2000

I. Staff shares with Task Force a draft copy of ARCON96 Guidance document and another draft guidance document on preparations of submittals addressing dose assessment and control room habitability. It is expected that NRC will publish these documents as an Attachment to the meeting minutes

II. Iodine Spiking Issues (Continued from previous days discussion)
Jack Hayes addressed the sub-group to provide background on iodine spiking issues. Discussed evolution of issues within NRC and in other industry initiatives (Alternate Repair Criteria). There were Differing Professional Opinions which were resolved. Staff feels current state of literature supports reducing spiking on SGTR, but no data supports relaxing this for MSLB. Could find no simple relationship between initial iodine levels and spiking factor. Discussed spike duration, and some acknowledgment that it doesn't last forever.

Staff feels that TECHNICAL SPECIFICATION limits on DE Iodine in RCS and secondary should be safety analysis inputs and that it is within the power of licensee to lower these as appropriate.

Opinion expressed by industry that the pre-accident spike can only be present for 2 out of 365 days, so why should we have to assess for dose consequences to control room operator. The probability of a SGTR or MSLB in this window is very low. Inconsistent with other allowed outage times (EDG A.O.T.'s, de-inerted BWR containments). Staff also feels here that licensees can justify and lower this technical specification value (pre-accident spike of 60 mCi/gm typically). Staff also objects that the AOT justification is a very selective argument.

Action item : Assemble available NRC and Industry literature on iodine spiking and reevaluate possibility of reducing spiking. (Jim Metcalf lead)

III. Continued Discussion of Technical Issues Identified By Industry
Mark Blumberg gave continued discussion of staff reaction issues listed by task force. Much of the discussion which followed centered around clarifying industry's position on these issues, why they were thought to be important.
Suppression pool scrubbing
Containment mixing
Secondary containment bypass leakage
Iodine partition factors: Staff feels that credit for CsI chemical form needs to restricted to Alternate Source term framework. Gopal Patel indicated that studies support a much lower partition factor than the present 10% allowed, and took an action to provide information supporting this.
SBLOCA and Rod Ejection Accidents : Discussion on whether automatic spray initiation setpoint reached. Discussion of EOPs and manual actuation. Discussion of need for EOPs and safety analyses to be consistent. In addressing industry position that rod ejection accident could be dismissed on probabilistic terms, Staff points out that probabilistic arguments have already been made to disposition evidence of fuel fragmentation from the Capri experiments.

IV. Duane Gore takes action to prepare strawman outline of Accident Analysis.

V. The Group moved to identify and prioritize issues we want to address. This list is not complete, and will evolve.

The following list of issues was developed broken down by the group that proposed it:

NRC:
(1) 50 rem thyroid dose limit for TID source term
(2) Use of ARCON96 per draft NRC guidance
(3) Deletion of requirement to postulate a 50 gpm leak due to passive failure at 24 hours

Later we identified 2 issues inadvertently left off the above list
a) Use of enthalpy vs DNBR to determine fuel damage
b) Use of Alternate Source Term

Industry
(1) Containment mixing credit
(2) Use of wind tunnel experiments to justify lower chi/Qs
(3) Revisiting fuel handling accident input parameters
(4) Exchange data on iodine spiking factors

(5) Justification for treating ADVs as an elevated release
(6) Credit for deposition for secondary bypass leakage
(7) Credit for suppression pool scrubbing
(8) Development of basis for overall level of conservatism (>95th percentile)
(9) ICRP 30 dose conversion factors
(10) Iodine partition factors for ESF leakage
(11) Control room occupancy factors (Different discussions in other groups)

These issues were reviewed and rated on the potential for gaining margin and the effort required to resolve the issue. The results are listed as an attachment.

VI. The concern was expressed regarding a plant being able to retain its current licensing basis if the plant submits new analyses. The view was expressed that as long as the proposed changes do not affect the design basis, then the licensing basis would remain the same. However, it was recognized that the Licensing / Design Basis sub group was addressing this issue and we would need to get feedback from that subgroup.

VII. Staff stated that the industry had committed to look at and identify non-conservatisms we saw in the analyses, and what ones we had identified. The sub-group indicated that it recognizes that a commitment was made to ensure a balanced consideration of conservatisms and non-conservatisms is made, and that the strategy of the sub-group is to perform this balanced consideration in the Appendices in the development of guidance for JCO determination. Progress on this is expected prior to the next meeting. The sub-group Task Force also requested an NRC list of identified non-conservatisms.

