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SEP 0 9 1986

Dr. Anthony Buhl
Program Manager IDCOR
c/o International Technology Corporation
575 Oak Ridge Turnpike
Oak Ridge, TN 37830

Dear Dr. Buhl:

In accordance with the severe accident policy implementation schedule, the NRC staff has completed a preliminary review of the draft Individual Plant Examination Methods (IPEM) submitted by IDCOR on May 2, 1986. Our review of the documents leads us to believe that the IPEM has the potential to be an effective alternative for the individual plant examinations, particularly in the level of detail in the systems interogations (e.g., Report T85.3 R1, Appendix D) and the development of "systems notebooks." However, we have identified some areas where additional information or modification is needed to meet the severe accident policy objective of identifying plant-specific vulnerabilities. The details of the additional information modification needed are developed in the enclosure while the important preliminary comments are summarized here:

1. The two proposed groundrules (core damage frequency and releases from containment) should be consistent with the NRC safety goals and need to quantitatively account for the impact of uncertainties when the individual plants are compared with the groundrules.

2. The IDCOR IPEM calls for "matching" an individual plant to the reference plant at several levels, e.g., "nodes," "segments," fault trees, systems. Because the comparison of an individual plant to a reference plant is fundamental to the IDCOR IPEM, there needs to be a definition for matching at each level. The definition should not only (1) specify the characteristics being compared but should also (2) specify the effects being compared in the matching step. For example, the IDCOR IPEM calls for comparing fission-product mitigation systems based only upon the existence of such a system without specifying any performance characteristic for the system at an individual plant. Additionally, the IDCOR IPEM needs to specify those effects essential for matching an individual plant to a reference plant since matched systems at two plants can yield unequivalent effects due to differing interactions with the other systems.

3. An adequate characterization of successful venting for BWR Mark I and Mark II containments is needed.

4. Because the entire objective is to use the IDCOR IPEM to identify vulnerabilities, plant-specific vulnerabilities need to be defined and examples provided. The potential vulnerabilities found in the reference plants

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need to be described. Also, the potential vulnerabilities based upon deviations from the reference plant at each level of systems matching needs to be identified in an explicit manner.

5. The IDCOR IPEM needs to describe for the utilities the means for (1) identifying the essential equipment that should survive the severe accident environment and (2) assessing the expected effects on accident progression.

6. The staff is concerned that treatment of the phenomenological issues was simplified without an explicit treatment of the potential impact of the uncertainties on the results. For example, the IDCOR IPEM assumes that no direct heating of containment occurs. It appears that at least a screening criterion is needed for the possibility of direct heating in some containments along with an evaluation method for containments that do not meet such a screening criteria.

7. The IDCOR IPEM identifies some potential benefits of visual inspections. Visual inspections procedures need to be added to the IDCOR IPEM to assure realizing the potential benefits.

8. The IDCOR IPEM specifies some documentation requirements, however, these requirements are incomplete. A complete list of documents should be specified in the IPEM. The documentation should be sufficient to support plant safety assessments, accident management decisions and operator training. It should also be auditable permitting an assessment of the completeness and technical quality of the individual plant examination.

The staff has not yet completed the review of the test applications provided by IDCOR on June 26, 1986, to demonstrate the IPEM's ability to identify outliers. The staff may have additional questions after reviewing these test applications.

The final evaluation of the IDCOR IPEM and the test applications is scheduled for completion by October 31, 1986, at which time it will be forwarded to IDCOR. In the identified areas, we expect either the incorporation of our comments into the IDCOR IPEM or a discussion of the adequacy of the IDCOR IPEM. Please provide the final documentation of the IPEM by September 23, 1986, that we can issue our final evaluation on schedule. We are available for discussions if needed, please contact Zoltan Rosztoczy at (301) 492-8016.

Sincerely,

/s/

Themis P. Speis, Director
Division of Safety Review and Oversight
Office of Nuclear Reactor Regulation

(*See Previous Concurrence)

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1. The two proposed groundrules (core damage frequency and releases from containment) should be consistent with the NRC safety goals. The goal level for core damage frequency needs to quantitatively account for the impact of uncertainties when the individual plants are compared with the groundrule. The proposed groundrule on the releases from contain-ment should be in a more practical form, e.g., a major release probability less than 1/1,000,000 reactor-years.

2. The IDCOR IPEM calls for "matching" an individual plant to the reference plant at several levels, e.g., "nodes," "segments," fault trees, systems. Because the comparison of an individual plant to a reference plant is fundamental to the IDCOR IPEM, there needs to be a definition for matching at each level. The definition should not only (1) specify the characteristics being compared but should also (2) specify the effects being compared in the matching step. For example, the IDCOR IPEM calls for comparing fission-product mitigation systems based only upon the existence of such a system without specifying any performance characteristic for the system at an individual plant. Additionally, the IDCOR IPEM needs to specify those effects essential for matching an individual plant to a reference plant since matched systems at two plants can yield unequivalent effects due to differing interactions with the other systems.

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Themis P. Speis, Director
Division of Safety Review and Oversight

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ATE	:08/21/86	:08/26/86	:08/3/86	:08/ /86	:	:	:

Preliminary Evaluation of the IDCOR IPEM

I. INTRODUCTION

Existing plants are to be examined for plant-specific vulnerabilities as called for by the Severe Accident Policy (50 FR 32138). The Industry Degraded Core Rulemaking (IDCOR) Individual Plant Examination (IPE) Methods are intended to provide an analytical means for the systematic examination of existing plants. Also, the methods could provide algorithms for approximating the risk profile of an existing plant that was not previously assessed relative to the appropriate reference plant that most closely equates with the design of the individual plant.

