NEDC-32264-A
Class 2
September 1996
DRF No. AOO-05828
Revision 2

APPLICATION OF PROBABILISTIC SAFETY ASSESSMENT TO GENERIC LETTER 89-10 IMPLEMENTATION

TOPICAL REPORT - 1
BWR Owners' Group
Integrated Risk Based Regulation

Reviewed by: R.A. Hill,
Sr. Technical Program Manager

Verified by: W. P. Sullivan,
Principle Engineer

Approved by: S.J. Stark, Manager
BWR Owners' Group Projects

NEDC-32264-A
CLASS 2
Revision 2

Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation

TOPICAL REPORT - 1
BWR Owners' Group
Integrated Risk Based Regulation

September 1996

Prepared by the BWROG Integrated Risk Based Regulation Committee in cooperation with the Valve Technical Resolution Group Committee

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

The only undertakings of General Electric Company (GE) respecting information in this document are contained in the contract between the Boiling Water Reactors Owners' Group (BWROG) and GE, as identified in the respective utilities' BWROG Standing Purchase Order for the performance of the work described herein, and nothing in this document shall be construed as changing those individual contracts. The use of this information, except as defined by said contracts, or for any purpose other than that for which it is intended, is not authorized, and with respect to any other unauthorized use, neither GE, nor any of the contributors to this document makes any representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

<u>PARTICIPATING UTILITIES</u>:

Carolina Power & Light
Commonwealth Edison
Detroit Edison
Entergy Operations, Inc.
Georgia Power
GPU Nuclear
Nebraska Public Power District
New York Power Authority
Niagara Mohawk Power
Northern States Power
Pennsylvania Power & Light
PECO Energy
Public Service Electric & Gas
Tennessee Valley Authority
Washington Public Power System

This is a Class II document. Distribution of Class II documents is limited to the participating utilities and may be distributed to others only by the authorization of the participating utilities and the BWR Owners' Group.

EXECUTIVE SUMMARY

Initiatives undertaken by utilities in response to the Nuclear Regulatory Commission's (NRC) Generic Letter (GL) 88-20 have made new tools available for the quantification of risk and the closure of regulatory issues. These tools are known collectively as Individual Plant Examinations (IPEs).

In January, 1992 the Boiling Water Reactor Owners' Group (BWROG) formed the Integrated Risk Based Regulation (IRBR) Committee. The purpose of this committee is to study and apply risk based analyses to the operation of BWR nuclear power plants. The first study undertaken was the prioritization of motor operated valves (MOVs) for the NRC GL 89-10 program.

The GL 89-10 process, relative to PSA, can be considered in two parts: Initial testing and periodic verification. The process described herein provides an approach that allows either or both above mentioned parts to be prioritized relative to safety impact.

The technical approach developed is a seven task analysis that utilizes the Probabilistic Safety Assessment (PSA), the experience of operating staff, qualitative studies, and the identified GL 89-10 program scope as input. The goal of the assessment is to place each MOV in one of three application categories based on the high, medium, or low safety significance of the valve. This ranking of the MOVs is based on widely used risk importance criteria and represents discrete contributions to overall plant risk. The MOVs are initially ranked by the importance measures as calculated in the PSA. ADDENDUM 1 provides a detailed presentation on "Importances". Valves not included in the PSA or masked by modeling techniques are evaluated qualitatively and all valves are subjected to qualitative evaluation by the plant operating staff. On the basis of these studies, the valves are assigned to the appropriate application category.

The number of categories and the boundaries that separate these categories are based on engineering judgment. After several sensitivity studies the IRBR committee chose three categories. Once placed into an importance category, GL 89-10 recommendations would be applied to valves within that category.

The tasks discussed in this topical report are:

1. Review of Plant PSA to determine how well the PSA represents the MOVs pertinent to the GL 89-10 program.

2. Review of GL 89-10 MOVs not included in the PSA,

3. Importance measures used in the PSA,

4. Quantifying the importance of MOVs implicitly modeled in the PSA,

5. Sensitivity analysis to further assure that MOVs are evaluated properly,

6. Compilation of results including expert panel review, and

7. Application Criteria placing MOVs into one of three categories and then applying valve testing criteria specific to each category.

The concept of distributing resources according to risk significance was applied in the development of application criteria in this topical report.

In the above tasks, MOVs not in the GL 89-10 program have not been deleted. If an MOV not currently in the GL-10 program were to show high relative risk importance compared to valves which were in the program, it is proposed that the licensee would take action to evaluate the valve's operability in a manner similar to GL 89-10.

Some present GL 89-10 MOVs with a safety-related classification may be considered for reclassification based on the reviews performed in Tasks 1 through 6. Such reclassification would be outside the scope of this report and should be treated under the 10 CFR 50.59 process. The testing of reclassified valves would be determined by programs established by the plant licensees.

The application criteria stated within have been coordinated with and developed in conjunction with the BWROG Valve Technical Resolution Group.

Because of the nature of GL 89-10 postulated failure modes, especially inter-system Common Cause Failure, additional sensitivity studies need to be considered above and beyond conventional PSA ranking.

The results of this study will provide tools to optimize the allocation of resources in addressing the concerns of GL 89-10. Plant operational safety and efficiency will be maximized, and utilities can be assured that priorities for valve testing and maintenance have been effectively established.

Following NRC review of Revision 1 of this report, a request for additional information was issued to the BWR Owners' Group (Addendum 2). The BWR Owners' Group responded to this request (Addendum 3). The NRC Safety Evaluation Report for this report is Addendum 4).

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

1.0 INTRODUCTION

Initiatives undertaken by utilities in response to the Nuclear Regulatory Commission's (NRC) Generic Letter 88-20 (GL 88-20), "Individual Plant Examination for Severe Accident Vulnerabilities," have made new tools available for the quantification of risk. These tools which were derived from GL 88-20 requirements are known collectively as Individual Plant Examinations (IPEs) and generally take the form of Probabilistic Safety Assessments (PSAs).

In January, 1992 the Boiling Water Reactors Owners Group (BWROG) formed a new committee, the Integrated Risk Based Regulation (IRBR) Committee. The purpose of this committee is to study the feasibility of applying risk based analyses to the operation of BWR nuclear power plants and to develop appropriate techniques.

In December, 1992 the IRBR decided to produce a series of topical reports, each dealing with a specific technical issue where risk analyses would be appropriate and useful. These topical reports offer considerable advantages to both BWROG members and to the NRC, including:

- They can improve safety by focusing on the issues of greater risk significance,

- They can introduce a level of standardization in applying PSA analyses,

- This, in turn, can significantly reduce resource requirements of both the NRC and the BWR utilities when resolving issues, and

- Simultaneously, the work will reflect a more complete input from a larger group of contributors.

The first undertaking of the IRBR Committee applies PSA techniques, drawn from a number of plant specific analyses, to the risk prioritization of motor operated valves (MOVs). This effort will provide information for prudent resource allocation for the Generic Letter 89-10 (GL 89-10) Programs currently underway.

1.1 Purposes and Scope

The purposes of this study were to develop a methodology for risk based prioritization of MOVs, and to apply this prioritization methodology to the ranking of MOVs at several BWRs. This process of ranking or prioritization of MOVs according to risk significance forms the technical underpinning for safety enhancement and prudent resource allocation within the context of the NRC GL 89-10 programs. The topical report process and recommendations can be applied on a plant specific basis.

Two scope related issues were identified and reconciled. These include:

a) GL 89-10 Which MOVs are in a plant's GL 89-10 program, and

b) IPE Which MOVs are in a plant's IPE and the justification for not including particular MOVs within an IPE,

The IPEs, as a tool, generally provide quantitative information for "at power" plant configurations only. As such, qualitative considerations of external events and shutdown risk need to be performed. In addition, due to the variety of Level II methodologies used in IPEs, some plants may need to quantitatively evaluate Level II issues as well.

This report also addresses issues such as analytical truncation effects, the treatment of multi-component unavailability, and the potential of masking risk important valves. These issues, relative to their effect on ranking, are addressed for initial test prioritization and periodic performance verification.

1.2 Background

The NRC has issued many NRC bulletins and information notices concerning MOV performance, including IEB 85-03, "Motor Operated Valves Common Mode Failure Plant Transients Due to Improper Switch Settings". This IEB recommended that plants develop and implement a program to verify how MOV switch settings are selected, set, and maintained in order to assure their functioning under design basis conditions. The following is a brief history of the regulation documents concerning MOV operability.

- November 15, 1985 - NRC issued IEB 85-03; this bulletin recommended that utilities establish a program to ensure MOV switch settings are correctly set and maintained for selected systems.

- April 27, 1988 - NRC issued Supplement 1 to IEB 85-03; this supplement expanded the scope of valves to address the concern of mispositioning valves from the Control Room.

- June 28, 1989 - NRC issued GL 89-10, "Safety Related Motor Operated Valve Testing and Surveillance," which superseded IEB 85-03; this generic letter redefined the scope of MOVs to include all safety related valves, valves important to safety, and position changeable valves in safety related systems. GL 89-10 recommends the examination of MOVs from their design basis service conditions.

- June 13, 1990 - NRC issued Supplement 1 to GL 89-10; this document stated the NRC's position on issues raised during public meetings related to the implementation of this program.

- August 3, 1990 - NRC issued Supplement 2 to GL 89-10; this supplement provided utilities additional time to implement their MOV program.

- October 25, 1990 - NRC issued Supplement 3 to GL 89-10; this document states the NRC's concerns involving MOV performance based on results from INEL tests.

- January 14, 1991 - NRC issued Temporary Instruction 2515/109; this instruction provided direction to the NRC teams that would be conducting audits of GL 89-10 programs after January 1, 1991.

- February 12, 1992 - NRC issued Supplement 4 to GL 89-10; this supplement stated that the NRC staff no longer considered MOVs affected by inadvertent operation of MOVs from the control room to be within the scope of GL 89-10 for BWR plants.

- June 28, 1993 - NRC issued Supplement 5 to GL 89-10, which raises general concern regarding the reliability of data presented by MOV diagnostic equipment.

- March 8, 1994 - NRC issued Supplement 6 to GL 89-10, which clarifies the staff position on the schedule for completing the MOV testing and the grouping of MOVs to establish valve setup conditions.

Risk considerations are implicit in the development of GL 89-10 in that passive failures of MOVs were removed from consideration by the NRC, based on their low probability of occurrence. The NRC also used risk considerations in the value impact analysis of GL 89-10.

While there are recognized limitations to present PSAs, they do provide an excellent structure by which to assess the relative risk of issues relating to plant safety. The systematic and well reviewed PSAs provided in response to GL 88-20 analyzed various challenges to plant safety by considering plant design, operational procedures, and plant specific equipment performance data. This provided an assessment of the relative risk importance of one plant component or operator action versus another. As such, the NRC did well to utilize PSA in its development of GL 89-10 and utilities can do well to use PSA in efficiently responding to GL 89-10. This is especially the case since utilities are under increasing pressure to prioritize their resources to achieve the maximum safety benefit while addressing the GL 89-10 issue and other issues with safety relevance. PSAs should always be combined with sound judgment and insights from deterministic and mechanistic analyses.

GL 88-20 requests that Licensees evaluate Generic Safety Issues (GSIs) and Unresolved Safety Issues (USIs) using plant IPEs. Closure of GSIs and USIs as a result of these evaluations is recognized within GL 88-20. Generic letters are another means of the NRC conveying concerns to the industry; therefore, the application of PSA methods to the recommendations of GL 89-10 is appropriate.

1.3 Methodology

The technical approach developed is a seven task analysis utilizing the plant PSA and the identified GL 89-10 program scope as input. The goal of the assessment is to place each MOV in one of three application categories based on risk significance. The ranking of the MOVs is established based on widely used risk importance criteria and represents defined contributions to overall plant risk. Due to the inability of PSAs to adequately address all aspects of GL 89-10 concerns, the final ranking is supplemented with qualitative analysis and expert panel review. The number of categories and the boundaries that separate these categories are based on engineering judgment. After several sensitivity studies the IRBF committee chose three categories. Once placed into an importance category, category-specific GL 89-10 recommendations can be applied to each valve within that category. The steps and sequence of performing the rankir are shown in the flow diagram of Figure 1, "FLOW CHART FOR RANKING MOVS BASED ON RISK". The GL 89-10 program can, relative to PSA, be broken into two parts: Initial testing and periodic verification. If the methodology of this report is to be used for prioritization for initial testing, some additional tasks must be performed under the sensitive analysis task discussed in Section 1.3.5.

1.3.1 Task 1 - Review Plant PSA

A thorough understanding of the PSA is crucial. Without a working understanding of PSA assumptions, modeling techniques, and results the following tasks can not be properly completed. A simplistic approach could lead to underestimating an MOV's importance. In addition, since the GL 89-10 program has raised new insights regarding MOV performance, a thorough understanding of GL 89-10 issues is likewise crucial. It must be understood that PSAs may not have incorporated these insights since these were, for the most part, unavailable during the time-frame of the PSA analysis.

To determine MOV risk importance, the analyst should review both the PSA Level 1 and Level 2 analyses. This captures valves which affect core damage frequency and/or valves which affect radionuclide release frequency (loss of containment integrity). Task 2 addresses treatment of MOVs in the GL 89-10 program that do not appear in a plant's PSA.

PSAs model different failure modes for equipment. In the case of MOVs, the failure modes typically include failure to change position on demand, failure to control flow, and transfer closed or open (spurious actuation). For the purposes of this effort, because the GL 89-10 program is concerned with active valve failures, the failure to change position on demand is the failure mode of most concern. Consideration of the other failure modes in importance calculations is conservative and may be included if desired. The basic building block of the PSAs is typically called a basic event, because, depending on the scenario, a particular valve may have more than one important failure mode (e.g., in one scenario it may be failure to open, while in another scenario it may be failure to close). Therefore, the overall importance of the valve must consider the failure modes relevant to all pertinent scenarios.

Risk perspectives have the potential to improve the MOV test process itself. For example valves may be tested to "best estimate" conditions that might occur during the risk dominant accident sequences. This approach to testing is different from testing valves to the extreme design basis conditions, such as the instantaneous, double-ended guillotine break of the largest primary system pipe. Of particular concern are the severe tests of low probability events that could themselves degrade valve operability during the more likely accident sequences.

During the review of the PSA the analyst should be cognizant of MOVs which may be "masked". There are several mechanisms by which the true importance of an MOV may be masked. Specifically, initiating events may include certain MOV failures and the linking of the initiating event importance to the valve's importance may not be automatic with the PSA software. In PSAs sometimes independent sub-fault trees are modularized and treated as basic events in the analysis. The analyst should review the PSA to identify any MOVs included in the modules, so that the importance of the MOV may be examined. It is by no means obvious that such MOVs are of low importance. Similarly, if operator error were to dominate a particular event, the valve failure may not have been explicitly modeled. These situations should also be identified by the risk analyst to assure that the valve importances can be correctly estimated.

As a part of the PSA review the analyst should consider how the valves involved in the high energy line break (HELB) scenarios are modeled. This type of break will put the maximum pressure differential across particular valves and this condition is a primary of concern of GL 89-10. If the PSA does not adequately model these valves a qualitative assessment should be made of the significance of each of these valves.

The risk analyst should also evaluate the part that MOVs play in any initiating event for which screening analyses were performed. For example, flooding analysis or high to low pressure interfacing system LOCA analyses could take implicit credit for MOVs at a particular failure rate. If this failure rate were raised significantly, the scenarios could become important. Determination of the valve importance for the last two items is addressed in Task 4.

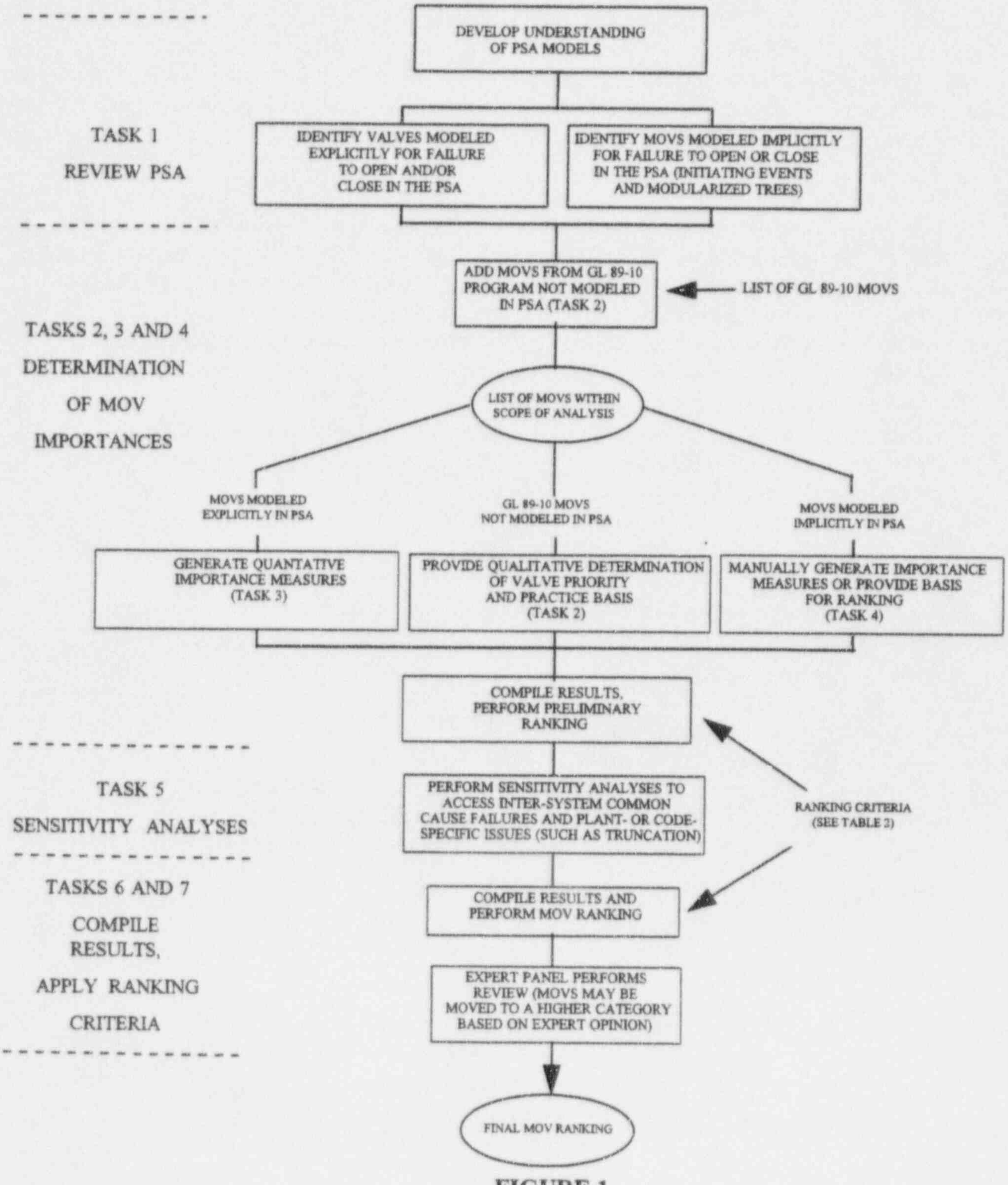


FIGURE 1.

FLOW CHART FOR RANKING MOVS BASED ON RISK

In addition the GL 89-10 issues raise concern relative to the applicability of PSA calculated MOV failure rates and Common Cause Failure (CCF) rate (i.e., the associated β-factors) in the PSA. As such they may need to be reconsidered relative to GL 89-10 postulated failure modes. This task lays the foundation by which to critically examine any importance reports that may be generated by the PSA software.

1.3.2 Task 2 - Review MOVs Not Included in PSA

To perform this task a listing of the MOVs addressed in the PSA is needed. This task examines MOVs that have been identified in a plants' GL 89-10 program scope, but that are not modeled in the PSA.

Some GL 89-10 MOVs may not be explicitly modeled in the PSA. This stems from the limitations on model size. The PSA analyst may choose not to model some components based on engineering judgment of their extremely low contributions to risk. In light of GL 89-10 concerns, the reason for not modeling specific MOVs should be briefly documented. This brief description will provide a qualitative or quantitative justification for a low risk contribution by the subject valve. In a few cases a quantitative justification may need to be developed, based on a small model evaluation. For example, a calculation could be prepared for a valve not in the PSA that demonstrates that it has negligible contribution to the overall risk. Review of these justifications by plant personnel is recommended.

1.3.3 Task 3 - Importance Measures Used in PSAs

Most of the software used in PSAs have the ability to quantify various risk importance measures for equipment modeled in the PSA. Completion of this task results in a listing of the MOVs and their associated numerical importance measure. Risk importance, as it is commonly used in PSA terminology, is the quantitative measure of the impact that each basic event contained in the PSA has on the results of the analysis.

These importance measures generally relate to the overall contribution to Core Damage Frequency (CDF) in the Level 1 analysis and Radionuclide Release Frequency (RRF) in the Level 2 analysis. ADDENDUM 1 describes various ranking processes utilized in contemporary PSA software. A commonly used risk importance factor is calculated using the following equation:

$$\textbf{Importance} = \frac{\textbf{Sum of frequencies of all minimal cutsets involving a particular MOV}}{\textbf{Total CDF or RRF}}$$

The above risk importance measure is analogous to the Fussell-Vesely (F-V) importance measure. The F-V importance measure is acceptable for determining relative basic event importances for cases in which the basic event probabilities are not expected to change dramatically

The F-V importance measure is acceptable for prioritization of MOVs based on the following reasoning. The F-V identifies which MOVs are in accident sequences, or in accident sequence cutsets, representing the largest fraction of the total core damage frequency, assuming the MOV basic events are included in the accident cutsets, or sequence database, and PSA MOV failure rates and β-factors are nominally equivalent to actual failure rates. An error in the failure probability of those MOVs would have the greatest effect on CDF. The purpose of the GL 89-10 testing is, ultimately, to assure that MOV reliability is as good as the risk analysts have calculated that it is. It is most important to confirm the reliability of MOVs in sequences that contribute the most to CDF.

When a uniform failure probability is assumed for all MOVs in the PSA, then the F-V, Risk Achievement Worth (RAW), and the Risk Reduction Worth (RRW) of all individual valve failures will yield identical rankings. Since all MOVs then have failure probabilities that change the same amount when set to 1.0 or 0.0, importance will be based on whether or not a particular MOV appears in sequences important to core damage. Other importance measures may give similar rankings to components. However, if the importances are calculated for failures of sets of valves, these measures may lead to different rankings because some cutsets may contain multiple valves.

Section 2.3 describes the results of sensitivity analyses that were performed to show the applicability of a few other importance measures. These include comparisons of the generic MOV failure rates used in plant PSA's versus the MOV failure rate of 0.087/demand which was derived in NUREG/CR-5140 as a conservative mean estimate based primarily on static MOV testing results obtained during implementation of IEB 85-03.

Small differences between the relative risk positions of an MOV in one ranking methodology versus another is even less of a concern because of placing groups of valves into risk categories. It is likely that even if two different ranking methods resulted in somewhat different rankings in their lists of MOVs, this would still result in the same particular valves populating the same risk category. The "binning" of MOVs into risk categories, therefore, diminishes concerns about the choice of ranking methods.

The specific set of accident sequences used in the importance calculation is straightforward for the Level 1 analysis, in that the sequences of interest are those that lead to core damage. However, for the Level 2 analysis, because of the various techniques used, the definition of sequences of interest may not be as clear and importances may not be calculated as part of the software analysis results. The risk analyst will have to carefully consider the analytical techniques used in the specific plant PSA and describe the approach utilized for the Level 2 importance calculations.

The product of this task is the Level 1 and Level 2 importance ranking results. The importance ranking results must account for MOVs which were included in the PSA modularized basic events, initiating events, and operator errors mentioned in Task 1, as well as the GL 89-10 program MOVs.

More extensive information on importance measures appears in Addendum 1. This addendum represents the present state of knowledge and is appropriate for use with this topical report. It is anticipated that this addendum will evolve as further applications of PSA technology are undertaken.

1.3.4 Task 4 - Quantify Importances of MOVs Implicitly Modeled in the PSA

Because PSAs generally treat some potential failures implicitly, an expanded review of MOV importance is required. As discussed in Task 1, two cases where MOVs are potentially modeled implicitly are initiating event frequency and human error frequency.

If MOV failure modes are modeled implicitly, one must understand the nature of their inclusion in the PSA models. This type of modeling, in which components are implicitly incorporated, is generally called "modularization". The basic event probability represents the aggregate of the failure modes of several components and operator actions required to accomplish a function. Operator failure usually dominates. For example, a basic event titled "operator aligns containment venting" obviously includes an operator action but it may also implicitly require an MOV in the containment vent system to operate. To determine overall containment vent MOV importance in this example, one would multiply the containment vent basic event importance by the MOV contribution to the containment vent failure probability. This MOV contribution would be the corresponding F-V basic event importance of the vent valve to the fault tree or other representation of "operator aligns containment venting". This value would then be added to any importance calculated for the individual valve during the Task 3 study. A similar case exists for some initiating events.

Alternatively, for these cases, the overall importance of an event like "operator fails to align containment venting" can be used as an estimate for the importance of the masked MOV. As above, it should be realized that PSA MOV failure rates may need to be reconsidered based on GL 89-10 data and insights. In this regard, PSA assumptions regarding MOV failure rates should be re-evaluated as described in Task 5. In the example above, a sensitivity assessment should be made regarding the MOV contribution to the "operator aligns containment venting" event. It may be possible that due to GL 89-10 failure modes, the MOV failure rate actually dominates the event rather than the operator failure rate.

For completeness, an evaluation must be made of the importance of the MOVs dropped from the PSA model in any PSA screening analysis which was performed for the PSA. Alternatively, a screening analysis validity verification should be performed and documentation should be provided showing that MOVs not included explicitly in the PSA are not significant contributors to CDF and RRF.

1.3.5 Task 5 - Sensitivity Analyses

In considering PSA utilization for implementation of GL 89-10, three issues have been raised: 1) truncation of valve contributions because of assumed low failure probabilities, 2) truncation of valve contributions because of calculational cut-offs and 3) combinations of MOVs across systems not functioning properly (inter-system CCF). Resolution of these issues can be made by performing certain sensitivity studies:

1) The truncation (base events dropping out of the model) due to low failure probabilities occurs in the generation of cutsets from fault trees. Temporarily setting high failure rates (e.g., 0.10 or higher) and β-factors and regenerating cutsets from fault trees assures that the MOVs appear in the cutsets. The failure rates in the data base are then restored to their original PSA values for evaluating the cutsets to obtain CDF and importances.

2) The truncation of valve contribution because of calculation cut-off occurs because of the truncation limits set in both the cutset generation and the cutset evaluation. The limitation to setting very low cut-off values comes from the necessity for setting limitations on program "run time" with the some programs. This can be fixed, as with the above, by temporarily setting high MOV failure rates and β-factors to assure that MOV cutsets are not truncated. As such, the technique of using high MOV failure rates for cutset generation or accident sequence database development effectively solves both truncation issues.

3) GL 89-10 raises new concerns relative to inter-system CCF of MOVs due to the potential for widespread MOV performance inadequacies. Considering that PSAs do not generally model these types of failures, they need to be considered in addition to the PSA based tasks described above.

Since initial testing of valves should verify that inter-system CCF has a very low probability, utilities using PSA to rank valves for periodic performance verification only (i.e., PSA not used to change initial testing schedule) would not be required to perform any additional sensitivity studies. However, if PSA will be used to alter initial testing schedule, the ranking impact of inter-system CCFss should be considered. The approach is described below.

Valves determined to be more important due solely to inter-system CCF would be grouped in a higher category for initial testing and can be reduced back to the original category when the periodic verification phase is entered. When one valve in a common cause set of valves is tested satisfactorily, the importance of the entire set of valves is decreased. In other words, testing one valve in a set of valves may be judged applicable to the entire set of valves for purposes of initial test ranking.

Dependent failures resulting from a valve failure are typically modeled in PSAs. These failures occur when, for example, a valve failure causes the failure of cooling water flow to a component resulting in its failure. In this case the PSA would equate the MOV failure with failure of the supported component.

Inter-system Common Cause Failure (CCF) Sensitivity Analysis

Realizing that PSAs do not generally model inter-system CCF, it is important to consider the potential impact of GL 89-10 failure modes. Also, even if inter-system CCF is modeled, the uncertainty in CCF rates, caused by GL 89-10 concerns, would justify consideration of inter-system MOV failures.

Since the probability of inter-system CCF is uncertain, the best way to study the potential impact is to perform sensitivity analysis. The existence and probability of different CCF events should be varied and results reviewed. Since PSAs are generally stronger in dealing with single element basic events, a model cutset regeneration and requantification with high failure rates may be required to assure the severe accident cutset/sequence databases include a full complement of valves to be studied. However, it may be possible to justify the current cutset/sequence database without requantification provided the PSA staff consider the potential for truncating potentially important failure modes.

The failure rate of valves, including common cause sets of valves, that could be challenged within individual accident sequences should be varied. Valves and CCF sets of valves that, when their probability is varied, result in large increases in CDF or Level II end-states should be considered for elevation of importance to a higher category. Sections 2.1.1.1 and 2.1.4 show the specifics of the approach and results for reference plants. It may be possible to justify keeping some valves in a lower category even with high sensitivity impacts if it can be shown that testing a valve in a higher category effectively lowers the importance of the rest of the CCF set of valves. As such, it may be possible to show that testing and verifying adequate performance of one valve in a CCF set of valves effectively eliminates the need to qualitatively raise the importance of the remainder of valves in the CCF set of valves.

In addition, the expert panel should be apprised of the limitations of PSA related to inter-system CCF so that they can provide an additional review of the potential for PSA to mask the importance of some valves when the potential GL 89-10 failure modes are considered.

1.3.6 Task 6 - Compilation of Results/Expert Panel Review

Results of the previous tasks should be compiled into a table similar to that shown in Table 1. This table is a list of MOVs by importance. Valves not modeled in the PSA and the justification of their low importance prepared in Task 2 should be included at the end of the list.

The third column summarizes in words the crux of the argument of the PSA numerics that result in the particular importance analysis. This is particularly useful for reviewers who are not familiar with PSA. In addition, the effort necessary to put together this text provides another review of the basis for the PSA importance ranking.

A consideration in qualitative review of valves is the feasibility of recovery of a failure of the valve by other means (e.g., manual operation) if the failure is a "normal actuation" failure. If the recovery action is not modeled in the PSA, there may be a basis for a lower importance ranking for a particular valve if some credit is given for recovery by operator action.

In considering valves which were not included in the PSA (see Table 1) the most important considerations are, "What are the consequences of the MOV failure to function" and "What is the possibility that the MOV will fail in concert with other valves?" When the consequences and probability of occurrence are expressed in terms of CDF or RRF, the consequences can then be compared to failure of other valves which have similar consequences and a similar importance can be assigned.

The assessment of risk associated with the failure of valves with a primary function of controlling release of radioactive material is more complex. Not all utilities have performed detailed Level 2 PSAs and there is less standardization in methods and agreement in phenomenological processes. Therefore, the results on the ones which have been performed are not as easily comparable as the results from Level 1 analysis. However, a similar assessment of consequence can be done and a "qualitative" assignment of risk "importance" can be made.

The overall ranking results must be critically reviewed by an expert panel to ensure that important aspects are not missed. Personnel from design, maintenance, and operations as well as personnel familiar with the concerns raised by GL 89-10 are recommended as members of such a panel. The expert panel should be briefed on the limitations of PSA and should be specifically instructed as to whether or not external events or shutdown events are included in the PSA.

In addition to reviewing the specifics of the PSA results, the panel should independently consider the nature of the MOV performance and the potential for MOVs to fail in common cause. In particular, the panel should consider how current testing and operational procedures affect their appreciation of MOV functionality.

The panel should also review actual industry events where GL 89-10 concerns were demonstrated such that an appreciation of the actual findings relative to MOV performance are assured.

TABLE 1

MOV RISK PRIORITIZATION RESULTS

VALVE ID	DESCRIPTION	IMPACT of MOV FAILURE	RISK IMPORTANCE
2SWP*MOV94A	Division 1 EDG service water cooling supply valve	Results in failure of EDG due to lack of cooling	Values filled in from importance calculations (i.e. 0.03 F-V, 1.38 RAW)
2ICS*MOV120	RCIC Steam Supply Valve	Results in failure of RCIC and impacts high pressure make-up	
2CSH*MOV105	HPCS pump discharge to suppression pool	Results in failure of HPCS and impacts high pressure makeup	
2RHS*MOV1A	RHR pump a suction valve	Results in failure of Div. I RHR and impacts Cmt heat removal	
2DEH*MOV119	Equip drain isolation valve	With failure of its inboard valve pair results in containment bypass	
2ICS*MOV124	RCIC Test return MOV	Open for approx. 6 hrs per qtr for RCIC testing, is assumed in failed state during test	
2SWP*MOV1B	Auto-straining backwash MOV	Provides strainer backwash. Assumed not clogged at start of accident it won't clog over relatively short accident duration. As initiator is small contributor because of redundant pumps and low flow alarms which give much time for recovery	

1.3.7 Task 7 - Application Criteria

The concept of distributing resources according to risk significance was applied in the development of application criteria in this topical report. In the previous tasks MOVs not in the GL 89-10 program have not been deleted. If a valve not currently in the GL 89-10 program were to show high relative risk importance compared to valves which were in the program, it is proposed that the licensee would take action to assure the valves' performance in a manner similar to GL 89-10.

Another concept would be for the licensee to consider reclassification of any GL 89-10 MOVs whose inclusion in GL 89-10 or safety-related classification was called into question by the reviews performed in Tasks 1 through 6. This establishment of guidelines for this reclassification is outside the scope of this report and should be treated under the 10 CFR 50.59 program.

The NRC's recommended GL 89-10 program can be summarized in five basic steps (These steps are for the convenience of the PSA analysts and are not intended to be individually equivalent to GL 89-10 recommendations):

Step 1. Identify MOVs within the scope of GL 89-10 (i.e., active safety-related MOVs).

Step 2. Perform design basis reviews, establish switch setting methodology, calculate required operating forces - based on these reviews certain "upgrades" may be identified.

Step 3. Verify switch settings. It is recommended that periodic verification of performance be repeated every five years.

Step 4. Conduct dynamic dp tests where practicable.

Step 5. Post maintenance/modification testing[a].

Based on the insights gained from MOV importance ranking, safety improvements and better use of resources can be obtained by grouping the valves into three risk categories. Each risk category is associated with particular valve performance verification frequency. This maximizes the benefit of implementing the GL 89-10 in that the valves of greatest risk significance would be identified and efforts would be concentrated on these valves. Qualitatively these valve categories are:

[a]The extent of post maintenance/modification testing varies, depending on the type of maintenance/modification performed.

HIGH CATEGORY: These valves appear high on the importance ranking results for core damage or large release. Typically, these valves are associated with relatively high frequency sequences in which the failure of the valve(s) in combination with a single operator error or active system failure results in core damage or release of radionuclides. Failure of the valves severely limits the paths available for achieving safe shutdown. An example of high importance valves would be MOVs in the cooling water supply to the diesels which must close or open to provide adequate cooling water to the diesels at a plant in which loss of offsite power was a major contributor to CDF or RRF.

MEDIUM CATEGORY: These valves contribute less significantly to core damage or large release, but still appear above the insignificant range in the importance reports. These valves typically perform a risk-significant function, but the importance of these valves is reduced by factors such as the availability of other systems which can perform the same function, availability of time for recovery, or low frequency of the initiating event(s). An example of medium impact valves could be the shutdown cooling suction valves. The importance of these valves is reduced because other RHR modes are provided for cooling the reactor.

LOW CATEGORY: These valves have a low contribution to core damage or large releases. Typically, failure of these valves does not significantly change the progression of any accident sequence. Factors, similar to the medium priority valves, are present to that extent that failure of the valve(s) does not significantly impact plant risk. An example of a low category valve could be a service water system isolation valves designed to protect against line breaks in an area in which flooding was found to be a negligible risk contribution. It is important to understand that just because a valve has a low importance does not mean that one cannot conceive of a scenario in which the valve is needed. It simply means that when the function of the valve is evaluated within the comparative framework of a PSA, it is found to be of low importance relative to that for other valves.