VIII. Staff briefly discussed their perspective on occupancy factors. Their view is that GDC 19 is not limited to control operators. It would apply to anyone in the control room. He cited the TMI event where the plant manager was in the control room for four days and people were sleeping in the control room during the recovery period. He expressed his belief that operators would tend to stay until the plant was in a safe condition. The current occupancy factors are consistent with 10 or 12 hour shifts with a one-hour shift turnover. He also indicated exigent conditions could also apply, such as personnel being required to stay on site due to severe weather.

ATTACHMENT 6-I ATTENDANCE LIST

Control Room Habitability Task Force
Analysis Subgroup
2/1-2/00 Meeting Attendance

Name	Company	Phone	email
Norman Wolfhope	Virginia Power	(804) 273-2268	norman_wolfhope@vapower.com
Tom Mscisz	PECO Energy	(610) 640-6875	tmscisz@peco-energy.com
Gopal Patel	NUCORE	(856) 596-4141	nucore29@aol.com
David Black	Wisconsin Electric	(920) 755-7354	david.black@wepco.com
John Cotton	Entergy	(501)858-4669	jcotton@entergy.com
Nick Trikouros	GPU Nuclear	(973)316-7124	ntrikouros@gpu.com
Jim Metcalf	Polestar	(603) 433-2711	jmetcalf@polestar.com
Steve Schultz	Duke Power	(704) 373-8499	spschultz@duke-energy.com
Michelle Hart	NRC/SPSB	(301) 415-1265	mlh3@nrc.gov
Leta Brown	NRC/SPSB	(301) 415-1232	lab2@nrc.gov
Syed Ahmed	Virginia Power	(804) 273-??	syed_ahmed@vapower.com
Mark Blumberg	NRC	(301) 424-8226	wmb1@nrc.gov
Jerry Gryczkowski	BGE	(410) 495-6521	gerard.e.gryczkowski@bge.com
Duane Gore	STPNOC	(361) 972-8909	degore@stpegs.com

ATTACHMENT 6-II
PRIORITIZED ISSUES LIST

Priority	Identified Margins for Control Room Habitability Radiological
1	ICRP 30 Dose Conversion Factors
2	Guidance for Use of Arcon96 to Calculate X/q Values
3	50 Rem Thyroid Dose Limit for Tid Source Term / TEDE for Alternate Source Term
4	Elimination of Passive ESF Failure (50 Gpm Leak for ½ Hour at 24 Hours) for Plants Without ESF Filtration Systems for ECCS Pump
5	Relief Through Atmospheric Dump Valves (ADV) Treated as an Elevated Release
6	Fuel Handling Accident Input Parameters
7	Increase in Mixing Rates Between Sprayed and Unsprayed Containment Volumes
8	BWR Suppression Pool Scrubbing
9	Iodine Partition Factor for ESF Leakage
10	Iodine Spiking Factors Assumed in SGTR and MSLB
11	Guidance for Use of Wind Tunnel Data to Support Lower chi/Q Values
12	Credit for Deposition/Plateout in Secondary Containment Bypass Leakage
13	Control Room Occupancy Factor
14	Statistical Basis for Demonstrating Over Conservativism in Analysis

ATTACHMENT 6-III

Analysis Subgroup Action Items:

1. Prepare strawman outline of the radiological analysis process (Duane Gore)
2. Assemble coolant iodine activity spiking data (Jim Metcalf / NRC)
3. Assemble iodine partition factor data for ESF leakage (Gopal Patel)
4. Assemble Suppression Pool Scrubbing Data (Gopal Patel)
5. Identify potential strategies for FUEL HANDLING ACCIDENT input parameters (Dave Black)
6. Prepare list of identified non-conservatisms (John Cotton lead)

Design Basis/Licensing Subgroup Meeting Summary

The design bases and licensing bases of control room habitability issues at nuclear power plants were discussed by industry representatives and NRC counterparts. The items discussed are indicated on the attached agenda and are briefly summarized here. A proposed purpose and scope statement was discussed by the subgroup and a draft statement was prepared by the industry representatives. Writing assignments for the document were made amongst the industry representatives.

The industry representatives advanced the position that the purpose of this effort is to provide guidance to licensees on demonstrating that their control room meets their licensing basis. NRC representatives noted that while this is a potentially acceptable approach, there would need to be a recognition that ultimately, the licensing basis is GDC-19, other regulations and/or licensee commitments in this regard. The staff noted that some aspects of control room design often believed to be the licensing basis were more properly design inputs. In particular, the staff believes that the infiltration rate is a design input subject to design control criteria in Appendix B to 10 CFR Part 50.

The staff also believes that the licensee is responsible to ensure that the most limiting accident is considered in demonstrating compliance to GDC-19, the previous attention to the DBA LOCA notwithstanding. The group advanced the position that the "*any accident*" terminology of GDC-19 refers only to the design basis accidents already analyzed in the facility's FSAR. There was discussion on whether licensees could be required to update their earlier analysis assumptions to meet current regulatory guidance, such as that in the Standard Review Plan. The staff noted that licensees needed to differentiate between what appear as changes in staff position (i.e., a backfit) versus changes that were the result of actions on the part of the licensee (e.g., inconsistencies between accident analyses and actual plant configuration and operating procedures).