The IDCOR IPE Methods are being evaluated to establish the regulatory acceptability of at least one method that may be used by the individual utilities during the IPEs. An acceptable method will be part of the guidance to be issued by the Commission for the performance of the IPEs.

The IDCOR IPE Methods were submitted in four volumes:

1. Draft T85.3-A1 PWR Accident Sequence - IPEM
2. Draft T85.3-A2 PWR Source Term - IPEM
3. Draft T85.3-B1 BWR Accident Sequence - IPEM
4. Draft T85.3-B2 BWR Source Term - IPEM

The preliminary evaluation was performed by collecting comments from the following individuals:

Individual	Organization
P. Baranowsky	NRC-RES
R.Barrett	NRC-DSRO-RRAB
E.Chelliah	NRC-DSRO-RRAB
N.Cho	BNL-DNE
F.Coffman	NRC-DSRO-RIB
S.Davis	NRC-DSRO-RRAB
A.El-Bassioni	NRC-DSRO-RRAB
F.Eltawila	NRC-DSRO-RIB
B.Hardin	NRC-DSRO-RRAB
W. Hodges	NRC-DBL-RSB
G. Hulman	NRC-DBL-PSB
J.Lehner	BNL-DNE
R.Palla	NRC-DSRO-RIB
K.Perkins	BNL-DNE
J.Rosenthal	NRC-DSRO-RRAB
R.Sammons	NRC-DSRO-RIB
R.Youngblood	BNL-DNE

Since no precedent exists for the regulatory acceptability of severe-accident methods for consistency with the Severe Accident Policy, the comments were discussed and screened to assure that the comments evaluated the methods against the following general standards:

1. Review the methods for their capability to find severe accident vulnerabilities by comparing them against previously identified PRA insights, relevant USIs, GSIs and TMI items, and selected operating events.

2. Review the methods for the degree to which the risk profile of the existing plants that have not been previously assessed can be approximated by the reference plants.

3. Review the methods for the role and content of the visual examinations of the plant configurations for potential vulnerabilities.

4. Review the methods for their coverage of insights available from experts and ad hoc panels along with postulated events derived from known precursors to severe accidents.

5. Since the Severe Accident Policy requires a "systematic" examination of the existing plants, determine the degree to which the methods integrate considerations from significant individual safety concerns, balance considerations of prevention and mitigation, achieve uniform examinations among the utilities, and provide a reasonably complete assessment of severe accident hazards.

6. The methods should be consistent with the resolution of generic issues. The ''sues include Unresolved Safety Issues, Generic Safety Issues, TMI-2 Ac on Items, and the NRC/IDCOR Issues.

7. Review the methods for adequate coverage of the scope of the NRC Guidelines and Criteria being developed.

8. Review the degree to which the documentation of the methods provides usable guidance to the individual utility's engineering and operations pesonnel for an IPE. The methods should also provide for an adequate display of the results using conventional nomenclature, uniform definitions, and explicit assumptions.

9. Identify any limitations determined by the review on the scope of the vulnerabilities to be identified by the method. State any cautions needed to preclude unfounded extrapolations and overgeneralizations from the results of the methods.

The reviewer's comments were to be relevant to at least one of the standards. The reviewer's comments were to be translated into a coherent action or a justified position. The preliminary evaluation comments are being dispositioned by three actions: (1) Issued to IDCOR for information and response, (2) Identified for NRC or NRC-contractor action, and (3) Assigned to a reviewer to begin writing the evaluation of the regulatory acceptability of the particular feature in the IDCOR IPE Methods. The comments issued to IDCOR as part of this preliminary evaluation are expected to lead to possible improvements to the IDCOR IPE Methods, modifications to the reference plant analyses, or supplemental information.

The review is proceeding along the following schedule:

1. Receipt of the IDCOR IPEM reports - May 2, 1986
2. IDCOR workshop on their IPEM - May 14 & 15, 1986
3. Coordination meeting for the reviews - May 19, 1986.
4. Meeting to consolidate review comments - June 19, 1986
5. Individual reviewer's preliminary evaluations - June 25, 1986.
6. Receipt of 5 IDCOR IPEM Applications reports - June 25, 1986
7. Preliminary evaluation to IDCOR - July 18, 1986.
8. Outline of Evaluation Report established - August 23, 1986
9. Receipt of Calvert Cliffs Applications report - August 31, 1986
10. Individual reviewer's final evaluations - September 1, 1986
11. Receipt of Sequoyah Applications report - mid September 1986
12. Final Evaluation Report to IDCOR - December, 1986

II. GENERAL COMMENTS

1. Equivalence with Reference Plants

Fundamentally, the IDCOR IPEM takes a differencing approach by comparing individual plants to the reference plant appropriate for the plant of interest. The individual plant's vulnerabilities to severe accidents is concluded to be equivalent to the reference plant's vulnerabilities if the differences between the IPE plant and the reference plant match within tolerable criteria. The IDCOR IPEM contains provisions for matching at several levels within the methods, e.g., Core Damage Frequency, Containment Performance, Sequences, Systems, Fault Trees, Segments, or Nodes. The importance of establishing the matching criteria to the success of the IDCOR IPEM can not be over emphasized. The entire objective of identifying plant vulnerabilities hinges on the correct modelling of plant specific systems and potential accident sequences. The degree of resolution described in the methods should give the appropriate assurance that the policy objective will be met, i.e., that plant vulnerabilities will be identified. The staff has inferred, although the IDCOR IPEM does not explicitly state, that an absence of a match at any level constitutes a potential vulnerability for the individual plant.