Valves are assigned to these three categories based on the criteria in Table 2. The sensitivity analyses and any other available information (operational reviews, etc.) used to move additional MOVs into the HIGH and MEDIUM category, based on engineering judgment.

TABLE 2 RANKING CRITERIA FOR MOVS FOR GENERIC LETTER 89-10		
RANK	**CRITERIA[(a)(b)(c)]**	**NOTES**
High	**> 1% CDF GL 89-10 MOVs**	**Additional MOVs can be added based on judgment, sensitivity analyses.**
Medium	**≥ 1% CDF ≥ 0.1% GL 89-10 MOVs**	
Low	**Remaining GL 89-10 MOVs < 0.1% CDF**	**Adequate justification for valves in this category should exist.**

(a) These importance criteria establish the baseline for valve inclusion. However, as noted in Task 4, qualitative assessments further evaluate the inclusion of other MOVs.

(b) Similar criteria for Level 2/RRF should be utilized.

(c) See ADDENDUM 1 for correlation of %CDF and F-V.

The evaluation of MOVs on a qualitative basis is expected to "up-grade" rather than down-grade the categorization of GL 89-10 program MOVs.

The above criteria are consistent with previous industry prioritization studies. However, many plant-specific issues could cause individual plants to modify the above for their specific applications. Specific considerations could include absolute values for PSA core damage frequency or radionuclide release frequency.

The specific applications of the risk importance to the GL 89-10 criteria are summarized in Table 3.

It is believed that the test frequencies recommended in Table 3 are conservative. The recommended test frequencies for the medium and low categories are far more frequent than would be dictated by risk considerations alone. For example, if resources are applied according to risk significance, then testing frequencies would be inversely proportional to an MOV's risk ranking. However, as seen in Table 2, the medium and low risk categories are about factors of 10 and 100, respectively, less risk significant than the high risk category. The periodic testing frequencies recommended in Table 3 for the medium and low risk categories is every 5 and 8 outages and every two outages for the high risk category. This is far more frequent than would be recommended based on risk considerations only. Thus the

recommended testing frequencies are reasonable from a risk perspective. These frequencies are based on an average of 18 month outage cycles. For plants on other cycle frequencies, "time equivalent" frequencies should be used.

Furthermore, in several instances utilities have performed actuator refurbishment prior to performance of the GL 89-10 baseline diagnostic static testing. This refurbishment commonly includes the disassembly and inspection of all internal actuator parts. This practice has afforded an opportunity to evaluate the effectiveness of preventative maintenance programs in preventing degradation of the actuator drive train. After an average of 10 to 15 service years since comparable maintenance, utilities generally reported very few wear or age related failures unless the actuator was under-sized or served in a high temperature environment. Comparing industry experience with GL 89-10 recommendations of testing every five years, the retest periods proposed by the above application criteria are considered reasonable.

The above test frequencies are considered to be reasonable, based on risk, but could be modified by each plant, if necessary, based on maintenance history and on the new data which develop as test results are obtained.

These application criteria will allow appropriate resources to be applied to the most risk significant valves while maintaining the intent of the GL 89-10 program to increase the overall effectiveness of MOV operation in a cost-beneficial manner.

The content of periodic performance verification tests is not assessed here. The testing necessary to verify continued operability following initial testing and setup should be developed based on plant experience and with NRC guidance in mind. Likewise, details of tests required following major maintenance or modification are not assessed here. These tests should be developed based on consideration of the change to the individual valve and should consider NRC guidance. However, in both these cases, consideration of the risk significance of the individual valves may be useful.

When using extended testing intervals, per GL 89-10, written NRC notification is required. Extended testing intervals amounts to an exception to basic guidance presented by NRC.

TABLE 3 APPLICATION OF RISK IMPORTANCE RELATIVE TO GENERIC LETTER 89-10

RISK[a] CATEGORY	SCOPE & DB REVIEW	INITIAL[e] TEST SCHEDULES	UPGRADE	PERIODIC[c][d][h] PERFORMANCE VERIFICATION	POST MAINTENANCE/ MODIFICATION TESTING[f]
High	Yes	Risk significant schedule	In accordance with current licensing commitment on risk significant schedule	Every 2-3 outages	***Static test*** when torque & thrust output are affected.
Medium	Yes	Resource appropriate schedule -- sooner than low risk valves	Resource appropriate schedule, not to exceed current licensing commitments	Every 5-7 outages	***Static test*** when normal operability is affected -- less severe than high risk.
Low[b]	Yes	Resource appropriate schedule	Based on plant judgment only. [g]	Every 8-10 outages	***Static test*** based on plant judgment **only**. [g]

a Resolution of emerging technical issues should be evaluated commensurate with a valve's category.

b. Low risk valves =
- GL 89-10 valves modeled in the PSA and determined to be of low risk significance.
- GL 89-10 valves not modeled in the PSA and confirmed to be of low risk significance.

c. May be altered based on performance as trending information is available. Definition of acceptable performance verification may be modified based on technological advances.

d Valve testing should consider combinations of equipment that may be out of service during the testing. Certain combinations of equipment out of service could lead to high risk configurations.

e. Supplement 6 to GL 89-10 provides guidance on initial valve testing schedules.

f. The extent of maintenance/modification may be judged by plant staff to require dynamic test.

g This is not intended to limit the Licensee's responsibility to maintain MOV operability.

h. Plants on other than 18 month average outage cycle can use "time equivalent" frequencies.

2.0 RANKING STUDY RESULTS

The following subsections provide plant specific results of MOV prioritization.

2.1 Individual Plant Results

2.1.1 Results for BWR A

BWR A is one unit of a dual unit configuration with a BWR 4 vessel and containment. Important system features include high pressure injection systems HPCI and RCIC, low pressure injection systems Core Spray (4 pumps) and LPCI (4 pumps), four shared diesel generators, High Pressure Service Water (HPSW) utilized for cooling 4 RHR heat exchangers, and an Emergency Service Water (ESW) system that supplies diesel cooling as well as ECCS pump and room cooling.

The one unit and the shared systems involve 92 of the 178 MOVs included in the GL 89-10 program at the site. The Level 1 PSA models 55 valves with failure modes identical (i.e., failure to open or close on demand) to those required in GL 89-10. 74 valves of the 92 MOVs are modeled in the Level 1 PSA.

The ranking of the MOVs is based on F-V importance measure and the RAW (see Addendum 1 for definitions) calculated from the Level 1 PSA. The risk prioritization results presented in Table A1 include all MOVs in the GL 89-10 scope plus any additional MOVs which exceed a F-V importance of 0.0001 or a single valve RAW of 1.0. F-V and RAW are used as complementary measures since RAW can verify that appropriate rankings have been made.

Quantitative Level 2 analyses using importance measures based on large release were performed to assess if any MOVs would be considered risk significant. All valves that were determined to be significant, based on release, were also found to be significant in Level 1 analyses and therefore release importances did not contribute additional MOVs to the list of significant valves.

Deterministic evaluations, results of which are not included in Table A1, were also used to prioritize specific MOVs and were based on potential of closure after a line break and on design margins.

Alternate unit PSA ranking was also performed to assess the effect on the relative importance of the MOVs of non-symmetries (mostly due to the difference in power supplies). The calculated F-V and RAW measures for the alternate unit were very similar to those reported in Table A1 except for one valve, the Emergency Cooling Water (ECW) pump discharge valve. This valve, which is common to both units, has a F-V and RAW of 0.001 and 1.1, respectively. The difference in importance is due to a non-symmetry between the units. Therefore the valve's importance is based on the alternate unit's importance.

Qualitative judgments or practical testing factors were not considered when developing the ranking of MOVs in this section. The Tables provide only a listing as produced by manipulating the IPE models as a demonstration of risk based ranking.

2.1.1.1 Sensitivity Results for BWR A

A number of probabilistic evaluations were performed using the Level 1 IPE for BWR A to determine the risk significance of motor operated valves. These sensitivity studies provide insights into the impact of truncation effects, valve failure rates, and valve failure combinations on the number and categorization of valves considered risk significant.

This sensitivity assessment of valve importance was quantitatively performed using only a Level 1 IPE model and does not therefore consider MOVs associated with the Level 2 analysis (i.e., containment isolation valves) or those MOVs considered important from a purely deterministic perspective. All sensitivities were performed by re-quantifying the entire IPE model at constant truncation values. A truncation value of 1E-11 was used during quantification since this would allow, at the IPE valve failure rate of 1.2E-2, a significant number of valve failure combinations within a cutset to occur without truncation affecting a valve's importance contribution. Increasing the MOV failure rate would have the same effect as lowering the truncation value because there would be a net increase in the number of cutsets generated that would represent valve failures. It is highly unlikely that valves below this level would represent a significant risk contribution.

Table A1 illustrates the impact that assumed valve failure rates have on the number of MOVs with a F-V importance greater than 1.0E-4. This table indicates that an upper limit on the number of valves exists given extremely high failure rates and that many valves, considered insignificant in terms of risk, do not contribute collectively to overall risk. Another sensitivity, illustrated in Table A4 was performed to confirm this conclusion. All failure to stroke valves that did not achieve a F-V importance of 1.0E-4 in the IPE model, 36 in all, were arbitrarily failed (failure rate set to 1.0) and the model regenerated and requantified. The increase in CDF was only 19% greater than the base IPE model CDF, indicating that most of those valves are truly risk insignificant. Failing all valves simultaneously represents failure combinations across a number of systems (i.e., inter-system common cause).

Additional selected inter-system failures were investigated for BWR A to determine the sensitivity of valve combinations to further address the multi-component issue. The combinations involved the simultaneous failure of the HPCI and RCIC injection valves (both high rank) and the HPCI and LPCI Loop B injection valves (high and medium rank respectively). The valve failure rate was set to 1.0 and the model regenerated and requantified. The results indicate a factor of 19 increase in CDF resulting from an inter-system failure of the HPCI and RCIC injection valves. The HPCI and LPCI simultaneous valve failures resulted in an approximate factor of 5 increase in CDF. These sensitivities in addition to those performed for the low ranked valves indicate that multi-component, inter-

system CCFs will not affect the identification or ranking of the MOVs beyond that of the standard ranking methods described in this report.

In addition to the sensitivities performed on the categorization of valves, the change in core damage frequency is shown in Table A3 as a measure of the integrated impact MOVs have on the Level 1 risk profile. The results indicate that increases in valve reliability (i.e., lower valve failure rates) from the IPE value have little effect on the CDF and only significant decreases in reliability of all valves change the CDF by appreciable amounts.

Comparison between different risk ranking methods, namely F-V and RAW, was also performed to assess the sensitivity of the number of valves considered risk significant. The results of this comparison is shown in Table A4.

2.1.2 Results for BWR B

BWR B is a BWR 4 with a Mark I containment. Important features include HPCI, RCIC, Core Spray (two pumps), LPCI (four pumps), three emergency diesel generators, a dedicated RHR service water system and a normal service water system that supplies normal and emergency loads. The unit has 81 active safety-related MOVs included in the GL 89-10 program. The total core damage frequency is estimated at approximately 2E-5.

This information used to rank the MOVs in presented in Table B1. This Table includes all MOVs within the GL 89-10 scope plus any other MOVs exceeding 0.01 percent importance to the core damage frequency. The importance values represent only MOVs failing to open or close on demand. Only one valve on the list, 1P52-F874, is outside the scope of GL 89-10. Of the 81 valves within the scope of GL 89-10, 33 were not explicitly modeled in the IPE as basic events.

The importance measures were also calculated based on the containment failure frequency (all modes) and the large release frequency. These data are also presented in Table B1. A comparison between the importance measures for core damage, containment failure and large releases reveals that MOVs that appear to contribute significantly to containment failure or large releases also appear as visible contributors to core damage.

The valve priorities shown in Table B1 were assigned using the criteria in Table 2. Based on an additional qualitative review of the results, a number of valves were moved to the medium and high categories from lower categories. The justification for these upgrades is included in Table B1.

The IPE for this plant was performed using the RISKMAN software package from PLG, Inc. Quantification was performed with the quantification truncation limit set to the same frequency as the cutoff limit for saving sequences to the data base, at 5E-10. This cutoff value resulted in 2600 sequences being used in the importance calculations, representing 95% of the total core damage frequency. Lower cutoff and truncation limits would result in a

larger sequence data base for the importance calculations, but experience has shown that it is unlikely that the importance results would change.

The Level 2 analysis was performed using the containment performance analysis approach employed by Fauske and Associates. A containment event tree was developed and quantified concurrently with the Level 1 event trees. Containment systems modeled using fault trees for the Level 2 analysis included the drywell spray mode of RHR, the containment vent hardware, and important containment isolation valves. The quantification of the Level 2 trees with the Level 1 trees allowed all systems to be included in the generation of basic event importances for the containment failure frequency and for the large release frequency.

Several manipulations were performed with the "as calculated" importance results:

a. Some initiating events were modeled using fault trees. The importances of these basic events were manually included.

b. The importances of common cause events, which are listed separately from independent events in the importance reports, were manually added to the independent failure events, so that the total importance of the valve could be determined.

c. Failure modes not applicable to GL 89-10 (e.g., transfer closed/open, maintenance and misalignment) were removed from the list.

d. Some valves had basic events for failure to open and failure to close (different scenarios). The importances for both basic events were totaled.

2.1.3 Results for BWR C

BWR C is a BWR 5 with a Mark II containment. The Unit has 177 active safety-related valves in its GL 89-10 program. Total core damage frequency is calculated to be 3.1E-5/yr. Level II Early/High radionuclide release frequency is calculated to be 7.8E-7/yr. MOV failure rate is calculated to be 0.002/d.

Table C1 shows the result of the prioritization of MOVs using the Level I and II models. Table C2 shows the qualitative reasoning for individual valve importance for those valves with lower priority. This table, while providing a check of the PSA quantification, provides a description of valve importance that could be easily understood by those not versed in PSA.

A number of sensitivity studies were performed to evaluate the above-mentioned results. Quantification of the model with the low-important MOVs set to guaranteed failure demonstrated the low contribution of less important MOVs even if very high failure rates are used. In addition, RAW importance ranking were shown to produce the same ranking of MOVs as did the F-V importance rankings used for Table C1. This occurs in this application since the PSA used the same failure rate for all MOVs in the model. Because of this, ranking

is not sensitive to MOV failure rate. However, a quantification with the MOV failure rate set to 1.0 for all MOVs resulted in a CDF increase of 80 times. This sensitivity study showed that the functioning of MOVs is a critical aspect of plant safety. However, as shown above, this safety is highly dominated by a relatively few MOVs.

2.1.4 Results for BWR D

BWR D is a BWR 3 with a Mark 1 containment. Important features include HPCI, RCIC, Core Spray (two loop), LPCI (two loops, four pumps), two emergency diesel generators, dedicated RHR service water, and a normal service water system that can supply normal and emergency loads. The unit has 61 active safety related MOVs included in the GL 89-10 program. The total core damage frequency is 2.6E-5/yr. from the PSA submitted in February, 1992.

The ranking of MOVs based on the F-V importance measures is presented in Table D4. Tables D1 and D2 are included to show which valves were not modeled in the PSA and which valves had minimal impact on the PSA (i.e. F-V < 0.1%). This is also summarized in Table D6.

To verify the important MOVs, a requantification of the Level 1 PSA was completed. This effectively replaced the regulatory backfit analysis provided by NUREG/CR-5140. This showed that the same MOVs were identified as important whether a CCFs related to design or maintenance was included or not. This requantification process was also completed for a PWR as part of a Cooperative Efforts Group, and it showed similar results.

As stated above, this work was based on Level 1 results. The MOVs associated with decay heat removal do not impact risk significantly for the following reasons:

- All containment heat removal systems are manually initiated,
- There is substantial time available for initiation, and
- Makeup to the reactor is possible, subsequent to containment heat removal failure, from sources inside or outside the reactor building.

This requantification was performed under two separate conditions. A higher failure rate was added to all valves that would have to operate under a "high Δp" (refer to Table D3). The second requantification only added the higher failure rate to MOVs that would not be subject to the full GL 89-10 testing and would also have to operate in an accident situation under "high Δp". For the purpose of this sensitivity study, this common cause basic event was assigned to "high Δp" valves with a F-V ranking of less than 0.1%. In the re-quantification, when a cutset contained more than one of these higher failure rates, the rest of the valves were assumed to fail with a probability of one. (This is a function of the Boolean Algebra.) This ensures that the multi-component failures are examined. This sensitivity study confirms

that all potentially risk significant MOVs have been retained in the results of the original PSA and they can be identified by the importance measures from the original PSA. The results of the sensitivity study are summarized in Table D5.

On identification of risk significant MOVs, each MOV was reviewed to determine the reasons why it ranked high or low in importance. Specific design features were identified for each MOV to justify its importance and whether or not additional testing in accordance with the Generic Letter was of benefit. Consideration was given to functions performed by the MOVs other than that modeled in the PSA to determine each MOV's importance. Table D2 contains a summary of all MOVs included in the PSA or classified as safety related. The importance of each MOV is determined based on a PSA or deterministic perspective. Design features or operating conditions are identified where either the PSA or deterministic review differ from the safety related classification. It is on the basis of these design features that the importance of an MOV is established and the applicability of the Generic Letter is determined. The PSA is used only to generate insights as to the basis for each MOV's risk significance.

Conclusions

1. Birnbaum, RAW and RRW are generally consistent in determining a measure of an MOVs importance.

2. The addition of the MOV CCF in the PSA has a significant effect on the computed CDF. This is in part due to the fact that no recovery factors were included.

3. Selective removal of the MOV CCF term in branches of the modified PSA to simulate credit taken for certain valves being subjected to the GL 89-10 MOV Testing Program was effective in establishing the importance of these valves. This optimized PSA yields CDFs that are almost identical to the baseline PSA.

4. The MOVs above the threshold in the importance ranking from the baseline PSA had the .087/d rate removed in the optimized PSA (taking credit for the GL 89-10 testing program). The resulting CDFs in the optimized PSA were almost identical to the baseline CDFs. This result confirmed the appropriateness of the set of MOVs selected as the most important, hence those requiring the GL 89-10 testing. This confirms the premise that important MOVs can be identified by the baseline PSA, without the need to modify the PSA to perform sensitivity studies.

2.1.5 Results for BWR E

BWR E is single unit BWR 6 with a Mark III containment. Important features include HPCS, RCIC, LPCS, LPCI (3-pumps), three emergency diesel-generators, and a standby service water system which supplies the RHR heat exchangers, the diesels, and other safety-related components. The CDF for the plant is 1.55E-5 per year and is dominated (86%) by station blackout (SBO).

The Mark III containment includes a free-standing steel containment liner surrounded by a concrete shield building. An annulus exists between these two structures. Penetration failures amount to 15% of all containment failures following core damage.

The unit has a total of 219 active safety-related MOVs included in the GL 89-10 program. Of these, 82 MOVs were modeled in the Level 1 PSA, 8 MOVs were modeled in both Level 1 and Level 2 PSAs, and 10 MOVs were Level 2 valves only. Tables E1 and E2 list these valves and their importance to CDF or containment failure.

Also shown on Table E1 are the containment isolation valves (CIVs). Some of these CIVs are exempted from manual operator closure during a SBO. The rules for these exemptions are provided in the SBO Rule analysis for BWR E, and were accepted by NRC in the plant's SBO Safety Evaluation Report (SER). This is significant since SBO dominates CDF for this plant, and NRC accepts that most motor-operated CIVs do not need to automatically function during this event. The SBO Rule exemptions formed one basis for selection of Level 2 MOVs.

The initial step in determining the importance of MOVs in the Generic Letter 89-10 program was to determine which of the valves in the program were modeled in the PSA. This information was gathered from the plant Level 1 PSA database and from the containment isolations considered in the Level 2 PSA.

The MOVs important to core damage were determined using the F-V importance ranking calculated by the SAIC CAFTA 386 computer code. This importance measure is calculated by summing the cutsets which contain a specific component failure mode and dividing by the overall core damage frequency. If a component has multiple failure modes the total F-V importance is calculated by summing the importance for each failure mode.

Three sensitivities were performed to determine which motor-operated valves (MOVs) were important to core damage and containment failure. The MOVs were originally ranked using the generic failure rate from NUREG/CR-4550 of 3.00E-03/demand for MOVs required to change state during an accident condition. The importance of these MOVs was then determined if the generic failure rate were 0.087 . This failure rate was used for all MOVs required to change state during an accident whether it was included as part of the GL 89-10 program or not. These rankings are shown in Table E3. The final sensitivity determined the increase in core damage frequency if only the high and/or medium important valves were

tested in full compliance with GL 89-10 and all others were tested at less than full compliance (See Table E5).

In the base case, the MOV importance was taken directly from the Level 1 PSA results to determine a valve ranking. Based on an MOV failure rate of 3.00E-03/demand, only twenty-three MOVs were determined to have any effect on overall core damage frequency, including 6 high importance MOVs and 14 medium importance MOVs. These valves consisted mostly of standby service water header and discharge valves, HPCS valves, and RCIC valves since 86% of CDF was due to SBO. All other valves were of low importance or did not appear in any Level 1 PSA cutsets.

In the GL 89-10 sensitivity, the generic failure rate for MOV failure to open or failure to close was changed to 0.087/demand. The CCFss were also updated to reflect this new failure rate. The SBO sequences were reviewed and no new MOVs were found which would show up at the new failure rate. Therefore, the initial cutsets were updated and recoveries were added. This method was considered acceptable since these valves already had a high or medium importance ranking for the base case. The transients sequences were re-quantified at the new MOV failure rate and recoveries were added to the cutsets as applicable. The LOCA sequences were not re-quantified because of their low probability compared to transient and station blackout sequences. The Loss of Off-site Power (LOOP) sequences were not re-quantified since no MOVs are in these sequences that are not in the transient sequences and no low or medium importance valves would increase to high importance based on LOOP sequences. The ATWS sequences were not re-quantified because the ATWS failure probability is below truncation and does not contain any MOVs. The core damage frequency increases to approximately 6.10E-04/yr for this sensitivity. Based on the results of this sensitivity, sixty three MOVs contributed to 99.99% of core damage frequency. Another 19 valves showed up in the sample as having an importance less than 1.0E-04. The rest of the MOVs were evaluated to determine why they did not contribute to core damage even at the higher failure rate. This evaluation determined that the importance for a majority of the remaining valves was insignificant because the valve was not required to change state during an accident. The rest of the valves did not show up because they were required to change position during ATWS event only, and since the ATWS probability is extremely low, the valves are insignificant.

Finally, the core damage frequency was determined if the valves that were ranked as having a high importance were tested at regular intervals so that the failure rate of these valves is 3.0E-03/d while the other valves are not as frequently tested and therefore had a failure rate of 0.087/d. The high importance measure was considered at two points, valves which contributed to the top 95% of core damage (F-V => 0.05) and valves which contributed to the top 99% of core damage (F-V => 0.01). The second part of this sensitivity calculated the core damage frequency if both the high and medium importance valves were tested as stated in GL 89-10. The medium importance measure was also considered at two points, valves which contribute to the top 99.9% of core damage (F-V => 0.001) and valves which contribute to

the top 99.99% of core damage (F-V => 0.0001). The core damage frequency for each of these importance measures is shown in Table E6.

Level 2 MOV importance measures are primarily qualitative in nature. The Level 2 software used, Halliburton - NUS's NUCAP+ code, does not provide direct importance measures. PSA analysts qualitatively evaluated each MOV included in the Level 2 analysis with respect to containment isolation and ESF functionality. In addition, the list of GL 89-10 MOVs was compared to the list of containment isolation valves identified in the plant's SBO analysis. MOVs related to systems identified as important in the Level 2 analysis (such as the suppression pool cooling mode of RHR) were also evaluated for risk significance. Based on this analysis, each MOV was then ranked as having either a HIGH or LOW risk significance with respect to Level 2 and an explanation of ranking was provided.

The overall risk ranking of MOVs was done by taking the Level 1 importance ranking for the base case and assigning a quantitative importance for the Level 2 valves based on the qualitative ranking of the valve. The Level 2 importance rankings were determined to be either HIGH, LOW, or none. The quantitative risk ranking for high importance Level 2 valves was taken to be 0.01, the lower bound for high importance chosen in Table 2. Similarly, the quantitative risk ranking for low importance Level 2 valves was taken to be 0.001, the lower bound for medium importance chosen in Table 2. The overall risk ranking was then calculated using the formula:

$$O.R. = 0.75 * L1 + 0.25 * L2$$

where O.R. = the overall risk ranking

L1 = the Level 1 PSA importance ranking

L2 = the Level 2 PSA importance ranking
(HIGH = 0.01, LOW = 0.001)

The overall importance for Level 1 MOVs was considered greater than Level 2 MOVs, since a significant radiological release would have to be preceded by a core damage event and since the importance ranking for Level 2 valves is more subjective than the Level 1 importance ranking.

All valves in either the Level 1 or the Level 2, which did not appear in the importance rankings of either list, were assigned an importance of <1.0E-05 since the lowest importance ranking for Level 1 PSA components is in the 1.0E-5 range. All other valves were assigned an importance of <1.0E-7, based on the justification for not including these valves in either PSA.

2.2 Comparison of Results

Table 4 summarizes the results for the five plants that performed a demonstration of the BWROG-IRBR MOV Prioritization methodology. Overall, the results correspond well even with the diversity of the five BWR designs. This shows that the methodology is consistent and applies well at numerous plants.

The results show that even among plants with widely different numbers of GL 89-10 MOVs, relatively few contribute significantly to plant risk as quantified by individual PSAs. At least 2/3 of each plant's valves fall into the lowest priority category.

2.3 Sensitivities (Task 5)

Several sensitivity assessments were performed to study the effect of various uncertainties on plant results. The primary goal of these assessments was to determine the robustness of the methodology in the face of numerous uncertainties surrounding PSA and GL 89-10. In general, these assessments showed that the methodology is not sensitive to key uncertainties relating to this application of PSA, and results can be used as described under Task 7 with the assurance that the methodology adequately supports MOV prioritization.

As described in Section 2.1, the uncertainty in MOV failure rate was studied by arbitrarily assigning high failure rates for MOVs. This sensitivity also addresses the concern that MOV importance can be underestimated since MOV failures can be truncated from quantification due to low failure rate. These studies showed that while CDF can dramatically increase as MOV failure rate increases, individual MOV ranking is preserved. In addition, arbitrarily assigning high failure rates to only low prioritized valves resulted in very minor increases in CDF. These sensitivities show that while MOV failure rate is important, a relatively few MOVs contribute to this risk. Therefore concern over MOV failure rates and low PSA quantification truncation limits need not deter the use of MOV ranking in assigning resources to the resolution of GL 89-10.

The concern that the F-V ranking scheme is not adequate for prioritization of MOVs was addressed by using different ranking schemes, in particular, the use of RAW. The sensitivity of results of this study to the ranking scheme chosen were found to be minor. Since PSAs often use the same failure rate, or very similar rates, for all MOVs the ranking of MOVs is relatively independent of ranking scheme such that prioritized lists are similar. In particular, for plants that use the same failure rate for all MOVs, the F-V and RAW ranking schemes produce similar results. Generally, this study found that the method of ranking is more sensitive when comparing components and operator actions with relatively different failure rates.

Table 4 MOV Prioritization Results Summary

Plant	GL 89-10 VALVES	HIGH	MEDIUM	LOW	NOTES
BWR A	92	4	8	80	Level 1 PSA
BWR B	81	14	10	57	Level 2 PSA
BWR C	177	6	17	154	Level 1 & Level 2 PSA
BWR D	60	31	N/A	29	Level 1 PSA - BWR D used only high & low categorizations.
BWR E	219	6	14	199	Level 1 AND 2 PSA

2.3.1 Multi-component Issues

Several multi-component issues were examined during the course of the development of this topical report. One area of initial concern was whether or not the importance ranking of specific MOVs might be higher or lower because of simultaneous failures or unavailabilities of other MOVs. A related issue is in the conduct of testing of MOVs, i.e., should multi-component issues somehow affect the valve testing program?

Multi-component issues in PSAs are not new and many are routinely treated as part of a PSA's intra-system CCF mode analyses. However PSAs do not usually analyze coincident-incident failures of like components, e.g., MOVs, that are inter-system failures. Inter-system failures involve more than one system while intra-system failures are all within the same system.

Two arguments can be made that inter-system MOV failures would be unlikely. First, differences in valve size, function, environment, etc. generally lead to very low probabilities of CCFss of valves in different systems. Second, some, if not all, of the valves in such a common cause set of valves would be included in the "high" risk category and would be subject to the most stringent testing. Therefore, coincident failures of all such valves would be unlikely.

Further insights on multi-component issues can be gained by examining the results of various sensitivity studies described in this topical report. One multi-valve study is described in Section 2.1.1.1 where, for BWR A, 36 low ranked valves were simultaneously assumed to be totally unavailable [failure rate set equal to 1.0] and cutsets regenerated and requantified. This large, but individually low ranked group of valves, would only increase BWR A's core damage frequency by 19% under the extreme situation of total unavailability of this whole valve group. Therefore multi-component issues for this low group of valves appears to be rather unimportant for BWR A.

In addition, multi-component failures involving high and medium ranked valves were also investigated for BWR A. Sensitivities performed (as described in Section 2.1.1.1) by combining the failures of high ranked valves and high and medium valves indicate that multi-component, inter-system CCFss will not affect the ranking of valves determined through the ranking process described in this report.

Sensitivity studies for BWR D utilized high assumed CCF rates for valves that may have to operate under "high Δp". These CCFss cross system boundaries and could be classified as inter-system. Also, the way they are operated on by the SETS program would show the plant's sensitivity to the multi-component issues. In one part of the study, all MOVs with a low importance had a common cause factor of 0.087 added to each valve. Cutsets with more than one MOV of a "higher" failure rate would have these multi- components failed with a probability of one. When the Level 1 PSA was requantified with these CCFs included for the low importance valves, there was no appreciable increase in CDF. This implies that they can

not be part of any multiple valve importance ranking. Therefore, multi-component inter-system CCFss for the low importance MOVs will not obscure the ability to identify the valves belonging to the high risk category.

An additional realization was that even when different ranking schemes were used each identified the same valves as belonging to the same particular risk category. Based on the above, multi-component issues do not appear to be an important consideration when ranking MOVs or their placement into risk categories.

With regard to whether multi-component issues should somehow affect the valve testing program, some studies indicate that certain pairs of valves, simultaneously unavailable, produce a considerably higher importance for the pair than one could get by merely summing the individual importances of each valve. This could be a consideration during valve testing, i.e., it might be valuable to delay the testing of a particular valve if it is part of a high ranked valve pair and the other pair member is unavailable because of failure, test, maintenance, etc.

The IRBR Committee of the BWROG views the above concern as a subset to the larger issue of configuration control, i.e., the avoidance of high risk configurations. Furthermore, an analysis of configuration control could include considerations beyond valve pairs. This analysis could be performed as part of the test planning. It is possible that the combination of an unavailable MOV with some other unavailable plant component, such as pump or a diesel generator, could also lead to high CDFs while both are in that configuration. Utilization of the periodic performance verification test frequencies, as suggested in Table 3, may serve to reduce this concern. The most important MOVs are to be tested most frequently. However, since the population of MOVs in the high risk category is small, simultaneous testing of members of this category could be avoided. There are many more MOV members in the low risk category, but the intervals between tests would be longer. This would lend itself to avoiding certain MOV pairs from being simultaneously unavailable. Further, the sensitivity studies performed on BWR A imply that even if low ranked MOV's are simultaneously unavailable, e.g. because of testing, in many cases this will not result in temporary high risk situations.

2.3.2 Mechanistic Discussion of Multi-component Issues

The issue of widespread MOV failure, introduced by GL 89-10, should be accounted for in ranking methodologies designed to focus 89-10 program research. Since little data exists to suggest that CCF probabilities are either very large or very small, the exact treatment is subject to some controversy. However, while no one can suggest that high inter-system CCF rates do not have a very high risk significance, the consideration of the practical aspects of how common cause can occur in plants and how it is currently modeled in PSA does a great deal to temper the concern over inter-system failure risk significance. The remainder of this section will discuss some "high level" aspects of plant operation and PSA modeling and also will discuss grouping of inter-system MOVs by function to show the nature of their risk significance.

PSAs model independent component failure modes and CCF modes within a system. By considering the probability of MOV demands, MOV failure rates, and MOV failure consequences in terms of loss of safety functions, PSAs develop sets of accident sequences including individual sequence probability. Each accident sequence may include one or more MOV failures.

These failures could occur as independent or common-mode events. Consider the following simplified accident scenario representing a conventional PSA treatment of CCF:

UPSET*MOV1*MOVCCF1*OP

where:

- UPSET is some initiating event that requires mitigation
- MOV1 is the failure of an individual MOV
- MOVCCF1 is the CCF of two similar MOVs (of different design, maintenance or operation than that of MOV1)
- OP is an operator action.

This sequence has some probability equal to the product of the four basic event probabilities. Implicit in this example is that the MOV1 and MOVCCF1 CCF probability is very small. Now, according to GL 89-10, this inter-system CCF rate may not be very small. What is the implication to MOV ranking? For this consideration let's assume a "worst case" situation in terms of that which gives PSA the most problem. Let's say that the MOVCCF1 failure mode was quantitatively shown to be important by the PSA but the MOV1 failure mode was not. If the ranking approach included sensitivity assessment and/or expert panel review, it is likely that the MOV1 failure mode would be qualitatively determined risk significant. However, even if qualitative assessment were not made the overall ranking is not changed. While the MOV1-MOVCCF1 inter-system CCF may indeed greatly increase overall plant risk, as long as MOVCCF1 is labeled as highly risk significant and gets a full compliment of resource allocation we have confidence that it is not vulnerable to the 89-10 failure modes. With this being the case, the MOVCCF1 failure mode can not "hold up its end of the bargain" in terms of failure in inter-system common cause with MOV1 even though MOV1 may have a whole host of 89-10 related undetected problems. Therefore, when considering common cause, if we eliminate concern for one of the players in a common cause group we lessen the impact of the group.

A case where two or more unimportant MOVs group in inter-system common cause to become highly important is another consideration. In reviewing the contents of a typical plant's unimportant MOV list, it is difficult to envision such a combination becoming important. In order to illustrate this contention, and further strengthen the case for the

considerations of the above example, the operation of MOVs relative to critical safety functions at a typical BWR can be discussed.

Nuclear accidents can occur when critical safety functions are lost. For example, vessel level control, reactivity control, or heat removal. Failure modes that can render functions inoperable are therefore prime considerations in risk assessment. Inter-system common cause MOV failures are potentially capable of rendering functions inoperable. As such, a discussion of MOV by function provides great insight into the inter-system CCF mode concern.

RPV Injection: MOVs can render the RPV injection mode inoperable primarily in terms of injection valves failing to open on demand to allow ECCS system injection to occur. Inter-system CCF of all injection valves obviously is of great concern. In the case of high RPV pressure scenarios, typically only one or two systems are capable of injection. Regardless of whether common cause is modeled or not, PSA importance shows that, in the case of two high pressure systems, at least one is quantified as highly risk important (RCIC/HPCI) and thus its ranking is unchanged regardless of CCF probability. The second is identified qualitatively if not quantitatively, but even if it isn't the testing on the highly important valve gives us confidence that the common cause probability is small.

In the case of low pressure injection, two or more systems may provide injection. MOVs for these systems are typically quantified in PSAs as less important due to their redundancy, the reliability of the high pressure system, and the lower probability sequences in which they typically function.

CCF of these valves, in injection mode, is less likely, regardless of GL 89-10 because they are used when the RPV is depressurized. Once depressurized, GL 89-10 differential pressure concerns are reduced and MOV operation is in a pressure region in a range close to where they are tested according to long-standing (i.e. pre-89-10) test procedures. The data from these tests was used in PSAs and shows no indication of large inter-system CCF probabilities for ECCS MOVs operating in low pressure injection mode. Other system valves, like pump suction isolation valves, have potential to fail systems and functions. The above applies to them except, in addition, they also typically operate at much lower Δp's and system functional tests essentially demonstrate operability at design basis, for injection mode, conditions. As such, considering the injection function, current MOV ranking is considered adequate.