Using the example of iodine spiking, the staff noted that some SRP analysis guidance may be applicable due to provisions in a facility's technical specifications and other licensee commitments. The group came to the conclusion that the licensing bases for the facilities would be greatly different and that the document needed to concentrate, in part, in providing guidance to licensees on what needs to be considered in establishing a specific facility's licensing basis.

Design Basis / Licensing Subgroup

John Duffy, chair	PSEG Nuclear
Jerry Burford	Entergy
David Distel	PECO Nuclear
Steve Leonard	NMPC
Mike Ruby	REGULATORY GUIDE & E
Ken Taplett	STPNGC
Everett Whitaker	TVA
Steve LaVie, liaison	NRC

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<u>Guidance</u>

The May 9, 1997, version of the ARCON96 computer code as described in NUREG/CR-6331 r1 is an acceptable methodology for assessing control room χ/Q values for use in design basis accident radiological analyses, subject the conditions listed below, unless unusual siting, building arrangement, release characterization, source-receptor configuration, meteorological regimes, or terrain conditions indicate otherwise.

1. The ARCON96 code is obtained and maintained under an appropriate software quality assurance program that complies with the applicable criteria of 10 CFR Part 50 Appendix B and meets other applicable industry consensus standards. Although the software was developed under a software quality assurance program, the licensee is ultimately responsible for the accuracy and appropriateness of use of the ARCON96 results.

2. Meteorological observation data input to ARCON96 are obtained from instrumentation that are maintained under the site's meteorological measurements program, as described in the facility's licensing basis. The data must be shown to be representative for the control room χ/Q assessments. Five years of hourly observations should be used. If less data are used, additional evaluations may be necessary to demonstrate that the lesser data period used is representative of long-term meteorological trends at the site.

3. All potential locations from which the control room may draw air from the environment must be considered as an intake. This includes all ventilation system intakes and infiltration locations, such as doors and penetrations. The potential intakes may change over the course of the accident due to plant systems response or manual operator actions. While ventilation intakes can be located via reviews of FSAR drawings, the location of significant infiltration intakes is more subjective and will require judgement on the part of the dose analyst.

   3.1 A χ/Q value should be evaluated for each release-intake combination. It may be possible to qualitatively show that the χ/Q values for some release-intake combinations would be bounded by values calculated for other combinations and in doing so reduce the number of needed calculations.

   3.2 The licensee should use the most restrictive (i.e., resulting in the highest dose) χ/Q value for each release-intake combination applicable to the particular radiological analysis.

   3.3 For control rooms with dual intake designs, the guidance of Section III.D and Figure 1 of the Murphy-Campe paper applies. Also, the practice of determining the χ/Q for the more restrictive intake and dividing by two is acceptable only if it can be shown that the two intakes have equal flow rates and are not simultaneously within the wind direction window for any given wind direction.

4. ARCON96 provides options that allow a user to model three different release types -- ground level, stack, and vent. An area source can be modeled as a subtype of a ground level release.

4.1 Ground Level Release. The ground level release type is appropriate for the majority of control room χ/Q assessments.

4.2 Stack Release. The stack release type is appropriate for releases from standalone stacks that are two and one-half times the height of adjacent solid structures. Plume rise from buoyancy and mechanical jet effects are not to be used in demonstrating compliance with this criterion. Use of the elevated plume option may lead to unrealistically low concentrations at control room intakes located close to the base of tall stacks. If the χ/Q values generated by ARCON96 are all extremely low, other models should be used to estimate the potential control room intake χ/Q's during low wind speed conditions.

4.2.1 If addressed in the current licensing basis, fumigation[3] conditions are to be considered using the guidance of Regulatory positions 1.3.2.b, 2.1.2, and 2.2.2 of Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants.* Ground level χ/Q values generated by ARCON96 may be substituted for values generated with equation 5 of RG 1.145.

4.3 Area Source. The diffusion models in ARCON96 are based on point-source formulations. However, some release sources can be better characterized as area sources. Examples might include postulated releases from the surface of a reactor or secondary containment building, or releases from multiple points such as the roof vents on typical turbine buildings. ARCON96 reduces an area source to a virtual point source using two initial diffusion coefficients entered by the code user.