However, clearly and explicitly articulated criteria for matching between the IPE plant and the reference plant are missing. (See comments B2.7 and B2.8 in Section V). In the absence of explicit criteria, the BWR nodal questions and the PWR changes in reference-plant templates will be subject to large plant-wise variances introduced by differences among different analysts judgements. Provide clearly and explicitly articulated matching criteria for all levels of analysis at which plant-specific vulnerabilities could potentially be identified, e.g., A1 page 2-284, Case II, 2.4.3.1 Comparison Summary Table; A1, page 3-5, Task 5: Develop System

Analysis Model; and A1 Figure 2.4-13b. The matching criteria should not only (1) specify the characteristics being compared but should also (2) specify the effects being compared in the matching step. For example, the IDCOR IPEM calls for comparing fission-product mitigation system based only upon the existence of such a system without specifying any performance characteristic for the system at an individual plant. Additionally, the IDCOR IPEM needs to specify those effects essential for matching an individual plant to a reference plant since matched systems at two plants can yield unequivalent effects due to differing interactions with the other systems.

As a part of articulating the matching criteria, a description should be provided of the degree of resolution accorded by the proposed criteria, i.e., exactly how similar to the reference plant is an individual plant when it is considered matched? Because the methods look for outliers at different levels (e.g., CDF outliers and sequence outliers), the degree of resolution accorded by the methods should be described for each level of analysis.

Additionally, the two proposed groundrules (core damage frequency and releases from containment) should be consistent with the NRC safety goals and need to quantitatively account for the impact of uncertainties when the individual plants are compared with the groundrules.

2. Systematic Examination of NSSS Designs

The intent of the IPEs includes a systematic examination of existing plants regardless of NSSS design. There are many differences between the methods described for BWRs (B1) and PWRs (A1). For example, in the searching of dependent failures, the PWR method includes more support systems details where the BWR method considers only entire support systems. Also, the PWR method only infers the need and means for visual inspections while the BWR method includes a reasonably detailed description of the performance of a visual inspection. To assure completeness and orderliness for the IPEs on both types of plants, provide a comparison between BWR and PWR methods that establishes the degree of similitude in the methods' features, e.g., the role and the conduct of visual inspections, selections and modification of data, terminology, methods management, interfaces between A1 and A2 versus interfaces between B1 and B2, treatment of the effects of common-cause failures, treatment of operator errors, integration of sequence faults for overall insights, and the treatment of support systems and states.

3. Data Base

The generic data used for baselining rely on either outdated data bases (e.g., IREP and WASH-1400) or the reference plant data base.

The methods should incorporate a data base such as in Appendix C, NUREG/CR-2815, for the purpose of identifying severe accident outliers due uniquely to design features of the specific plant (in contrast with outliers due uniquely to equipment unavailabilities at the specific plant).

4. Methods Management

The method does not specify the necessary elements for an adequate management of the application during the IPEs. Provide a description of the essential planning, scheduling, and coordination needed to assure uniform applications of the methods across various utilities. The management elements should include guidance to assure proper interfaces among the tasks and elements.

Additionally, the methods management needs provisions to control the technical quality within the applications for assurance that the resulting conclusions are robust, internally consistent, and reasonably complete. The methods management needs to include either an internal or an external process to verify and validate the application, the intermediate findings, and the overall conclusions. The provisions to control the technical quality should include (1) the establishment of an independent verification and validation group, (2) the group's composition, (3) the content of the information to be documented for verification and validation and (4) the group's authority and functions. The independent verification and validation group (or audit team) should review each critical juncture of the process. These junctures could be at the end of each major step so that errors are not propagated all the way through to the major conclusions. Some suggested junctures are after event tree construction, system modelling, fault tree construction, assignation of failure rates, etc. The functions of the independent verification and validation group should explicitly identify the points at which control of the technical quality will occur. The PRA Review Manual (NUREG/CR-3485) contains an outline for the review of PRA-type results.

The IDCOR IPEM specifies some documentation requirements, however, these requirements are incomplete. A complete list of documents should be specified in the IPEM. The documentation should be sufficient to support plant safety assessments, accident management decisions and operator training. It should also be auditable permitting an assessment of the completeness and technical quality of the individual plant examination.

5. Equipment Survivability

The operating environment created during the progress of severe accidents holds the potential to stress some equipment far beyond operating temperatures, pressures, moisture levels, and radiation levels. The survival of some equipment may be vulnerable to the postulated severe environments for specific plants. The methods should alert utility personnel to search for such specific equipment vulnerabilities also. The methods should list the equipment that needed to survive the severe accident conditions because the equipment is either has a potential to reduce risk or, more importantly, a potential to increase risk. The methods should provide guidance concerning severe-accident-environment-created failure modes and the magnitudes of changes in the failure rate of equipment. The methods should cover the range of feasible locations for similar equipment among the plants and among the postulated environments.