Heat Removal: The heat removal function whereby reactor coolant is cooled via recirculation to the vessel requires trains of the ECCS system above. As such, the treatment for heat removal in this mode is that same as that above. However, in addition, CCF is typically modeled for the (typically two) trains of RHR and explicit quantitative ranking is produced by the PSA. This is likewise true for modes of containment heat removal. Instead of recirculating to the vessel, water is cooled and recirculated to the suppression pool. CCFs are modeled and quantitative values are available from PSAs. In addition, differential

pressures relating to the suppression pool are even less than those relatively low Δp's for vessel injection. Thus, associated 89-10 CCF modes would have low expected probability. Again we see that PSA ranking is adequate to address 89-10 concerns.

Reactivity Control: The only MOVs directly related to reactivity control are those in the standby liquid control system. These valves, if in redundant trains, would have common cause modeling in PSAs. As such, PSA ranking directly considers the common cause potential relative to the loss of the reactivity function. In addition, these MOVs typically see low Δp, on demand, since the main interface with the vessel is via the explosive valves. As such, system functional tests demonstrate Standby Liquid Control MOV operation at or near accident conditions relative to boron injection.

Containment Isolation: MOVs that serve as containment isolation, while of little importance to core damage frequency, provide a dramatic quantitative significance to level II quantification. PSA models include CCF of redundant MOVs located in the same penetration. Since success of the containment requires that no penetrations fail to isolate, the CCF of containment isolation MOVs along multiple penetrations is quantitatively meaningless. In other words, once one penetration has failed the containment is failed, Therefore, the common cause group of two valves per penetration is a minimal cutset for containment failure. As such, current PSA ranking approaches adequately represent the risk significance of all containment isolation valves.

High Energy Line Break (HELB): The isolation of valves in lines that penetrate containment present a special risk in that containment bypass can occur. These valves are discussed above in terms of their function in injection and heat removal modes. Their function to isolate in the event of a line break is an important consideration. In terms of CCF, they are modeled the same as the containment isolation valves above and have the same impact on ranking. The CCF of redundant valves on a line is a minimal cutset for failure to isolate a HELB. As such, the issue of inter-system CCF again poses no impact of PSA ranking of important MOVs.

Support Systems: Several support systems contain MOVs that must operate to mitigate an accident. One such grouping of MOVs occurs in conjunction with component cooling. Service Water and Reactor Building Closed Loop Cooling (RBCLC) combine to provide heat removal to critical components. PSAs model CCFss within system and, as such, provide quantitative values in regard to MOV risk significance. The issue of inter-system CCF between these systems is again non-critical relative to MOV ranking. Since service water provides the heat sink for RBCLC, it is a minimal cutset for failure of the component cooling function. Any failures beyond that required for service water failure do not affect failure probability of the function. Should service water fail, the common cause treatment within RBCLC suffices to demonstrate their relative MOV importance.

Emergency Diesel Generators (EDG) typically have MOVs that provide cooling water. CCF of these MOVs is modeled in PSAs. In that regard, PSAs provide direct quantitative values in terms of importance.

Test Return and Backwash Valves: MOVs are used in lines that provide strainer backwash and test return lines. These MOVs typically need function only when an event occurs while a test or backwash is in progress. Because technical specifications and manpower availability limit the number of the operations that can be concurrent, CCF is not a concern. One MOV, if any, would likely be required to respond and thus multi-component issues can not arise.

Combinations of MOV failures within each of the above is likewise not a concern. As long as each function is met, core damage will not occur. Therefore, for core damage to occur, some minimal cutset of failures within a function described above must occur. As such, any common cause, or otherwise, failures beyond that minimal set of failures required for core damage are of no importance.

In addition, PSAs are conservative because no credit is taken for recovery. In many GL 89-10 failure modes the valve would not damage itself and operators would have the opportunity to reconfigure systems to allow valves to operate. Many highly probable recovery scenarios could be envisioned because core damage accident scenarios develop over several hours to over 24 hours.

The issue of cascading failures has also arisen in context of CCF. This is taken to mean, by this author, as a failure which causes the failure of another component. PSAs use dependency matrixes to denote this type of failure. Using the dependency the primary failure is logically modeled as equivalent to the consequence of the failure(s) it creates. As such, PSA models include explicit quantitative treatment of such failures.

In summary, based on the consideration of the practical impact of CCFss and current approaches for quantification it is clear that PSAs have adequately assessed overall valve importance in current proposed MOV ranking methodologies. In addition, it should be reiterated that uncertainty relative to the magnitude of 89-10 related MOV failure rate will be reduced as licensees complete the expanded testing program. In this regard, and in spite of the solid justification presented above, much of the controversy regarding MOV failure rate should subside as each successful 89-10 test (or failure with modification) is performed.

3.0 Additional Methodology Considerations

This section discusses additional considerations that must be evaluated during the application of this report. These additional considerations were identified by the NRC Staff during the review of this report.

3.1 The Scope of GL 89-10 Versus the Scope of PSA Analyses

PSA should not be the sole basis to delete MOVs from the GL 89-10 program. MOVs can be removed from the GL 89-10 program by reclassifying their safety-related active status. This should be accomplished with the 10 CFR 50.59 process. To the extent that PSA can support the 10 CFR 50.59 process, it should be used. The methodology in this report does not address eliminating valves from the GL 89-10 program. GL 89-10 and Supplements provide guidance on GL 89-10 program scope and mechanisms for removing valves from the program.

The use of plant-specific IPE models to evaluate MOV safety significance and to prioritize testing frequencies are desirable applications of the PSA studies. However, additional deterministic considerations must be made when applying the probabilistic evaluation results to the implementation of a GL 89-10 test program. This is due to the differing approaches between scopes of GL 89-10 PSA studies and GL 89-10 MOV programs. By considering the insights from both PSA and deterministic analyses, the strengths of both can be balanced such that the GL 89-10 program is most effective.

The approach of the GL 89-10 MOV program was to address MOVs in safety-related piping systems and establish their design basis functions and service conditions based on worst case licensing basis conditions. IPE studies, on the other hand, consider all available systems and components and use best estimate service conditions and success criteria. Instead of deterministic single failure criterion, PSAs consider multiple failures in a probabilistic manner. These differences may result in: 1) GL 89-10 MOVs not being modeled in the PSA, 2) the PSA may identify non safety-related but safety-significant MOVs in the IPE model that are not included in the GL 89-10 MOV program, 3) and it is likely that some GL 89-10 MOVs have little or no safety significance in the PSA.

Plant-specific IPEs generally evaluate accidents leading to core damage (and significant radioactivity release) and assesses system performance to determine the likelihood of system operation to preclude or mitigate core damage and significant radioactivity release events. In the case of a PSA developed for an IPE, the scope of the PSA model is generally limited to accidents or events initiated by internal events such as plant transients and loss of coolant accidents.

External events can lead to abnormal events at nuclear power plants. In response to these events, plants must maintain the same functions as those analyzed in the IPE. As such, the same systems important in the internal events only IPE will also be important in the IPE for External Events (IPEEE), see Section 1.3.5 of this report. It is expected that MOV safety

significance rankings will not significantly change based on IPEEE. If they do, the IPEEE feedback to the Maintenance Rule will assure continued risk grouping is adequate. During the expert panel review, as described in Section 1.3.6 of this report, the effects of external events should be considered.

In addition, the PSA generally considers only events while the plant is at power operation (Modes 1 and 2). Consideration of safety significant MOVs during Modes 3, 4 and 5 should be accomplished during the expert panel review.

3.2 Integration of Probabilistic and Deterministic Methods of Ranking MOVs

The methodology in this report describes an expert panel contribution, which is a process by which the deterministic approach is blended with PSA analyses to achieve an overall evaluation of risk significance. Instructions relative to this expert panel review are found in Section 1.3.6 of this report. In addition, expert panel guidance can be found in the Maintenance Rule Guidance as well as other documents.

Since the licensee must maintain equipment operability and follow GL 89-10 guidance, deterministic criteria and analysis are required. By integrating the PSA approach into existing programs, a balance can be maintained between the two methodologies. In this manner, PSA can be used as another tool for issue resolution.

Based on the information gathered by Plants A through E in conducting Tasks 1 through 7, a list of valves has been assembled to assist the expert panel in their evaluation of MOV risk rankings. This list is presented in the following table and represents a composite of the valve functions which were categorized as "High Risk" for Plants A through E, after incorporating the inputs from the expert panel review. It is recommended that if a licensee's "High Risk" category from the PSA analysis does not contain these valves, the expert panel consider them as part of their evaluation and provide appropriate documentation of the basis for the final disposition.

BWROG Composite List Of "High Risk" Ranked Valves

HPCI (HPCS) Injection Valve
HPCI Steam Inlet Valve
HPCI (HPCS) Torus Suction
HPCI Steam Line Isolation
HPCI Lube Oil Cooling
RCIC Injection Valve
RCIC Steam Inlet Valve
RCIC Torus Suction
RCIC Lube Oil Cooling
RCIC Steam Line Isolation
RHR Torus Cooling, Spray and Test Valves
RHR Heat Exchanger Service Water Supply
RHR Shutdown Cooling Suction from Vessel
Containment Isolation - Equipment Drains
CS/LPCI (LPCS) Injection

Service Water Pump Discharge	Service Water - Diesel Generator Jacket Coolers
Service Water Train Discharge	RBCCW Drywell Supply/Return isolation*
Service Water Non-essential Load Isolation	

* These valves were classified as "high based on seismic and high energy line break considerations

3.3 Design Basis Capability and Verification

GL 89-10 requires that all licensees perform initial testing by June 1994. In GL 89-10, Supplement 6, the NRC provided guidance for utilities that required a schedule extension. As part of the justification for extension, the guidance suggested that the licensee set up all valves with the best available information by June 1994. In addition, PSAs showed that the risk significance of delaying full testing of less important valves was minimal. In this regard, PSA provides a very powerful additional justification for a schedule extension that augments the Supplement 6 information. Thus, schedule extension for a number of low risk MOVs, provided they are set up with the best available information prior to June 1994, is fully justifiable.

It is recognized for most BWR utilities, safety significance ranking of MOVs relative to initial design basis verification is no longer applicable. Nevertheless, this report presents the methodology for initial verification which it could be valuable for future applications. Based on the discussion with the NRC Staff during the development of this report, the report was modified with footnote (e) to Table 3 which addressed initial verification.

The licensee is responsible for maintaining operability of components in the plant. The methodology in this report suggests an approach for establishing risk based testing intervals. This methodology is not intended to relieve a licensee of responsibility to maintain MOV design basis capability. It is expected that a licensee will demonstrate that GL 89-10 MOVs are capable over the entire duration between tests regardless of risk significance.

3.4 Testing Intervals

There are currently insufficient data available to establish a quantitative link between testing intervals and MOV reliability. The methodology in this report does not attempt to describe such a process. Rather it has been demonstrated that regardless of specific MOV reliability, there is minimal risk associated with the intervals recommended.

In addition, testing at the intervals recommended in the report will provide the industry with data regarding the time-dependent reliability of MOVs. If the testing intervals are not varied, information will not be developed to establish a link between test interval and reliability. If short intervals are selected for risk significant valves, the safety significance of testing intervals will be small.

Additional "margin" in the methodology is the realization that testing will be performed continually. Even a selection of low risk valves will be tested at any given time. With that in mind, any failures would be investigated and insights applied to other valves.

In the January 13, 1995 letter, (Addendum 2) the NRC Staff suggested the use of a low category verification frequency of ten years. In GL 89-10, a frequency of five years was used as a base. The valves in the low category ranged from a factor of ten to one hundred lower risk significance. The methodology in this report specifies a factor of three to be applied to the five year frequency for the low importance valve verification frequency (or 15 years). The frequency of the medium valves then became the mid-point between the other two frequencies.

Once the risk rankings are achieved and reviewed by the expert panel, the high, medium and low risk valves should then be reviewed by the GL 89-10 program manager to determine the appropriate periodic verification frequency. The GL 89-10 program manager may assign a more frequent periodic verification interval to certain medium and low risk valves based on deterministic considerations. Factors should include, but are not limited to, the results of the design basis review, operational importance, service conditions, margin available, and valve performance history. In addition, valves of a design type, or group, that has no family members in the high risk category could be placed in a higher test frequency bin. Thus, at least one valve in each group would be tested with higher frequency to provide data relevant to the whole group. This adjustment is one of several that the GL 89-10 program manager may adopt in augmenting his program with PSA based methods described in this report. Additionally, it should be pointed out that conservatively short MOV testing intervals are likely to lead to a risk increase. If too much time is expended on risk-neutral MOVs, opportunities for more significant plant maintenance are lost. To illustrate how risk rankings would be combined with deterministic considerations to arrive at final periodic verification intervals, the following example is provided. This example illustrates how deterministic criteria could be combined with risk insights by the GL 89-10 program manager to establish testing intervals.

TABLE 5 TEST INTERVAL ASSIGNMENT DATA

Valve Description	Valve ID	PSA Rank	Valve Group[1]	Thrust Margin[2,5]	Service Conditions[3]	Test Interval Rank[4,5,6]	Comments
HPCI injection	1	H	1	30%	Nominal	A (2 cycles)	
Containment isolation	2	H	2	5%	Nominal	A (1 cycle)	Raised to 1 cycle based on PSA and low margin
RHR torus cooling test	3	M	1	15%	Nominal	B (4 cycles)	
SW Pump Discharge	4	L	4	10%	Harsh (often used)	B (3 cycles)	Raised based on margin and service conditions
HPCI CST Suction	5	L	1	5%	Nominal	A (2 cycles)	Raised based on low margin.
Main Steam line drain isolation	6	L	2	15%	Nominal	C (7 cycles)	
RCIC Injection	7	H	4	10%	Nominal	A (2 cycles)	
RHR SW HX supply	8	M	4	20%	Nominal	B (4 cycles)	
Cooling supply to recombiner	9	L	3	10%	Nominal	B (3 cycles)	Raised to ensure group 3 valves are represented in higher test frequency bins

[1] Valve group defined by valve design, manufacturer, size, etc.

[2] Thrust Margin is based on an as-left thrust at torque switch trip compared to the minimum required thrust at design basis conditions including the reduction in margin based on uncertainties such as test instrument uncertainty, equipment repeatability, load sensitive behavior, time related performance degradation, and other deterministic considerations which are outside the scope of this document.

[3] Service conditions are based on the valve use (strokes /year), environmental conditions, etc

[4] Test interval rank - A = a test interval of every 1-2 fuel cycles (18 month cycles)
B = a test interval of every 3-4 fuel cycles
C = a test interval of every 5-7 fuel cycles

[5] Thrust margin values presented are for example purposes only. As stated in Section 3.3, the licensee must demonstrate that MOVs are capable over the test interval regardless of risk significance. This includes consideration of the amount of margin; potential time related degradation; uncertainties such as measurement uncertainty, equipment repeatability, and load sensitive behavior; and other deterministic considerations which are addressed in other industry guidance and are outside the scope of this document.

[6] Until additional performance data are available, a maximum test interval of 10 years has been discussed by the industry and the NRC.

3.5 Changes in Plant Design or State of Knowledge of Valve Categorization

For licensees who have a "living PSA", the best way to evaluate the potential for changes in valve rankings over time is to re-evaluate the GL 89-10 valves during each PSA update. This could be accomplished using the updated model and re-generating each MOVs importance measures.

Licensees who do not maintain their PSA can maintain GL 89-10 lists. The expert panel can be reconvened to review plant changes since the original evaluation. This review will be adequate to ensure that valve rankings accurately reflect the relative importance of each MOV. In addition to re-convening the expert panel, the Maintenance Rule requires tracking of equipment performance relative to the safety significance of that equipment. Thus, through the application of the expert panel review and Maintenance Rule, the effects of future plant modifications on valve rankings will be properly considered.

It is beyond the scope of the MOV ranking significance methodology presented in this report to establish licensee administrative criteria or requirements to assess revision to MOV periodic verification intervals based on new information. The user of this methodology should, however, consider the potential change of risk importance of MOVs as a result of plant modifications and introduction of new PSA technology/methods. The Maintenance Rule as well as the GL 89-10 programs should provide such a mechanism.

3.6 Other Considerations

The NRC staff raised a suggestion to use two categories of high and low versus three categories of high, medium, and low. Eliminating the medium category has several negative features relative to achieving the most complete approach to verification. These are:

- Adding more MOVs to the high risk category that belong in the medium category does not significantly improve plant safety. The high risk group was defined so that it would contain 99% of the core damage frequency contribution of MOVs. During the development of this BWR Owners' Group report, a F-V boundary of 0.1 was considered for the high risk category. However, to minimize concerns about data, human error, etc., the boundary for the high risk category was set at 0.01.

- With the use of three categories, plants will be able to collect MOV verification data more frequently (the medium category has a more frequent periodic verification requirement than the low category) and provide a broader data base to feedback into the MOV program relative to potential time dependent degradation of MOVs.

- The use of three categories (high, medium, and low risk significance) makes risk significance ranking less sensitive to potential changes in PSA. It is less likely for valves to switch between high and low categories if a medium category is present to demonstrate a moderate risk impact.

- The use of three groups minimizes the effect of valves whose importance is close to risk group cutoffs. For example a valve just below the high risk cutoff would be classified a low in a two group scheme. in this case, the medium group effectively captures the valve's importance. Thus, the effect of valves on the "cusp" is minimum.

4.0 CONCLUSIONS

This study provides a methodology for prioritization of MOVs relative to their significance to plant safety. It has demonstrated the methodology at five representative plants, and includes sensitivity analyses to demonstrate the effectiveness of the methodology. The results of this study show that plants can use their PSA analyses to establish MOV prioritization for application to a plant's GL 89-10 program.

NEDC-32264-A
REVISION 2

SEPTEMBER 1996

APPENDIX A

DATA TABLES FOR BWR A

TABLE A1
MOV RISK PRIORITIZATION RESULTS (BWR A)

VALVE ID	DESCRIPTION	IMPACT of MOV FAILURE	RISK IMPORTANCE
MO-23-019	HPCI Injection Valve	Results in failure of HPCI and impacts high pressure makeup	FV =.033 RAW = 3.8
MO-23-014	HPCI Steam Admission Valve	Results in failure of HPCI and impacts high pressure makeup	FV = .033 RAW = 3.8
MO-13-021	RCIC Injection Valve	Results in failure of RCIC and impacts high pressure makeup	FV = .025 RAW = 3.1
MO-13-131	RCIC Steam Admission Valve	Results in failure of RCIC and impacts high pressure makeup	FV = .025 RAW = 3.1
MO-10-25A	LPCI Loop A Injection Valve	Results in failure of LPCI and Shutdown Cooling Loop A	FV = .005 RAW = 1.5 CCF RAW = 54 for A&B Level 2 RAW = 5.8
MO-10-25B	LPCI Loop B Injection Valve	Results in failure of LPCI and Shutdown Cooling Loop B	FV = .005 RAW = 1.5 CCF RAW = 54 for A&B Level 2 RAW = 5.8
MO-10-174	HPSW Injection Crosstie to RHR MOV	Results in failure of HPSW ability to inject into reactor vessel given failure to inject from other low pressure sources	FV =.003 RAW = 1.3
MO-10-176	HPSW Injection Crosstie to RHR MOV	Results in failure of HPSW ability to inject into reactor vessel given failure to inject from other low pressure sources	FV = .003 RAW = 1.3
MO-10-39A	RHR Loop A Suppression Pool Cooling Valve	Results in failure of RHR Loop A Suppression Pool cooling and Torus spray	FV = .001 RAW = 1.1 CCF RAW = 7.5 for A&B
MO-10-39B	RHR Loop B Suppression Pool Cooling Valve	Results in failure of RHR Loop B Suppression Pool Cooling and Torus Spray	FV = .001 RAW = 1.1 CCF RAW = 7.5 for A&B
MO-10-34A	RHR Loop A Suppression Pool Cooling Valve	Results in failure of RHR Loop A Suppression Pool Cooling	FV = .001 RAW = 1.1
MO-10-34B	RHR Loop B Suppression Pool Cooling Valve	Results in failure of RHR Loop B Suppression Pool Cooling	FV = .001 RAW = 1.1

TABLE A1 MOV RISK PRIORITIZATION RESULTS (BWR A) (continued)

VALVE ID	DESCRIPTION	IMPACT of MOV FAILURE	RISK IMPORTANCE
MO-10-089B	RHR heat exchanger B cooling water discharge MOV.	Results in failure of HPSW to cool RHR heat exchanger B for containment heat removal. Similar valves associated with other trains have lower significance due to diesel loading during LOOP	FV = .0008 RAW = 1.06
MO-10-017/018	RHR Shutdown Cooling Suction Valves	Results in failure of RHR to remove heat from the reactor vessel	FV = .0006 RAW = 1.05
MO-14-005A/B/C/D	LPCS Minimum Flow Valve (4 functionally identical valves)	Each minimum flow valve results in the failure of its respective LPCS pump train and impacts low pressure make-up	FV = .0004 RAW = 1.03 CCF RAW = 1.17 for A/B/C/D trains
MO-14-012A/B	LPCS Injection Valve (A and B Loop)	Results in failure of LPCS Loop A/B injection and impacts low pressure injection	FV = .0004 RAW = 1.03
MO-32-2803	HPSW to Emergency Cooling Tower reservior discharge valve	Results in failure of closed loop mode of HPSW to the ECT	Insignificant
MO-12-015/018	RWCU Suction Valves	Failure to close will cause SLC dilution during ATWS and is modeled explicitly. Failure to close to isolate ISLOCA is implicitly modeled in the LOCA outside containment initiator probability.	Insignificant for SLC mode. High importance is qualitatively assigned for ISLOCA
MO-13-015/016	RCIC Inboard/Outboard Steam Isolation Valves	89-10 failure mode not modeled in PSA. Normally open valve is not required to stroke for RCIC operation. Failure to close to isolate LOCA outside containment was not modeled because the RCIC steam line is of limited diameter and therefore not considered a potential LOCA source.	Insignificant
MO-23-015/016	HPCI Inboard/Outboard Steam Isolation Valves	89-10 failure mode not modeled in PSA. Normally open valve is not required to stroke for HPCI operation. Failure to close to isolate ISLOCA is implicitly modeled in the LOCA outside containment initiator probability.	Insignificant
MO-02-029A/B	Feedwater Loop A/B Injection to Reactor vessel	Normally open valve required for RCIC/HPCI injection. Failure to close to isolate a LOCA outside containment is implicitly modeled in the initiator.	Insignificant

TABLE A1 MOV RISK PRIORITIZATION RESULTS (BWR A) (continued)

VALVE ID	DESCRIPTION	IMPACT of MOV FAILURE	RISK IMPORTANCE
MO-48-0841	Emergency Cooling Water pump discharge Valve	Results in failure of ECW pump and impacts redundancy of diesel cooling water system. Opposite unit important only.	FV =.001 RAW = 1.1
MO-10-089A/C/D	RHR heat exchanger A/C/D cooling water discharge Valves	Results in failure of HPSW to cool RHR heat exchangers for containment heat removal. "A" valve importance artificially increased to that of B valve due to modelling non-symmetries.	Insignificant
MO-02-053A/B	Recirc pump discharge block Valves	Normally open valve not required to change state, therefore not modeled in PSA. Valve required to close for recirc line LOCA.	Insignificant
MO-13-132	RCIC Lube oil cooling Valve	Results in failure of RCIC and impacts high pressure makeup. Not explicitly modeled but included in data for pump failure.	FV = .025 RAW = 3.1 (estimated)
MO-02-074/077	Main Steam Line drain Valve	Normally closed valves are not required for injection or isolation and are therefore not modeled in PSA.	Insignificant
MO-10-154A/B	RHR Recirc Loop A/B return (LPCI injection) Valves	Normally open valve not required to change state for LPCI injection, plugging mechanism modeled in PSA.	Insignificant
MO-12-068	RWCU Recirculation flow to reactor valve	Normally open valve failing to isolate during LOCA outside containment is an initiator and is implicitly modeled in PSA.	Insignificant
MO-13-018	RCIC CST suction Valve	Failure to close on transfer of RCIC suction from CST to suppression pool will fail RCIC.	Insignificant
MO-32-2344	HPSW cross-tie valve	Failure to open limits the ability to line up any HPSW pump to any RHR heat exchanger. Modeled in PSA.	Insignificant
MO-32-2486	HPSW discharge valve to pond	Normally open valve only required to close on loss of pond to utilize closed loop cooling. Modeled in PSA.	Insignificant
MO-33-0498	ESW discharge valve to pond	Normally open valve only required to close on loss of pond to utilize closed loop cooling. Modeled in PSA.	Insignificant
MO-35-2373/4	RBCCW Recirculation pump cooling water isolation valves	Normally open valves allow cooling of recirc pump seals. Failure to close is not modeled in PSA since pumps are tripped in model.	Insignificant
MO-44-2200A/B	Drywell Cooler Inlet Isolation Valves	Failure to close for containment LOCA conditions. Not modeled in PSA due to closed loop system and small diameter line.	Insignificant

TABLE A1 MOV RISK PRIORITIZATION RESULTS (BWR A) (continued)

VALVE ID	DESCRIPTION	IMPACT of MOV FAILURE	RISK IMPORTANCE
MO-48-2804A/B	Emergency Cooling Tower Reservoir Flow to HPSW/ESW Pump Bay Valve	Failure to open in the event that the pond is unavailable will cause loss of closed loop cooling. Addressed in PSA.	Insignificant
MO-02-038A/B	Feedwater Start-up Recirculation Isolation	Failure to open during feedwater system recirculation mode with the reactor feed pumps shut off will fail start-up and failure to close when the reactor pressure is greater than 600 psig will not impact the PSA model at power. Therefore the valves are not modeled.	Insignificant
MO-10-013A/B/C/D	RHR Suppression Pool Suction Valves	Failure to open to for Suppression Pool Cooling and LPCI Injection modes and failure to close for Shutdown Cooling would cause failure of those modes of RHR. The functions are addressed in PSA.	Insignificant
MO-10-016A/B/C/D	RHR Pumps Min Flow Bypass Valves	Failure to open on pump low flow modeled in PSA for LPCI mode only for pump dead head protection, failure to open for LPCI mode would fail train.	Insignificant
MO-10-026A/B,-031A/B	RHR Drywell Cooling Spray Water Valves	Failure to open for drywell spray modeled in PSA. Little credit given for use of valves due to procedural restrictions.	Insignficant
MO-10-038A/B	RHR Suppression Chamber Cooling Water Spray Valve	Failure to open to for wetwell spray is addressed in PSA and would fail this mode of containment cooling.	Insignificant
MO-13-020	RCIC Pump Discharge Block Valve	Normally open valve not required to change state. Plugging mechanism modeled in PSA. 89-10 failure is to open when pump discharge valve downstream is in test.	Insignificant
MO-13-27	RCIC Pump Minimum flow Valve	Failure to open on pump low flow would not fail pump because injection occurs in sufficient time to limit dead head condition.	Insignificant
MO-13-039,041	RCIC Torus Suction Block Valve	Failure to open when transferring suction to the suppression pool will fail RCIC. Modeled in PSA.	Insignificant
MO-14-007A/B/C/D	CS Pump Suction Valves	Normally open valve not required to change state for primary PSA function.	Insignificant
MO-14-011A/B	CS Outboard Isolation Valves	Normally open valve not required to change state. Plugging mechanism modeled in PSA. 89-10 failure mechanism insignificant due to time in test.	Insignificant
MO-14-070,-071	Torus Water Filter Pump Isolation Valves	Failure to close on LOCA conditions. Not modeled in PSA.	Insignificant

TABLE A1 MOV RISK PRIORITIZATION RESULTS (BWR A) (continued)

VALVE ID	DESCRIPTION	IMPACT of MOV FAILURE	RISK IMPORTANCE
MO-23-017	HPCI CST Suction Valve	Normally open valve fails to close when transfering suction to the suppression pool and will fail HPCI.	Insignificant
MO-23-020	HPCI Pump Discharge Block Valve	Normally open valve not required to change state. Plugging mechanism modeled in PSA. 89-10 failure mode identical to RCIC description.	Insignificant
MO-23-025	HPCI Pump Minimum Flow Valve	Failure to open on HPCI pump low flow would not fail pump because injection occurs in sufficient time to limit dead head condition.	Insignificant
MO-23-057,058	HPCI Torus Suction Block Valves	Failure to open when transferring suction to suppression pool will fail HPCI. Addressed in PSA.	Insignificant
MO-23B-4245	HPCI Turbine Exhaust Vacuum Breaker Valve	Normally open, failure to close to provide containment isolation would not fail HPCI. Small diameter line insignificant source term contributor and not modeled in PSA.	Insignificant
MO-44-2201A/B	Drywell Cooler Outlet Isolation Valves	Failure to close for containment LOCA conditions. Not included in PSA due to closed loop system and small diameter line.	Insignificant
MO-48-501/502A/B/C	Emergency Cooling Tower Block Valves for closed loop flow.	Failure to open for HPSW and ESW flow to ECT will cause loss of systems if pond is unavailable. Addressed in PSA.	Insignificant
MO-13C-4244	RCIC Turbine Exhaust Vacuum Breaker Valve	Normally open valve failing to close would not impact RCIC. Small diameter line is an insignificant source term contributor.	Insignificant

TABLE A2

PROBABILISTIC SENSITIVITY ANALYSES
ON VALVE GROUPING (BWR A)
[NUMBER OF VALVES IN EACH CATEGORY]

1-(FV IMPORTANCE)	VALVE FAILURE RATE (FAILURE TO STROKE ON DEMAND)				
	.1	.087	.05	.012 (IPE VALUE)	.003
95	12	10	6	0	0
99	8	9	6	4	0
99.9	5	3	10	8	4
99.99	4	7	6	9	6
TOTAL *	29	29	28	21	10

* The total number of valves can be compared to the 55 valves (one unit and common) modeled in the IPE with failure modes consistent with the GL 89-10 list of valves.

TABLE A3

RELATIVE CHANGE IN CORE DAMAGE
FREQUENCY VERSUS VALVE FAILURE RATE
(BWR A)

	VALVE FAILURE RATE (FAILURE TO STROKE ON DEMAND)					
	.1	.087	.05	.012	.003	0
Multiplier on IPE CDF	6.9	5.3	2.3	1.0	.9	.8

TABLE A4
COMPARISON OF RISK RANKING METHODS
(BWR A)

VALVE DESCRIPTION	FV IMPORTANCE	RAW IMPORTANCE
HPCI INJECTION VALVE	.033	3.8
HPCI TURBINE STEAM ADMISSION VALVE	.033	3.8
RCIC INJECTION VALVE	.025	3.1
RCIC TURBINE STEAM ADMISSION VALVE	.025	3.1
LPCI LOOP B INJECTION VALVE	.006	1.5
LPCI LOOP A INJECTION VALVE	.005	1.5
HPSW INJECTION CROSSTIE VALVE	.003	1.3
HPSW INJECTION CROSSTIE VALVE	.003	1.3
RHR SUPPRESSION POOL COOLING VALVE	.001	1.1
RHR SUPPRESSION POOL COOLING VALVE	.001	1.1
RHR SUPPRESSION POOL COOLING VALVE	.001	1.1
RHR SUPPRESSION POOL COOLING VALVE	.001	1.1
RHR HEAT EXCHANGER VALVE	.0008	1.06
RHR SHUTDOWN COOLING VALVE	.0006	1.05
RHR SHUTDOWN COOLING VALVE	.0005	1.05
CORE SPRAY PUMP A MIN FLOW VALVE	.0004	1.03
CORE SPRAY PUMP B MIN FLOW VALVE	.0004	1.03
CORE SPRAY PUMP C MIN FLOW VALVE	.0004	1.03
CORE SPRAY PUMP D MIN FLOW VALVE	.0004	1.03
CORE SPRAY LOOP A INJECTION VALVE	.0004	1.03
CORE SPRAY LOOP B INJECTION VALVE	.0004	1.03
36 VALVES < FV OF 1E-4		1.19 (COMBINED EFFECT)

NEDC-32264-A
REVISION 2

SEPTEMBER 1996

APPENDIX B

DATA TABLES FOR BWR B

TABLE B1
PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B

VALVE NUMBER	FUNCTION	89-10 SCOPE	PRA SCOPE	MOV IMPORTANCES TO: CORE DAMAGE	CNMT FAIL	LARGE REL	COMMENTS/JUSTIFICATION FOR PRIORITY
				H I G H P R I O R I T Y M O V S			
1E11-F068A 1E11-F068B	Heat Exch Flow Control Heat Exch Flow Control	Y Y	Y Y	0.510 1.348	1.047 2.916	0.340 0.984	Failure of F068A or B causes loss of heat removal for all modes of one RHR loop. The importance of F068B to the CDF and containment failure frequency exceeded 1 percent, placing it in the HIGH category. The importance of F068A to the CDF was less than one percent, but its contribution to containment failure exceeded 1 percent. F068A was upgraded to the HIGH category. No credit was taken for local manual recovery of F068A or B in the PRA.
1E41-F001 1E41-F006 1E51-F013 1E51-F045	HPCI Steam Inlet HPCI Injection RCIC Injection RCIC Steam Inlet	Y Y Y Y	Y Y Y Y	1.198 1.199 0.743 0.742	0.426 0.426 0.057 0.057	0.160 0.161 0.023 0.023	Demand failure of the valves listed on the left cause complete loss of HPCI or RCIC. HPCI and RCIC are risk-significant systems for Plant B because high pressure injection systems are relatively limited compared to low pressure injection systems. Feedwater has turbine-driven pumps which fail on MSIV closure, and HPCI and RCIC are both single-train systems with relatively high unavailabilities compared to the redundant low pressure motor-driven systems. Loss of high pressure injection with ADS inhibited requires operator actions to emergency depressurize. The RCIC valves had CDF importances just below one percent, but these valves were upgraded to the HIGH category because of the similarity of function to the HPCI valves, and because the RCIC system was one of the most important systems to the CDF.
1E41-F059 1E51-F046	HPCI Lube Oil Cooling Water RCIC Lube Oil Cooling Water	Y Y	N N	0.000 0.000	0.000 0.000	0.000 0.000	These valves were included within the pump/turbine boundary of the HPCI and RCIC systems and were not explicitly modeled in the PRA. However, demand failure of these valves is expected to cause loss of HPCI and RCIC. HPCI and RCIC total importances were 40% and 16% respectively. These valves were upgraded to HIGH based on the importance of HPCI and RCIC to the CDF.

TABLE B1 PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B (Continued)

1E41-F002 1E41-F003 1E51-F007 1E51-F008	HPCI Steam Line Isolation HPCI Steam Line Isolation RCIC Steam Line Isolation RCIC Steam Line Isolation	Y Y Y Y	Y Y Y Y	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	The HPCI/RCIC valves function to isolate the steam lines given a break outside containment. The valves isolate on high steam line flow or high temperature in the respective rooms. The isolation function of these valves was implicitly modeled in the unisolated LOCAs outside containment initiating event frequency. Unisolated LOCAs outside containment accounted for less than 1 percent of the total CDF, but exceeded 1% of the frequency of large releases. Sensitivity analysis shows that small changes in the common cause failure probability of motor operated valves can significantly increase the contribution of unisolated LOCAs outside containment to the frequency of large releases. Other factors which support the categorization of these valves as high priority valves are: 1) the valves are required to close against high dp conditions which are not replicated during operability tests, and 2) failure of the valves to isolate leads to a potential large release outside containment.
1G31-F001 1G31-F004	RWCU Isolation RWCU Isolation	Y Y	Y Y	0.000 0.001	0.000 0.003	0.000 0.000	The RWCU isolation valves function to isolate the RWCU lines given a break outside containment. The isolation function of these valves was implicitly modeled in the unisolated LOCAs outside containment initiating event frequency. Both valves were explicitly modeled in the containment isolation model. The priority of these valves was upgraded to HIGH based on the same reasoning as the HPCI/RCIC steam line isolation valves.
MEDIUM PRIORITY MOVS							
1E11-F015A 1E11-F015B	LPCI Injection LPCI Injection	Y Y	Y Y	0.047 0.270	0.016 0.059	0.000 0.000	Failure of a single LPCI injection valve fails one loop of LPCI. These valves fall below the HIGH importance ranking because of the redundancy and diversity of low pressure injection systems.
1E11-F028A 1E11-F028B	RHR Torus Test/Spray RHR Torus Test/Spray	Y Y	Y Y	0.044 0.596	0.098 1.323	0.022 0.430	Failure of F028A or F028B fails both suppression pool cooling and suppression pool spray modes for one loop of RHR. These valves are not ranked as HIGH priority valves because failure of these valves does not affect the Shutdown Cooling Mode of RHR, and because other means of decay heat removal are available (main condenser and containment venting). Also, local manual actions can open these valves for most sequences in which these valves are failed.
1E21-F005A 1E21-F005B	CS Injection CS Injection	Y Y	Y Y	0.069 0.088	0.044 0.072	0.078 0.108	Failure of the Core Spray injection valve to open causes loss of one loop of Core Spray. These valves were just below the cutoff for LOW importance valves, and were upgraded to MEDIUM because of the similarity of function to the LPCI injection valves.
1P41-F310A 1P41-F310B 1P41-F310C 1P41-F310D	PSW Turbine Bldg Header Iso PSW Turbine Bldg Header Iso PSW Turbine Bldg Header Iso PSW Turbine Bldg Header Iso	Y Y Y Y	Y Y Y Y	0.175 0.151 0.008 0.008	0.336 0.254 0.018 0.019	0.480 0.420 0.000 0.000	The Turbine Building PSW header isolation valves are required to close during LOCA or LOSP to ensure adequate cooling water to essential components. Failure to close during an LOSP is the most important failure mode, because of the dependence of the diesels on PSW for cooling. The A and B valves had importances in the MEDIUM importance range, while the C and D valves had importances in the LOW range. The A and B valves are more important because of the divisional power arrangement (only valve A can isolate service water for diesel A when diesel C is down). Valves C and D were upgraded to MEDIUM importance for consistency.