4.3.1 LOCA radiological analyses have typically assumed that the containment structure could leak anywhere on the exposed surface. As such, these analyses typically used the shortest distance between the containment surface and the control room intake and treated the containment as a point source. This approach may be unnecessarily conservative. A more reasonable approach is to model the containment surface as a vertical area source with ARCON96. This treatment is acceptable for design basis calculations provided that it is used in conjunction with the total release rate (e.g., Ci/sec) from the containment.

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[3] For facilities that are implementing or have implemented an alternative source term, fumigation conditions should be assumed to exist at the onset of the major radioactivity release in lieu of the start of the accident as specified in Regulatory Guide 1.145.

4.3.2 Since leakage is more likely to occur at a penetration, dose analysts must consider the potential impact of containment penetrations exposed to the environment within this modeled area. It may be necessary to consider several cases to ensure that the χ/Q value for the most limiting location is assigned. Penetrations that are enclosed within safety-related structures need not be considered here.

4.3.3 In the absence of site-specific empirical data the initial diffusion coefficients are found by:

$$\sigma_Y = \frac{\text{Width}_{\text{area source}}}{6}$$

$$\sigma_Z = \frac{\text{Height}_{\text{area source}}}{6}$$

4.3.4 The height and width of the area source (e.g., the containment surface) are taken as the maximum vertical and horizontal dimensions of the building cross-sectional area perpendicular to the line of sight to the control room intake. The shortest horizontal distance from the building surface to the control room intake is used as the source-receptor distance. The release height is set at the point on the surface of the area source that will result in the shortest slant path.

4.3.5 Bypass leakage from secondary containment buildings may be treated in a similar manner.

4.3.6 Multiple roof vents could be modeled as a horizontal circular area source of a sufficient radius to encompass all of the vents. This treatment would be acceptable for those configurations in which (1) the vents are arranged in a pattern that approximates a circular area, (2) if no individual vent is significantly[4] closer to the control room intake than the center of the assumed circular area source, and (3) the release rate from each vent is approximately the same. The distance to the receptor is measured from the closest point on the circumference of the assumed circular area source. In the absence of site-specific empirical data the initial diffusion coefficients are found by:

$$\sigma_Y = \frac{\text{Diameter}_{\text{area source}}}{6}$$

$$\sigma_Z = 0.0$$

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[4] The degree of significance will depend on the radius of the assumed circle and the proximity of the vent cluster to the control room intake. As the radius decreases or the distance from the cluster to the control room intake increases the less significance the position of any one vent has.

4.4 Vent Release. The vent release type was intended for use with uncapped upward-directed vents on or slightly above building surfaces. The model used for the vent release type is based on the mixed-mode model used in long-term routine effluent calculations. This model may be inappropriate for the short-term releases associated with accident assessments. Pending further confirmatory study, the vent release type is not acceptable for use in design basis accident applications.

5. Appropriately structured site-specific atmospheric diffusion tests will be considered by the staff as the basis for deviations from this guidance. Such tests must encompass a sufficient range of meteorological conditions applicable to the site so as to ensure that the limiting case(s) have been evaluated. The testing and the results obtained should be verified and validated.

6. With regard to review assignments, the dose analysts are expected to characterize the release point, i.e., location, release height, velocity, duct diameter, type of release (e.g., ground, elevated, area), stack flow, release temperature, source dimensions (if diffuse); and characterize the control room intake, i.e., location, height, position relative to release point, etc.; as applicable. The assigned meteorologist will review the appropriateness of the licensee's data and perform confirming calculations as deemed necessary, using the parameters provided by or confirmed by the dose analyst.

Attached to this memorandum is a table that identifies each ARCON96 input and acceptable values (or range of values) for each.

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ARCON96 INPUT PARAMETER SUMMARY

Parameter	Discussion	Acceptable Input
Lower Measurement Height, meters	The value of this parameter is used by ARCON96 to adjust wind speeds for differences between the heights of the instrumentation and the release.	Use the actual instrumentation height when known. Otherwise, assume 10 meters.
Upper Measurement Height, meters	The value of this parameter is used by ARCON96 to adjust wind speeds for differences between the heights of the instrumentation and the release.	Use the actual instrumentation height when known. Otherwise, use the height of the containment or the stack height, as appropriate. If wind speed measurements are available at more than two elevations, the instrumentation at the height closest to the release height should be used.
Wind Speed Units	ARCON96 requires that wind speed be entered as miles per hour, meters per second, or knots.	Use the wind speed units that correspond to the units of the wind speeds in the meteorological data file.
Release Height, meters	The value of the release height is used for three purposes in ARCON96: (1) to adjust wind speeds for differences between the heights of the instrumentation and the release, (2) to determine slant path for ground level releases, (3) to correct off-centerline data for elevated releases.	Use the actual release heights whenever available. Plume rise from buoyancy and mechanical jet effects may be considered in establishing the release height if the licensee can demonstrate with reasonable assurance that the vertical velocity of the release will be maintained during the course of the accident. If actual release height is not available, set release height equal to intake height.
Building Area, m^2	ARCON96 uses the value of the building area in the high speed wind speed adjustment for ground level and vent release models.	Use the actual building vertical cross-sectional area perpendicular to the wind direction. Use default of 2000 m^2 if the area is not readily available. Do not enter zero. Use 0.01 m^2 if a zero entry is desired. *Note: This building area is for the building(s) that has the largest impact on the building wake within the wind direction window. This is usually, but need not always be, the reactor containment. With regard to the diffuse area source option, the building area entered here may be different from that used to establish the diffuse source.*