6. Visual Inspections

The role of visual inspections in the IDCOR methods appears minor relative to the NRC staff's current understanding of the apparent contribution that visual inspections could make toward the identification of plant-specific severe-accident vulnerabilities. The incorporation of visual inspections into the methods becomes particularly critical when searching for spatially coupled vulnerabilities such as those due to internally initiated floods. Visual inspections for internal flooding should incorporate a rigorous search for flood sources while not overlooking possible drainage systems failures. Only an allusion to visual inspections is made by a passing reference to "targets" and "sources" without definitions on page 2-186,A1. The method for visual inspections described in the B1 report contains more instructions but the discussion is still minimal. To contribute to the identification of vulnerabilities, both the BWR and the PWR methods should be revised to reflect that visual inspections should be composed of the following elements:

a. Defined objectives and examination criteria to include (1) the feasible spatial hazards created by all leading severe accident sequences, (2) along with a predetermined list of critical safety equipment, and (3) any potential accident environment that could challenge equipment within the spatial domain of the failure effects. Since the IDCOR IPEM assesses only internally initiated events at this time it would be less confussing for the externally initiated hazards of earthquakes, lighting, and rainwater to be excluded from the hazards listed in table 2.3-7 (page 2-180, 2.3.5.5 Common Cause Failure Unavailability, A1)

b. Written procedures that include (1) the composition of the visual inspection teams, (2) the assignment of responsibilities for the visual inspection team members, (3) phasing of the visual inspections at appropriate stages during the IPE, and (4) a prediction of the personnel exposure impact in terms of person-REM.

c. Procedures for the incorporation of the results from the visual inspections into the systems models to assess the impact of the spatial hazards.

d. A retrievable documentation scheme.

7. <u>Methods Invoked by Reference</u>

Throughout the IPEM, a number of references are cited as bases for procedures followed, potentially making them part of the methodology.

For example, in Technical Report 85.3 A-1, classifications of plant damage states were extracted from the Zion Probabilistic Safety Study. In A-2, MAAP is implicitly made part of the methodology, yet it is not part of the documentation, nor has it been made available to the NRC for review. There were also references to documents yet to be issued by IDCOR for example, Appendix E, A1, relies upon reference 12. NRC recognizes that reliance on outside resources and previously accumulated experience is essential; however, the staff does not plan to review each of the references in its entirety. Please provide a listing of all references that contain procedures which are incorporated into the methodology.

8. Examples of Plant-specific Vulnerabilities

Noted during the preliminary review of the IPEM is the lack of examples of plant-specific vulnerabilities. Specific examples would be helpful to a user unfamiliar with PRA methodology to aid utility personnel in recognizing plant vulnerabilities. The inclusion of concrete examples in the text may facilitate the success of the methodology.

9. Role of MAAP and MAAP Results

Under certain circumstances, e.g., for sequences in which both the isolation function and containment heat removal are unavailable, the IDCOR IPEM recommends that plant-specific analyses be performed using "MAAP or another qualified code." The use of the present version of MAAP as well as certain MAAP input parameters used by IDCOR in the reference plant analyses is considered by the staff to be unacceptable for this purpose. Eighteen major modelling differences between MAAP and NRC codes have been identified during previous IDCOR/NRC technical exchange meetings. Although some of these issues have been resolved on the basis of IDCOR analyses and modelling changes described in IDCOR report 85.2, the resolution of several of the issues is contingent upon the implementation of additional changes to MAAP models and input assumptions, and the consideration of the uncertainty in several parameters (e.g. the quantity of hydrogen produced in-vessel) via uncertainty analyses. Hence, MAAP should not be characterized as an NRC "qualified" code at this time.

Following completion of the technical issue resolution process, use of a suitably modified version of the MAAP code may be acceptable for certain applications. The staff envisions that an acceptable version of the MAAP code would incorporate all modelling and input assumption modifications agreed upon by the staff and IDCOR as part of the issue resolution process. The Code would be frozen and fully documented. The staff would perform a final review of the documentation to confirm its understanding of the MAAP models and the implementation of agreed upon modifications prior to approving use of the Code for IPEs. Approval of the Code would also be conditional upon the use, by utilities, of certain user-input parameters. The need to benchmark the revised MAAP code against the source-term-code-package codes to ensure a reasonable degree of consistency between the two methodologies is also being considered by the staff. Conclusions drawn during an IPE from use of the present version of the MAAP code for plant-specific calculations is conditioned upon the status of MAAP.

The use of the NRC source term code package (STCP) for plant-specific calculations is the preferred alternative to the lengthy process of establishing an acceptable version of MAAP. The STCP is publicly available, and guidelines for use of the code are presently being developed by the staff.

10. Containment Event Trees

The containment event trees proposed by IDCOR in technical reports 85.3-A2 and -B2 were developed based on insights obtained using earlier versions of MAAP. The adequacy of these trees should be reconfirmed by IDCOR considering (1) the effect of subsequent changes in MAAP (including those required as part of issue resolution) on the risk profiles for each of the reference plants and (2) the influence of those uncertainties identified in the issue resolution process as requiring further attention by IDCOR. Possible changes to the event trees could involve nodal questions regarding plant systems and design features which did not appear to be risk-important using IDCOR's earlier methodology, but which may influence whether or not a plant is an outlier when the MAAP code revisions and effects of uncertainties are taken into account.

11. Interfaces

Lack of coordinated interfaces between Accident Sequences and Mitigators is likely to result in unidentified potential outliers. Shared dependence such as relying on the same pumps or same water supply for both prevention and mitigation has not been taken into account in the methodology. To illustrate this point, the reactor building fire sprays could be aligned to inject into the RPV or into the drywell via the spray header. In addition, in completing the reactor building checklist, analyst can assume maximum fission product retention in the reactor building if it is equipped with fire sprays. Obviously, the lack of coordinated interfaces would lead to taking credit for the same system in several operating modes.