TABLE B1 PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B (Continued)

LOW PRIORITY MOVS							
1B21-F016	MSL Drain Isolation	Y	N	0.000	0.000	0.000	F016 and F019 are opened during startup to drain condensate from the main steam lines. These valves are closed once the main turbine is rolled. Discharge from these valves passes through other valves to the condenser. Closure of the MSIVs does not isolate these valves from the reactor, so that failure of both F016 and F019 to close could result in continued blowdown from the reactor to the condenser. Flow is limited by restrictive orifices in the drain lines from each MSIV. The low importance ranking of these valves is justified because the valves are normally closed during power operation.
1B21-F019	MSL Drain Isolation	Y	N	0.000	0.000	0.000	
1B31-F031A	Recirc Pump Disch Isolation	Y	N	0.000	0.000	0.000	The only accident sequence in which recirculation pump discharge valve closure is needed to prevent core damage is a large break in the recirculation piping. These valves were modeled implicitly in the large LOCA initiating event model. Failure of the discharge valve in the unbroken loop to close could result in LPCI flow from both loops being lost through the break. Both loops of Core Spray would also have to fail before significant core damage would occur. Based on estimates for the IPE, less than 15 percent of large break LOCAs would require discharge valve closure. If core damage did occur because LPCI flow was diverted through the break, containment failure is unlikely due to the availability of debris cooling. A LOW priority is justified because of the combined low frequency of large break LOCAs and the low failure probability of both loops of Core Spray.
1B31-F031B	Recirc Pump Disch Isolation	Y	N	0.000	0.000	0.000	
1E11-F003A	RHR Heat Exch Outlet	Y	N	0.000	0.000	0.000	The heat exchanger inlet and outlet valves are normally open and not required to close for any accident sequences modeled in the IPE. These valves receive no automatic isolation signals. The risk significance of these valves is low.
1E11-F003B	RHR Heat Exch Outlet	Y	N	0.000	0.000	0.000	
1E11-F047A	RHR Heat Exch Inlet	Y	N	0.000	0.000	0.000	
1E11-F047B	RHR Heat Exch Inlet	Y	N	0.000	0.000	0.000	
1E11-F004A	RHR Torus Suction	Y	Y	0.000	0.000	0.000	Each RHR pump has one Torus suction and one vessel suction isolation valve. The F004 valves isolate the Torus suction paths, and the F006 valves isolate the vessel suction paths. The F004 valves are normally open, and the F006 valves are normally closed. Each F004 and F006 valve pair must close/open respectively to align an RHR pump for shutdown cooling. To eliminate a modeling problem, only two of the vessel suction valves were modeled in the PRA (this was conservative). These valves are considered LOW importance to risk because failure of a valve pair to function only impacts one RHR pump for one mode of RHR operation. Also, for most events for which shutdown cooling is needed, time is available to manually open/close the valves given failure of a motor operator. All of the F004 and F006 valves have hand-wheel operators, and would be accessable for most accident sequences.
1E11-F004B	RHR Torus Suction	Y	Y	0.000	0.000	0.000	
1E11-F004C	RHR Torus Suction	Y	Y	0.000	0.000	0.000	
1E11-F004D	RHR Torus Suction	Y	Y	0.000	0.000	0.000	
1E11-F006A	RHR SDC Pump Suction	Y	Y	0.000	0.000	0.000	
1E11-F006B	RHR SDC Pump Suction	Y	Y	0.000	0.000	0.000	
1E11-F006C	RHR SDC Pump Suction	Y	N	0.000	0.000	0.000	
1E11-F006D	RHR SDC Pump Suction	Y	N	0.000	0.000	0.000	

TABLE B1 PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B (Continued)

1E11-F007A	RHR Minimum Flow	Y	N	0.000	0.000	0.000	There are two RHR minimum flow valves, one for each loop. The minimum flow valves are normally open and provide a flow path for the RHR pumps in the LPCI mode until the injection valves open and vessel pressure decreases below the LPCI shutoff head. Failure of the minimum flow valves results in some reduction in RHR flow in all modes of operation. The IPE evaluated the realistic impact of failure of a minimum flow valve to close, and concluded that the remaining flow rate would be adequate for all modes of RHR operation. Thus, failure of the minimum flow valves to close is considered of low risk significance. If an RHR loop is operating in test or suppression pool cooling, the minimum flow valve could be closed. If a LOCA occurred, the RHR system is designed to automatically realign to the LPCI mode, and the minimum flow valve would receive a signal to open. It was concluded in the IPE analysis that even if the minimum flow valve failed to realign, the RHR pumps would likely operate long enough for either vessel depressurization or operator intervention.
1E11-F007B	RHR Minimum Flow	Y	N	0.000	0.000	0.000	
1E11-F008	RHR SDC Vessel Isolation	Y	Y	0.000	0.000	0.000	Demand failure of either F008 or F009 fails the shutdown cooling mode of RHR. This mode is not risk-significant because Shutdown Cooling is vulnerable to single failures and is less likely to be available than Suppression Pool Cooling. These valves also receive isolation signals designed to prevent vessel drain-down during refueling outages, but the risk significance of failures to isolate during refueling is beleived to be small because of the low differential pressure and the time available for operator intervention.
1E11-F009	RHR SDC Vessel Isolation	Y	Y	0.000	0.000	0.000	
1E11-F016A	RHR Drywell Spray	Y	Y	0.092	0.073	0.122	The RHR F016A/F021A and F016B/F021B valve pairs are normally closed containment isolation valves that must be opened to initiate the Drywell spray mode of RHR. Failure of any single valve to open fails one loop of RHR in the Drywell spray mode, but has no impact on other modes of RHR operation. The Drywell sprays appear in both the Level 1 and Level 2 IPE models. The RHR Drywell spray mode may be used to reduce the Drywell temperature to prevent the vessel level instrumentation reference legs from boiling. If no containment cooling is available and Drywell spray cannot be initiated, emergency depressurization and vessel flooding must be performed. These types of sequences were relatively unimportant to plant risk. Drywell sprays were also modeled in preventing containment failure following vessel failure. The sprays are relatively unimportant because for many of the sequences in which the sprays could perform, LPCI injection is also available for debris cooling. Either Drywell sprays or LPCI or Core Spray injecting through the failed vessel were considered adequate to prevent containment failure following a core damage event.
1E11-F016B	RHR Drywell Spray	Y	Y	0.004	0.004	0.000	
1E11-F021A	RHR Drywell Spray	Y	Y	0.092	0.073	0.122	
1E11-F021B	RHR Drywell Spray	Y	Y	0.004	0.004	0.000	
1E11-F017A	LPCI Throttle	Y	Y	0.007	0.015	0.000	The LPCI throttle valves (F017A,B) are normally open and not required to close during any accident sequence modeled in the IPE. The throttle valves are interlocked open for 10 minutes following any LPCI initiation signal, to prevent operators from throttling flow until core cooling requirements are satisfied. Failure of the F017 valve to throttle flow does not impact the ability to cool the core. Following LPCI injection, either the throttle valve or injection valve (F015) may be required to close before other modes of RHR can be initiated. The redundancy of the throttle valve with the F015 valve makes this function relatively unimportant to plant risk. Containment isolation is provided by the F050 check valves and F015 injection valves.
1E11-F017B	LPCI Throttle	Y	Y	0.018	0.039	0.000	

TABLE B1 PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B (Continued)

1E11-F024A 1E11-F024B 1E11-F027A 1E11-F027B	RHR Torus Test Inboard RHR Torus Test Inboard RHR Torus Spray Inboard RHR Torus Spray Inboard	Y Y Y Y	Y Y Y Y	0.007 0.018 0.007 0.018	0.015 0.039 0.015 0.039	0.000 0.000 0.000 0.000	Establishing suppression pool heat removal requires opening F028A/B and either F024A/B (test line) or F027A/B (suppression pool spray). Because of the added redundancy of the F024/F027 valves, these valves are significantly less important to the core damage frequency than F028. For almost all sequences involving loss of decay heat removal, adequate time is available for these valves to be manually opened using the handwheel operators. Thus, the risk significance of these valves is low.
1E11-F048A 1E11-F048B	RHR Heat Exch Bypass RHR Heat Exch Bypass	Y Y	Y Y	0.000 0.000	0.000 0.000	0.000 0.000	This valve is normally open, and remains open during the LPCI injection phase. It must be throttled closed to control flow through the RHR heat exchanger for any RHR mode involving heat removal. If RHR is in suppression pool cooling when a LOCA occurs, this valve could degrade LPCI flow if it fails to open. This failure mode is relatively unimportant, because adequate LPCI flow can still pass through the heat exchanger to realistically prevent significant core damage. Failure of this valve to close will degrade the heat removal capacity of a single loop of RHR in suppression pool cooling, shutdown cooling, and other modes. This failure mode is relatively risk-insignificant because the heat removal capability is not completely failed and because for most risk-significant sequences, time is available to manually close the valve using the hand-wheel operator.
1E11-F103A 1E11-F103B	Heat Exch Vent Heat Exch Vent	Y Y	N N	0.000 0.000	0.000 0.000	0.000 0.000	This valve is only used to vent the heat exchangers of noncondensible gases in the steam condensing mode, and to flush the heat exchanger during shutdown cooling. It is normally closed and remains closed during all other modes of RHR operation. The steam condensing mode was not modeled in the IPE, because it is not a preferred mode of operation at Plant B, and because it is a more complex and therefore less reliable heat removal mode than suppression pool cooling or shutdown cooling. If shutdown cooling was the only heat removal mode available, a failed closed vent valve would not physically prevent the operators from using shutdown cooling to protect containment.
1E21-F001A 1E21-F001B	CS Pump Suction Isolation CS Pump Suction Isolation	Y Y	Y Y	0.000 0.000	0.000 0.000	0.000 0.000	The core spray suction isolation valve is normally open and receives no automatic isolation signal. These valves are not required to be closed for any accident modeled in the IPE.
1E21-F031A 1E21-F031B	CS Minimum Flow Isolation CS Minimum Flow Isolation	Y Y	N N	0.000 0.000	0.000 0.000	0.000 0.000	There are two CS minimum flow valves, one for each pump. The minimum flow valves are normally open and provide a flow path for the CS pumps until the injection valves open and vessel pressure decreases below the CS shutoff head. Failure of the minimum flow valves to close results in some reduction in flow. The IPE evaluated the realistic impact of failure of a minimum flow valve to close, and concluded that the remaining flow rate would be adequate to prevent significant core damage. Thus, failure of the minimum flow valves to close is considered of low risk significance. If a loop of CS is in test mode, the minimum flow valve could be closed. If a LOCA occurred, the CS system is designed to automatically realign from test to injection, and the minimum flow valve would receive a signal to open. It was concluded in the IPE analysis that even if the minimum flow valve failed to realign during a test, the CS pump would likely operate long enough for either vessel depressurization or operator intervention.

TABLE B1 PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B (Continued)

1E41-F004	HPCI CST Suction Isolation	Y	Y	0.000	0.000	0.000	HPCI and RCIC will auto-swap from the CST to the suppression pool on low CST level or high suppression pool level. Interlocks are provided such that the CST suction valve will only close after the suppression pool suction valves are both fully open. Thus, if either suppression pool suction valve fails to open the CST line will remain available. If the CST valve fails to close or if the torus pathway fails to open, HPCI/RCIC will continue to operate until the CST inventory is depleted. For all but a small fraction of LOCA events, operation of HPCI or RCIC from the CST provides an extended period of high pressure cooling. For a transient, if HPCI or RCIC maintains vessel level until the CST is depleted, more than an hour is available before adequate core cooling becomes a concern. This is adequate time for the operators to either manually open the failed valves or provide injection from other high pressure sources such as CRD or condensate. Thus, demand failures of the HPCI/RCIC CST and suppression pool suction lines are insignificant contributors to core damage.
1E41-F041	HPCI Torus Suction Isolation	Y	N	0.000	0.000	0.000	
1E41-F042	HPCI Torus Suction Isolation	Y	N	0.000	0.000	0.000	
1E51-F010	RCIC CST Suction Isolation	Y	Y	0.000	0.000	0.000	
1E51-F029	RCIC Torus Suction Isolation	Y	N	0.000	0.000	0.000	
1E51-F031	RCIC Torus Suction Isolation	Y	N	0.000	0.000	0.000	
1E41-F012	HPCI Minimum Flow	Y	N	0.000	0.000	0.000	The minimum flow valves for HPCI and RCIC did not appear as risk-significant in the IPE because it is not anticipated that HPCI and RCIC would ever operate without a flow path to the vessel or the CST. If the HPCI/RCIC discharge MOV failed to open on HPCI/RCIC initiation, a dead-head condition would exist, but in this case, HPCI/RCIC is unavailable for injection regardless of the status of the minimum flow valve.
1E51-F019	RCIC Minimum Flow	Y	N	0.000	0.000	0.000	
1E41-F104	HPCI Vac Breaker Isolation	Y	N	0.000	0.000	0.000	The vacuum breaker isolation valves isolate the vacuum breaker line on low steam line pressure and high Drywell pressure. The purpose of this isolation is to eliminate a potential leakage pathway from the suppression pool airspace through the turbine exhaust line and turbine seals into secondary containment. This leakage pathway could exist if containment pressure was high and HPCI was tripped. This pathway would bypass the water seal that the exhaust line normally has. The importance of this isolation failure is small because any releases would be filtered through the suppression pool, and because of the redundancy of the isolation valves. If this pathway fails to isolate, it is likely due to loss of power to the valves and not hardware failure.
1E41-F111	HPCI Vac Breaker Isolation	Y	N	0.000	0.000	0.000	
1E51-F104	RCIC Vac Breaker Isolation	Y	N	0.000	0.000	0.000	
1E51-F105	RCIC Vac Breaker Isolation	Y	N	0.000	0.000	0.000	
1E51-F119	RCIC Low Speed Bypass	Y	N	0.000	0.000	0.000	The RCIC low speed bypass line was added as an operational improvement to reduce stresses on the RCIC components during startup. Failure of this valve to open during RCIC startup will not prevent RCIC initiation, and failure of this valve to close will not impact the isolation functions of the RCIC steam line isolation valves.
1E51-F524	RCIC Trip and Throttle	Y	N	0.000	0.000	0.000	RCIC trip and throttle valve closure is needed to terminate RCIC injection given a RCIC turbine trip. Failure of RCIC to trip with no other malfunctions present results in continued injection to the vessel. Because of the small injection capacity of RCIC, operators have adequate time to take actions to prevent vessel overfill. Failure of F524 to close given a condition requiring RCIC trip could result in damage to the RCIC system. If a condition requiring RCIC trip is present, then RCIC would most likely be unavailable for the remainder of the event regardless of F524 success or failure. If RCIC was damaged due to failure of F524 to close, steam release outside primary containment would be limited by isolation valves F007 and F008. Furthermore, the ability of the trip and throttle valve to close while exposed to full reactor pressure is verified during monthly RCIC operability testing.

TABLE B1 PRIORITIZATION OF MOTOR-OPERATED VALVES FOR PLANT B (Continued)

1P41-F049 1P41-F050	PSW to DW Coolers Isolation PSW to DW Coolers Isolation	Y Y	Y Y	0.000 0.000	0.000 0.000	0.000 0.000	The PSW System is a closed system within containment, and the isolation valves receive no automatic isolation signals. Isolation is only needed if the PSW pressure boundary within containment is failed. PSW breaks within containment will require a shutdown due to loss of drywell cooling and will likely generate a LOCA signal on high drywell pressure. However, risk significance is LOW because no systems important to safe shutdown are impacted.
1P41-F312	PSW Radwaste Dilution Line	Y	N	0.000	0.000	0.000	The 30" dilution line ties directly into Unit 1 division 1 PSW, and is typically only opened occasionally during outages. During non-outage periods, dilution flow is provided from circulating water blowdown to the river.
1P42-F051 1P42-F052	RBCCW Drywell Inlet RBCCW Drywell Outlet	Y Y	Y N	0.000 0.000	0.000 0.000	0.000 0.000	The RBCCW System is a closed system within containment, and the containment isolation valves receive no automatic isolation signal. Isolation is only required if the RBCCW pressure boundary within containment is failed. If an RBCCW break occurs within containment during power operation, a shutdown due to loss of reactor recirculation pump cooling is required. However, risk significance is LOW because no systems important to safe shutdown are impacted.
1P52-F874	N2 Backup MOV to Inst Air	N	Y	0.023	0.051	0.000	This valve opens on low pressure in the noninterruptible instrument air header to pressurize the header from the nitrogen system. This valve is not in the scope of GL 89-10, but is modeled in the PRA. Its importance to the CDF is below the medium cutoff of 0.1 percent, so this MOV does not need to be added to the test schedule. It is provided here as an example of an MOV in the PRA that is not in the scope of GL 89-10.

NEDC-32264-A
REVISION 2

SEPTEMBER 1996

APPENDIX C

DATA TABLES FOR BWR C

Table C1 - Prioritization of MOVs for BWR C

FV Importance	Number of Valves in Category	Cumulative Number of Valves
0.05	0	0
0.01	6	6
0.001	17	23
0.0001	34	57
<0.0001	120	177

Table C2
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2CCP*MOV122	DRS-CONT ISO INBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT ISOLATION SECTION. THE REACTOR CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN CONTAINED IN THE LOOP. THE FAILURE MECHANISM NECESSARRY TO BREACH CONTAINMENT IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT , AND 2 MOVS FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTOR IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV124	DRS-CONT ISOL OUTBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT ISOLATION SECTION. THE REACTOR CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN CONTAINED IN THE LOOP. THE FAILURE MECHANISM NECESSARRY TO BREACH CONTAINMENT IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT , AND 2 MOVS FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTOR IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV14A	GATE VALVE SFC*E1A INLET (MOTOR OPERATED VALV	-	YES	REACTOR BUILDING CLOSED LOOP COOLING (CCP) TO SPENT FUEL COOLING. THIS VALVE IS IN ONE OF TWO REDUNDANT TRAINS OF COOLING. SPENT FUEL COOLING IS NOT INCLUDED IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE SYSTEM. HOWEVER, SPENT FUEL POOL COOLING RISK IS LOW BECAUSE HEATUP OCCURS SLOWLY AND MANY HOURS ARE AVAILABLE FOR RECOVERY. ALSO, THIS VALVE IS NORMALLY OPEN AND MUST REMAIN OPEN.
2CCP*MOV14B	GATE VALVE SFC*E1B INLET (MOTOR OPERATED VALV	-	YES	REACTOR BUILDING CLOSED LOOP COOLING (CCP) TO SPENT FUEL COOLING. THIS VALVE IS IN ONE OF TWO REDUNDANT TRAINS OF COOLING. SPENT FUEL COOLING IS NOT INCLUDED IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE SYSTEM. HOWEVER, SPENT FUEL POOL COOLING RISK IS LOW BECAUSE HEATUP OCCURS SLOWLY AND MANY HOURS ARE AVAILABLE FOR RECOVERY.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2CCP*MOV15A	RCS-CONT ISOL OUTBD (MOTOR OPERATED VALVE)	-	YES	TH'S IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV15B	RCS-CONT ISOL OUTBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV16A	RCS-CONT ISOL INBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

04/07/93 Page 3 of 18

Component ID	Description	PRA	89-10	PRA REASONING
2CCP*MOV16B	RCS-CONT ISOL INBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV17A	RCS-CONT ISOL OUTBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV17B	RCS-CONT ISOL OUTBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV18A	GATE VLV. SFC*E1A OUTLET (MOTOR OPERATED VALV	-	YES	REACTOR BUILDING CLOSED LOOP COOLING (CCP) TO SPENT FUEL COOLING. THIS VALVE IS IN ONE OF TWO REDUNDANT TRAINS OF COOLING. SPENT FUEL COOLING IS NOT INCLUDED IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE SYSTEM. HOWEVER, SPENT FUEL POOL COOLING RISK IS LOW BECAUSE HEATUP OCCURS SLOWLY AND MANY HOURS ARE AVAILABLE FOR RECOVERY. ALSO, THIS VALVE IS NORMALLY OPEN, AND MUST REMAIN OPEN.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2CCP*MOV18B	GATE VLV. SFC*E1B OUTLET (MOTOR OPERATED VALV	-	YES	REACTOR BUILDING CLOSED LOOP COOLING (CCP) TO SPENT FUEL COOLING. THIS VALVE IS IN ONE OF TWO REDUNDANT TRAINS OF COOLING. SPENT FUEL COOLING IS NOT INCLUDED IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE SYSTEM. HOWEVER, SPENT FUEL POOL COOLING RISK IS LOW BECAUSE HEATUP OCCURS SLOWLY AND MANY HOURS ARE AVAILABLE FOR RECOVERY. ALSO, THIS VALVE IS NORMALLY OPEN AND MUST REMAIN OPEN.
2CCP*MOV265	DRS-CONT ISOL OUTBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV273	DRS-CONT ISOL INBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CCP*MOV94A	RCS-CONT ISOL INBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2CCP*MOV94B	RCS-CONT ISOL INBD (MOTOR OPERATED VALVE)	-	YES	THIS IS A CONTAINMENT ISOLATION VALVE, AND WAS CONSIDERED IN THE CONTAINMENT SECTION. THE REACTOR BUILDING CLOSED LOOP COOLING SYSTEM (CCP) IS A CLOSED LOOP SYSTEM. IF LEAKAGE WERE TO LEAK INTO THE SYSTEM, IT WOULD REMAIN IN THE LOOP. THE FAILURE MECHANISM NECESSARY TO BREACH CONTAINMENT,IS A LINE BREAK BOTH INSIDE AND OUTSIDE CONTAINMENT, AND 2 MOV'S FAILING TO ISOLATE (BOTH CONTAINMENT ISOLATION VALVES). THIS IS CONSIDERED A VERY SMALL CONTRIBUTER IN COMPARISON TO OTHER FAILURE MODES.
2CSH*MOV110	MOTOR OPERATED VALVE	-	YES	VALVE IS IN A FULL FLOW TEST RETURN LINE. VALVE IS ONLY PLACED IN THE OPEN POSITION ON A QUARTERLY BASIS FOR ABOUT SIX HOURS. THE EXPOSURE TO AN INCIDENT FOR THIS VALVE IS SO SMALL AS NOT TO BE CONSIDERED. ALSO, ON SYSTEM INITIATION, THE VALVE RECEIVES AN ISOLATION SIGNAL AND THEREFORE IS NOT FURTHER CONSIDERED.
2CSH*MOV111	MOTOR OPERATED VALVE	-	YES	VALVE IS IN A FULL FLOW TEST RETURN LINE. VALVE IS ONLY PLACED IN THE OPEN POSITION ON A QUARTERLY BASIS FOR ABOUT SIX HOURS. THE EXPOSURE TO AN INCIDENT FOR THIS VALVE IS SO SMALL AS NOT TO BE CONSIDERED. ALSO, ON SYSTEM INITIATION, THE VALVE RECEIVES AN ISOLATION SIGNAL AND THEREFORE IS NOT FURTHER CONSIDERED.
2CSH*MOV112	MOTOR OPERATED VALVE	-	YES	VALVE IS IN A FULL FLOW TEST RETURN LINE. VALVE IS ONLY PLACED IN THE OPEN POSITION ON A QUARTERLY BASIS FOR ABOUT SIX HOURS. THE EXPOSURE TO AN INCIDENT FOR THIS VALVE IS SO SMALL AS NOT TO BE CONSIDERED. ALSO, ON SYSTEM INITIATION, THE VALVE RECEIVES AN ISOLATION SIGNAL AND THEREFORE IS NOT FURTHER CONSIDERED
2CSL*FV114	CORE SPRAY PUMP TEST	-	YES	VALVE IS IN A FULL FLOW TEST RETURN LINE. VALVE IS ONLY PLACED IN THE OPEN POSITION ON A QUARTERLY BASIS FOR ABOUT SIX HOURS. THE EXPOSURE TO AN INCIDENT FOR THIS VALVE IS SO SMALL AS NOT TO BE CONSIDERED. ALSO, ON SYSTEM INITIATION, THE VALVE RECEIVES AN ISOLATION SIGNAL AND THEREFORE IS NOT FURTHER CONSIDERED.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2CSL*MOV107	GATE VALVE	-	YES	THIS IS A MINIMUM FLOW VALVE, FOR PUMP PROTECTION, AND IN COMBINATION WITH A LOCKED POSITION DOWNSTREAM MANUAL VALVE, THIS VALVE CAN ONLY PASS 1000 GPM IN TEST FLOW. IF THE VALVE DOES NOT CLOSE ON DEMAND (A SYSTEM ACTUATION), THE LOSS OF 1000 GPM IS MINOR COMPARED TO THE PUMP OUTPUT OF 7800 GPM.
2CSL*MOV112	LPCS PMP SUCT VALVE (P1)	YES	YES	THIS IS THE PUMP SUCTION ISOLATION VALVE. IT IS NORMALLY KEYLOCKED OPEN AND DOES NOT NEED TO CHANGE POSITION FOR SYSTEM OPERATION. IT IS THEREFORE CONSIDERED OF LITTLE IMPORTANCE IN THE IPE.
2FWS*MOV21A	REACTOR VESSEL SUCTION ISOLATION VALVE	-	YES	THESE VALVES ARE NOT MODELED IN THE IPE. FOR FEEDWATER INJECTION, THE VALVE IS NOT REQUIRED TO REPOSITION. FOR ISOLATION, IF THE VALVE FAILS TO CLOSE, THERE IS SUFFICIENT PASSIVE REDUNDANCY (3 CHECK VALVES IN SERIES) TO CONSIDER THE MOV FAILURE OF LOW IMPORTANCE.
2FWS*MOV21B	REACTOR VESSEL SUCTION ISOLATION VALVE	-	YES	THESE VALVES ARE NOT MODELED IN THE IPE. FOR FEEDWATER INJECTION, THE VALVE IS NOT REQUIRED TO REPOSITION. FOR ISOLATION, IF THE VALVE FAILS TO CLOSE, THERE IS SUFFICIENT PASSIVE REDUNDANCY (3 CHECK VALVES IN SERIES) TO CONSIDER THE MOV FAILURE OF LOW IMPORTANCE.
2GTS*MOV1A	GAS TREATMENT FILTER TRAIN SUCTION ISO VALVE	-	YES	THESE VALVES WERE IMPLICITELY MODELED IN THE IPE. THE DOMINANT FAILURE MECHANISM IN THE SCENARIO IS OPERATOR ERROR TO ALIGN STANDBY GAS TREATMENT FOR VENTING.
2GTS*MOV1B	GAS TREATMENT FILTER TRAIN SUCTION ISO VALVE	-	YES	THESE VALVES WERE IMPLICITELY MODELED IN THE IPE. THE DOMINANT FAILURE MECHANISM IN THE SCENARIO IS OPERATOR ERROR TO ALIGN STANDBY GAS TREATMENT FOR VENTING.
2HCS*MOV1A	GATE VALVE - MOTOR OPERATED RBNR1A OUTLET OUT	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV1B	GATE VALVE - MOTOR OPERATED RBNR1B OUTLET OUT	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2HCS*MOV25A	MOTOR OPERATED - GLOBE VALVE RBNR1A IN FLOW	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV25B	MOTOR OPERATED - GLOBE VALVE RBNR1B IN FLOW	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV26A	MOTOR OPERATED - GLOBE VALVE RBNR1A CLG WTR I	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV26B	MOTOR OPERATED - GLOBE VALVE RBNR1B CLG WTR I	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV2A	MOTOR OPERATED - GLOBE VALVE RBNR1A INLET	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV2B	MOTOR OPERATED - GLOBE VALVE RBNR1A INLET	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2HCS*MOV3A	MOTOR OPERATED - GATE VALVE RBNR1A INLET OUTL	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV3B	RBNR1B INLET OUTLBD ISOL	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV4A	RBNR1A OUTLET INBD ISOL	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV4B	RBNR1B OUTLET INBD ISOL	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV5A	MOTOR OPERATED - GLOBE VALVE RBN1A INLET INBD	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV5B	MOTOR OPERATED - GLOBE VALVE RBN1B INLET INBD	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2HCS*MOV6A	RBN1A INLET INBD ISOL	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HCS*MOV6B	RBN1B INLET INBD ISOL	-	YES	THIS IS IN A HYDROGEN RECOMBINER SYSTEM. NO CREDIT IS TAKEN FOR THIS SYSTEM IN THE IPE. THIS SYSTEM DOES NOT IN ANY WAY MITIGATE THE RESULTS OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF ANY VALVE TO OPERATE IS OF NO CONSEQUENCE BECAUSE IT IS A CLOSED SYSTEM.
2HVC*MOV1A	SPCL FLTR TRAIN BYP VALVE	-	YES	LOSS OF AIR CONDITIONING TO THE CTRL ROOM WOULD BE DETECTED EARLY SINCE THE OPERATORS ARE IN THE CONTROL ROOM AND THERE ARE BOTH TROUBLE AND INOP ALARMS ASSOCIATED WITH THE SYSTEMS. EVEN IF THE CTRL ROOM BECAME VERY HOT AND STARTED TO IMPACT ELECTRICAL EQ. AND SYSTEMS, THE OPERATORS STILL HAVE THE OPTION OF TAKING CONTROL AT THE REMOTE SHUTDOWN ROOMS AT EL 261. THESE ROOMS HAVE THERE OWN SAFETY RELATED AIR CONDITIONERS. GIVEN THESE CAPABILITIES, VENTILATION FAILURES ARE UNIMPORTANT, AND NOT MODELED
2HVC*MOV1B	SPCL FLTR TRAIN BYP VALVE	-	YES	LOSS OF AIR CONDITIONING TO THE CTRL ROOM WOULD BE DETECTED EARLY SINCE THE OPERATORS ARE IN THE CONTROL ROOM AND THERE ARE BOTH TROUBLE AND INOP ALARMS ASSOCIATED WITH THE SYSTEMS. EVEN IF THE CONTROL ROOM BECAME VERY HOT AND STARTED TO IMPACT ELECTRICAL EQ AND SYSTEMS, THE OPERATORS STILL HAVE THE OPTION OF TAKING CONTROL AT THE REMOTE SHUTDOWN ROOMS AT EL 261'. THESE ROOMS HAVE THERE OWN SAFETY RELATED AIR CONDITIONERS. GIVEN THESE CAPABILITIES VENTILATION FAILURES ARE UNIMPORTANT, AND NOT MODELED.
2ICS*FV108	TEST BYP TO CNDS STOR TK	-	YES	THE VALVE IS IN A FULL FLOW TEST RETURN LINE. THE VALVE IS ONLY PLACED IN THE OPEN POSITION ON A QUARTERLY BASIS FOR ABOUT SIX HOURS. THE EXPOSURE TO AN INCIDENT FOR THIS VALVE IS SO SMALL AS NOT TO BE CONSIDERED. ALSO, ON SYSTEM INITIATION, THE VALVE RECEIVES AN ISOLATION SIGNAL AND THEREFORE IS NOT CONSIDERED FURTHER.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2ICS*MOV121	STEAM SPLY LINE ISOL VALVE	YES	YES	THIS IS THE RCIC TURBINE STEAM SUPPLY SHUTOFF. IT IS NORMALLY OPEN, AND MUST REMAIN OPEN FOR INJECTION. IT IS THEREFORE CONSIDERED OF LITTLE IMPORTANCE COMPARED TO OTHER FAILURE MECHANISMS. THE PROBABILITY OF HELB, DURING WHICH THIS VALVE COULD CLOSE AND ISOLATE THE RUPTUE, IS CONSIDERED LOW RISK SIGNIFICANCE TO CORE DAMAGE (i.e., LOW IE PROBABILITY AND HIGH PROBABILITY TO PROVIDE ADEQUATE CORE COOLING).
2ICS*MOV122	RCIC TURB EXH TO SUPPR	YES	YES	THIS IS THE RCIC TURBINE EXHAUST TO THE SUPPRESSION POOL. IT IS NORMALLY OPEN AND MUST REMAIN OPEN FOR OPERATION. IT IS THEREFORE CONSIDERED UNIMPORTANT COMPARED TO OTHER FAILURE MODES. THE PROBABILITY OF LINE RUPTURE IS LOW BECAUSE THE PRESSURE IN THIS PORTION OF THE SYSTEM IS LOW AND RUN TIME IS SHORT.
2ICS*MOV124	MOTOR OPERATED VALVE FOR RCIC TEST FCV TO CND	-	YES	THE VALVE IS IN A FULL FLOW TEST RETURN LINE. VALVE IS ONLY PLACED IN THE OPEN POSITION ON A QUARTERLY BASIS FOR ABOUT SIX HOURS. THE EXPOSURE TO AN INCIDENT FOR THIS VALVE IS SO SMALL AS NOT TO BE CONSIDERED. ALSO, ON SYSTEM INITIATION, THE VALVE RECEIVES AN ISOLATION SIGNAL AND THEREFORE IS NOT FURTHER CONSIDERED.
2ICS*MOV128	RCIC ST SPLY LINE ISOLATION MOTOR OPERATED	YES	YES	THIS IS THE RCIC INSIDE ISOLATION VALVE. IT IS NORMALLY OPEN AND MUST REMAIN OPEN FOR SYSTEM OPERATION. IT IS THEREFORE CONSIDERED UNIMPORTANT IN COMPARISON TO OTHER FAILURES. THE PROBABILITY OF HELB, DURING WHICH THIS VALVE COULD CLOSE AND ISOLATE THE LINE RUPTURE, IS CONSIDERED LOW RISK SIGNIFICANCE TO CORE DAMAGE (i.e., LOW IE PROBABILITY AND HIGH PROBABILITY TO PROVIDE ADEQUATE CORE COOLING).
2ICS*MOV129	MOTOR OPERATED VALVE FOR PUMP SUCT FROM CNDS	YES	YES	THIS IS THE PUMP SUCTION ISOLATION VALVE. IT IS NORMALLY OPEN, AND NEEDS TO REMAIN OPEN FOR INJECTION. IT IS THEREFORE CONSIDERED OF SMALL IMPORTANCE IN COMPARISON TO OTHER FAILURES.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2ICS*MOV136	MOTOR OPERATED VALVE FOR RCIC PMP SUCT FROM	-	YES	RCIC IS MODELED TO FAIL IF EITHER OF THE CONDENSATE STORAGE TANKS (CST A & B) ARE NOT AVAILABLE. 135,000 GAL. OF CST A ARE DEDICATED TO RCIC. THE SUPPRESSION POOL SUCTION PATH IS NOT MODELED BECAUSE ITS IMPORTANCE IS VERY SMALL. BOTH TANKS ARE CONNECTED ABOVE THE PROTECTED 135,000 GAL. AND THE FREQUENCY OF NOT HAVING SUFFICIENT WATER FROM BOTH TANKS TO CONTINUE INJECTING FOR 24 HOURS IS NEGLIGIBLE AND NOT EVALUATED IN ANY SEQUENCE ANALYSIS. N2-EOP-RPV, SEC RL INSTRUCTS OPERATORS TO CONTINUE USING THE CST SOURCE, IF AVAILABLE.
2ICS*MOV143	MOTOR OPERATED VALVE FOR RCIC MIN FLOW TO	-	YES	MINIMUM FLOW TO THE SUPPRESSION POOL IS NOT MODELED. LOW FLOW CONDITIONS WHICH REQUIRE THIS (PUMP) PROTECTION ARE CONSIDERED UNLIKELY BECAUSE THE STEAM ADMISSIONS VALVE CLOSES, THEREBY TERMINATING INJECTION ON RPV LEVEL 8, AND IF MOV143 FAILS OPEN, FLOW DIVERSION IS NOT SIGNIFICANT ENOUGH TO PREVENT SUCCESS.
2ICS*MOV148	RCIC VAC BRKR ISOLATION MOTOR OPERATED VALVE	-	YES	THIS IS A VACUUM BREAKER USED TO PREVENT THE SIPHONING OF WATER INTO THE STEAM DISCHARGE LINE ON THE TERMINATION OF STEAM TO THE TURBINE. NO CREDIT IS TAKEN FOR THE OPERATION OF THIS VALVE IN THE PRA. IT IS NORMALLY OPEN, THERE IS A LOW PROBABILITY OF WATER HAMMER OCCURING DUE TO SIPHONING OF SUPRESSION POOL WATER, AND EVEN SO, THE SYSTEM CAN TOLERATE WATER HAMMER TO THE DIFFUSER IN AN ACCIDENT SITUATION.
2ICS*MOV164	RCIC VAC BRKR ISOLATION MOTOR OPERATED VALVE	-	YES	THIS IS A VACUUM BREAKER USED TO PREVENT THE SIPHONING OF WATER INTO THE STEAM DISCHARGE LINE ON THE TERMINATION OF STEAM TO THE TURBINE. WE DON'T TAKE CREDIT FOR THIS VALVE IN THE PRA. IT IS NORMALLY OPEN, THERE IS A LOW PROBABILITY OF WATER HAMMER OCCURING DUE TO SIPHONING OF SUPRESSION POOL WATER, AND EVEN SO, THE SYSTEM CAN TOLERATE WATER HAMMER TO THE DIFFUSER IN AN ACCIDENT SITUATION.
2ICS*MOV170	RCIC STEAM LINE WARM-UP MOTOR OPERATED VALVE	-	YES	NOT USED DURING OPERATION. STRICTLY A SMALL BYPASS LINE USED TO WARM UP THE DOWNSTREAM LINE BEFORE OPENING, FOR TESTING THE SYSTEM AND SYSTEM WARM-UP AFTER A SHUTDOWN. IT HAS A VERY LOW EXPOSURE TIME TO AN ACCIDENT SITUATION.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance-