ARCON96 INPUT PARAMETER SUMMARY (continued)

Parameter	Discussion	Acceptable Input
Vertical Velocity, m/s	In ARCON96, the value of the vertical velocity is used only in vent and stack release models. It is used for the downwash calculation. In the vent release model the velocity is used in the mixed-mode calculation. If the vertical velocity is set to zero, the maximum downwash will be calculated and the release height will be reduced by an amount equal to six times the stack radius.	***Note: the vent release model should not be used for DBA accident calculations.*** For stack release calculations only, use the actual vertical velocity if the licensee can demonstrate with reasonable assurance that the value will be maintained during the course of the accident (e.g., addressed by technical specifications), otherwise, enter zero. If the vertical velocity is set to zero, the stack radius should also be set to zero.
Stack Flow, m^3/s	ARCON96 uses the value of the stack flow in χ/Q calculations for all 3 release types to ensure that the near field concentrations are no greater than the concentration at the release point. The impact diminishes with increasing distance.	Use actual flow if the licensee can demonstrate with reasonable assurance that the value will be maintained during the course of the accident (e.g., addressed by technical specifications). Otherwise, enter zero.
Stack Radius, meters	ARCON96 uses the value of the stack radius in downwash calculations in the vent and stack release models.	Use the actual stack internal radius when both stack radius and vertical velocity are available. If the stack flow is zero, the radius should be set to zero.
Distance to Receptor, meters	The value of horizontal distance to the receptor from the release point is used in ARCON96 for calculating the slant range for ground level releases and the off-centerline correction factors for stack release models.	Use the actual straight line horizontal distance between the release point and the control room intake. For ground level releases, it may be appropriate to consider flow around an intervening building if the building is sufficiently tall that it is unrealistic to expect flow from the release point to go over the building. *Note: if the distance to receptor is less than about 10 meters, ARCON96 should not be used to assess relative concentrations*

ARCON96 INPUT PARAMETER SUMMARY (continued)

Parameter	Discussion	Acceptable Input
Intake Height, meters	The value of the intake height is used in ARCON96 for calculating the slant range for ground level releases and the off-centerline correction factors for stack release models.	Use the actual intake height. If the intake height is not available for ground level releases, assume the intake height is equal to the release height. For elevated releases, assume the height of the tallest site building.
Elevation Difference, meters	The value of this parameter is used by ARCON96 to normalize the release heights and the intake heights, in those cases where the two heights are specified as "above grade" with different grades for the release point and intake height, or where one measurement is referenced to "above grade" and the other "above sea level".	Use zero unless it is known that the release heights are reported relative to different grades or reference datum.
Direction to Source, degrees	ARCON96 uses the value of this parameter and the Wind Direction Window to establish which range of wind directions should be included in the assessment of the χ/Q.	Use the direction FROM the intake back TO the release point. (Wind directions are reported as the direction from which the wind is blowing. Thus, if the direction from the intake to the release point is north, a north wind will carry the plume from the release point to the intake.) *Note: some facilities have a "plant north" shown on site arrangement drawings that is different from "true north." The direction entered must have the same point of reference as the wind directions reported in the meteorological data.* For ground level releases, if the plume is assumed to flow around a building rather than over it, the direction may need to be modified to account for the redirected flow. In this case, the χ/Q should be calculated assuming flow around and flow over (through) the building and the higher of the two χ/Qs should be used.
Surface Roughness Length	ARCON96 uses the value of this parameter in adjusting wind speeds to account for differences in meteorological instrumentation height and release height.	Use a value of 0.2 in lieu of the default value of 0.1 for most sites. (Valid values range from 0.1 for sites with low surface vegetation to 0.5 for forest covered sites.)