In general, mitigators such as containment sprays, wetwell venting and reactor building retention are judged effective or not independent of the accident sequence and of each other. Therefore it is the staff's position that the interface between the accident sequence leading to core melt and the systems used to mitigate consequences should be carefully described in the methodology. Interdependence of mitigating systems and preventing systems must extend in details to include the availability of support systems for the leading sequences. If a particular mitigating system is relied on to minimize unacceptable fission product releases, its unavailability should be quantified.

Specifically,

a. Operator actions are assumed likely to be correct. No attempt conditions. An indepth evaluation of operator action that might be taken to respond to an accident and mitigate their consequences is not performed to see the effect on the progression of the accident. For example, the drywell spray which is manually activated is provided with interlock to prevent its operation with RHR pumps for specific period of time after a demand on PLCI (low RPV level). Thus if the RPV level is ocillating, as is likely in an ATWS, the spray will shutdown as the RPV water level reduces below the LPCI activation set point. Therefore, continued spray operation is unlikely and the operator has to reinitiate it following each shutdown. In addition, the methodology does not require review of plant's procedures and training programs to support the assumptions on operator effectiveness during severe accident condition.

b. Events are not fully developed to account for plant unique emergency procedures, e.g., some plants dump into the condenser following an ATWS event. Should the condenser fail due to overpressurization, containment bypass will result. In addition, PRA experience suggest that probability of ATWS event is driven by hardware on some plant and by operator failure on the others. Some guidance for assessing the success or failure of a particular mitigator should be incorporated in the methodology to assure that inconsistencies between IPE is minimal and that the methodology does not rely on the analyst's judgment.

It is not made clear in the IPEM documentation if and how the results of the front-end evaluation (A1) will be linked with the containment event tree (CET) and source term calculation in the back-end evaluation (A2), and how consistency will be maintained between the front and Back-end with regard to containment availability, heat removal system availability, and other nodal questions in the CET. IDCOR should provide additional clarification concerning the linkage between the A1 and A2 B1 and B2 evaluations, the specific products or outputs expected from each, and the criteria against which each output will be judged.

12. Legible Copies

The Fault Trees are difficult to read in many places and totally illegible in other places, e.g., A1, page 2-168 and 2-270. Review the documents provided to the NRC and replace the necessary tables and figures with legible copies.

13. External Events

The IPE methods do not consider external events at the present time. It should be clearly pointed out that the results for each IPE do not include the contribution from externally initiated events when being compared with any quantitative goal that is presumed to capture both internally and externally initiated events. It is especially important that this be noted when assessing the dominant contributors to risk as well as overall core melt frequency. In some cases, an externally initiated sequence may contribute predominately to risk (in terms of fatalities) due to containment failure mode and timing and radioactive release than to core melt frequency.

14. <u>Interfacing Systems LOCA Checklist</u>

The V-Sequence checklist does not specify the acceptance criteria to be used as the basis for decisions on each checklist question. As such, the checklist does not provide adequate assurance that the V-sequence will be properly addressed in the IPEM. IDCOR should modify the checklist to include guidance and prescriptive acceptance criteria for each checklist question. This should include a description of or reference to:

(a) The methods and assumptions to be used in defining the low pressure system boundary which must be analyzed by each utility

(b) Required actions in the event that only portions of the RHR lines are maintained water-filed, and acceptable bases (e.g., Technical Specifications/Plant Operating Procedures) for ensuring a water-filled state

(c) Methods and frequencies of hydrostatic testing by which system integrity should be demonstrated (if applicable). In this regard, a one-time only test is considered insufficient since aging effects, particularly for valve and pump seals, would not be identified.

(d) Analytical techniques to be used for analysis of piping stresses at elbows, piping supports, etc., and material properties to be used for all stress analyses, e.g., actual material properties with suitable margins to account for uncertainties in modelling, material properties and construction tolerance.

(e) Quantitative criteria regarding submergence of the failure site required to take credit for pool scrubbing in the auxiliary building, and methods/assumptions to be used to calculate the water additions and flood-up level.

(f) The method to be used by each utility for identifying the potential pathways to the environment (including guidance on assessing auxiliary building pressure capability, performance and failure location), and quantitative criteria regarding the minimum release pathway length and intervening structures required to claim applicability of the reference plant analysis.

(g) Acceptable bases for ensuring that fire sprays are available and would be actuated (e.g., emergency operating procedures/automatic initiation), and prescriptive criteria regarding the minimum acceptable coverage of auxiliary building (and release pathways) by fire sprays required to claim applicability of the reference plant analysis.

(h) Analyses required by each utility in order to claim that ventilation systems will remain intact and effective. Such analyses should address structural capabilities as well as filter effectiveness.

15. Release Categories

The PWR source term methodology assumes low releases (noble gases plus 5% volatiles) for unisolated containment sequences with coolable debris. IDCOR should provide justification that this assumption is valid for all PWR plant designs and all sequences in this release category. As part of this justification, IDCOR should assess the effect that dispersed debris which remains uncovered in certain regions of containment (e.g., on walls, intermediate floors, or structures) would have on the source term, and provide a separate release category for sequences with debris dispersal, if appropriate. The same concern applies to the BWR source term methodology.