Component ID	Description	PRA	89-10	PRA REASONING
2MSS*MOV111	MN STEAM DRN INBD ISOL VALVE	YES	YES	MAIN STEAM LINE DRAIN INBOARD ISOLATION VALVE. NORMALLY CLOSED. USED IN EOP-6 FOR RPV VENTING IF MSIVS CANNOT BE OPENED. THIS VALVE IS NOT USED TO PREVENT CORE DAMAGE IN ANY SCENARIOS MODELED, AND HAS A SMALL CONTRIBUTION TO CONTAINMENT FAILURE.
2MSS*MOV112	MN STEAM DRN OUTBD ISOL VALVE	YES	YES	MAIN STEAM LINE DRAIN OUTBOARD ISOLATION VALVE. NORMALLY CLOSED AND DE-ENERGIZED. THIS VALVE IS NOT USED TO PREVENT CORE DAMAGE IN ANY SCENARIOS MODELED, AND IS A SMALL CONTRIBUTOR TO CONTAINMENT FAILURE. THIS VALVE IS USED IN EOP-6 TO VENT THE RPV IF THE MSIVS CANNOT BE OPENED.
2MSS*MOV118	REAC VESSEL HEAD VENT VALVE	-	YES	NORMALLY CLOSED. REACTOR VESSEL HEAD VENT VALVE USED TO VENT HEAD AFTER SHUTDOWN AND PRIOR TO HEAD REMOVAL. NOT USED TO RESPOND TO ACCIDENT SITUATIONS OR DURING OPERATIONS AND THEREFORE NOT IN THE PRA.
2MSS*MOV119	REAC VESSEL HEAD VENT VALVE	-	YES	NORMALLY CLOSED. REACTOR VESSEL HEAD VENT VALVE USED TO VENT HEAD AFTER SHUTDOWN AND PRIOR TO HEAD REMOVAL. NOT USED TO RESPOND TO ACCIDENT SITUATIONS OR DURING OPERATIONS AND THEREFORE NOT IN THE PRA.
2MSS*MOV208	INBD MSIV DRN ISOL VALVE	-	YES	THIS VALVE DOES NOT SERVE TO MITIGATE THE RESULTE OF ANY ANALYZED ACCIDENT SCENARIO THROUGH A LEVEL 2 IPE ANALYSIS. THE FAILURE OF THIS VALVE TO OPERATE IS OF NO CONSEQUENCE, AND IS THEREFORE NOT MODELED
2RHS*FV38C	RHR FLOW CONTROL VALVE	-	YES	THIS VALVE IS A FLOW CONTROL VALVE IN THE TEST RETURN LINE OF THE RHS SYSTEM. IT IS NORMALLY CLOSED AND ONLY OPERATED FOR A FEW HOURS PER QUARTER. ITS EXPOSURE TIME TO AN ACCIDENT SCENARIO IS SMALL, AND IS THEREFORE CONSIDERED UNIMPORTANT COMPARED TO OTHER FAILURES.
2RHS*MOV104	RHR HEAD SPRAY ISOLATION, GLOBE VALVE	-	YES	THIS VALVE SERVES THE STEAM CONDENSING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE.
2RHS*MOV112	RHR SHT DN CLG SUCT ISOL MOTOR OPERATED GATE	-	YES	THIS VALVE SERVES THE SHUTDOWN COOLING FUNCTION OF RHS, AND IS THEREFORE NOT IN THE SCOPE OF THE IPE.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2RHS*MOV113	RHR SHT DN CLG SUCT ISOL , GATE VALVE	-	YES	THIS IS AN ISOLATION VALVE FOR THE SHUTDOWN COOLING FUNCTION, AND IS THEREFORE NOT APPLICABLE TO IPE AND DO NOT TAKE CREDIT FOR IT. VALVE SERVES ONLY A SHUTDOWN MODE AND SERVES NO PURPOSE TO PREVENT OR MITIGATE A SEVERE ACCIDENT.
2RHS*MOV12A	DISCHARGE FROM E1A	YES	YES	THIS IS THE HEAT EXCHANGER OUTLET VALVE. IT IS NORMALLY OPEN, AND DOES NOT NEED TO CLOSE. IT IS THEREFORE CONSIDERED UNIMPORTANT COMPARED TO OTHER FAILURES.
2RHS*MOV12B	DISCHARGE FROM E1B	YES	YES	THIS IS THE HEAT EXCHANGER DISCHARGE VALVE. IT IS NORMALLY OPEN AND DOES NOT NEED TO CLOSE UNLESS THE OPERATOR IS ALIGNING THE SERVICE WATER SYSTEM TO FLOOD CONTAINMENT. THE FAILURE TO FLOOD CONTAINMENT IS NOT AN IMPORTANT CONTRIBUTION TO RISK.
2RHS*MOV142	RHR DISCHARGE TO RADWASTE GLOBE VALVE , MOTOR	-	YES	THIS IS AN ISOLATION VALVE FOR THE SHUTDOWN COOLING FUNCTION, AND IS THEREFORE NOT APPLICABLE TO IPE AND DO NOT TAKE CREDIT FOR IT. VALVE SERVES ONLY A SHUTDOWN MODE AND SERVES NO PURPOSE TO PREVENT OR MITIGATE A SEVERE ACCIDENT.
2RHS*MOV149	RHR DISCHARGE TO RADWASTE , GATE VALVE , MOTO	-	YES	THIS IS AN ISOLATION VALVE FOR THE SHUTDOWN COOLING FUNCTION, AND IS THEREFORE NOT APPLICABLE TO IPE AND DO NOT TAKE CREDIT FOR IT. VALVE SERVES ONLY A SHUTDOWN MODE AND SERVES NO PURPOSE TO PREVENT OR MITIGATE A SEVERE ACCIDENT.
2RHS*MOV1A	RHR PMP P1A SUCTION , MOTOR OPERATED VALVE	YES	YES	THIS IS THE PUMP SUCTION VALVE FROM THE SUPPRESSION POOL. IT IS NORMALLY OPEN, AND DOES NOT NEED TO CHANGE POSITION FOR SYSTEM OPERATION. IT IS THEREFORE CONSIDERED UNIMPORTANT IN COMPARISON TO OTHER FAILURES.
2RHS*MOV1B	RHR PMP P1B SUCTION , MOTOR OPERATED VALVE	YES	YES	RHR PUMP 'B' SUCTION ISOLATION VALVE FROM SUPPRESSION POOL, NORMALLY OPEN, IT IS NOT REQUIRED TO CHANGE POSITION. IT IS THEREFORE CONSIDERED UNIMPORTANT COMPARED TO OTHER FAILURES.
2RHS*MOV1C	RHR PMP P1C SUCTION , MOTOR OPERATED VALVE	YES	YES	RHR PUMP SUCTION ISOLATION VALVE, NORMALLY OPEN, AND IT DOES NOT NEED TO CHANGE POSITION FOR SYSTEM OPERATION. THEREFORE IT IS CONSIDERED UNIMPORTANT TO SYSTEM OPERATION.
2RHS*MOV22A	RHR A STM LINE ISOL , GLOBE VALVE MOTOR	-	YES	SERVES AS A STEAM CONDENSING FUNCTION ONLY IN SHUTDOWN MODE. NORMALLY, CLOSED DURING OPERATION. DE-ENERGIZED DURING NORMAL PLANT OPERATION. THEREFORE NOT IN THE SCOPE OF IPE.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2RHS*MOV22B	RHR B STM LINE ISOL , GLOBE VALVE MOTOR	-	YES	SERVES AS A STEAM CONDENSING FUNCTION ONLY IN SHUTDOWN MODE. NORMALLY, CLOSED DURING OPERATION. DE-ENERGIZED DURING NORMAL PLANT OPERATION. AS THIS VALVE IS DOWNSTREAM OF A CLOSED DE-ENERGIZED VALVF, IT HAS NO CONSEQUENCE DURING PLANT FULL POWER OPERATION AND IS NOT MODELED IN THE IPE.
2RHS*MOV23A	RHR A STM LINE ISOL , MOTOR OPERATED VALVE	-	YES	SERVES AS A STEAM CONDENSING FUNCTION ONLY IN SHUTDOWN MODE. NORMALLY, CLOSED DURING OPERATION. DE-ENERGIZED DURING NORMAL PLANT OPERATION. AS THIS VALVE IS DOWNSTREAM OF A CLOSED DE-ENERGIZED VALVE, IT HAS NO CONSEQUENCE DURING PLANT FULL POWER OPERATION AND IS NOT MODELED IN THE IPE.
2RHS*MOV23B	RHR B STM LINE ISOL , GLOBE MOTOR OPERATED	-	YES	SERVES AS A STEAM CONDENSING FUNCTION ONLY IN SHUTDOWN MODE. NORMALLY, CLOSED DURING OPERATION. DE-ENERGIZED DURING NORMAL PLANT OPERATION. AS THIS VALVE IS DOWNSTREAM OF A CLOSED DE-ENERGIZED VALVE, IT HAS NO CONSEQUENCE DURING PLANT FULL POWER OPERATION AND IS NOT MODELED IN THE IPE.
2RHS*MOV26A	RHR H.E. A VENT TO SUPP P , MOTOR OPERATED	-	YES	DO NOT TAKE CREDIT FOR THIS IN THE IPE. USED TO VENT HEAT EXCHANGER AS YOU FILL IT AFTER MAINTENANCE, DURING SHUTDOWN. NORMALLY CLOSED.
2RHS*MOV26B	RHR H.E. VENT TO SUPP P , MOTOR OPERATED GLOB	-	YES	DO NOT TAKE CREDIT FOR THIS IN THE IPE. USED TO VENT HEAT EXCHANGER AS YOU FILL IT AFTER MAINTENANCE, DURING SHUTDOWN. NORMALLY CLOSED.
2RHS*MOV27A	RHR H.E. A VENT TO SUPP P , MOTOR OPERATED	-	YES	DO NOT TAKE CREDIT FOR THIS IN THE IPE. USED TO VENT HEAT EXCHANGER AS YOU FILL IT AFTER MAINTENANCE, DURING SHUTDOWN. NORMALLY CLOSED.
2RHS*MOV27B	RHR H.E. B VENT TO SUPP P , MOTOR OPERATED	-	YES	DO NOT TAKE CREDIT FOR THIS IN THE IPE. USED TO VENT HEAT EXCHANGER AS YOU FILL IT AFTER MAINTENANCE, DURING SHUTDOWN. NORMALLY CLOSED.
2RHS*MOV2A	RHR A SHUT DOWN COOLING SUCTION , MOTOR	-	YES	THIS IS ONE OF TWO CROSS TIE VALVES BETWEEN THE A AND B TRAINS. THE IPE DOES NOT TAKE CREDIT FOR THIS VALVE. IT IS USED DURING SHUTDOWN OPERATIONS, AND IS THEREFORE NOT IN THE SCOPE OF THE IPE.
2RHS*MOV2B	RHR B SHT DN COOLING SUCT , MOTOR OPERATED	-	YES	THIS IS ONE OF TWO CROSS TIE VALVES BETWEEN THE A AND B TRAINS. THE IPE DOES NOT TAKE CREDIT FOR THIS VALVE. IT IS USED DURING SHUTDOWN OPERATIONS, AND IS THEREFORE NOT IN THE SCOPE OF THE IPE.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2RHS*MOV30A	RHR A RTN TO SUPP POOL IS MOTOR OPERATED	YES	YES	THIS IS THE SUPPRESSION POOL INJECTION VALVE. IT IS NORMALLY OPEN AND DOES NOT NEED TO CHANGE POSITION FOR SYSTEM OPERATION. THEREFORE IT IS CONSIDERED UNIMPORTANT IN COMPARISON TO OTHER FAILURES.
2RHS*MOV30B	RHR B RTN TO SUPP POOL IS MOTOR OPERATED	YES	YES	THIS IS THE SUPPRESSION POOL COOLING ISOLATION VALVE. IT IS NORMALLY OPEN, AND MUST REMAIN OPEN FOR SYSTEM OPERATION. THEREFORE IT IS CONSIDERED UNIMPORTANT IN COMPARISON TO OTHER FAILURES.
2RHS*MOV32A	RHR H.E. A FLOW TO RCIC MOTOR OPERATED GATE	-	YES	THIS VALVE IS USED IN THE STEAM CONDENSING MODE OF RHS. IT IS A SHUTDOWN FUNCTION AND IS NOT CONSIDERED IN THE IPE
2RHS*MOV32B	RHR H.E. B FLOW TO RCIC , MOTOR OPERATED VALV	-	YES	THIS IS IN THE STEAM CONDENSING MODE OF RHS, A SHUTDOWN FUNCTION. IT IS THEREFORE NOT IN THE SCOPE OF THE IPE.
2RHS*MOV33A	RHR A SUPP POOL SPRAY , MOTOR OPERATED GLOBE	YES	YES	THIS IS SUPPRESSION POOL SPRAY ISOLATION VALVE. IT IS NORMALLY CLOSED, AND MUST OPEN FOR OPERATION. ITS IMPORTANCE TO CORE DAMAGE IS INSIGNIFICANT IN COMPARISON TO OTHER FAILURES.
2RHS*MOV33B	RHR B SUPP POOL SPRAY , MOTOR OPERATED GLOBE	YES	YES	THIS IS THE SUPPRESSION POOL SPRAY ISOLATION VALVE. IT IS NORMALLY CLOSED AND MUST OPEN FOR OPERATION. ITS CONTRIBUTION TO CORE DAMAGE IS MINOR COMPARED TO OTHER FAILURES.
2RHS*MOV37A	RHR H.E. A FLOW TO SUPP P , MOTOR OPERATED	-	YES	THIS VALVE SERVES THE STEAM CONDENSING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE.
2RHS*MOV37B	RHR H.E. B FLOW TO SUPP P , MOTOR OPERATED	-	YES	THIS VALVE SERVES THE STEAM CONDENSING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE.
2RHS*MOV40A	RHR A SHT DN CLG RETURN , MOTOR OPERATED VALV	-	YES	THIS VALVE SERVES THE SHUTDOWN COOLING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE.
2RHS*MOV40B	RHS B SHUTDOWN COOLING , MOTOR OPERATED VALVE	-	YES	THIS VALVE SERVES THE SHUTDOWN COOLING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE.
2RHS*MOV4A	RHR A MIN FLOW BYPASS , MOTOR OPERATED GATE	YES	YES	THIS IS THE MINIMUM FLOW BYPASS VALVE, NORMALLY OPEN. IT DOES NOT NEED TO CLOSE, EVEN UPON INJECTION, AS THE BYPASS FLOW IS MINOR. IT DOES NEED TO OPEN FOR PUMP PROTECTION, IF IT CLOSES.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2RHS*MOV4B	RHR B MIN FLOW BYPASS , MOTOR OPERATED VALVE	YES	YES	THIS IS THE MINIMUM FLOW BYPASS VALVE. IT IS NORMALLY OPEN AND DOES NOT NEED TO CLOSE, AS BYPASS FLOW WOULD BE MINIMAL. IT DOES NEED TO OPEN FOR PUMP PROTECTION, IF IT CLOSES.
2RHS*MOV4C	RHR C MIN FLOW BYPASS , MOTOR OPERATED VALVE	YES	YES	THIS IS A MINIMUM FLOW BYPASS VALVE. IT IS NORMALLY OPEN, AND DOES NOT NEED TO CLOSE AS BYPASS FLOW WOULD BE MINIMAL. IT DOES NEED TO OPEN FOR PUMP PROTECTION, IF IT CLOSES.
2RHS*MOV67A	RHR A SHT DNCLG CV BYPASS , MOTOR OPERATED	-	YES	THIS VALVE SERVES THE SHUTDOWN COOLING FUNCTION OF RHS, AND IS THEREFORE NOT IN THE SCOPE OF THE IPE.
2RHS*MOV67B	PHR B SHT DN CLG CV BYPAS	-	YES	THIS VALVE SERVES THE SHUTDOWN COOLING FUNCTION OF RHS, AND IS THEREFORE NOT IN THE SCOPE OF THE IPE.
2RHS*MOV80A	HEAT EXCHANGER SUCTION ISOLATION VALVE	-	YES	THIS VALVE SERVES THE STEAM CONDENSING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE. THIS VALVE IS ALSO DE-ENERGIZED DURING NORMAL OPERATION.
2RHS*MOV80B	HEAT EXCHANGER SUCTION ISOLATION VALVE	-	YES	THIS VALVE SERVES THE STEAM CONDENSING MODE, A SHUTDOWN FUNCTION. SHUTDOWN FUNCTIONS ARE NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THE VALVE. THIS VALVE IS ALSO DE-ENERGIZED DURING NORMAL OPERATION.
2RHS*MOV9A	RHR H.E. A SHELL SIDE INL MOTOR OPERATED	YES	YES	THIS IS THE HEAT EXCHANGER INLET VALVE, NORMALLY OPEN. IT DOES NOT NEED TO CHANGE POSITION FOR SYSTEM OPERATION. ITS CONTRIBUTION TO CORE DAMAGE IS MINIMAL IN COMPARISON TO OTHER FAILURES.
2RHS*MOV9B	RHR H.E. B SHELL-SIDE INL MOTOR OPERATED VALV	YES	YES	THIS IS THE HEAT EXCHANGER INLET VALVE, NORMALLY OPEN. IT DOES NOT NEED TO CHANGE POSITION FOR SYSTEM OPERATION. ITS CONTRIBUTION TO CORE DAMAGE IS MINIMAL IN COMPARISON TO OTHER FAILURE MODES.
2SLS*MOV5A	RPV INJECTION ISOL STOP CHECK VALVE	-	YES	THIS IS A MOTOR OPERATED STOP CHECK VALVE. IT OPERATES AS A GLOBE STYLE CHECK VALVE DURING OPERATION. THE MOTOR IS USED TO ASSURE POSITIVE SEATING LATE IN CERTAIN SCENARIOS. THE MOTOR DOES NOT AID IN OPENING OR CLOSING THE VALVE.
2SLS*MOV5B	RPV INJECTION ISOL STOP CHECK VALVE	-	YES	THIS IS A MOTOR OPERATED STOP CHECK VALVE. IT OPERATES AS A GLOBE STYLE CHECK VALVE DURING OPERATION. THE MOTOR IS USED TO ASSURE POSITIVE SEATING LATE IN CERTAIN SCENARIOS. THE MOTOR DOES NOT AID IN OPENING OR CLOSING THE VALVE.

Table C2 (Continued)
Current 89-10 MOVs with Low Risk Significance

Component ID	Description	PRA	89-10	PRA REASONING
2SWP*MOV17A	SPENT FUEL COOLING HEAT EXCHANGER SUCTION VAL	-	YES	THIS IS A BACKUP COOLING SOURCE TO THE SPENT FUEL POOL COOLING SYSTEM. SPENT FUEL POOL COOLING IS NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THIS VALVE.
2SWP*MOV17B	SPENT FUEL COOLING HEAT EXCHANGER SUCTION VAL	-	YES	THIS IS A BACKUP COOLING SOURCE TO THE SPENT FUEL POOL COOLING SYSTEM. SPENT FUEL POOL COOLING IS NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THIS VALVE.
2SWP*MOV18A	SPENT FUEL COOLING HEAT EXCHANGER DISCHARGE V	-	YES	THIS IS A BACKUP COOLING SOURCE TO THE SPENT FUEL POOL COOLING SYSTEM. SPENT FUEL POOL COOLING IS NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THIS VALVE.
2SWP*MOV18B	SPENT FUEL COOLING HEAT EXCHANGER DISCHARGE V	-	YES	THIS IS A BACKUP COOLING SOURCE TO THE SPENT FUEL POOL COOLING SYSTEM. SPENT FUEL POOL COOLING IS NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN FOR THIS VALVE.
2SWP*MOV1A	SERVICE WATER PUMP DISCHARGE ISOLATION VALVE	-	YES	THIS VALVE PROVIDES AUTOMATIC STRAINER BACKWASH FOR THE SERVICE SYSTEM. THERE IS SUFFICIENT PUMPING CAPACITY SUCH THAT THESE VALVES ARE NOT NEEDED TO RESPOND IN AN ACCIDENT SITUATION. SYSTEM PROCEDURES AND ALARMS ALERT OPERATORS TO ANY CLOGGING CONCERNS.
2SWP*MOV1B	SERVICE WATER PUMP DISCHARGE ISOLATION VALVE	-	YES	THIS VALVE PROVIDES AUTOMATIC STRAINER BACKWASH FOR THE SERVICE SYSTEM. THERE IS SUFFICIENT PUMPING CAPACITY SUCH THAT THESE VALVES ARE NOT NEEDED TO RESPOND IN AN ACCIDENT SITUATION. SYSTEM PROCEDURES AND ALARMS ALERT OPERATORS TO ANY CLOGGING CONCERNS.
2SWP*MOV1C	SERVICE WATER PUMP DISCHARGE ISOLATION VALVE	-	YES	THIS VALVE PROVIDES AUTOMATIC STRAINER BACKWASH FOR THE SERVICE SYSTEM. THERE IS SUFFICIENT PUMPING CAPACITY SUCH THAT THESE VALVES ARE NOT NEEDED TO RESPOND IN AN ACCIDENT SITUATION. SYSTEM PROCEDURES AND ALARMS ALERT OPERATORS TO ANY CLOGGING CONCERNS.
2SWP*MOV1D	SERVICE WATER PUMP DISCHARGE ISOLATION VALVE	-	YES	THIS VALVE PROVIDES AUTOMATIC STRAINER BACKWASH FOR THE SERVICE SYSTEM. THERE IS SUFFICIENT PUMPING CAPACITY SUCH THAT THESE VALVES ARE NOT NEEDED TO RESPOND IN AN ACCIDENT SITUATION. SYSTEM PROCEDURES AND ALARMS ALERT OPERATORS TO ANY CLOGGING CONCERNS.

Table C2 (Continued)
Current 89-10 MOVs with Low Ri*k Significance

Component ID	Description	PRA	89-10	PRA REASONING
2SWP*MOV1E	SERVICE WATER PUMP DISCHARGE ISOLATION VALVE	-	YES	THIS VALVE PROVIDES AUTOMATIC STRAINER BACKWASH FOR THE SERVICE SYSTEM. THERE IS SUFFICIENT PUMPING CAPACITY SUCH THAT THESE VALVES ARE NOT NEEDED TO RESPOND IN AN ACCIDENT SITUATION. SYSTEM PROCEDURES AND ALARMS ALERT OPERATORS TO ANY CLOGGING CONCERNS.
2SWP*MOV1F	SERVICE WATER PUMP DISCHARGE ISOLATION VALVE	-	YES	THIS VALVE PROVIDES AUTOMATIC STRAINER BACKWASH FOR THE SERVICE SYSTEM. THERE IS SUFFICIENT PUMPING CAPACITY SUCH THAT THESE VALVES ARE NOT NEEDED TO RESPOND IN AN ACCIDENT SITUATION. SYSTEM PROCEDURES AND ALARMS ALERT OPERATORS TO ANY CLOGGING CONCERNS.
2SWP*MOV21A	SPENT FUEL EMERGENCY SERVICE WATER VALVE	-	YES	THIS VALVE SUPPLIES A REDUNDANT SOURCE OF COOLING TO THE SPENT FUEL POOL COOLING SYSTEM, WHICH IS NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN.
2SWP*MOV21B	SPENT FUEL EMERGENCY SERVICE WATER VALVE	-	YES	THIS VALVE SUPPLIES A REDUNDANT SOURCE OF COOLING TO THE SPENT FUEL POOL COOLING SYSTEM, WHICH IS NOT IN THE SCOPE OF THE IPE, AND NO CREDIT IS TAKEN.
2SWP*MOV67A	SWP TO CLR 2HVK*CHL1A-MOTOR OPERATED VALVE	-	YES	THIS VALVE IS IN THE CONTROL BUILDING CHILLED WATER SYSTEM. THE REDUNDANCY IN SYSTEM TRAINS MAKES THE FAILURE OF ANY SINGLE VALVE INSIGNIFICANT TO RISK.
2SWP*MOV67B	MOTOR OPER VALVE , SWP TO CLR 2HVK*CHL1B	-	YES	THIS VALVE IS IN THE CONTROL BUILDING CHILLED WATER SYSTEM. THE REDUNDANCY IN SYSTEM TRAINS MAKES THE FAILURE OF ANY SINGLE VALVE INSIGNIFICANT TO RISK.
2SWP*MOV95A	SWP TO CLR 2EGS*EG2- MOTOR OPERATED VALVE	YES	YES	FAILURE OF THE DIVISION III HPCS DIESEL TO POWER ITS EMERGENCY BUS IS NOT IMPORTANT TO RISK, SINCE THIS CAPABILITY IS NOT CREDITED IN THE STATION BLACKOUT EVENT MODEL
2SWP*MOV95B	MOTOR OPER VALVE SWP TO CLR 2EGS*EG2	YES	YES	FAILURE OF THE DIVISION III HPCS DIESEL TO POWER ITS EMERGENCY BUS IS NOT IMPORTANT TO RISK, SINCE THIS CAPABILITY IS NOT CREDITED IN THE STATION BLACKOUT EVENT MODEL.
2WCS*MOV200	RWCU RETURN ISOL , MOTOR OPERATED GLOBE VALVE	-	YES	OTHER THAN FOR CONTAINMENT ISOLATION, WHICH IS MODELED, (THIS VALVE IS NOT APPLICABLE) THE REACTOR WATER CLEANUP SYSTEM HAS NO FUNCTION IN THE PREVENTION OR MITIGATION OF A SEVERE ACCIDENT. THIS VALVE IS NOT IMPORTANT TO CONTAINMENT ISOLATION BECAUSE OF REDUNDANT CHECK VALVE AND HIGH PRESSURE DESIGN. THEREFORE THIS VALVE IS NOT MODELED IN THE IPE.

NEDC-32264-A
REVISION 2

SEPTEMBER 1996

APPENDIX D

DATA TABLES FOR BWR D

Table D1 MOVs NOT MODELED IN THE PSA FOR BWR D

Valve Number	Valve Signal	Function	Valve Position		Comments
			Normal	Accident	
MO-2010	NONE	RHR TORUS SPRAY (TRAIN A)	CLOSED	OPEN	NOT CREDITED IN IPE DUE TO SIMILARITY IN FUNCTION WITH DW SPRAY AND TORUS COOLING. SPRAY IS INITIATED TO COOL NON-CONDENSIBLE GASES IN TORUS AIR-SPACE.
MO-2011	NONE	RHR TORUS SPRAY (TRAIN A)	CLOSED	OPEN	NOT CREDITED IN IPE DUE TO SIMILARITY IN FUNCTION WITH DW SPRAY AND TORUS COOLING. SPRAY IS INITIATED TO COOL NON-CONDENSIBLE GASES IN TORUS AIR-SPACE.
MO-2026	TO CLOSE (ISOLATION)	RHR HEAD SPRAY	CLOSED	CLOSED	DELETED FROM SCOPE OF MMOVP. NOT CREDITED IN IPE DUE TO LINE HAVING NO ACTIVE SAFETY FUNCTION.
MO-2027	TO CLOSE (ISOLATION)	RHR HEAD SPRAY	CLOSED	CLOSED	DELETED FROM SCOPE OF MMOVP. NOT CREDITED IN IPE DUE TO LINE HAVING NO ACTIVE SAFETY FUNCTION.
MO-2032	TO CLOSE	RHR TO RADWASTE SURGE TANK	CLOSED	CLOSED	VALVE RECEIVES ISOLATION SIGNAL. NOT CREDITED IN IPE DUE TO LINE PERFORMING NO ACCIDENT RESPONSE FUNCTION.
MO-2407	NONE	RHR TO RADWASTE SURGE TANK	CLOSED	CLOSED	NOT CREDITED IN IPE DUE TO LINE PERFORMING NO ACCIDENT RESPONSE FUNCTION.
MO-2-43A	NONE	RECIRC. PUMP SUCTION	OPEN	OPEN	NOT CREDITED IN IPE DUE TO VALVE NOT HAVING AN ACTIVE SAFETY FUNCTION.
MO-2-43B	NONE	RECIRC. PUMP SUCTION	OPEN	OPEN	NOT CREDITED IN IPE DUE TO VALVE NOT HAVING AN ACTIVE SAFETY FUNCTION.
MO-2071	TO CLOSE	HPCI TEST RETURN TO CST	CLOSED	CLOSED	NOT CREDITED IN IPE DUE TO LINE PERFORMING NO ACTIVE SAFETY FUNCTION.
MO-2110	TO CLOSE	RCIC TEST RETURN TO CST	OPEN	CLOSED	NOT CREDITED IN IPE DUE TO VALVE NOT PERFORMING AN SAFETY FUNCTION AND ITS SIMILARITY WITH MO-3502 (VALVES ARE IN SERIES).

Table D1 MOVs NOT MODELED IN THE PSA FOR BWR D (Continued)

Valve Number	Valve Signal	Function	Valve Position		Comments
			Normal	Accident	
MO-2373	TO CLOSE	MS CONDENSATE DRAIN LINE ISOLATION VALVE (INBOARD)	CLOSED	CLOSED	NOT CREDITED IN IPE DUE TO VALVES PERFORMING NO ACTIVE SAFETY FUNCTION.
MO-2374	TO CLOSE	MS CONDENSATE DRAIN LINE ISOLATION VALVE (OUTBOARD)	CLOSED	CLOSED	NOT CREDITED IN IPE DUE TO VALVES PERFORMING NO ACTIVE SAFETY FUNCTION.
MO-4043A		COCS INLET			NOT CREDITED IN THE IPE DUE TO SYSTEM'S LIMITED CAPACITY TO REMOVE COMBUSTIBLE GASES.
MO-4043B		COCS INLET			NOT CREDITED IN THE IPE DUE TO SYSTEM'S LIMITED CAPACITY TO REMOVE COMBUSTIBLE GASES.
MO-4044A		COCS RECIRC.			NOT CREDITED IN THE IPE DUE TO SYSTEM'S LIMITED CAPACITY TO REMOVE COMBUSTIBLE GASES.
MO-4044B		COCS RECIRC.			NOT CREDITED IN THE IPE DUE TO SYSTEM'S LIMITED CAPACITY TO REMOVE COMBUSTIBLE GASES.
MO-4047A		COCS COOLING WATER SUPPLY			NOT CREDITED IN THE IPE DUE TO SYSTEM'S LIMITED CAPACITY TO REMOVE COMBUSTIBLE GASES.
MO-4047B		COCS COOLING WATER SUPPLY			NOT CREDITED IN THE IPE DUE TO SYSTEM'S LIMITED CAPACITY TO REMOVE COMBUSTIBLE GASES.

TABLE D2 MOV SUMMARY - BWR D

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE	PRA CONT.	DETERM. REVIEW	COMMENTS
HPCI --								
MO-2034 MO-2035	Steam supply to turbine Steam Line Isolation	NO NO-C	Y Y	X			X	Prevention of part 100 release.
MO-2036	Steam supply to turbine	NC-O	Y	X	X	X	X	
MO-2061 MO-2062	Torus suction isolation Torus suction	NC NC-O	Y Y	X			X	CSTs are not Seismic I; required for switchover to Torus on depleted or ruptured CST.
MO-2063	CST suction CST suction isolation	NO NO-C	Y Y	X				Valve does not need to close to maintain pump NPSH.
MO-2067 MO-2068	Pump discharge to vessel	NC-O	Y	X	X	X	X	
MO-2071	Test line to CST	NC	Y					
RCIC -- (System considered safety-related by plant)								
MO-2075 MO-2076	Steam supply to turbine Steam line isolation	NO NO-C	Y	X			X	Prevention of part 100 release.
MO-2078	Steam supply to turbine	NC-O	Y	X	X	X	X	
MO-2080	Trip throttle valve	NO						
MO-2096	Cool H_2O to barometric cond.	NC-O	Y	X	X	X	X	
MO-2100 MO-2101	Torus suction isolation Torus suction	NC NC-O	Y	X			X	CSTs are not Seismic I; required for switchover to Torus on depleted or ruptured CST.
MO-2102	CST suction CST suction isolation	NO NO-C	Y	X				Valve does not need to close to maintain NPSH; not required for LOCA.

TABLE D2 MOV SUMMARY - BWR D *(CONTINUED)*

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE	PRA CONT.	DETERM. REVIEW	COMMENTS
MO-2106 MO-2107	Pump discharge to vessel	NC-O	Y	X	X	X	X	
MO-2110	Test line to CST	NO	Y					
MO-3502	Test line to CST	NC	Y					
FW/Cond --								
MO-1088 MO-1089 MO-1133 MO-1134 MO-1614 MO-1615	Feedwater heater isolation	NO						
Core Spray --								
MO-1741 MO-1742	Torus Spray	NO	Y					See Note (1).
MO-1749 MO-1750	Test line to torus	NC	Y					
MO-1751 MO-1752	Pump discharge to vessel	NO	Y	X -				Valves normally in safety position.
MO-1753 MO-1754	Pump discharge to vessel Pump discharge isolation	NC-O O-C	Y	X	X	X	X	
RHR (LPCI) --								
MO-1986 MO-1987	Torus suction Torus suction isolation (SDC)	NO NO-C	Y	X				Valves may be useful in isolation of a pump for a seal failure, but not a safety related function.
MO-2012	Pump discharge to vessel	NC-O	Y	X				PRA assumes valves normally open whereas it is currently closed. Non-selected loop - requested only for LOCA in opposite loop.