ARCON96 INPUT PARAMETER SUMMARY (continued)

Parameter	Discussion	Acceptable Input
Wind Direction Window, degrees **Code Default**	ARCON96 uses the value of this parameter and the Direction to Source to establish which range of wind directions should be included in the assessment of the χ/Q.	Use the default window of 90 degrees (45 degrees on either side of line of sight from the source to the receptor).
Minimum Wind Speed, m/s **Code Default**	ARCON96 uses the value of this parameter to identify calm conditions.	Use the default wind speed of 0.5 m/s (regardless of the wind speed units entered earlier), unless there is some indication that the anemometer threshold is greater than 0.6 m/s.
Averaging Sector Width Constant **Code Default**	ARCON96 uses the value of this parameter to prevent inconsistency between the centerline and sector-average χ/Qs for wide plumes. Has largest effect on ground level plumes.	Although the default value is 4, a value of 4.3 is preferred. DRAFT
Initial Diffusion Coefficients, meters	See Section 3.3 of the memo.	These values will normally be set to zero. If the diffuse source option is being used, see Section 3.3 of the memo.
Hours in Averages **Code Default**	The values of this parameter were selected to provide results for desired periods and to provide a smooth χ/Q curve.	Use the default values.
Minimum Number of Hours **Code Default**	The default values of this parameter will allow processing with up to 10% missing data.	Use the default values.

The DBAs were structured to provide a conservative set of assumptions to test the performance of one or more aspects of the facility design. Many physical processes and phenomena are represented by conservative, bounding assumptions rather than by being modeled directly. The staff has selected assumptions and models that, when used in combination, form a basis for evaluating the facility design to ensure an appropriate and prudent safety margin against unpredicted events in the course of an accident and to compensate for uncertainties in plant parameters, accident progression, human performance, radioactive material transport, and atmospheric dispersion.

1. Facility Design Basis

Radiological consequence analyses performed in support of license amendment requests must use analysis assumptions, inputs, and methods that are consistent with the current facility design basis and with current facility normal and emergency operating procedures. Licensees may take analysis credit for plant features that were included in design-basis radiological consequence calculations previously approved by the NRC staff. Such credit should be taken only if assumptions related to equipment operability and performance are consistent with the facility's current design basis and current normal and emergency operating procedures. The NRC staff generally does not accept analyses that credit plant features that (a) are not safety-related, (b) are not covered by technical specifications, (c) do not meet single-failure criteria, or (d) rely on availability of offsite power unless these assumptions were previously accepted by the NRC in a site-specific licensing action and are therefore part of the facility design-basis. Design-basis delays in actuation of these features should be considered, especially for those features that rely on manual operator intervention.

Generally, the NRC staff will consider assumptions made in a licensee analysis supporting a docketed amendment request to be part of the current design basis if the staff relied upon that assumption in granting the license amendment.

2. Level of Detail in Submittals

The NRC staff reviews licensee amendment requests to ensure that the proposed change will maintain an adequate level of protection of public health and safety. The NRC staff accomplishes these reviews by evaluating the information submitted in the amendment request against the current plant design basis as documented in the FSAR, previously issued staff safety evaluation reports (SERs), regulatory guidance, other licensee commitments, and staff experience gained in approving similar requests for other plants. The NRC staff bases its finding that the amendment is acceptable on its assessment of the licensee's analysis, since it is the licensee's analysis that becomes part of the facility's design basis. Licensees should ensure that adequate information, including analysis assumptions, inputs, and methods, are presented in the submittal to support the staff's assessment. The NRC staff's assessment may include performance of independent analyses to confirm the licensee's conclusions. Licensees should expect an NRC staff effort to resolve critical differences in analysis assumptions, inputs, and methods used by the licensee and those deemed acceptable to the NRC staff.

Regulatory Guide 1.70 (Ref. 1) offers guidance on information to be included in accident analysis descriptions in FSARs, and may be useful in determining the minimum information that should be submitted in support of a license amendment. Additional information may be needed, depending on the particular analysis. Licensees may want to consider submitting affected FSAR pages annotated with changes reflecting the revised analyses, submitting the actual calculation documentation, or submitting both, in addition to submitting the analysis summary.

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3. <u>Analysis Inputs</u>

Analysis inputs based on plant parameters should be selected from the range of design values possible during the specific accident event so that the postulated consequences of the accident are maximized, that is, the most-restrictive value for the parameter. It is generally inappropriate to use values characterized as "best estimates." Licensee commitments to particular regulatory guides and standard review plan sections may establish the value of certain parameters and should continue to be used where applicable. Other considerations follow:

a. The range of values applicable during an accident may vary from accident to accident, and will likely differ from the range that applies during normal operations. For example, a loss-of-offsite-power assumption may affect ventilation system flow rates.

b. In some situations the minimum and maximum value of the range may be applicable in a single analysis. For example, the minimum containment spray flow rate is used in determining the spray removal lambda, but the maximum flow rate may be appropriate in determining the minimum sump pH. Therefore, it may be necessary to use different parameter values in different portions of the analyses or to perform a sensitivity analysis to determine the limiting value.