16. Revaporization

The PWR and BWR source term methodologies do not consider plant specific differences which can influence the magnitude of volatile fission product revaporization. Specifically, IDCOR attempts to illustrate via a scoping calculation that the peak primary system temperature will remain below the value at which significant revaporization would be expected. This calculation is based on simplifying assumptions which have not been validated for all plants. For example, IDCOR assumes that (a) fission product distribution within the RCS will result in a uniform primary system temperature, and (b) a reactor coolant system (RCS) heat loss of 2 MW, uniformly distributed over the system boundary, is representative of all plants. This characterization does not adequately consider the potential for non-uniform fission product distribution and RCS heating which can occur in certain sequences, plant-specific differences in RCS heat loss, and the effect of spatial variations in RCS heat losses. In this regard, an RCS insulation/heat loss screening criteria should be added to the IPEM to address the above concerns. Supporting analyses to justify the screening criteria should also be provided by IDCOR , separately from the IPEM, as part of the issue resolution process.

17. Aerosol Plugging

The credit given the aerosol plugging of leaking containments may not be justified in all cases. Clarification and justification regarding treatments of aerosol plugging is required.

III. COMMENTS ON A1

A1.1. Accounting for Plant Experience

The data provided in A1, page 2-11, 2.1.3.1 on the frequency of transients by plant age yields the following observations:

North Anna-1 experienced no Loss-of-Offsite-Power (LOOP) events in 5.6 years while North Anna-2 experienced 3 LOOP events in 3.1 years. Also, ANO-1 experienced 2 LOOP events in 9.0 years while ANO-2 experienced 2 LOOP events in 3.8 years.

If the data presented in A1, Table 2.1-5, PWR Loss of Offsite Power Data, is representative of experience with operating plants, it appears that subsequent units are not assured of performing better than older units at the same site. (Interestingly, the only domestic severe accident experienced at a large commercial reactor was during the first year of operation of a second unit.) It would appear possible that specific plants are more vulnerable to transients and accidents early in their operating experience.

In view of the data reported in A1, Table 2.1-5, provide justification for moderating the impact of the plant-specific occurrence rates from the first five years of commercial operations. Isn't it better to find plant-specific vulnerabilities sooner than later? The needed justification should compare the IDCOR IPEM position with the benefits of including plant-specific data for all years of commercial operation. Since plant-specific data is not available until the plant has accrued signification operating experience, the procedure for incorporating plant-specific data should be optimized to discover vulnerabilities. A weighting algorithm is included in the method (A1, page 2-12, 2.1.3.1 Frequent Transients) without justification. The more conventional method for calculating plant specific data and combining it with generic data using a Bayesian approach is presented in NUREG/CR 2815, Vol. 1, Rev. 1, "Probabilistic Safety Analysis Procedures Guide." With this method, generic data is used for the prior distribution and plant specific data, if any, is used to update the data for a posterior distribution. The weighting algorithm should be justified relative to the more conventional Bayesian approach.

The data in A1, Table 2.1-5 also provides evidence of another problem that appears to have been totally ignored by the method in its search for plant-specific vulnerabilities. There appears to be a problem that the feedback system for the experience gained from the operation of earlier units is not working to a safety benefit, i.e., safe operations are not keeping up with operating experience. It should be inevitable that newer plants are safer than older plants.

A1.2. Motivation for an IPE at Group II Plants

(cf A1, page 1-11, Table 1.2-2) The IDCOR IPEM for PWRs calls for the time phasing of the IPEs. The second phasing of plants, Group II consists of the plants that already have performed a PRA. The IPEM is applied to verify the IPEM "applicability" and to develop "templates" needed for the subsequent Group III plants. The NRC has allowed in SECY-86-76 that the IDCOR IPEM might not be needed if a plant has performed an analysis for vulnerabilities using an equivalent or superior method. The motivation for Group II plants to apply the IDCOR IPEM is not clear. If the Group II plants do not develop the "templates" and establish the IPEM "applicability" for Group III plants, then what viability exists for this method? Provide a discussion of how a Group III utility would perform an IPEM on their plant if no templates are available from Group II.

A1.3. Expected Readers

The document's explanations jumble reader levels. In one place the writers presume that the readers' understanding is elementary while at another place the readers' understanding is presumed to be sophisticated. For example, the discussion in A1 on the generation of cutsets and their probabilities: The readers are first presumed to need an introduction to the term "cutsets" and then the readers are presumed to have a working knowledge of the linking of segment and nodal level models for computer code quantification of cutsets (A1, page 2-166 and Figure 2.3-56, Page 2-270). And later the readers are presumed to have worked Boolean identities through large Fault Trees by hand for the purpose of generating cutsets. IDCOR should edit the documents against a consistent set of ground-rules concerning the presumed readers. It is preferred that the reports be written for the user rather than to the NRC reviewers.

A1.4. Assessment Factors for Common-cause Failures

The treatment of common-cause failures in A1 involves using parametric factors to requantify common property Dependence Suspect Minimal Cutsets of systemic Fault Trees. The parametric factors used seem to be arbitrary and need justification closely tied to an empirical basis. For example, (A1, page 2-186, paragraph (d), 2.3.5.5 Common Cause Failure Unavailability) The basis for the derivation of the values for the "dependent failure parametric factor" needs to be documented. The values appear to transcend component types, designs, applications, assembly, and failure modes (e.g., whether it fails by blockage or breakage).