TABLE D2 MOV SUMMARY - BWR D *(CONTINUED)*

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE	PRA CONT.	DETERM. REVIEW	COMMENTS
MO 2013	Pump discharge to vessel	NC-O	Y	X	X	X	X	Selected loop.
MO-2014	Pump discharge to vessel Pump discharge isolation	NC-O O-C	Y	X				PRA assumes valves normally open whereas it is currently closed. Non-selected loop - requested only for LOCA in opposite loop.
MO-2015	Pump discharge to vessel Pump discharge isolation	NC-O O-C	Y	X	X	X	X	Selected loop.

TABLE D2 MOV SUMMARY - BWR D *(CONTINUED)*

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE	PRA CONT.	DETERM. REVIEW	COMMENTS
RHR (SDC) --								
MO-1988 MO-1989	SDC Suction	NC-O	Y	X				SDC function is backed by other modes of RHR.
MO-2029 MO-2030	SDC Suction SDC suction isolation	NC-O O-C	Y Y	X			X	RHR overpressure protection during shutdown.
RHR (SPC) --								
MO-2006 MO-2007 MO-2008 MO-2009	Pump discharge to torus	NC-O	Y	X			X	Principal means of decay heat removal for accidents and transients even though containment can survive days with no decay heat removal before failure.
RHR (Torus Spray) --								
MO-2010 MO-2011	Pump discharge to torus	NC-O	Y	X				Other means of DHR (SPC, MC, Vent).
RHR (DW Spray) --								
MO-2020 MO-2021 MO-2022 MO-2023	Pump discharge to drywell	NC-O	Y	X				Other means of DHR (SPC, MC, Vent). No credit in limiting containment pressure during DBA. No credit in compliance with 10CFR100.
RHR (Misc.) --								
MO-2002 MO-2003	RHR hx bypass	NO-C	Y	X				Failure of valve to close on demand does not disable DHR function.

TABLE D2 MOV SUMMARY - BWR D (CONTINUED)

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE	PRA CONT.	DETERM. REVIEW	COMMENTS
MO-2026 MO-2027	Head spray	NC	Y					
MO-2033	RHR loop crosstie	NO	Y					
MO-2032 MO-2407	Discharge to radwaste	NC	Y	X				Valves normally in their safety-position.
MO-4085A MO-4085B	Recirc loop intertie	NC	Y					
MO-4086	Recirc loop intertie	NO	Y					
Reactor Recirc. --								
MO-2-43A MO-2-43B	Recirc pump suction isolation	NO	Y					
MO-2-53A MO-2-53B	Recirc pump disch isolation	NO-C	Y	X				LPCI adequate without valve closure for all transients and LOCAs except recirc LOCA. Even large recirc. LOCA requires failure of both core spray trains.
Reactor Cleanup --								
MO-2397 MO-2398	Reactor cleanup isolation	NO-C	Y	X			X	Prevention of part 100 release.
Main Steam --								
MO-2373 MO-2374	MSL drain isolation	NC	Y	X				Valves normally in their safety position.

TABLE D2 MOV SUMMARY - BWR D (CONTINUED)

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE.	PRA CONT.	DETERM. REVIEW	COMMENTS
RBCCW --								
MO-1426 MO-4230	DW cooler return isolation	NO-C	Y	X			X	DW coolers are closed loops inside containment but are not structurally Seismic I or HELB protected.
MO-4229	DW cooler supply isolation	NO-C	Y	X			X	DW coolers are closed loops inside containment but are not structurally Seismic I or HELB protected. In series with check valve.
MO-1427 MO-1428 MO-1429 MO-1430	DW cooler supply isolation	NO						
CGCS --								
MO-4043A MO-4043B	Gas inlet to recombiner	NC-O	Y	X				More than 3 days is required to reach the point that combustible gas concentration exists. If the decay heat removal system is working then Torus is subcooled and O_2 generation is minimized. If O_2 were generated, venting or purging is available as an option.
MO-4044A MO-4044B	Gas recirculation	NO-T	Y	X				
MO-4047A MO-4047B	Cooling supply to recombiner	NC-O	Y	X				
TG/Sealing Steam --								
MO-1045	Steam seal reg. steam supply	NO						
MO-1048 MO-1049	Steam packing exhaust blower	NO						
Main Condenser --								
MO-1087A MO-1087B	Condenser vacuum breaker	NC						

TABLE D2 MOV SUMMARY - BWR D (CONTINUED)

SYSTEM/ VALVE	FUNCTION	POSITION	SR	MOV INDEX	PRA CORE	PRA CONT.	DETERM. REVIEW	COMMENTS
Circ Water --								
MO-1154 MO-1155 MO-1155 MO-1157	Condenser inlet/outlet	NO						
MO-1850 MO-1851	Circ water pump outlet	NO						Not credited in Fire Hazards or SBO or ATWS mitigation.

KEY

SYS/VALVE	System ID and MOV tag number
FUNCTION	Function the valve serves from a safety perspective. Note an MOV may perform more than one safety function.
POSITION	NO - Normally open and does not have to change position. NO - Normally closed and does not have to change position. NO-O - Normally open and must close to perform function. NO-T - Normally open and throttled to perform function. NO-O- Normally closed and must open to perform function. O-C- Temporarily in open position and must close to perform function.
SR	MOV is safety-related.
MOV INDEX	MOV is within scope of GL 89 10
PRA CORE	MOV is important to safety in the PRA for core damage purposes.
PRA CONT.	MOV is important to safety in the PRA for containment failure purposes.
DETERM. REVIEW	MOV is important from either a PRA or a Design/Licensing Basis perspective.
COMMENTS	Comment provided if deterministic review column differs from eitherthe MOV Index or PRA columns.

7272-003.pre/F94A

Table D3

MOVs WITH A COMMON CAUSE FAILURE BASIC EVENT - BWR D

RCS Inventory	LOCAs				Transients			LOOP
	Large	Med	Small	Out Ct.	SORV	125 VDC	Others	
MO 1753 & 1754 SI INBOARD INJECTION - FTO	X	X	X	X	X	X	X	X
MO-2036 HPCI STM ADM - FTO		X	X				X	X
MO-2061 & 2062 HPCI TORUS SUCTION - FTO		X	X				X	X
MO-2067 HPCI INJ./TEST - FTO		X	X				X	X
MO-2068 HPCI INJ. - FTO		X	X				X	X
MO-2078 RCIC STM ADM - FTO			X				X	X
MO-2096 RCIC ACC. COOLING - FTO			X				X	X
MO-2102 RCIC CST SUCTION - FTO			X				X	X
MO-2106 & 2107 RCIC INJECTION - FTO			X				X	X
MO-2014 & 2015 RHR INBOARD INJ. - FTO	X	X	X	X	X	X	X	X

Table D3 MOVs WITH A COMMON CAUSE FAILURE BASIC EVENT (Continued)

RCS Inventory	LOCAs				Transients			LOOP
	Large	Med	Small	Out Ct.	SORV	125 VDC	Others	
MO-2-53A & 53B RECIRC. PUMP DISCH. - FTO	X	X	X	X	X	X	X	X
Reactivity Control	**LOCAs**	**Transients**						**LOOP**
		Turbine Trip	Main Cond.	MSIV Closure	SORV	LOFW	Others	
RWCU ISOLATION - FTC		X	X	X	X	X		X
Containment Heat Removal	**LOCAs**				**Transients**			**LOOP**
	Large	Med	Small	Out Ct.	SORV	125 VDC	Others	
MO-1988 & 1989 RHR SDC SUCTION - FTO	X	X	X	X	X	X	X	X
MO-2006 & 2007 RHR TO TORUS - FTO	X	X	X	X	X	X	X	X
MO-2008 & 2009 RHR/TORUS COOLING - FTO	X	X	X	X	X	X	X	X
MO-2020 & 2021 RHR/OUTBD. DW SPRAY - FTO	X	X	X	X	X	X	X	X
MO-2022 & 2023 RHR/INBD. DW SPRAY - FTO	X	X	X	X	X	X	X	X
MO-2029 & 2030 RHR SDC VALVES - FTO	X	X	X	X	X	X	X	X

TABLE D4 MOV COMPONENT IMPORTANCE RANKING FOR CORE DAMAGE -BWR D
(2.6E-5/yr)

BASIC EVENT	FUSSELL-VESELY	RRW	BIRNBAUM	RAW
C-MO1754	1.82E-02	1.02E+00	5.87E-03	2.32E+02
R-MO2015	7.19E-03	1.01E+00	5.73E-03	2.27E+02
C-MO1753	6.81E-03	1.01E+00	5.75E-03	2.28E+02
H-MO2062	5.35E-03	1.01E+00	5.41E-05	3.13E+00
H-MO2061	5.35E-03	1.01E+00	5.41E-05	3.13E+00
H-MO2036	5.29E-03	1.01E+00	5.35E-05	3.10E+00
H-MO2068	5.29E-03	1.01E+00	5.35E-05	3.10E+00
H-MO2067	5.29E-03	1.01E+00	5.35E-05	3.10E+00
I-MO2078	5.22E-03	1.01E+00	4.53E-05	2.78E+00
I-MO2096	5.22E-03	1.01E+00	4.53E-05	2.78E+00
I-MO2107	5.22E-03	1.01E+00	4.53E-05	2.78E+00
I-MO2106	5.22E-03	1.01E+00	4.53E-05	2.78E+00
I-MO2101	5.19E-03	1.01E+00	4.51E-05	2.77E+00
I-MO2100	5.19E-03	1.01E+00	4.51E-05	2.77E+00
L-MO2398	6.72E-06	1.00E+00	5.85E-08	1.00E+00
L-MO2397	5.55E-06	1.00E+00	4.82E-08	1.00E+00
H-MO2034 (ISO)	3.38E-06	1.00E+00	1.25E-07	1.00E+00
I-MO2075(ISO)	3.38E-06	1.00E+00	1.25E-07	1.00E+00
C-MO1742	2.75E-06	1.00E+00	1.45E-05	1.57E+00
C-MO1752	2.75E-06	1.00E+00	1.45E-05	1.57E+00
H-MO2063	1.44E-06	1.00E+00	7.60E-06	1.30E+00
H-MO2035	1.44E-06	1.00E+00	7.60E-06	1.30E+00
H-MO2034	1.44E-06	1.00E+00	7.60E-06	1.30E+00
H-MO2035(ISO)	1.23E-06	1.00E+00	1.06E-07	1.00E+00
I-MO2076(ISO)	1.23E-06	1.00E+00	1.06E-07	1.00E+00
C-MO1750	4.20E-07	1.00E+00	4.44E-06	1.18E+00
R-MO2015 (ISO)	1.60E-08	1.00E+00	1.39E-10	1.00E+00
R-MO2014 (ISO)	1.55E-08	1.00E+00	1.34E-10	1.00E+00
L-MO2397 (ISO)	4.58E-09	1.00E+00	4.63E-11	1.00E+00
C-MO1753 (ISO)	4.99E-10	1.00E+00	4.32E-12	1.00E+00
C-MO1754 (ISO)	4.98E-10	1.00E+00	4.32E-12	1.00E+00
H-MO2036(ISO)	2.51E-10	1.00E+00	4.33E-11	1.00E+00
L-MO2098 (ISO)	8.53E-11	1.00E+00	7.38E-12	1.00E+00

NOTES: (1)Above ranking sorted by Fussell-Vesely..

Table D5

GL 89-10 SENSITIVITY STUDY FOR BWR D

Accident Class	Baseline Case CDF (1)	Modified Case			Optimized Case	
		CDF (2)	Delta (4)	%Dif (5)	CDF (3)	Delta (4)
IA TRAN - HIGH RPV PRESS	3.1E-06	2.3E-05	2.0E-05	0.27	3.1E-06	1.0E-08
IB STATION BLACKOUT	1.2E-05	2.3E-05	1.1E-05	0.15	1.2E-05	0.0
ID TRAN - LOW RPV PRESS	3.2E-07	6.8E-03	6.8E-03	90.89	3.2E-07	0.0
II LOSS OF CONT HEAT REMOVAL	1.3E-07	1.4E-04	1.3E-04	1.81	2.7E-07	1.3E-07
IIIA LOCA - RPV RUPTURE	1.1E-07	9.8E-05	9.8E-05	1.32	1.1E-07	0.0
IIIB LOCA - HIGH RPV PRESS	3.0E-07	3.6E-06	3.3E-06	0.04	3.0E-07	0.0
IIIC LOCA - LOW RPV PRESS	3.9E-07	3.2E-04	3.2E-04	4.32	3.9E-07	0.0
IIID LOCA - VAP SUP FAILURE	3.0E-07	3.0E-07	0.0	0.00	2.9E-07	1.0E-09

Table D5 GL 89-10 SENSITIVITY STUDY FOR BWR D (Continued)

Accident Class	Baseline Case CDF (1)	Modified Case			Optimized Case	
		CDF (2)	Delta (4)	%Dif (5)	CDF (3)	Delta (4)
IV ATWS	1.9E-06	3.4E-06	1.5E-06	0.02	3.4E-06	1.5E-06
V LOCA OUTSIDE CONT	6.7E-10	1.4E-09	7.2E-10	0.00	6.7E-10	0.0
S-TOTAL	1.8E-05	7.4E-03	7.4E-03	98.78	2.0E-05	1.6E-06
VI INTERNAL FLOOD	7.9E-06	7.3E-05	6.5E-05	0.87	7.9E-06	0.0
TOTAL	2.6E-05	7.4E-03	7.4E-03		2.8E-05	1.6E-06

Notes

1. From BWR D IPE
2. Common Cause Factor of .087 applied to every MOV which operates under high dp conditions, where high dp conditions are MOV opening or closing against reactor pressure, containment pressure or pump dicharge pressure.
3. Common Cause Factor of .087 applied only to those MOVs below a specified importance.
4. "Delta" column is a comparison against the Baseline CDF.
5. % of total change in CDF.

Table D6
MOV SUMMARY - BWR D

- Important Valves Based on PSA Backed Up by Deterministic Rationale

HPCI & RCIC Pump Discharge MO-2067, MOV-2068, MO-2106, MO-2107
HPCI & RCIC Steam Supply to Turbine MO-2036, MO-2078
RCIC Cooling Water to Barometric Condenser MO-2096
Core Spray Discharge to Vessel MO-1753, MO-1754
RHR Pump Discharge to Vessel MO-2015

- Important Valves Based on Deterministic Rationale

HPCI & RCIC Steam Line Isolation MO-2034, MO-2035, MO-2075, MO-2076
HPCI & RCIC Torus Suction MO-2061, MO-2062, MO-2100, MO-2101
RHR Pump Discharge to Vessel MO-2012, MO-2013
RHR Suppression Pool Cooling MO-2006, MO-2007, MO-2008, MO-2009
RHR SD Cooling Suction MO-2029, MO-2030
Reactor Water Cleanup Isolation MO-2397, MO- 2398
RBCCW DW Cooler Return Isolation MO-1426, MO-4230
RBCCW DW Cooler Supply Isolation MO-4229

- Unimportant Safety Related Valves (<.1% F-V or Not Modeled)

HPCI & RCIC CST Suction MO-2063, MO-2102
Core Spray Pump Discharge to Vessel MO-1751, MO-1752
RHR Torus Suction MO-1986, MO-1987
RHR Pump Discharge to Vessel MO-2014
RHR SDC Suction MO-1988, MO-1989
RHR Torus Sprays MO-2010, MO-2011
RHR DW Spray MO-2020, MO-2021, MO-2022, MO-2023
RHR Discharge Radwaste MO-2032, MO-2407
RHR Hx Bypass MO-2002, MO-2003
Recirc Discharge Isolation MO-2-53 A & B
Main Steam Line Drain Isolation MO-2373, MO-2374
CGCS Gas Inlet to Recombiner MO-4043 A & B
CGCS Gas Recirculation MO-4044 A & B
CGCS Cooling Supply to Recombiner MO-4047 A & B

NEDC-32264-A
REVISION 2

SEPTEMBER 1996

APPENDIX E

DATA TABLES FOR BWR E

TABLE E1 - GL 89-10 MOV CATEGORIES AND IMPORTANCE

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1B21*MOVF001	Reactor Downstream Head Vent to Drywell Equip Drain Sump							<1.0E-07
1B21*MOVF002	Reactor Upstream Head Vent to Drywell Equip Drain Sump							<1.0E-07
1B21*MOVF005	Reactor Head Vent to Main Steam Line A							<1.0E-07
1B21*MOVF016	Main Steam Line Warmup Header Inboard Containment Isol Valve		X	X			LOW	2.50e-04
1B21*MOVF019	Main Steam Line Warmup Header Outboard Containment Isol Valve		X	X			LOW	2.50e-04
1B21*MOVF027A	Main Steam Isolation Valve Leakoff Drain Connection							<1.0E-07
1B21*MOVF027B	Main Steam Isolation Valve Leakoff Drain Connection							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1B21*MOVF027C	Main Steam Isolation Valve Leakoff Drain Connection							<1.0E-07
1B21*MOVF027D	Main Steam Isolation Valve Leakoff Drain Connection							<1.0E-07
1B21*MOVF065A	Feedwater to Reactor Outboard Isolation Valve			X				<1.0E-07
1B21*MOVF065B	Feedwater to Reactor Outboard Isolation Valve			X				<1.0E-07
1B21*MOVF067A	Main Steam Line A Drain Outboard Isolation Valve			X	X			<1.0E-07
1B21*MOVF067B	Main Steam Line B Drain Outboard Isolation Valve			X	X			<1.0E-07
1B21*MOVF067C	Main Steam Line C Drain Outboard Isolation Valve			X	X			<1.0E-07
1B21*MOVF067D	Main Steam Line D Drain Outboard Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1B21*MOVF085	Main Steam Line Warmup Header Shutoff Valve							<1.0E-07
1B21*MOVF086	Main Steam Line Drain Header Shutoff Valve							<1.0E-07
1B21*MOVF098A	Main Steam Line A Shutoff Valve							<1.0E-07
1B21*MOVF098B	Main Steam Line B Shutoff Valve							<1.0E-07
1B21*MOVF098C	Main Steam Line C Shutoff Valve							<1.0E-07
1B21*MOVF098D	Main Steam Line D Shutoff Valve							<1.0E-07
1B33*MOVF023A	Recirculation Pump A Discharge Valve							<1.0E-07
1B33*MOVF023B	Recirculation Pump B Discharge Valve							<1.0E-07
1B33*MOVF067A	Recirculation Pump A Supply Valve							<1.0E-07
1B33*MOVF067B	Recirculation Pump B Supply Valve							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1CCP*MOV16A	RPCCW Loop A Normal Supply Valve	X						<1.0E-05
1CCP*MOV16B	RPCCW Loop B Normal Supply Valve	X						<1.0E-05
1CCP*MOV129	RPCCW Loop A Normal Return Valve	X						<1.0E-05
1CCP*MOV130	RPCCW Loop B Normal Return Valve	X						<1.0E-05
1CCP*MOV138	RPCCW Containment Supply Outboard Isolation Valve			X	X			<1.0E-07
1CCP*MOV142	Reactor Recirculation Pump Cooling Supply							<1.0E-07
1CCP*MOV143	Reactor Recirculation Pump Downstream Return							<1.0E-07
1CCP*MOV144	Reactor Recirculation Pump Upstream Return							<1.0E-07
1CCP*MOV158	RPCCW Containment Supply Inboard Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1CCP*MOV159	RPCCW Containment Return Outboard Isolation Valve			X	X			<1.0E-07
1CCP*MOV163	RPCCW to CRD Pump Seals	X						<1.0E-05
1CCP*MOV169	RPCCW to CRD Pump Seals	X						<1.0E-05
1CCP*MOV335	RPCCW Loop A Normal Return Valve	X						<1.0E-05
1CCP*MOV336	RPCCW Loop B Normal Return Valve	X						<1.0E-05
1CNS*MOV125	Condensate Makeup Containment Isolation Valve			X	X			<1.0E-07
1CNS*MOV130	Condensate Makeup Containment Isolation Valve			X				<1.0E-07
1CPM*MOV1A	Hydrogen Mixing Outlet - Outboard Drywell Isolation Valve			X				<1.0E-07
1CPM*MOV1B	Hydrogen Mixing Outlet - Outboard Drywell Isolation Valve			X				<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1CPM*MOV2A	Hydrogen Mixing Inlet - Outboard Drywell Isolation Valve			X				<1.0E-07
1CPM*MOV2B	Hydrogen Mixing Inlet - Outboard Drywell Isolation Valve			X				<1.0E-07
1CPM*MOV3A	Hydrogen Mixing Outlet - Inboard Drywell Isolation Valve			X				<1.0E-07
1CPM*MOV3B	Hydrogen Mixing Outlet - Inboard Drywell Isolation Valve			X				<1.0E-07
1CPM*MOV4A	Hydrogen Mixing Inlet - Inboard Drywell Isolation Valve			X				<1.0E-07
1CPM*MOV4B	Hydrogen Mixing Inlet - Inboard Drywell Isolation Valve			X				<1.0E-07
1CPP*MOV104	Hydrogen Purge Discharge Containment Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1CPP*MOV105	Hydrogen Purge Discharge Containment Isolation Valve			X	X			<1.0E-07
1C11*MOVF083	CRD Containment Isolation MOV	X		X	X			<1.0E-05
1C41*MOVF001A	SLCS Pump 1A Discharge MOV	X						<1.0E-05
1C41*MOVF001B	SLCS Pump 1B Discharge MOV	X						<1.0E-05
1DFR*MOV146	Suppression Pool Pumpback Return - Cont. Isolation Valve			X	X			<1.0E-07
1E12*MOVF003A	RHS Train A Hx Discharge MOV (N.O.)	X						<1.0E-05
1E12*MOVF003B	RHS Train B Hx Discharge MOV (N.O.)	X						<1.0E-05
1E12*MOVF004A	RHS Pump A Suppression Pool Suction MOV (N.O.)	X			X			<1.0E-05

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E12*MOVF004B	RHS Pump B Suppression Pool Suction MOV (N.O.)	X			X			<1.0E-05
1E12*MOVF006A	RHS Pump A SDC Suction MOV	X						<1.0E-05
1E12*MOVF006B	RHS Pump B SDC Suction MOV	X						<1.0E-05
1E12*MOVF008	RHS Pumps A and B SDC Suction MOV	X			X			<1.0E-05
1E12*MOVF009	RHS Pumps A and B SDC Suction MOV	X			X			<1.0E-05
1E12*MOVF011A	Heat Exchangers A & C Discharge to Suppression Pool				X			<1.0E-07
1E12*MOVF011B	Heat Exchangers B & D Discharge to Suppression Pool				X			<1.0E-07
1E12*MOVF021	RHR "C" Test Return Containment Isolation Valve			X	X			<1.0E-07
1E12*MOVF023	Head Spray Isolation - Containment Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E12*MOVF024A	Train A SPC Injection Valve Back to Suppression Pool (N.O.)	X	X		X		HIGH	2.50e-03
1E12*MOVF024B	Train B SPC Injection Valve Back to Suppression Pool (N.O.)	X	X		X		HIGH	2.50e-03
1E12*MOVF026A	RHR Discharge to RCIC							0
1E12*MOVF026B	RHR Discharge to RCIC							0
1E12*MOVF027A	LPCI Train A Injection MOV (N.O.)	X			X			<1.0E-05
1E12*MOVF027B	LPCI Train B Injection MOV (N.O.)	X			X			<1.0E-05
1E12*MOVF037A	Return to Upper Pool - Containment Isolation Valve			X	X			<1.0E-07
1E12*MOVF037B	Return to Upper Pool - Containment Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E12*MOVF040	Discharge to Radwaste							<1.0E-07
1E12*MOVF042A	LPCI Train A Injection MOV	X			X	5.50e-04		4.12e-04
1E12*MOVF042B	LPCI Train B Injection MOV	X			X	5.50e-04		4.12e-04
1E12*MOVF042C	LPCI Train C Injection MOV	X			X	5.50e-04		4.12e-04
1E12*MOVF047A	RHS Train A Hx Inlet Valve (N.O.)	X						<1.0E-05
1E12*MOVF047B	RHS Train B Hx Inlet Valve (N.O.)	X						<1.0E-05
1E12*MOVF048A	RHS A Heat Exchanger Bypass MOV (N.O.)	X	X				HIGH	2.50e-03
1E12*MOVF048B	RHS B Heat Exchanger Bypass MOV (N.O.)	X	X				HIGH	2.50e-03
1E12*MOVF049	RHR Discharge to Radwaste							<1.0E-07
1E12*MOVF052A	Heat Exchanger Steam Supply - Locked Closed							0

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E12*MOVF052B	Heat Exchanger Steam Supply - Locked Closed							0
1E12*MOVF053A	SDC Train A MOV to Mixing Tee	X			X			<1.0E-05
1E12*MOVF053B	SDC Train B MOV to Mixing Tee	X			X			<1.0E-05
1E12*MOVF064A	RHS Pump A Minimum Flow Recirculation MOV	X			X			<1.0E-05
1E12*MOVF064B	RHS Pump B Minimum Flow Recirculation MOV	X			X			<1.0E-05
1E12*MOVF064C	RHS Pump C Minimum Flow Recirculation MOV (N.O.)	X			X			<1.0E-05
1E12*MOVF068A	SWP Train A from RHR Heat Exchangers A & C	X	X				HIGH	2.50e-03
1E12*MOVF068B	SWP Train B from RHR Heat Exchangers B & D	X	X				HIGH	2.50e-03

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E12*MOVF073A	Heaat Exchanger Vent - Containment Isolation Valve			X	X			<1.0E-07
1E12*MOVF073B	Heaat Exchanger Vent - Containment Isolation Valve			X	X			<1.0E-07
1E12*MOVF074A	Heat Exchanger Vent to Suppression Pool							<1.0E-07
1E12*MOVF074B	Heat Exchanger Vent to Suppression Pool							<1.0E-07
1E12*MOVF087A	Heat Exchanger Pressure Regulating Bypass Valve							0
1E12*MOVF087B	Heat Exchanger Pressure Regulating Bypass Valve							0
1E12*MOVF094	SWP Injection Line MOV	X						<1.0E-05
1E12*MOVF096	SWP Injection Line MOV	X						<1.0E-05
1E12*MOVF105	LPCI Pump C Suppression Pool Suction Valve (N.O.)	X			X			<1.0E-05

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E21*MOVF001	LPCS Suction MOV from Suppression Pool (N.O.)	X			X			<1.0E-05
1E21*MOVF005	LPCS Injection Line MOV	X			X	4.40e-04		3.30e-04
1E21*MOVF011	LPCS Min Flow Recirculation. MOV (N.O.)	X			X	4.40e-04		3.30e-04
1E21*MOVF012	LPCS Test Return - Containment Isolation Valve			X	X			<1.0E-07
1E22*MOVF001	HPCS Suction from CST (N.O.)	X						<1.0E-05
1E22*MOVF004	HPCS Injection MOV	X			X	9.84e-03		7.38e-03
1E22*MOVF010	HPCS Test Return to CST							<1.0E-07
1E22*MOVF011	HPCS Test Return to CST							<1.0E-07
1E22*MOVF012	HPCS Minimum Flow Valve	X			X	9.84e-03		7.38e-03
1E22*MOVF015	HPCS Suction from Suppression Pool	X			X	9.66e-03		7.25e-03

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E22*MOVF023	HPCS Return to Suppression Pool - Cont. Isolation Valve			X	X			<1.0E-07
1E33*MOVF005	MSIV Sealing System Division I Injection Valve							<1.0E-07
1E33*MOVF006	MSIV Sealing System Division I Drain Valve							<1.0E-07
1E33*MOVF007	MSIV Sealing System Division I Isolation Valve							<1.0E-07
1E33*MOVF008	MSIV Sealing System Division I Containment Isolation Valve			X	X			<1.0E-07
1E33*MOVF025	MSIV Sealing System Division II Injection Valve							<1.0E-07
1E33*MOVF026	MSIV Sealing System Division II Drain Valve							<1.0E-07
1E33*MOVF027	MSIV Sealing System Division II Isolation Valve							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E33*MOVF028	MSIV Sealing System Division II Containment Isolation Valve			X				<1.0E-07
1E51*MOVC002	RCIC Turbine Trip Throttle Valve							<1.0E-07
1E51*MOVF010	RCIC CST Suction Valve (N.O.)	X						<1.0E-05
1E51*MOVF013	RCIC Reactor Injection MOV	X			X	3.97e-03		2.98e-03
1E51*MOVF019	RCIC Test Return Line MOV	X			X	3.97e-03		2.98e-03
1E51*MOVF022	RCIC CST Test Return							<1.0E-07
1E51*MOVF031	RCIC Suppression Pool Suction MOV	X			X	4.63e-03		3.47e-03
1E51*MOVF045	RCIC Turbine Steam Inlet MOV	X				4.04e-03		3.03e-03
1E51*MOVF046	RCIC Lube Oil Cooler MOV	X				3.97e-03		2.98e-03
1E51*MOVF059	RCIC CST Test Return			X				<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1E51*MOVF063	RCIC Turbine Inboard Isolation MOV (N.O.)	X		X	X			<1.0E-05
1E51*MOVF064	RCIC Turbine Outboard Isolation MOV (N.O.)	X			X			<1.0E-05
1E51*MOVF068	RCIC Turbine Exhaust Line MOV (N.O.)	X			X			<1.0E-05
1E51*MOVF076	RCIC Line Warming Containment Isolation Valve			X	X			<1.0E-07
1E51*MOVF077	RCIC Vacuum Breaker Containment Isolation Valve		X	X	X		LOW	2.50e-04
1E51*MOVF078	RCIC Vacuum Breaker Containment Isolation Valve			X	X			<1.0E-07
1FPW*MOV121	Fire Protection Header - Containment Isolation Valve			X	X			<1.0E-07
1FPW*MOV122	Fire Protection Water Leakage Control Valve							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1FWS*MOV7A	"A" Reactor Feedwater Inlet - Containment Isolation Valve			X	X			<1.0E-07
1FWS*MOV7B	"B" Reactor Feedwater Inlet - Containment Isolation Valve			X	X			<1.0E-07
1G33*MOVF001	RWCU Pump Suction Inboard Containment Isolation Valve	X	X	X			LOW	2.50e-04
1G33*MOVF004	RWCU Pump Suction Outboard Containment Isolation Valve	X	X	X			LOW	2.50e-04
1G33*MOVF028	RWCU Blowdown Inboard Containment Isolation Valve		X	X	X		LOW	2.50e-04
1G33*MOVF031	RWCU Blowdown Orifice Bypass							<1.0E-07
1G33*MOVF034	RWCU Blowdown Outboard Containment Isolation Valve		X	X	X		LOW	2.50e-04

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1G33*MOVF035	RWCU Drain to Radwaste							<1.0E-07
1G33*MOVF039	RWCU Return to Feedwater Containment Isolation Valve		X	X			LOW	2.50e-04
1G33*MOVF040	RWCU Return to Feedwater Containment Isolation Valve		X	X			LOW	2.50e-04
1G33*MOVF042	RWCU Heat Exchanger Throttle Valve							<1.0E-07
1G33*MOVF044	RWCU Filter Demineralizer Bypass							<1.0E-07
1G33*MOVF046	RWCU Drain to Main Condenser							<1.0E-07
1G33*MOVF053	RWCU Pump Discharge Containment Isolation Valve		X	X			LOW	2.50e-04

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1G33*MOVF054	RWCU Pump Discharge Containment Isolation Valve		X	X			LOW	2.50e-04
1G33*MOVF100	RWCU Suction from Reactor Recirculation							<1.0E-07
1G33*MOVF101	RWCU Bottom Head Drain							<1.0E-07
1G33*MOVF102	Recirculation Suction Valve							<1.0E-07
1G33*MOVF104	RWCU Heat Exchanger Bypass Valve							<1.0E-07
1G33*MOVF106	RWCU Suction from Reactor Recirculationulation							<1.0E-07
1G33*MOVF107	RWCU Regenerative Heat Exchanger Bypass Valve							<1.0E-07
1HVC*MOV1A	Controm Room Air Handling Unit Inlet Isolation Valve							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1HVC*MOV1B	Controm Room Air Handling Unit Inlet Isolation Valve							<1.0E-07
1HVK*MOV10A	Chilled Water Compression Tank Makeup Water Valve							<1.0E-07
1HVK*MOV10B	Chilled Water Compression Tank Makeup Water Valve							<1.0E-07
1HVK*MOV11A	Chilled Water Comp. Tank Alternate Makeup Water Valve							<1.0E-07
1HVK*MOV11B	Chilled Water Comp. Tank Alternate Makeup Water Valve							<1.0E-07
1HVK*MOV20A	Control Building Chilled Water Pump P1A Discharge Valve (N.O.)	X						<1.0E-05
1HVK*MOV20B	Control Building Chilled Water Pump P1B Discharge Valve (N.O.)	X						<1.0E-05

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1HVK*MOV20C	Control Building Chilled Water Pump P1C Discharge Valve	X						<1.0E-05
1HVK*MOV20D	Control Building Chilled Water Pump P1D Discharge Valve	X						<1.0E-05
1HVN*MOV22A	Containment Unit Cooler Discharge Valve							<1.0E-07
1HVN*MOV22B	Containment Unit Cooler Discharge Valve							<1.0E-07
1HVN*MOV102	Ventilation Chilled Water Return Containment Isolation Valve			X	X			<1.0E-07
1HVN*MOV127	Ventilation Chilled Water Supply Containment Isolation Valve			X	X			<1.0E-07
1HVN*MOV128	Ventilation Chilled Water Return Containment Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1HVN*MOV129	Ventilation Chilled Water Supply Valve							<1.0E-07
1HVN*MOV130	Ventilation Chilled Water Return Valve							<1.0E-07
1IAS*MOV106	Instrument Air Containment Isolation Valve				X			<1.0E-07
1IAS*MOV107	Instrument Air Containment Isolation Valve							<1.0E-07
1LSV*MOV11A	PVLCS Isolation Valve to FPW, HVN, WCS, & CNS							<1.0E-07
1LSV*MOV11B	PVLCS Isolation Valve to FPW, HVN, WCS, & CNS							<1.0E-07
1LSV*MOV13A	PVLCS Isolation Valve to SAS & IAS							<1.0E-07
1LSV*MOV13B	PVLCS Isolation Valve to SAS & IAS							<1.0E-07
1LSV*MOV15A	PVLCS Isolation Valve to Feedwater							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1LSV*MOV15B	PVLCS Isolation Valve to Feedwater							<1.0E-07
1LSV*MOV16A	PVLCS Isolation Valve to Feedwater							<1.0E-07
1LSV*MOV16B	PVLCS Isolation Valve to Feedwater							<1.0E-07
1LSV*MOV19A	PVLCS Header "A" Injection Valve							<1.0E-07
1LSV*MOV19B	PVLCS Header "B" Injection Valve							<1.0E-07
1RCS*MOV58A	"A" HPU Drywell Isolation Valve			X				<1.0E-07
1RCS*MOV58B	"B" HPU Drywell Isolation Valve			X				<1.0E-07
1RCS*MOV59A	"A" HPU Drywell Isolation Valve			X				<1.0E-07
1RCS*MOV59B	"B" HPU Drywell Isolation Valve			X				<1.0E-07
1RCS*MOV60A	"A" HPU Drywell Isolation Valve			X				<1.0E-07
1RCS*MOV60B	"B" HPU Drywell Isolation Valve			X				<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1RCS*MOV61A	"A" HPU Drywell Isolation Valve			X				<1.0E-07
1RCS*MOV61B	"B" HPU Drywell Isolation Valve			X				<1.0E-07
1SAS*MOV102	Service Air to Containment and Drywell Isolation Valve			X	X			<1.0E-07
1SAS*MOV103	Service Air Leakage Control Valve							<1.0E-07
1SFC*MOV119	Containment Fuel Pool Inlet Containment Isolation Valve			X	X			<1.0E-07
1SFC*MOV120	Fuel Pool Cooling Suction Containment Isolation Valve			X	X			<1.0E-07
1SFC*MOV121	Fuel Pool Purification Suction Containment Isolation Valve			X				<1.0E-07
1SFC*MOV122	Fuel Pool Cooling Suction Containment Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SFC*MOV139	Fuel Pool Purification Suction Containment Isolation Valve		X	X			LOW	2.50e-04
1SVV*MOV1A	Steam Safety & Relief Valve System Containment Isolation Valve			X	X			<1.0E-07
1SVV*MOV1B	Steam Safety & Relief Valve System Containment Isolation Valve			X	X			<1.0E-07
1SWP*MOV4A	Normal Service Water "A" Supply to Drywell Isolation Valve			X				<1.0E-07
1SWP*MOV4B	Normal Service Water "B" Supply to Drywell Isolation Valve			X				<1.0E-07
1SWP*MOV5A	Normal Service Water "A" Return to Drywell Isolation Valve			X	X			<1.0E-07
1SWP*MOV5B	Normal Service Water "B" Return to Drywell Isolation Valve			X	X			<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SWP*MOV27A	Control Building Chiller "A" Recirculation Pump Suction Valve							<1.0E-07
1SWP*MOV27B	Control Building Chiller "B" Recirculation Pump Suction Valve							<1.0E-07
1SWP*MOV27C	Control Building Chiller "C" Recirculation Pump Suction Valve							<1.0E-07
1SWP*MOV27D	Control Building Chiller "D" Recirculation Pump Suction Valve							<1.0E-07
1SWP*MOV40A	SSW Pump A Discharge MOV	X				4.05e-02		3.04e-02
1SWP*MOV40B	SSW Pump B Discharge MOV	X				3.79e-02		2.84e-02
1SWP*MOV40C	SSW Pump C Discharge MOV	X				4.16e-02		3.12e-02
1SWP*MOV40D	SSW Pump D Discharge MOV	X				3.79e-02		2.84e-02