c. If a plant parameter is associated with a technical specification limiting condition for operation (LCO), the value specified in the technical specification must be used. If the LCO specifies a range, or a value with a tolerance band, the most restrictive value must be used. The technical specifications may also specify numeric values in surveillance requirements or action statements; for example, acceptable emergency core cooling system (ECCS) leakage or transient reactor coolant system (RCS) iodine concentration. These should be used where appropriate.

d. Some parameters may change value during the duration of the accident; for example, RCS temperature and pressure decrease during plant cooldown. In these cases, the calculation should either assume the most restrictive value for the entire duration or the calculation should be performed in time steps, with the appropriate parameter values used for each time step. Containment leakage should be modeled as described in Regulatory Guides 1.3 and 1.4.

e. For parameters based on the results of less-frequent surveillance testing, for example, non-destructive testing (NDT) of steam generator tubes or efficiency testing of charcoal filters, consideration must be given to the degradation that may occur between periodic tests in establishing the analysis value.

f. Some analysis parameters can be affected by density changes that occur in the process stream. The NRC staff has noted errors made in converting volumes and volumetric flow rates, for example, gpm, to mass units, or vice versa, particularly in analyses involving primary-to-secondary leakage (Ref. 2). It is recommended that these calculations avoid volumetric units to the extent possible. With regard to the volumetric flow rates specified as LCOs, the density used should be consistent with the density that is assumed in the surveillance procedure that demonstrates compliance with the LCO. These procedures are typically based on cooled water and not on water at RCS operating temperature and pressure. Similarly, for those pressurized-water reactors (PWRs) using alternate repair criteria (ARC), the tube burst flow rate correlations are typically based on measurements of cooled water.

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4. Use of Incompatible Assumptions

Licensees should ensure that their analyses do not use assumptions that are incompatible with the accident conditions or with other assumptions. For example:

a. Regulatory Guide (RG) 1.3 (Ref. 3) and RG 1.4 (Ref. 4) present guidance that 50 percent of the iodine activity released from the core during a loss-of-coolant accident (LOCA) can be assumed to instantaneously plate out on containment surfaces, leaving 25 percent of the core inventory in the containment atmosphere available for release. Later revisions of the Standard Review Plan (SRP) (Ref. 5) Section 6.5.2, identify a mechanistic treatment of plateout that can be included in the determination of the containment spray lambda. It is inappropriate to assume 50 percent instantaneous plateout and to incorporate mechanistic treatment plateout in the same calculation, as this constitutes double credit of iodine plateout.

b. Regulatory Guide 1.25 (Ref. 6) contains a footnote specifying that the assumptions presented in the guide are acceptable for use if certain fuel parameters, including amount of burnup, are not exceeded. Some extended burnup fuel designs may exceed these prerequisites. NUREG/CR-5009 (Ref. 7) considers the impact of extended burnup fuel and suggests revised isotopic gap fractions for use in fuel handling accidents. The NRC staff has a task force considering the potential impact of extended burnup fuel on safety analysis assumptions, and this guidance may be changed in the future.

5. Analysis Source Terms

The source terms used in accident analyses should be consistent with the guidance presented in applicable regulatory guides and SRPs. Several source terms are tabulated in typical FSARs, each intended for specific purposes. Licensees should ensure the proper source terms are used. The NRC staff recommends that, for analyses performed in support of license amendment requests, the assumed core inventory data are appropriate for the currently licensed reactor power, fuel enrichment, and fuel burnup. Reactor coolant activity should be based on the technical specification specific activity LCO, including the specified transient specific activity.

6. Atmospheric Dispersion Values

The NRC guidance with regard to short-term atmospheric dispersion values (χ/Q) has changed over time. Many of the early plants were licensed on the basis of analyses that incorporated the conservative and simplistic dispersion methods described in RG 1.3 and RG 1.4. Most control room χ/Qs were based on guidance of Murphy and Campe (Ref. 8), but other methods have been used. Later plants may have used the guidance in RG 1.145 (Ref. 9) for determining offsite χ/Q's. The NRC staff is currently evaluating whether the ARCON96 (Ref. 10) methodology may be used to determine control room χ/Q. Licensees should use χ/Q values previously approved by the NRC staff and documented in the FSAR. If the licensee chooses to revise the χ/Q values using a methodology different from that accepted by the NRC staff and documented in the FSAR, the amendment submittal should identify this change in methodology and present sufficient information for the staff to make a determination regarding the acceptability of the revised values. Meteorological data used in the offsite and control room assessments should meet the guidance of Regulatory Position C.1.1 of RG 1.145.