The discussion of the use of the "ratio change in system unavailability" needs to be developed further for clarity. The derivation of the "ratio" and the determination of the system unavailabilities needs to be included in the discussion. The discussion should relate the "ratio" and the "dependent failure parametric factor" to more conventional adjustments to the assessed risks that account for common-cause failures.

The common-cause failure analysis needs to be expanded to include potential failures from common locations, common test/maintenance, and common design at the sequence cutsets level. The results of the visual inspections need to be incorporated into the quantification of the cutsets.

IV. COMMENTS ON A2

A2.1. Screening Criteria

Specific items for which the IPEM implicitly gives credit but does not actually address on a plant-specific basis include:

(a) Credit for an auxiliary building retention factor of about 10.

(b) Credit for fire sprays independent of reliability/availability, and procedures for using fire sprays in the event of an interfacing system LOCA.

(c) Credit for the ventilation system independent of filter effectiveness.

The interfacing system LOCA (V-Sequence) screening criteria should be lower than proposed to account for deviations from the reference plant design and performance which are not explicitly treated in the IPEM and which may tend to reduce safety margins at some operating plants. Furthermore, the staff believes that failure of the containment (exclusive of Event V) can be sufficiently severe to cause damage to the auxiliary building, and that no credit for retention in the auxiliary building should be given following containment failure.

With regard to failure of containment isolation upon demand, provide the cut off point at which plant specific analyses of releases are required.

A2.2. Cavity Phenomena

The PWR source term methodology does not address high pressure melt ejection following lower RPV head failure and the potential for direct containment heating. It is the staff position that the methodology be changed to provide a screening criteria for debris dispersal in PWRs (e.g., average velocities and the associated Kutateladze number) for each one of the volumes and flow paths for each class of cavity configuration identified in IDCOR report 85.3-A2, and guidance on the analyses to be performed to assess the containment pressurization due to dispersal of the molten core material to the containment atmosphere. In addition, the methodology should be modified to include the following:

(a) Guidance on how a plant demonstrate that the simplified cavity configuration depicted by IDCOR in 85.3-A2 is an accurate representation of its cavity configuration,

(b) A requirement that (1) the potential pathways for water ingress and egress to the cavity be identified for each plant to confirm that the characterization of cavity flooding in the reference plant, i.e., dry or flooded cavity, is applicable, and (2) the size and elevation of the vapor pathways into and out of the reactor cavity identified for each plant to confirm that the characterization of natural convection and recombination in the reference plant is applicable.

(c) A requirement to examine each plant to identify the potential for debris reaching the containment emergenc sump, and

(d) A requirement that an assessment be made for each ice condenser plant of the potential for seal table failure and subsequent melt through of the containment shell in high pressure sequences.

A2.3. Ice Condenser Source Terms

The source term methodology for ice condensers is based on the premise that the source term calculated for Sequoyah represents the limiting source term for all ice condenser plants. IDCOR should provide additional justification to support the use of this approach for the back-end, in view of potentially important containment design/performance differences among the various ice condenser plants, e.g., differences in fan and spray flow rates, containment pressure capacities and failure location, and the presence of lower compartment sprays in one ice condenser plant.

A2.4. Source Term Calculation

The PWR source term methodology largely consists of a simplified calculational scheme for determining the source term for station blackout type sequences. The staff's evaluation of the accuracy of the scheme will, in part, be based on comparisons of the simplified calculation with results of detailed mechanistic analyses performed by IDCOR for the 8 sample plants and by NRC for the NUREG-1150 reference plants. In this regard, IDCOR should provide a detailed comparison of the results of the two methods for each of the sample plants.

A2.5. Characterization of Releases

Releases for station blackout sequences are characterized in the IPEM in terms of only tellurium and molybdenum. Reference is made in 85.3-A2 to detailed models which show that releases of other aerosols are negligible for representative debris temperatures, however, the referenced document, FAI report 85-45, has not yet been made available to the staff. We request that IDCOR provide a copy of this report so that our review of the calculation scheme provided in the IPEM can proceed.

A2.6. Hydrogen Combustion

The threat to containment integrity from global hydrogen burns and local hydrogen detonations is not addressed in the IPEM. Certain plants can be more vulnerable to these threats due to differences in core mass/containment volume ratios, i.e., hydrogen concentrations which can ultimately exist, concrete composition, lack of sufficient mixing or flow paths in containment, or a lower than typical containment ultimate pressure capacity. The IPEM should address the threat of hydrogen combustion events on a plant specific basis and include screening and acceptance criteria for each of the above items.

V. COMMENTS ON B2

B2.1. Screening Criteria

The first and second questions of the streamlined containment event tree (CET) are concerned with containment bypass and containment isolation failure respectively. Cross reference between the CET and the front end sections that address these issues should be provided. In this regard, it was stated that if the probability of containment bypass (LOCA outside the containment, V-sequence) is greater than 10^{-6} core melt/Rx-Yr, detailed analyses are required to evaluate the source term. Considering the consequences of expressing containment and the uncertainties involved further justification is needed to use a screening criterion greater than 10^{-7}. With regard to failure of containment isolation upon demand, provide the cutoff point at which plant specific analyses of releases are required.