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SWP*MOV55A	SSW Train A Discharge Valve	X				5.80e-02		4.35e-02
1SWP*MOV55B	SSW Train B Discharge Valve	X				3.04e-02		2.28e-02
1SWP*MOV57A	NSW Supply to Safety-Related Service Water Train A	X						<1.0E-05
1SWP*MOV57B	NSW Supply to Safety-Related Service Water Train B	X						<1.0E-05
1SWP*MOV61A	NSW Isolation to Unit 2- No Seat Line Capped							<1.0E-07
1SWP*MOV61B	NSW Return to Unit 2- No Seat Line Capped							<1.0E-07
1SWP*MOV73A	Service Water Supply to HPCS UC HVR*UC5							<1.0E-07
1SWP*MOV73B	Service Water Supply to HPCS UC HVR*UC5							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SWP*MOV74A	Service Water Return to HPCS UC HVR*UC5							<1.0E-07
1SWP*MOV74B	Service Water Return to HPCS UC HVR*UC5							<1.0E-07
1SWP*MOV77A	Service Water to HPCS Diesel from Train A	X						<1.0E-05
1SWP*MOV77B	Service Water to HPCS Diesel from Train B	X						<1.0E-05
1SWP*MOV81A	NSW Return from Drywell & Containment Isolation Valve			X	X			<1.0E-07
1SWP*MOV81B	NSW Return from Drywell & Containment Isolation Valve			X	X			<1.0E-07
1SWP*MOV96A	NSW Train A Discharge Valve	X						<1.0E-05
1SWP*MOV96B	NSW Train B Discharge Valve	X						<1.0E-05

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SWP*MOV171	SSW Train A Discharge MOV from Aux. Bldg Unit Coolers	X						<1.0E-05
1SWP*MOV172	SSW Train A Header MOV to Aux. Bldg Unit Coolers	X						<1.0E-05
1SWP*MOV173	SSW Train B Discharge MOV from Aux. Bldg Unit Coolers	X						<1.0E-05
1SWP*MOV174	SSW Train B Header MOV to Aux. Bldg Unit Coolers	X						<1.0E-05
1SWP*MOV190	Service Water to CCP - Not Powered, Administratively Controlled							<1.0E-07
1SWP*MOV501A	SWP Supply Isolation to CCP Heat Exchangers							<1.0E-07
1SWP*MOV501B	SWP Supply Isolation to CCP Heat Exchangers							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SWP*MOV502A	SWP Train A to Containment Fan Unit Cooler	X				9.33e-05		7.00e-05
1SWP*MOV502B	SWP Train B to Containment Fan Unit Cooler	X				9.33e-05		7.00e-05
1SWP*MOV503A	SWP Train A from Containment Fan Unit Cooler	X			X	9.33e-05		7.00e-05
1SWP*MOV503B	SWP Train B from Containment Fan Unit Cooler	X			X	9.33e-05		7.00e-05
1SWP*MOV504A	SWP Train A from RPCCW Loads	X						<1.0E-05
1SWP*MOV504B	SWP Train B from RPCCW Loads	X						<1.0E-05
1SWP*MOV505A	SSW Crossover Valve							<1.0E-07
1SWP*MOV505B	SSW Crossover Valve							<1.0E-07
1SWP*MOV506A	Service Water from HPCS Diesel to SWP Train A	X						<1.0E-05

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1SWP*MOV506B	Service Water from HPCS Diesel to SWP Train B	X						<1.0E-05
1SWP*MOV507A	SWP Train A to Containment Fan Unit Cooler (N.O.)	X			X			<1.0E-05
1SWP*MOV507B	SWP Train B to Containment Fan Unit Cooler (N.O.)	X			X			<1.0E-05
1SWP*MOV510A	SWP Train A to RPCCW Loads	X						<1.0E-05
1SWP*MOV510B	SWP Train B to RPCCW Loads	X						<1.0E-05
1SWP*MOV511A	SWP Return Isolation to CCP Heat Exchangers							<1.0E-07
1SWP*MOV511B	SWP Return Isolation to CCP Heat Exchangers							<1.0E-07
1WCS*MOV111	RWCU Blowdown							<1.0E-07

TABLE E1 GL 89-10 MOV CATEGORIES AND IMPORTANCE (Continued)

MARK #	DESCRIPTION	MODELED IN PSA		CIV	SBO EXEMPT	PSA IMPORTANCE		OVERALL RISK RANKING
		LEVEL 1	LEVEL 2			LEVEL 1	LEVEL 2	
1WCS*MOV172	RWCU Backwash Discharge Containment Isolation Valve			X	X			<1.0E-07
1WCS*MOV173	RWCU Backwash to Radwaste							<1.0E-07
1WCS*MOV178	RWCU Backwash Discharge Containment Isolation Valve			X	X			<1.0E-07

TABLE E2 - GL 89-10 MOV INFORMATION

MARK #	DESCRIPTION	OVERALL RISK RANKING	EXPLANATION
1SWP*MOV55A	SSW Train A Discharge Valve	4.35e-02	Failure of this valve causes a failure of several systems important to safety, including EDG A, LPCS, LPCI A, SPC, SDC, RCIC (unless high temp. trips are bypassed) and Containment UC 1A. This valve is of high risk importance.
1SWP*MOV40C	SSW Pump C Discharge MOV	3.12e-02	Failure of this valve in conjunction with failure of 40A causes a failure of EDG A, LPCS, LPCI A, SPC, SDC, RCIC (unless high temp. trips are bypassed) and Containment UC 1A. This valve is of high risk importance.
1SWP*MOV40A	SSW Pump A Discharge MOV	3.04e-02	Failure of this valve in conjunction with failure of 40C causes a failure of EDG A, LPCS, LPCI A, SPC, SDC, RCIC (unless high temp. trips are bypassed) and Containment UC 1A. This valve is of high risk importance.
1SWP*MOV40B	SSW Pump B Discharge MOV	2.84e-02	Failure of this valve in conjunction with failure of 40D causes a failure of EDG A, LPCI B&C, SPC, SDC and Containment UC 1B. SSW B train requires both pumps due to high heat loads. This valve is of high risk importance.
1SWP*MOV40D	SSW Pump D Discharge MOV	2.84e-02	Failure of this valve in conjunction with failure of 40D causes a failure of EDG A, LPCI B&C, SPC, SDC and Containment UC 1B. SSW B train requires both pumps due to high heat loads. This valve is of high risk importance.
1SWP*MOV55B	SSW Train B Discharge Valve	2.28e-02	Failure of this valve causes a failure of several systems important to safety, including EDG B, LPCI B&C, SPC, SDC, RCIC (unless high temp. trips are bypassed) and Containment UC 1B. This valve is of high risk importance.
1E12*MOVF024A	Train A SPC Injection Valve Back to Suppression Pool (N.O.)	1.25e-02	Failure of this valve will cause a failure of SPC train A. This is important since loss of SPC could cause a long term containment overpressurization.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E12*MOVF024B	Train B SPC Injection Valve Back to Suppression Pool (N.O.)	1.25e-02	Failure of this valve will cause a failure of SPC train B. This is important since loss of SPC could cause a long term containment overpressurization.
1E12*MOVF048A	RHS A Heat Exchanger Bypass MOV (N.O.)	1.25e-02	This valve must close for SPC and SDC mode of RHR train A. However, the other train of heat exchangers is available for decay heat removal.
1E12*MOVF048B	RHS B Heat Exchanger Bypass MOV (N.O.)	1.25e-02	This valve must close for SPC and SDC mode of RHR train B. However, the other train of heat exchangers is available for decay heat removal.
1E12*MOVF068A	SWP Train A from RHR Heat Exchangers A & C	1.25e-02	This valve controls service water flow through the heat exchanger. Failure of this valve causes a loss of SPC and SDC in RHR train A. Containment over-pressurization could occur due to high SP temperature.
1E12*MOVF068B	SWP Train B from RHR Heat Exchangers B & D	1.25e-02	This valve controls service water flow through the heat exchanger. Failure of this valve causes a loss of SPC and SDC in RHR train B. Containment over-pressurization could occur due to high SP temperature.
1E22*MOVF004	HPCS Injection MOV	7.38e-03	This valve must open to allow HPCS injection into the reactor vessel. This valve has medium risk significance, since it is one of two sources of injection during an SBO and one of three high pressure injection sources.
1E22*MOVF012	HPCS Minimum Flow Valve	7.38e-03	This valve must open during HPCS startup and close after the flow reaches 750 gpm. Failure of this valve does not cause flow diversion from HPCS injection due to the line size. This valve has medium risk significance.
1E22*MOVF015	HPCS Suction from Suppression Pool	7.25e-03	This valve opens on low CST level or high SP level. PSA assumes swapover necessary for long term injection due to low CST level. This valve has medium importance.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E51*MOVF031	RCIC Suppression Pool Suction MOV	3.47e-03	This valve opens on low CST level or high SP level. PSA assumes swapover necessary for long term injection due to low CST level. This valve has medium importance because of RCIC's importance during SBO.
1E51*MOVF045	RCIC Turbine Steam Inlet MOV	3.03e-03	This valve must open to allow steam flow to the RCIC trubine. This valve is a medium risk valve because of RCIC's importance during SBO.
1E51*MOVF013	RCIC Reactor Injection MOV	2.98e-03	This valve must open to allow RCIC injection into the reactor vessel. This valve is a medium risk valve because of RCIC's importance during SBO.
1E51*MOVF019	RCIC Test Return Line MOV	2.98e-03	This valve must open to allow RCIC minimum flow during system startup. This valve is a medium risk valve because of RCIC's importance during SBO.
1E51*MOVF046	RCIC Lube Oil Cooler MOV	2.98e-03	This valve must open to allow flow to the turbine lube oil cooler. This valve is a medium risk valve because of RCIC's importance during SBO.
1E12*MOVF042A	LPCI Train A Injection MOV	4.12e-04	Failure of this valve would cause a loss of LPCI train A. Several other sources of low pressure injection are available to backup this failure, therfore this valve is of low importance. Common cause considered.
1E12*MOVF042B	LPCI Train B Injection MOV	4.12e-04	Failure of this valve would cause a loss of LPCI train B, SSW injection and FPW injection. Other sources of injection must also fail for core damage to occur. This valve is of low importance. Common cause considered.
1E12*MOVF042C	LPCI Train C Injection MOV	4.12e-04	Failure of this valve would cause a loss of LPCI train C. Several other sources of low pressure injection are available to backup this failure, therfore this valve is of low importance. Common cause considered.
1E21*MOVF005	LPCS Injection Line MOV	3.30e-04	This valve must open to allow LPCS injection into the reactor vessel. This valve has low risk significance due to the number of other systems available for core injection.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E21*MOVF011	LPCS Min Flow Recirculation. MOV (N.O.)	3.30e-04	This valve must remain open during LPCS startup and close after the flow reaches 875 gpm. Failure of this valve could cause flow diversion from LPCS injection. This valve has low risk significance due to the number of LP injection sources available.
1B21*MOVF016	Main Steam Line Warmup Header Inboard Containment Isol Valve	2.50e-04	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path. It can contribute to containment bypass since the line is 3" or larger (3" line)
1B21*MOVF019	Main Steam Line Warmup Header Outboard Containment Isol Valve	2.50e-04	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path. It can contribute to containment bypass since the line is 3" or larger (3" line)
1E51*MOVF077	RCIC Vacuum Breaker Containment Isolation Valve	2.50e-04	This valve was not modelled because failure of the valve would not effect RCIC operation during an accident.
1G33*MOVF001	RWCU Pump Suction Inboard Containment Isolation Valve	2.50e-04	This valve must isolate during an ATWS to prevent loss of boron after SLC injection. It also closes to prevent containment bypass. Low Risk from core damage standpoint since ATWS prob. is <0.01%.
1G33*MOVF004	RWCU Pump Suction Outboard Containment Isolation Valve	2.50e-04	This valve must isolate during an ATWS to prevent loss of boron after SLC injection. It also closes to prevent containment bypass. Low Risk from core damage standpoint since ATWS prob. is <0.01%.
1G33*MOVF028	RWCU Blowdown Inboard Containment Isolation Valve	2.50e-04	RWCU is not needed to mitigate the effects of an accident, however this valve must close to prevent containment bypass.
1G33*MOVF034	RWCU Blowdown Outboard Containment Isolation Valve	2.50e-04	RWCU is not needed to mitigate the effects of an accident, however this valve must close to prevent containment bypass.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1G33*MOVF039	RWCU Return to Feedwater Containment Isolation Valve	2.50e-04	RWCU is not needed to mitigate the effects of an accident, however this valve must close to prevent containment bypass.
1G33*MOVF040	RWCU Return to Feedwater Containment Isolation Valve	2.50e-04	RWCU is not needed to mitigate the effects of an accident, however this valve must close to prevent containment bypass.
1G33*MOVF053	RWCU Pump Discharge Containment Isolation Valve	2.50e-04	RWCU is not needed to mitigate the effects of an accident, however this valve must close to prevent containment bypass.
1G33*MOVF054	RWCU Pump Discharge Containment Isolation Valve	2.50e-04	RWCU is not needed to mitigate the effects of an accident, however this valve must close to prevent containment bypass.
1SFC*MOV139	Fuel Pool Purification Suction Containment Isolation Valve	2.50e-04	This function is not used during power operations, however this valve could represent a containment bypass if it does not close.
1SWP*MOV502A	SWP Train A to Containment Fan Unit Cooler	7.00e-05	This valve provides flow to Containment unit cooler 1A following a LOCA signal. This valve is required to open to supply SSW to the UC. This valve has low risk significance due to number of systems that must failure prior to HVR usage.
1SWP*MOV502B	SWP Train B to Containment Fan Unit Cooler	7.00e-05	This valve provides flow to Containment unit cooler 1B following a LOCA signal. This valve is required to open to supply SSW to the UC. This valve has low risk significance due to number of systems that must failure prior to HVR usage.
1SWP*MOV503A	SWP Train A from Containment Fan Unit Cooler	7.00e-05	This valve provides flow from Containment unit cooler 1A following a LOCA signal. This valve is required to open to supply SSW to the UC. This valve has low risk significance due to number of systems that must failure prior to HVR usage.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SWP*MOV503B	SWP Train B from Containment Fan Unit Cooler	7.00e-05	This valve provides flow from Containment unit cooler 1B following a LOCA signal. This valve is required to open to supply SSW to the UC. This valve has low risk significance due to number of systems that must failure prior to HVR usage.
1C11*MOVF083	CRD Containment Isolation MOV	<1.0E-05	CRD is used in accident conditions as a source of high pressure injection only when the flow rate is adequate for core cooling and nothing else is available. Containment bypass is prevented by a check valve in the line. Low Risk.
1C41*MOVF001A	SLCS Pump 1A Discharge MOV	<1.0E-05	Standby Liquid Control is used only in ATWS situations to lower core reactivity. ATWS Probability is very small. Low Risk.
1C41*MOVF001B	SLCS Pump 1B Discharge MOV	<1.0E-05	Standby Liquid Control is used only in ATWS situations to lower core reactivity. ATWS Probability is very small Low Risk.
1CCP*MOV129	RPCCW Loop A Normal Return Valve	<1.0E-05	Needed for RPCCW supply to RHR Pump Seals. Has low PSA Importance since the function is backed up by SSW.
1CCP*MOV130	RPCCW Loop B Normal Return Valve	<1.0E-05	Needed for RPCCW supply to RHR Pump Seals. Has low PSA Importance since the function is backed up by SSW.
1CCP*MOV163	RPCCW to CRD Pump Seals	<1.0E-05	Needed to supply RPCCW to the CRD pump seals. CRD pumps are used in accident conditions as a source of high pressure injection only when the flow rate is adequate for core cooling and nothing else is available. Low Risk.
1CCP*MOV169	RPCCW to CRD Pump Seals	<1.0E-05	Needed to supply RPCCW to the CRD pump seals. CRD pumps are used in accident conditions as a source of high pressure injection only when the flow rate is adequate for core cooling and nothing else is available. Low Risk.
1CCP*MOV16A	RPCCW Loop A Normal Supply Valve	<1.0E-05	Needed for RPCCW supply to RHR Pump Seals. Has low PSA Importance since the function is backed up by SSW.
1CCP*MOV16B	RPCCW Loop B Normal Supply Valve	<1.0E-05	Needed for RPCCW supply to RHR Pump Seals. Has low PSA Importance since the function is backed up by SSW.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1CCP*MOV335	RPCCW Loop A Normal Return Valve	<1.0E-05	RPCCW A return line from Safety-Related equipment. Low PSA importance since it has a low failure probability and is backup up by standby service water.
1CCP*MOV336	RPCCW Loop B Normal Return Valve	<1.0E-05	RPCCW B return line from Safety-Related equipment. Low PSA importance since it has a low failure probability and is backup up by standby service water.
1E12*MOVF003A	RHS Train A Hx Discharge MOV (N.O.)	<1.0E-05	RHR Hxs A and C are necessary for SPC and SDC modes of RHR. However, this valve is not required to change state during an accident, therefore the valve is a low risk valve.
1E12*MOVF003B	RHS Train B Hx Discharge MOV (N.O.)	<1.0E-05	RHR Hxs B and D are necessary for SPC and SDC modes of RHR. However, this valve is not required to change state during an accident, therefore the valve is a low risk valve.
1E12*MOVF004A	RHS Pump A Suppression Pool Suction MOV (N.O.)	<1.0E-05	This valve must remain open for LPCI or SPC modes of RHR and close during SDC mode of RHR. However, since other single failures will fail all three modes of RHR train A operation, this failure mode has low risk significance.
1E12*MOVF004B	RHS Pump B Suppression Pool Suction MOV (N.O.)	<1.0E-05	This valve must remain open for LPCI or SPC modes of RHR and close during SDC mode of RHR. However, since other single failures will fail all three modes of RHR train B operation, this failure mode has low risk significance.
1E12*MOVF006A	RHS Pump A SDC Suction MOV	<1.0E-05	This valve is necessary if the RHR train A is in SDC mode. However, since other failures will fail all three modes of RHR train A, this failure has low risk significance.
1E12*MOVF006B	RHS Pump B SDC Suction MOV	<1.0E-05	This valve is necessary if the RHR train B is in SDC mode. However, since other failures will fail all three modes of RHR train B, this failure has low risk significance.
1E12*MOVF008	RHS Pumps A and B SDC Suction MOV	<1.0E-05	Failure of this valve will cause a failure of all SDC. However, decay heat removal can still be performed via SPC. This failure is of low importance.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E12*MOVF009	RHS Pumps A and B SDC Suction MOV	<1.0E-05	Failure of this valve will cause a failure of all SDC. However, decay heat removal can still be performed via SPC. This failure is of low importance.
1E12*MOVF027A	LPCI Train A Injection MOV (N.O.)	<1.0E-05	Failure of this valve would cause a loss of LPCI train A. Several other sources of low pressure injection are available to backup this failure, therfore this valve is of low importance.
1E12*MOVF027B	LPCI Train B Injection MOV (N.O.)	<1.0E-05	Failure of this valve would cause a loss of LPCI train B, SSW injection and FPW injection. Other sources of injection must also fail for core damage to occur. This valve is of low importance.
1E12*MOVF047A	RHS Train A Hx Inlet Valve (N.O.)	<1.0E-05	RHR Hxs A and C are necessary for SPC and SDC modes of RHR. However, this valve is not required to change state during an accident, therefore the valve is a low risk valve.
1E12*MOVF047B	RHS Train B Hx Inlet Valve (N.O.)	<1.0E-05	RHR Hxs B and D are necessary for SPC and SDC modes of RHR. However, this valve is not required to change state during an accident, therefore the valve is a low risk valve.
1E12*MOVF053A	SDC Train A MOV to Mixing Tee	<1.0E-05	This valve is necessary if the RHR train A is in SDC mode. However, since other failures will fail all three modes of RHR train A, this failure has low risk significance.
1E12*MOVF053B	SDC Train B MOV to Mixing Tee	<1.0E-05	This valve is necessary if the RHR train B is in SDC mode. However, since other failures will fail all three modes of RHR train B, this failure has low risk significance.
1E12*MOVF064A	RHS Pump A Minimum Flow Recirculation MOV	<1.0E-05	This valve prevents RHR Train A deadhead during startup. This valve does not have to change position since it is kept normally open and does not have to close since the startup line is not big enough to be a diversion path during full flow.
1E12*MOVF064B	RHS Pump B Minimum Flow Recirculation MOV	<1.0E-05	This valve prevents RHR Train B deadhead during startup. This valve does not have to change position since it is kept normally open and does not have to close since the startup line is not big enough to be a diversion path during full flow.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E12*MOVF064C	RHS Pump C Minimum Flow Recirculation MOV (N.O.)	<1.0E-05	This valve prevents RHR Train C deadhead during startup. This valve does not have to change position since it is kept normally open and does not have to close since the startup line is not big enough to be a diversion path during full flow.
1E12*MOVF094	SWP Injection Line MOV	<1.0E-05	This valve is used to supply SSW for injection into the RHR B line as directed by the EOPs. Low risk due to multiple failures that must occur prior to use of SSW injection.
1E12*MOVF096	SWP Injection Line MOV	<1.0E-05	This valve is used to supply SSW for injection into the RHR B line as directed by the EOPs. Low risk due to multiple failures that must occur prior to use of SSW injection.
1E12*MOVF105	LPCI Pump C Suppression Pool Suction Valve (N.O.)	<1.0E-05	This valve must remain open for LPCI train C operation. This failure mode has low risk significance, since it disables only one of the seven sources of low pressure injection.
1E21*MOVF001	LPCS Suction MOV from Suppression Pool (N.O.)	<1.0E-05	This valve must remain open during LPCS operation for LPCS suction. This valve has low risk significance because it does not need to change state during an accident.
1E22*MOVF001	HPCS Suction from CST (N.O.)	<1.0E-05	This valve must remain open during HPCS operation for CST suction. This valve has low risk significance because it does not need to change state during an accident.
1E51*MOVF010	RCIC CST Suction Valve (N.O.)	<1.0E-05	This valve must remain open during RCIC operation. This valve has low risk significance because it is a passive valve under accident conditions.
1E51*MOVF063	RCIC Turbine Inboard Isolation MOV (N.O.)	<1.0E-05	This valve must remain open to permit steam flow to the RCIC turbine. This valve has low risk significance because it is a passive valve under accident conditions.
1E51*MOVF064	RCIC Turbine Outboard Isolation MOV (N.O.)	<1.0E-05	This valve must remain open to permit steam flow to the RCIC turbine. This valve has low risk significance because it is a passive valve under accident conditions.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E51*MOVF068	RCIC Turbine Exhaust Line MOV (N.O.)	<1.0E-05	This valve must remain open to permit steam condensed in the RCIC turbine to flow to the SP. This valve has low risk significance because it is a passive valve under accident conditions.
1HVK*MOV20A	Control Building Chilled Water Pump P1A Discharge Valve (N.O.)	<1.0E-05	This valve was modelled assuming that HVK pump 1A is running. Based on this assumption, the failure mode of this valve is passive and of low risk significance.
1HVK*MOV20B	Control Building Chilled Water Pump P1B Discharge Valve (N.O.)	<1.0E-05	This valve was modelled assuming that HVK pump 1B is in standby. Based on this assumption, the failure mode of this valve is passive and of low risk significance.
1HVK*MOV20C	Control Building Chilled Water Pump P1C Discharge Valve	<1.0E-05	This valve is modelled assuming that HVK pump 1C is in standby. Based on this assumption, the valve has to change state, however, HVK Pump train A also has to fail. Therefore the valve has low risk significance.
1HVK*MOV20D	Control Building Chilled Water Pump P1D Discharge Valve	<1.0E-05	This valve is modelled assuming that HVK pump 1D is in standby. Based on this assumption, the valve has to change state, however, HVK pump train B also has to fail. Therefore the valve has low risk significance.
1SWP*MOV171	SSW Train A Discharge MOV from Aux. Bldg Unit Coolers	<1.0E-05	This valve is provides SWP from Division A Aux. Building unit coolers and to the HPCS unit cooler. Failure of this valve would cause a loss of several safety systems, however since it is a passive valve, it is a low risk significant valve.
1SWP*MOV172	SSW Train A Header MOV to Aux. Bldg Unit Coolers	<1.0E-05	This valve is provides SWP to Division A Aux. Building unit coolers and to the HPCS unit cooler. Failure of this valve would cause a loss of several safety systems, however since it is a passive valve, it is a low risk significant valve.
1SWP*MOV173	SSW Train B Discharge MOV from Aux. Bldg Unit Coolers	<1.0E-05	This valve is provides SWP from Division B Aux. Building unit coolers and to the HPCS unit cooler. Failure of this valve would cause a loss of several safety systems, however since it is a passive valve, it is a low risk significant valve.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SWP*MOV174	SSW Train B Header MOV to Aux. Bldg Unit Coolers	<1.0E-05	This valve is provides SWP to Division B Aux. Building unit coolers and to the HPCS unit cooler. Failure of this valve would cause a loss of several safety systems, however since it is a passive valve, it is a low risk significant valve.
1SWP*MOV504A	SWP Train A from RPCCW Loads	<1.0E-05	This valve provides flow from safety-related CCP loads following a loss of CCP. This valve is a low risk significance since a train B failure must also occur to cause a loss of SPC or SDC.
1SWP*MOV504B	SWP Train B from RPCCW Loads	<1.0E-05	This valve provides flow from safety-related CCP loads following a loss of CCP. This valve is a low risk significance since a train A failure must also occur to cause a loss of SPC or SDC.
1SWP*MOV506A	Service Water from HPCS Diesel to SWP Train A	<1.0E-05	This valve returns SWP flow from the HPCS diesel generator. Failure of this valve is of low significance due to a backup flow path from SWP train B.
1SWP*MOV506B	Service Water from HPCS Diesel to SWP Train B	<1.0E-05	This valve returns SWP flow from the HPCS diesel generator. Failure of this valve is of low significance due to a backup flow path from SWP train A.
1SWP*MOV507A	SWP Train A to Containment Fan Unit Cooler (N.O.)	<1.0E-05	This valve provides flow from Containment unit cooler 1A following a LOCA signal. This valve is required to open to supply SSW to the UC. This valve has low risk significance becuase it does not have to change state.
1SWP*MOV507B	SWP Train B to Containment Fan Unit Cooler (N.O.)	<1.0E-05	This valve provides flow from Containment unit cooler 1B following a LOCA signal. This valve is required to open to supply SSW to the UC. This valve has low risk significance because it does not have to change state.
1SWP*MOV510A	SWP Train A to RPCCW Loads	<1.0E-05	This valve provides flow to safety-related CCP loads following a loss of CCP. This valve is a low risk significance since a train B failure must also occur to cause a loss of SPC or SDC.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SWP*MOV510B	SWP Train B to RPCCW Loads	<1.0E-05	This valve provides flow to safety-related CCP loads following a loss of CCP. This valve is a low risk significance since a train A failure must also occur to cause a loss of SPC or SDC.
1SWP*MOV57A	NSW Supply to Safety-Related Service Water Train A	<1.0E-05	This valve must close on a loss of service water or a loss of RPCCW. However, since NSW is a closed loop system, failure of the valve to close would not divert a significant amount of water from SSW. This valve is of low risk significance.
1SWP*MOV57B	NSW Supply to Safety-Related Service Water Train B	<1.0E-05	This valve must close on a loss of service water or a loss of RPCCW. However, since NSW is a closed loop system, failure of the valve to close would not divert a significant amount of water from SSW. This valve is of low risk significance.
1SWP*MOV77A	Service Water to HPCS Diesel from Train A	<1.0E-05	This valve supplies SWP flow to the HPCS diesel generator. Failure of this valve is of low significance due to a backup flow path from SWP train B.
1SWP*MOV77B	Service Water to HPCS Diesel from Train B	<1.0E-05	This valve supplies SWP flow to the HPCS diesel generator. Failure of this valve is of low significance due to a backup flow path from SWP train A.
1SWP*MOV96A	NSW Train A Discharge Valve	<1.0E-05	This valve must close on a loss of service water or a loss of RPCCW. However, since NSW is a closed loop system, failure of the valve to close would not divert a significant amount of water from SSW. This valve is of low risk significance.
1SWP*MOV96B	NSW Train B Discharge Valve	<1.0E-05	This valve must close on a loss of service water or a loss of RPCCW. However, since NSW is a closed loop system, failure of the valve to close would not divert a significant amount of water from SSW. This valve is of low risk significance.
1B21*MOVF001	Reactor Downstream Head Vent to Drywell Equip Drain Sump	<1.0E-07	This valve is normally closed and is not required to open to mitigate any PSA accident. Also failure to remain closed does not effect PSA scenarios because the line is 1B21*MOVF002 is also closed and the line is not big enough to be a diversion path.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1B21*MOVF002	Reactor Upstream Head Vent to Drywell Equip Drain Sump	<1.0E-07	This valve is normally closed and is not required to open to mitigate any PSA accident. Also failure to remain closed does not effect PSA scenarios because the line is 1B21*MOVF001 is also closed and the line is not big enough to be a diversion path.
1B21*MOVF005	Reactor Head Vent to Main Steam Line A	<1.0E-07	This valve does not need to change position in any PSA accident scenario. Also the line size for this valve is not big enough to represent a diversion path for MSL A
1B21*MOVF027A	Main Steam Isolation Valve Leakoff Drain Connection	<1.0E-07	MSIV leakage does not effect the ability of the MSIV to perform its necessary function during an accident.
1B21*MOVF027B	Main Steam Isolation Valve Leakoff Drain Connection	<1.0E-07	MSIV leakage does not effect the ability of the MSIV to perform its necessary function during an accident.
1B21*MOVF027C	Main Steam Isolation Valve Leakoff Drain Connection	<1.0E-07	MSIV leakage does not effect the ability of the MSIV to perform its necessary function during an accident.
1B21*MOVF027D	Main Steam Isolation Valve Leakoff Drain Connection	<1.0E-07	MSIV leakage does not effect the ability of the MSIV to perform its necessary function during an accident.
1B21*MOVF065A	Feedwater to Reactor Outboard Isolation Valve	<1.0E-07	This valve is not modelled because it is not required to change position during an accident and the probability of inadvertent closure of the valve during an accident is very small.
1B21*MOVF065B	Feedwater to Reactor Outboard Isolation Valve	<1.0E-07	This valve is not modelled because it is not required to change position during an accident and the probability of inadvertent closure of the valve during an accident is very small.
1B21*MOVF067A	Main Steam Line A Drain Outboard Isolation Valve	<1.0E-07	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path. It does not contribute to containment bypass since the line is <3" (2" line)