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7. Control Room Habitability

Many amendments submitted for NRC staff review address changes in the offsite dose consequences, but fail to address the impact of the increased releases on control room habitability. In approving the amendment, the NRC staff is required to make a finding that the radiological consequences of the proposed amendment, if implemented, would comply with 10 CFR Part 100 and with 10 CFR Part 50 (Appendix A, General Design Criterion 19 (GDC19)). Some believe that the LOCA dose consequences will be limiting for the control room because of the magnitude of the source term relative to the source term for other accidents. The NRC staff has identified several cases in which the LOCA was not the limiting accident for control room habitability. The following considerations should be evaluated in performing control room habitability analyses:

a. The control room design is often optimized for the DBA LOCA, and the protection afforded for other accident sequences may not be as advantageous. For example, in most designs, control room isolation is actuated by engineered safety feature (ESF) signals such as (i) containment high pressure or safety injection (SI), or (ii) radiation monitors, or (iii) both. For accidents that rely on radiation monitor actuation, there may be a time delay in isolation that would not occur for the immediate SI signal that would result from a LOCA. In such cases, contaminated air enters the control room for a longer period preceding isolation than it would for a LOCA.

b. The configuration of radiation monitors has an impact on their sensitivity. Ideally, the radiation monitors would be located in the outside air ventilation intake ductwork. However, there are system designs that place the radiation monitor in recirculation ductwork or downstream of filters. There are also designs that use area radiation monitors. In these latter designs, the contaminated air continues to build up in the control room volume until the concentration is large enough to actuate the radiation monitor.

c. In some cases control room radiation monitor set points may have been based on external exposure concerns, for example, 2.5 mrem/hour, rather than thyroid dose from inhalation. The airborne concentration of radioiodines will likely cause elevated thyroid doses before reaching the concentration of all radionuclides necessary to alarm the monitor. This condition is typically seen with accidents that involve a high iodine-to-noble-gas ratio, such as that involved with main steam line breaks in PWRs.

d. The distance between the control room and the release point, and the associated wind sectors, may be different for each postulated accident. These differences are usually not significant with regard to offsite doses, but may be significant for control room assessments because of the shorter distances typically involved. The χ/Q for the DBA LOCA may not be applicable to other DBAs. A ground-level release associated with a non-LOCA event may be more limiting that the elevated release associated with LOCAs at plants with secondary containments or enclosure buildings.

e. Licensees should ensure that assumptions regarding control room isolation and infiltration can be supported by appropriate test results or engineering evaluations.

Twenty percent of the licensed power reactors have performed tracer gas tests of control room integrity. All of the tests performed identified as-found infiltration rates greater than those assumed in the design-basis calculations.

f. The use of personal respirators, or the use of potassium iodide (KI) as a thyroid prophylaxis, should not be credited as a substitute for process or other engineering controls, as provided in 10 CFR 20.1702.

8. Dose Conversion Factors

The dose conversion factors (DCFs) used to convert release rate to doses should be appropriate for use in acute, short-term exposure situations. Whole-body doses have been traditionally based on semi-infinite cloud models, and thyroid doses have been based on DCFs presented in TID-14844 (Ref. 11) (which are based on ICRP-2 (Ref. 12)). The NRC staff considers thyroid dose conversion factors based on ICRP-30 (Ref. 13), such as those tabulated in Federal Guidance Report 11 (Ref. 14), to be an acceptable change in methodology that does not warrant prior review. Licensees using ICRP-30 DCFs in accident calculations should consider revising the technical specification definition for dose equivalent I-131 to reflect the DCFs used. However, total effective dose equivalent (TEDE) is not an acceptable alternative in showing compliance with GDC-19 and Part 100 whole-body and thyroid dose criteria.[1]

For control room whole-body dose estimates, it is common to adjust the semi-infinite cloud DCF to account for the finite size of the control room. This correction is not applied to beta skin dose estimates as the range of beta particles in air less than the typical control room dimensions. It is important to note that the skin dose DCFs presented in the recent literature (e.g., Federal Guidance Report 12 (Ref.15)) are based on both photon and beta emissions. Without the geometry correction, the photon dose component will be over-estimated. If the geometry correction is included, the beta dose component will be under-estimated. DOE/EH-0070 (Ref. 16) tabulates the beta and photon skin dose DCFs separately.

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1 Although TEDE subsumes both the whole body dose and the thyroid dose, the rule language in GDC-19 and 10 CFR 100.11 specifically identifies *whole-body* and *thyroid* doses. The staff is considering changes to GDC-19 to replace the current dose criterion with one based on TEDE. There are no current plans to revise the §100.11 guidelines due to the synergy that exists between the Technical Information Document (TID)-14844 source terms and the accident dose guidelines. For further information, see the discussion at 64 *Federal Register* 12119.

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