B2.2. Impact of Issue Uncertainties

The methodology relies very heavily on IDCOR models of severe accident phenomenology without provision for uncertainties. Some of IDCOR models are in disagreement with present NRC models outlined below: (a) The potential for core debris melt through a Mark I steel containment or a main vent is simplistically assumed not to occur if spray is on, (b) The effect of the severe environment produced by a core melt accident on the containment penetration seals has not been addressed. (c) The discussion regarding Mark II containment assumes that corium flow out of the pedestal can be accommodated by one or two downcomers and will not reach SRV pipe penetration, this assumption is not supportable, (d) The Mark II CET does not account for raised downcomer rims and the potential for debris retained on the drywell floor to reach and melt the omega seal, that connect the diaphragm floor to the containment wall on some plants, or melt through the steel containment (there is one Mark II plant with free standing steel containment), (e) The methodology also assumes that a diaphragm floor failure will lead to all corium transported and cooled in the suppression pool. This is not necessarily correct since partial failure of the diaphragm floor can cause suppression pool bypass, (f) The suppression pools in certain of the Mark II containments need to be checked to ensure that if molten core debris falls into the suppression pool space under the pedestal, there will be adequate communication between the water in that space and the remaining pool water in the outer (peripheral) space to preclude excessive heatup and the potential for steam explosions, (g) Finally, the possibility of core debris attacking the reactor pedestal or the weir wall in Mark III containment is not addressed.

The IPE methodology documentation should provide explicit discussions of the differences between IDCOR and NRC on such complex physical phenomena or adopt the NRC position on the nineteen NRC/IDCOR phenomenological issues.

B2.3. Drywell Sprays

The CET implies that if drywell spray is activated before containment failure, containment integrity would be maintained. However, because of the rapid increase in containment pressure in high pressure ATWS event, drywell spray activation will not be sufficient to suppress the pressure rise and hence containment failure is likely to occur if no other mitigating function is activated. The CET also assumes that if drywell spray is activated prior to failure of reactor vessel, substantial scrubbing of fission product is achieved (release are dominated by noble gases) even if the containment failed. Provide further justification for this statement including consideration that the drywell head could lift due to the increased pressure and a substantial fraction of fission products could escape before being scrubbed by the spray systems.

B2.4. Venting

Wetwell/drywell venting as described in the IPE does not provide any specific guidance on what a licensee should do to demonstrate adequate venting procedure and flow path capacity. In this regard, successful containment venting should be defined to mean the depressurization of the containment occurred. This particularly important for sequences where the opening of one venting flow path is not sufficient to depressurize the containment (e.g. ATWS). The methodology also does not address penalty associated with containment venting such as:

a. suppression pool becomes saturated, therefore, threatening reactor vessel injection systems that take suction from the suppression pool by means of inadequate net positive suction head,

b. failure of ducting and continuous steam source being introduced into the secondary containment could lead to failure of equipments that are used to mitigate the accident such as CRD pumps and preclude personnel access to the reactor building for repair of failed equipment.

c. the potential for hydrogen detonation or large deflagration that could lead to reactor building failure, if the hydrogen accumulated in the inerted containment is released to the reactor building following failure of ducting,

d. no guidance on when vent path should be reclosed and if failed to close what are the radiological consequences,

e. with regard to containment venting, IDCOR assigned medium success criteria for containment venting during station blackout because, in IDCOR opinion, operators would likely vent after extended blackout conditions. The staff noted that since the current procedure does not allow operator to vent before the containment set pressure is reached the IDCOR success criteria is not supportable.

f. No evaluation of the effect of containment venting on the progress of accident sequence is performed or proposed to be performed. For example, could containment venting cause core melt due to loss of NPSH for injection pumps or due to unaccessability of equipment needing repairs. What sequence containment venting is beneficial and what sequences it is counter productive should be identified prior to considering containment venting as a successful path in the CET.

In addition, since the procedure calls for opening wetwell venting first, significant time would be required for these action (e.g. deflating the valve's seat), the probability for successful drywell venting, to overcome the rapidly rising drywell pressure, will become negligibly small.

B2.5. Hydrogen Combustion

IDCOR contends that for Mark III containment a direct impairment of both the containment and the drywell is not considered to be outlier because the fission product capabilities of the containment are sufficient to retain virtually all of the fission products except the noble gases. Further justification is needed before the staff could agree with IDCOR. The methodology should address the probability of hydrogen detonation in Mark III containments.

B2.6. Reactor Building

The assumed IDCOR reactor building fission product decontamination factor of 10 has not been approved by NRC. In addition the reactor building checklist does not account for the interdependence of mitigating systems and the availability of support systems. As such, the checklist does not provide adequate assurance that the credit given for fission product retention is justified. The checklist should include guidance and prescriptive acceptance criteria for each checklist question and should be extended to include the refueling bay and to study the potential for hydrogen detonation or large deflagration. The methodology does not distinguish between containment venting or failure in assessing the reactor building retention. In fact the methodology give maximum retention credit if the containment failure is removed from doorway or other path to the environment. The staff believes that the failure of the drywell or wetwell is sufficiently severe to cause damage to the reactor building and no credit for retention should be given in such case.

B2.7. Likelihood of Potential Outlier

Streamlined event tree nodes present choices to the analyst of low, medium or high. The assignment of "low", "medium" or "high" likelihoods are made based on key time intervals and plant physical features. The calculations of these time intervals and characterization of the physical features appear very superficial; especially since a single low or two medium likelihoods eliminate each sequence from consideration as an outlier independently of its frequency.

B2.8. <u>Releases Categories</u>

Without quantifying fission product release for the dominant sequences, comparison with the reference plant can only be made based on whether similar general mitigating systems are available in the plant being analyzed. Such a general comparison does not ferret out subtle but important differences between plants.