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1B21*MOVF067B	Main Steam Line B Drain Outboard Isolation Valve	<1.0E-07	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path. It does not contribute to containment bypass since the line is <3" (2" line)
1B21*MOVF067C	Main Steam Line C Drain Outboard Isolation Valve	<1.0E-07	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path. It does not contribute to containment bypass since the line is <3" (2" line)
1B21*MOVF067D	Main Steam Line D Drain Outboard Isolation Valve	<1.0E-07	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path. It does not contribute to containment bypass since the line is <3" (2" line)
1B21*MOVF085	Main Steam Line Warmup Header Shutoff Valve	<1.0E-07	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path.
1B21*MOVF086	Main Steam Line Drain Header Shutoff Valve	<1.0E-07	This valve is a drain to the main condenser. It is not needed to mitigate any PSA accident scenarios and is not big enough to be a diversion path.
1B21*MOVF098A	Main Steam Line A Shutoff Valve	<1.0E-07	This valve is not modelled in the Level 1 PSA because it must only remain open following an accident to allow main steam flow to the condenser.
1B21*MOVF098B	Main Steam Line B Shutoff Valve	<1.0E-07	This valve is not modelled in the Level 1 PSA because it must only remain open following an accident to allow main steam flow to the condenser.
1B21*MOVF098C	Main Steam Line C Shutoff Valve	<1.0E-07	This valve is not modelled in the Level 1 PSA because it must only remain open following an accident to allow main steam flow to the condenser.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1B21*MOVF098D	Main Steam Line D Shutoff Valve	<1.0E-07	This valve is not modelled in the Level 1 PSA because it must only remain open following an accident to allow main steam flow to the condenser.
1B33*MOVF023A	Recirculation Pump A Discharge Valve	<1.0E-07	This valve is used to isolate Recirculation Pump A in an accident. This valve should close to isolate a potential Recirculation line break. This valve has low risk significance due to low probability of ATWS or LOCA events.
1B33*MOVF023B	Recirculation Pump B Discharge Valve	<1.0E-07	This valve is used to isolate Recirculation Pump A in an accident. This valve should close to isolate a potential Recirculation line break. This valve has low risk significance due to low probability of ATWS or LOCA events.
1B33*MOVF067A	Recirculation Pump A Supply Valve	<1.0E-07	This valve is used to isolate Recirculation Pump A in an accident. This valve should close to isolate a potential Recirculation line break. This valve has low risk significance due to low probability of ATWS or LOCA events.
1B33*MOVF067B	Recirculation Pump B Supply Valve	<1.0E-07	This valve is used to isolate Recirculation Pump A in an accident. This valve should close to isolate a potential Recirculation line break. This valve has low risk significance due to low probability of ATWS or LOCA events.
1CCP*MOV138	RPCCW Containment Supply Outboard Isolation Valve	<1.0E-07	All equipment in containment is assumed to be isolated during the PSA accident scenarios, therefore no this equipment is not modelled. However, this valve must close to maintain containment integrity.
1CCP*MOV142	Reactor Recirculation Pump Cooling Supply	<1.0E-07	The recirculation pump is not modelled except for its trip function during an ATWS. Therefore, RPCCW to recirculation is not needed during accident conditions.
1CCP*MOV143	Reactor Recirculation Pump Downstream Return	<1.0E-07	The recirculation pump is not modelled except for its trip function during an ATWS. Therefore, RPCCW to recirculation is not needed during accident conditions.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1CCP*MOV144	Reactor Recirculation Pump Upstream Return	<1.0E-07	The recirculation pump is not modelled except for its trip function during an ATWS. Therefore, RPCCW to recirculation is not needed during accident conditions.
1CCP*MOV158	RPCCW Containment Supply Inboard Isolation Valve	<1.0E-07	All equipment in containment is assumed to be isolated during the PSA accident scenarios, therefore no this equipment is not modelled. However, this valve must close to maintain containment integrity.
1CCP*MOV159	RPCCW Containment Return Outboard Isolation Valve	<1.0E-07	All equipment in containment is assumed to be isolated during the PSA accident scenarios, therefore no this equipment is not modelled. However, this valve must close to maintain containment integrity.
1CNS*MOV125	Condensate Makeup Containment Isolation Valve	<1.0E-07	Condensate Makeup is not needed during accident conditions for any system inside containment. A check valve inside containment prevents backflow from containment and thus containment bypass.
1CNS*MOV130	Condensate Makeup Containment Isolation Valve	<1.0E-07	Condensate Makeup is not needed during accident conditions for any system inside containment. A check valve inside containment prevents backflow from containment and thus containment bypass.
1CPM*MOV1A	Hydrogen Mixing Outlet - Outboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPM*MOV1B	Hydrogen Mixing Outlet - Outboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPM*MOV2A	Hydrogen Mixing Inlet - Outboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPM*MOV2B	Hydrogen Mixing Inlet - Outboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1CPM*MOV3A	Hydrogen Mixing Outlet - Inboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPM*MOV3B	Hydrogen Mixing Outlet - Inboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPM*MOV4A	Hydrogen Mixing Inlet - Inboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPM*MOV4B	Hydrogen Mixing Inlet - Inboard Drywell Isolation Valve	<1.0E-07	Hydrogen Mixing is not credited in Level 2 PSA since mixing is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPP*MOV104	Hydrogen Purge Discharge Containment Isolation Valve	<1.0E-07	Hydrogen Purge is not credited in Level 2 PSA since purge is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1CPP*MOV105	Hydrogen Purge Discharge Containment Isolation Valve	<1.0E-07	Hydrogen Purge is not credited in Level 2 PSA since purge is not available during significant scenarios (SBO, LOSP) and spreads the fission products to increase contamination in other scenarios.
1DFR*MOV146	Suppression Pool Pumpback Return - Cont. Isolation Valve	<1.0E-07	Suppression Pool Pumpback is not modelled in the PSA, since PSA assumes the S.P. level is kept within the limits specified in the EOPs throughout any accident.
1E12*MOVF011A	Heat Exchangers A & C Discharge to Suppression Pool	<1.0E-07	This valve is used as a test return during normal operations. It does not represent a diversion path for RHR operation.
1E12*MOVF011B	Heat Exchangers B & D Discharge to Suppression Pool	<1.0E-07	This valve is used as a test return during normal operations. It does not represent a diversion path for RHR operation.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E12*MOVF021	RHR "C" Test Return Containment Isolation Valve	<1.0E-07	This valve is used as a test return during normal operations. It does not change state during an accident. It does not represent a diversion path for RHR C operation.
1E12*MOVF023	Head Spray Isolation - Containment Isolation Valve	<1.0E-07	This valve is used to help maintain saturated conditions in the vessel head during SDC. Failure of this valve will not prevent SDC operation.
1E12*MOVF037A	Return to Upper Pool - Containment Isolation Valve	<1.0E-07	This valve is used for fuel pool cooling assist. This mode of RHR is not modelled since no fuel is stroed in the upper pools during power operation.
1E12*MOVF037B	Return to Upper Pool - Containment Isolation Valve	<1.0E-07	This valve is used for fuel pool cooling assist. This mode of RHR is not modelled since no fuel is stroed in the upper pools during power operation.
1E12*MOVF040	Discharge to Radwaste	<1.0E-07	Discharge to Radwaste is not performed during accident conditions. Could be a diversion path if running, however it receives an NSSS isolation signal as does F049 upstream.
1E12*MOVF049	RHR Discharge to Radwaste	<1.0E-07	Discharge to Radwaste is not performed during accident conditions. Could be a diversion path if running, however it receives an NSSS isolation signal as does F040 downstream.
1E12*MOVF073A	Heaat Exchanger Vent - Containment Isolation Valve	<1.0E-07	This valve is not required to operate during an accident. It does not represent a diversion path since it is only a 2" line.
1E12*MOVF073B	Heaat Exchanger Vent - Containment Isolation Valve	<1.0E-07	This valve is not required to operate during an accident. It does not represent a diversion path since it is only a 2" line.
1E12*MOVF074A	Heat Exchanger Vent to Suppression Pool	<1.0E-07	This valve is not required to operate during an accident. It does not represent a diversion path since it is only a 2" line.
1E12*MOVF074B	Heat Exchanger Vent to Suppression Pool	<1.0E-07	This valve is not required to operate during an accident. It does not represent a diversion path since it is only a 2" line.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E21*MOVF012	LPCS Test Return - Containment Isolation Valve	<1.0E-07	This valve is normally closed and is only opened during LPCS system test. The valve receives a close signal on system startup, therefore this valve was not modelled in the PSA.
1E22*MOVF010	HPCS Test Return to CST	<1.0E-07	This valve is normally closed and receives a close signal on system startup. This valve is also backed up by F011. Failure of multiple passive components is not modelled.
1E22*MOVF011	HPCS Test Return to CST	<1.0E-07	This valve is normally closed and receives a close signal on system startup. This valve is also backed up by F010. Failure of multiple passive components is not modelled.
1E22*MOVF023	HPCS Return to Suppression Pool - Cont. Isolation Valve	<1.0E-07	This valve is normally closed and receives a close signal on system startup. Failure of this passive component is not modelled.
1E33*MOVF005	MSIV Sealing System Division I Injection Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. In accidents in which the MSIVs must close, the leakage out the MSIVs will not cause containment bypass and will not significantly increase radiological dose.
1E33*MOVF006	MSIV Sealing System Division I Drain Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. In accidents in which the MSIVs must close, the leakage out the MSIVs will not cause containment bypass and will not significantly increase radiological dose.
1E33*MOVF007	MSIV Sealing System Division I Isolation Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. In accidents in which the MSIVs must close, the leakage out the MSIVs will not cause containment bypass and will not significantly increase radiological dose.
1E33*MOVF008	MSIV Sealing System Division I Containment Isolation Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. This valve must remain closed to prevent containment bypass.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E33*MOVF025	MSIV Sealing System Division II Injection Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. In accidents in which the MSIVs must close, the leakage out the MSIVs will not cause containment bypass and will not significantly increase radiological dose.
1E33*MOVF026	MSIV Sealing System Division II Drain Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. In accidents in which the MSIVs must close, the leakage out the MSIVs will not cause containment bypass and will not significantly increase radiological dose.
1E33*MOVF027	MSIV Sealing System Division II Isolation Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. In accidents in which the MSIVs must close, the leakage out the MSIVs will not cause containment bypass and will not significantly increase radiological dose.
1E33*MOVF028	MSIV Sealing System Division II Containment Isolation Valve	<1.0E-07	In the majority of accidents, it is advantagous to keep the MSIVs open. This valve must remain closed to prevent containment bypass.
1E51*MOVC002	RCIC Turbine Trip Throttle Valve	<1.0E-07	This valve is normally open and closes on a RCIC turbine trip. This valve protects the turbine from damage during trip conditions, but is not modelled in the PSA because it is a passive valve during RCIc operation.
1E51*MOVF022	RCIC CST Test Return	<1.0E-07	This valve is not modelled because it is normally closed and remains closed during an accident. F059 must also open for a diversion path. Multiple passion failures are not modelled by the PSA.
1E51*MOVF059	RCIC CST Test Return	<1.0E-07	This valve is not modelled because it is normally closed and remains closed during an accident. F022 must also open for a diversion path. Multiple passion failures are not modelled by the PSA.
1E51*MOVF076	RCIC Line Warming Containment Isolation Valve	<1.0E-07	This valve is normally closed and receives a close signal from several sources. This valve was not modelled because its failure mode is passive and would not effect RCIC operation.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1E51*MOVF078	RCIC Vacuum Breaker Containment Isolation Valve	<1.0E-07	This valve was not modelled because failure of the valve would not effect RCIC operation during an accident.
1FPW*MOV121	Fire Protection Header - Containment Isolation Valve	<1.0E-07	This valve is used for fire suppression inside containment. Since PSA does not consider fire initiators, this valve was not modelled. This valve does not lead to containment bypass because a check valve prevents backflow.
1FPW*MOV122	Fire Protection Water Leakage Control Valve	<1.0E-07	This valve is used for fire suppression inside containment. Since PSA does not consider fire initiators, this valve was not modelled.
1FWS*MOV7A	"A" Reactor Feedwater Inlet - Containment Isolation Valve	<1.0E-07	This valve is not modelled because it is not required to change position during an accident and the probability of inadvertent closure of the valve during an accident is very small.
1FWS*MOV7B	"B" Reactor Feedwater Inlet - Containment Isolation Valve	<1.0E-07	This valve is not modelled because it is not required to change position during an accident and the probability of inadvertent closure of the valve during an accident is very small.
1G33*MOVF031	RWCU Blowdown Orifice Bypass	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF035	RWCU Drain to Radwaste	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF042	RWCU Heat Exchanger Throttle Valve	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF044	RWCU Filter Demineralizer Bypass	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF046	RWCU Drain to Main Condenser	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF100	RWCU Suction from Reactor Recirculation	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1G33*MOVF101	RWCU Bottom Head Drain	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF102	Recirculation Suction Valve	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF104	RWCU Heat Exchanger Bypass Valve	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF106	RWCU Suction from Reactor Recirculationulation	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1G33*MOVF107	RWCU Regenerative Heat Exchanger Bypass Valve	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1HVC*MOV1A	Controm Room Air Handling Unit Inlet Isolation Valve	<1.0E-07	This valve is normally opened and does not need to change state during an accident, therefore it was not modelled.
1HVC*MOV1B	Controm Room Air Handling Unit Inlet Isolation Valve	<1.0E-07	This valve is normally opened and does not need to change state during an accident, therefore it was not modelled.
1HVK*MOV10A	Chilled Water Compression Tank Makeup Water Valve	<1.0E-07	This valve was not modelled because the compression tank are assumed to have suffiecent level (>12.5") prior to an accident, therefore makeup would not be needed during the mission time considered.
1HVK*MOV10B	Chilled Water Compression Tank Makeup Water Valve	<1.0E-07	This valve was not modelled because the compression tank are assumed to have suffiecent level (>12.5") prior to an accident, therefore makeup would not be needed during the mission time considered.
1HVK*MOV11A	Chilled Water Comp. Tank Alternate Makeup Water Valve	<1.0E-07	This valve was not modelled because the compression tank are assumed to have suffiecent level (>12.5") prior to an accident, therefore makeup would not be needed during the mission time considered.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1HVK*MOV11B	Chilled Water Comp. Tank Alternate Makeup Water Valve	<1.0E-07	This valve was not modelled because the compression tank are assumed to have suffiecent level (>12.5") prior to an accident, therefore makeup would not be needed during the mission time considered.
1HVN*MOV102	Ventilation Chilled Water Return Containment Isolation Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.
1HVN*MOV127	Ventilation Chilled Water Supply Containment Isolation Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.
1HVN*MOV128	Ventilation Chilled Water Return Containment Isolation Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.
1HVN*MOV129	Ventilation Chilled Water Supply Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.
1HVN*MOV130	Ventilation Chilled Water Return Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.
1HVN*MOV22A	Containment Unit Cooler Discharge Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1HVN*MOV22B	Containment Unit Cooler Discharge Valve	<1.0E-07	This valve was not modelled because PSA did not credit HVN supply to containment unit coolers, since this function is isolated on a LOCA signal anyway. Since HVN supply is closed loop, it does not matter if it isolates or not.
1IAS*MOV106	Instrument Air Containment Isolation Valve	<1.0E-07	This valve is used to isolate IAS to containment systems. The only instruments modelled in the PSA that IAS containment isolation would effect are the inboard MSIVs and possibly SRVs. This is a sub-category of loss of IAS scram.
1IAS*MOV107	Instrument Air Containment Isolation Valve	<1.0E-07	This valve is used to isolate IAS to containment systems. The only instruments modelled in the PSA that IAS containment isolation would effect are the inboard MSIVs and possibly SRVs. This is a sub-category of loss of IAS scram.
1LSV*MOV11A	PVLCS Isolation Valve to FPW, HVN, WCS, & CNS	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV11B	PVLCS Isolation Valve to FPW, HVN, WCS, & CNS	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV13A	PVLCS Isolation Valve to SAS & IAS	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV13B	PVLCS Isolation Valve to SAS & IAS	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV15A	PVLCS Isolation Valve to Feedwater	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1LSV*MOV15B	PVLCS Isolation Valve to Feedwater	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV16A	PVLCS Isolation Valve to Feedwater	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV16B	PVLCS Isolation Valve to Feedwater	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV19A	PVLCS Header "A" Injection Valve	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1LSV*MOV19B	PVLCS Header "B" Injection Valve	<1.0E-07	PVLCS is not modelled in the PSA because failure to control valve leakage would not effect the system availability during an accident and would not significantly increase radiological dose.
1RCS*MOV58A	"A" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1RCS*MOV58B	"B" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1RCS*MOV59A	"A" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1RCS*MOV59B	"B" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1RCS*MOV60A	"A" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1RCS*MOV60B	"B" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1RCS*MOV61A	"A" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1RCS*MOV61B	"B" HPU Drywell Isolation Valve	<1.0E-07	Reactor recirculation is not explicitly modelled by PSA. However, this system must trip to decrease power during an ATWS and must isolate during a LOCA in case a recirculation line breaks. Failure of this valve does not prevent either function.
1SAS*MOV102	Service Air to Containment and Drywell Isolation Valve	<1.0E-07	Service air is provided primarily for personnel use and is not require for the safe operation of any reactor shutdown equipment.
1SAS*MOV103	Service Air Leakage Control Valve	<1.0E-07	Service air is provided primarily for personnel use and is not require for the safe operation of any reactor shutdown equipment.
1SFC*MOV119	Containment Fuel Pool Inlet Containment Isolation Valve	<1.0E-07	Fuel pool cooling is not normally performed during power operations. The fuel pool cooling system is not used for cooling the core in-vessel. Fuel pool cooling will be considered in a Shutdown PSA.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SFC*MOV120	Fuel Pool Cooling Suction Containment Isolation Valve	<1.0E-07	Fuel pool cooling is not normally performed during power operations. The fuel pool cooling system is not used for cooling the core in-vessel. Fuel pool cooling will be considered in a Shutdown PSA.
1SFC*MOV121	Fuel Pool Purification Suction Containment Isolation Valve	<1.0E-07	Fuel pool cooling is not normally performed during power operations. The fuel pool cooling system is not used for cooling the core in-vessel. Fuel pool cooling will be considered in a Shutdown PSA.
1SFC*MOV122	Fuel Pool Cooling Suction Containment Isolation Valve	<1.0E-07	Fuel pool cooling is not normally performed during power operations. The fuel pool cooling system is not used for cooling the core in-vessel. Fuel pool cooling will be considered in a Shutdown PSA.
1SVV*MOV1A	Steam Safety & Relief Valve System Containment Isolation Valve	<1.0E-07	This valve supplies compressed air to open the Division A SRVs. This valve was not modelled because it does not change state during accident conditions and the accumulators for each SRV would also have to fail in order for pressure control to fail.
1SVV*MOV1B	Steam Safety & Relief Valve System Containment Isolation Valve	<1.0E-07	This valve supplies compressed air to open the Division B SRVs. This valve was not modelled because it does not change state during accident conditions and the accumulators for each SRV would also have to fail in order for pressure control to fail.
1SWP*MOV190	Service Water to CCP - Not Powered, Administratively Controlled	<1.0E-07	This valve takes SWP flow upsteam of 510A and directs it to the RHR pump A seals. It is a small line (1") any is not credited for any accident. Not called out in AOP-0011.
1SWP*MOV27A	Control Building Chiller "A" Recirculation Pump Suction Valve	<1.0E-07	This valve was modelled assuming that HVK pump 1A is running. Based on this assumption, the failure mode of this valve is passive and of low risk significance.
1SWP*MOV27B	Control Building Chiller "B" Recirculation Pump Suction Valve	<1.0E-07	This valve was modelled assuming that HVK pump 1B is in standby. Based on this assumption, the failure mode of this valve is passive and of low risk significance.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SWP*MOV27C	Control Building Chiller "C" Recirculation Pump Suction Valve	<1.0E-07	This valve is modelled assuming that HVK pump 1C is in standby. Based on this assumption, the valve has to change state, however, HVK Pump train A also has to fail. Therefore the valve has low risk significance.
1SWP*MOV27D	Control Building Chiller "D" Recirculation Pump Suction Valve	<1.0E-07	This valve is modelled assuming that HVK pump 1D is in standby. Based on this assumption, the valve has to change state, however, HVK pump train B also has to fail. Therefore the valve has low risk significance.
1SWP*MOV4A	Normal Service Water "A" Supply to Drywell Isolation Valve	<1.0E-07	This valve provides flow to the Drywell unit coolers. This valve was not considered in the PSA because it does not effect injection and drywell and containment analysis was done without drywell unit coolers.
1SWP*MOV4B	Normal Service Water "B" Supply to Drywell Isolation Valve	<1.0E-07	This valve provides flow to the Drywell unit coolers. This valve was not considered in the PSA because it does not effect injection and drywell and containment analysis was done without drywell unit coolers.
1SWP*MOV501A	SWP Supply Isolation to CCP Heat Exchangers	<1.0E-07	This valve is normally closed (MR-86-0161) to allow SWP division A heat loads to be able to be cooled by one SSW pump. It does not need to change state, therefore it is not modelled.
1SWP*MOV501B	SWP Supply Isolation to CCP Heat Exchangers	<1.0E-07	This valve normally supplies SWP flow through the CCP heat exchangers. Failure of this valve is considered in the loss of CCP initiator, however it is not modelled explicitly since it is a passive valve.
1SWP*MOV505A	SSW Crossover Valve	<1.0E-07	This valve allows for crossover flow from SSW A to SSW B. This valve is not credited due to lack of procedural guidance.
1SWP*MOV505B	SSW Crossover Valve	<1.0E-07	This valve allows for crossover flow from SSW A to SSW B. This valve is not credited due to lack of procedural guidance.
1SWP*MOV511A	SWP Return Isolation to CCP Heat Exchangers	<1.0E-07	This valve is normally closed (MR-86-0161) to allow SWP division A heat loads to be able to be cooled by one SSW pump. It does not need to change state, therefore it is not modelled.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SWP*MOV511B	SWP Return Isolation to CCP Heat Exchangers	<1.0E-07	This valve normally supplies SWP flow through the CCP heat exchangers. Failure of this valve is considered in the loss of CCP initiator, however it is not modelled explicitly since it is a passive valve.
1SWP*MOV5A	Normal Service Water "A" Return to Drywell Isolation Valve	<1.0E-07	This valve provides flow from the Drywell unit coolers. This valve was not considered in the PSA because it does not effect injection and drywell and containment analysis was done without drywell unit coolers.
1SWP*MOV5B	Normal Service Water "B" Return to Drywell Isolation Valve	<1.0E-07	This valve provides flow from the Drywell unit coolers. This valve was not considered in the PSA because it does not effect injection and drywell and containment analysis was done without drywell unit coolers.
1SWP*MOV61A	NSW Isolation to Unit 2-No Seat Line Capped	<1.0E-07	This valve is capped since there is no Unit 2. Therefore it is insignificant.
1SWP*MOV61B	NSW Return to Unit 2-No Seat Line Capped	<1.0E-07	This valve is capped since there is no Unit 2. Therefore it is insignificant.
1SWP*MOV73A	Service Water Supply to HPCS UC HVR*UC5	<1.0E-07	This valve supplies SWP to HPCS unit cooler. Loss of HPCS ventillation is assumed not to cause a HPCS system failure. If this failure were modelled it would be a low risk valve due to backup from 73B.
1SWP*MOV73B	Service Water Supply to HPCS UC HVR*UC5	<1.0E-07	This valve supplies SWP to HPCS unit cooler. Loss of HPCS ventillation is assumed not to cause a HPCS system failure. If this failure were modelled it would be a low risk valve due to backup from 73A.
1SWP*MOV74A	Service Water Return to HPCS UC HVR*UC5	<1.0E-07	This valve supplies SWP to HPCS unit cooler. Loss of HPCS ventillation is assumed not to cause a HPCS system failure. If this failure were modelled it would be a low risk valve due to backup from 74B.
1SWP*MOV74B	Service Water Return to HPCS UC HVR*UC5	<1.0E-07	This valve supplies SWP to HPCS unit cooler. Loss of HPCS ventillation is assumed not to cause a HPCS system failure. If this failure were modelled it would be a low risk valve due to backup from 74A.

TABLE E2 GL 89-10 MOV INFORMATION (Continued)

1SWP*MOV81A	NSW Return from Drywell & Containment Isolation Valve	<1.0E-07	This valve provides flow from the Drywell unit coolers. This valve was not considered in the PSA because it does not effect injection and drywell and containment analysis was done without drywell unit coolers.
1SWP*MOV81B	NSW Return from Drywell & Containment Isolation Valve	<1.0E-07	This valve provides flow from the Drywell unit coolers. This valve was not considered in the PSA because it does not effect injection and drywell and containment analysis was done without drywell unit coolers.
1WCS*MOV111	RWCU Blowdown	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1WCS*MOV172	RWCU Backwash Discharge Containment Isolation Valve	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1WCS*MOV173	RWCU Backwash to Radwaste	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1WCS*MOV178	RWCU Backwash Discharge Containment Isolation Valve	<1.0E-07	RWCU operation is not needed to mitigate the effects of an accident.
1E12*MOVF026A	RHR Discharge to RCIC	0.00	This valve was disabled during RF-3.
1E12*MOVF026B	RHR Discharge to RCIC	0.00	This valve was disabled during RF-3.
1E12*MOVF052A	Heat Exchanger Steam Supply - Locked Closed	0.00	This valve is deleted during RF-3.
1E12*MOVF052B	Heat Exchanger Steam Supply - Locked Closed	0.00	This valve is deleted during RF-3.
1E12*MOVF087A	Heat Exchanger Pressure Regulating Bypass Valve	0.00	This valve is deleted during RF-3.
1E12*MOVF087B	Heat Exchanger Pressure Regulating Bypass Valve	0.00	This valve is deleted during RF-3.

TABLE E3 - GL 89-10 MOV FAILURE RATE SENSITIVITY

MARK #	DESCRIPTION	MOV FAILURE RATE	
		Base Case (MOV=0.003)	Worst Case (MOV=0.087)
1SWP*MOV55A	SSW TRAIN A DISCHARGE VALVE	5.85E-02	3.59E-01
1SWP*MOV40C	SSW PUMP C DISCHARGE MOV	4.16E-02	1.27E-01
1SWP*MOV40A	SSW PUMP A DISCHARGE MOV	4.05E-02	1.30E-01
1SWP*MOV40D	SSW PUMP D DISCHARGE MOV	3.79E-02	2.54E-01
1SWP*MOV40B	SSW PUMP B DISCHARGE MOV	3.79E-02	2.54E-01
1SWP*MOV55B	SSW TRAIN B DISCHARGE VALVE	3.05E-02	1.86E-01
1E22*MOVF004	HPCS INJECTION MOV	9.84E-03	2.19E-01
1E22*MOVF012	HPCS MINIMUM FLOW VALVE	9.84E-03	2.17E-01
1E22*MOVF015	HPCS SUCTION FROM SUPPRESSION POOL	9.66E-03	2.29E-01
1E51*MOVF031	RCIC SUPPRESSION POOL SUCTION MOV	4.63E-03	2.34E-02
1E51*MOVF045	RCIC TURBINE STEAM INLET MOV	4.04E-03	5.37E-02
1E51*MOVF046	RCIC LUBE OIL COOLER MOV	3.97E-03	5.15E-02
1E51*MOVF019	RCIC TEST RETURN LINE MOV	3.97E-03	5.15E-02
1E51*MOVF013	RCIC REACTOR INJECTION MOV	3.97E-03	2.30E-02
1E12*MOVF042B	LPCI TRAIN B INJECTION MOV	5.50E-04	1.64E-01
1E12*MOVF042C	LPCI TRAIN C INJECTION MOV	5.50E-04	1.62E-01
1E12*MOVF042A	LPCI TRAIN A INJECTION MOV	5.50E-04	1.49E-01
1E21*MOVF011	LPCS MIN FLOW RECIRC. MOV (N.O.)	4.40E-04	9.95E-02
1E21*MOVF005	LPCS INJECTION LINE MOV	4.40E-04	9.18E-02
1SWP*MOV503A	SWP TRAIN A FROM CONTAINMENT FAN UNIT COOLER	9.33E-05	7.07E-02
1SWP*MOV502A	SWP TRAIN A TO CONTAINMENT FAN UNIT COOLER	9.33E-05	7.07E-02
1SWP*MOV503B	SWP TRAIN B FROM CONTAINMENT FAN UNIT COOLER	9.33E-05	2.17E-02
1SWP*MOV502B	SWP TRAIN B TO CONTAINMENT FAN UNIT COOLER	9.33E-05	2.17E-02
1SWP*MOV510A	SWP TRAIN A TO RPCCW LOADS	0	2.95E-02
1SWP*MOV504A	SWP TRAIN A FROM RPCCW LOADS	0	2.95E-02
1E12*MOVF068A	SWP TRAIN A FROM RHR HEAT EXCHANGERS A & C	0	2.79E-02
1E12*MOVF048A	RHS A HEAT EXCHANGER BYPASS MOV (N.O.)	0	2.34E-02
1SWC-MOV1C	SWC PUMP C DISCHARGE MOV	0	1.84E-02
1SWP-MOV170C	NSW PUMP C DISCHARGE MOV	0	1.84E-02
1E12*MOVF024A	TRAIN A SPC INJECTION VALVE BACK TO SUPPRESSION POOL (N.O.)	0	8.87E-03

TABLE E3 GL 89-10 MOV FAILURE RATE SENSITIVITY (Continued)

MARK #	DESCRIPTION	MOV FAILURE RATE	
		Base Case (MOV=0.003)	Worst Case (MOV=0.087)
1SWP*MOV510B	SWP TRAIN B TO RPCCW LOADS	0	5.86E-03
1SWP*MOV504B	SWP TRAIN B FROM RPCCW LOADS	0	5.86E-03
1E12*MOVF068B	SWP TRAIN B FROM RHR HEAT EXCHANGERS B & D	0	4.71E-03
1E12*MOVF053A	SDC TRAIN A MOV TO MIXING TEE	0	1.99E-03
1E12*MOVF009	RHS PUMPS A AND B SDC SUCTION MOV	0	1.99E-03
1E12*MOVF008	RHS PUMPS A AND B SDC SUCTION MOV	0	1.99E-03
1E12*MOVF006A	RHS PUMP A SDC SUCTION MOV	0	1.99E-03
1E12*MOVF004A	RHS PUMP A SUCTION MOV (N.O.)	0	1.99E-03
1CCP*MOV169	RPCCW TO CRD PUMP SEALS	0	5.38E-04
1CCP*MOV163	RPCCW TO CRD PUMP SEALS	0	5.38E-04
1E12*MOVF048B	RHS B HEAT EXCHANGER BYPASS MOV (N.O.)	0	2.16E-04
1E12*MOVF096	SWP INJECTION LINE MOV	0	2.04E-04
1E12*MOVF094	SWP INJECTION LINE MOV	0	2.04E-04
1E22*MOVF001	HPCS SUCTION FROM CST (N.O.)	0	8.27E-05
1SWC-MOV9H	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9G	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9F	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9E	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9D	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9C	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9B	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1SWC-MOV9A	SWC HEATER EXCHANGER BACKWASH MOVS	0	7.13E-05
1E12*MOVF064A	RHS PUMP A MIN FLOW RECIRC MOV	0	2.95E-05
1E12*MOVF047A	RHS TRAIN A HX INLET VALVE (N.O.)	0	2.95E-05
1E12*MOVF003A	RHS TRAIN A HX DISCHARGE MOV (N.O.)	0	2.95E-05
1HVK*MOV20C	CONT BLDG CHILLED WATER PUMP P1C DISCHARGE VALVE	0	2.45E-05
1E21*MOVF001	LPCS SUCTION MOV FROM SUPPRESSION POOL (N.O.)	0	2.01E-05
1HVK*MOV20D	CONT BLDG CHILLED WATER PUMP P1D DISCHARGE VALVE	0	1.22E-05
1E51*MOVF068	RCIC TURBINE EXHAUST LINE MOV (N.O.)	0	1.11E-05

TABLE E3 GL 89-10 MOV FAILURE RATE SENSITIVITY (Continued)

MARK #	DESCRIPTION	MOV FAILURE RATE	
		Base Case (MOV=0.003)	Worst Case (MOV=0.08?)
1E51*MOVF064	RCIC TURBINE OUTBOARD ISOLATION MOV (N.O.)	0	1.11E-05
1E51*MOVF063	RCIC TURBINE INBOARD ISOLATION MOV (N.O.)	0	1.11E-05
1E51*MOVF010	RCIC CST SUCTION VALVE (N.O.)	0	3.28E-06
1SWP-MOV57B	NSW MOV TO SERVICE WATER TRAIN B	0	0
1SWP-MOV57A	NSW MOV TO SERVICE WATER TRAIN A	0	0
1SWP-MOV170B	NSW PUMP B DISCHARGE MOV	0	0
1SWP-MOV170A	NSW PUMP A DISCHARGE MOV	0	0
1SWP*MOV96B	NSW TRAIN B DISCHARGE VALVE	0	0
1SWP*MOV96A	NSW TRAIN A DISCHARGE VALVE	0	0
1SWP*MOV77B	SERVICE WATER TO HPCS DIESEL FROM TRAIN B	0	0
1SWP*MOV77A	SERVICE WATER TO HPCS DIESEL FROM TRAIN A	0	0
1SWP*MOV507B	SWP TRAIN B TO CONTAINMENT FAN UNIT COOLER (N.O.)	0	0
1SWP*MOV507A	SWP TRAIN A TO CONTAINMENT FAN UNIT COOLER (N.O.)	0	0
1SWP*MOV506B	SERVICE WATER FROM HPCS DIESEL TO SWP TRAIN B	0	0
1SWP*MOV506A	SERVICE WATER FROM HPCS DIESEL TO SWP TRAIN A	0	0
1SWP*MOV174	SSW TRAIN B HEADER MOV TO AB UNIT COOLERS	0	0
1SWP*MOV173	SSW TRAIN B DISCHARGE MOV FROM AB UNIT COOLERS	0	0
1SWP*MOV172	SSW TRAIN A HEADER MOV TO AB UNIT COOLERS	0	0
1SWP*MOV171	SSW TRAIN A DISCHARGE MOV FROM AB UNIT COOLERS	0	0
1SWC-MOV1B	SWC PUMP B DISCHARGE MOV	0	0
1SWC-MOV1A	SWC PUMP A DISCHARGE MOV	0	0
1HVK*MOV20B	CONT BLDG CHILLED WATER PUMP P1B DISCHARGE VALVE (N.O.)	0	0
1HVK*MOV20A	CONT BLDG CHILLED WATER PUMP P1A DISCHARGE VALVE (N.O.)	0	0
1G33*MOVF004	RWCU ISOLATION MOV OUTSIDE CONTAINMENT	0	0
1G33*MOVF001	RWCU ISOLATION MOV INSIDE CONTAINMENT	0	0

TABLE E3 GL 89-10 MOV FAILURE RATE SENSITIVITY (Continued)

MARK #	DESCRIPTION	MOV FAILURE RATE	
		Base Case (MOV=0.003)	Worst Case (MOV=0.087)
1E12*MOVF105	LPCI PUMP C SUPPRESSION POOL SUCTION VALVE (N.O.)	0	0
1E12*MOVF064C	RHS PUMP C MIN FLOW RECIRC MOV (N.O.)	0	0
1E12*MOVF064A	RHS PUMP B MIN FLOW RECIRC MOV	0	0
1E12*MOVF053B	SDC TRAIN B MOV TO MIXING TEE	0	0
1E12*MOVF047B	RHS TRAIN B HX INLET VALVE (N.O.)	0	0
1E12*MOVF027B	LPCI TRAIN B INJECTION MOV (N.O.)	0	0
1E12*MOVF027A	LPCI TRAIN A INJECTION MOV (N.O.)	0	0
1E12*MOVF024B	TRAIN B SPC INJECTION VALVE BACK TO SUPPRESSION POOL (N.O.)	0	0
1E12*MOVF006B	RHS PUMP B SDC SUCTION MOV	0	0
1E12*MOVF004B	RHS PUMP B SUCTION MOV (N.O.)	0	0
1E12*MOVF003B	RHS TRAIN B HX DISCHARGE MOV (N.O.)	0	0
1CCP*MOV336	RPCCW LOOP B NORMAL RETURN VALVE	0	0
1CCP*MOV335	RPCCW LOOP A NORMAL RETURN VALVE	0	0
1CCP*MOV16B	RPCCW LOOP B NORMAL SUPPLY VALVE	0	0
1CCP*MOV16A	RPCCW LOOP A NORMAL SUPPLY VALVE	0	0
1CCP*MOV130	RPCCW LOOP B NORMAL RETURN VALVE	0	0
1CCP*MOV129	RPCCW LOOP A NORMAL RETURN VALVE	0	0
1C41*MOVF001B	SLCS PUMP 1B DISCHARGE MOV	0	0
1C41*MOVF001A	SLCS PUMP 1A DISCHARGE MOV	0	0
1C11*MOVF083	CRD CONTAINMENT ISOLATION MOV	0	0
Overall CDF		1.55E-05	6.10E-04

TABLE E4
BWR E PRIORITIZATION RESULTS

% RISK	NO. OF MOVs IN CATEGORY	CUMULATIVE NO. OF MOVs
High 95	0	0
Medium 99.9	20	20
Low >99.9	199	219
High 99	6	6
Medium 99.99	31	37
Low >99.99	182	219

TABLE E5
BWR E FAILURE RATE SENSITIVITY

	NO. OF MOVs IN CATEGORY	
% RISK	FAILURE RATE = 0.087	FAILURE RATE = 0.003*
High 95	22	0
Medium 99.9	34	20
Low>99.9	163	199
High 99	35	6
Medium 99.99	28	31
Low >99.99	156	182
CDF	6.1E-4/year	1.55E-5/year

*0.003 per demand used in plant IPE

TABLE E6
BWR E FAILURE RATE SENSITIVITY

MOV FAILURE RATE

% RISK	CASE 1	CASE 2
High 95	0.003	0.003
Medium 99.9	0.087	0.003
Low>99.9	0.087	0.087
CDF	1.96E-5/year	1.56E-5/year
High 99	0.003	0.003
Medium 99.99	0.087	0.003
Low>99.99	0.087	0.087
CDF	1.56E-5/year	1.55E-5/year

ADDENDUM 1

NEDC-32264-A
REVSION 2

SEPTEMBER 1996

BWR OWNERS' GROUP INTEGRATED RISK-BASED REGULATION

COMMITTEE REPORT

RANKING PROCESSES

CONTENTS

1.0 SUMMARY

Several measures exist to rank the importance of structures, systems, and components (SSCs) in Probabilistic Safety Assessments (PSAs) in relation to core damage frequency (CDF) and radionuclide release frequency (RRF).

The importances of SSCs in relation to CDF for average plant conditions are evaluated in Level 1 PSAs as follows:

- Importance in relation to the effect on CDF when the SSC is assumed not to fail, (i.e., failure probability of an SSC is set equal to 0).
- Importance in relation to the effect on CDF when the SSC is assumed to fail, (i.e., failure probability of an SSC is set equal to 1).
- Importance in relation to the SSC's contribution to the CDF.
- Importance in relation to the change in CDF when the SSC failure probability is increased or decreased by a specified factor.
- PSA importance measures can be applied at the component or system level.
- In addition to single SSC failures, PSAs include the importance of initiating events, common cause failures, maintenance unavailabilities, operator errors, and non-recovery factors on the CDF.
- The evaluation of the importance measures for a typical BWR plant PSA indicates there is a small set of components and failure events (less than 200) that significantly affect the CDF. The remaining components and events have a marginal to insignificant effect on the CDF. This same conclusion is drawn from a review of the majority of current PSAs.
- PSA importance measures provide an effective means of identifying the proper regulatory emphasis and requirements to be placed on SSCs and other elements that contribute to plant risk.

The importance of SSCs in relation to RRF is not as easily quantified as for CDF. The significance depends upon what boundary is breached: the vessel, the drywell, and/or the wetwell; and the accident class. Several different analytical techniques have been used by the utilities for Level 2 PSAs, so no attempt is made in this report to identify a uniform method for evaluating the importance of the SSCs on RRF.

Some utilities have performed Level 2 PSAs but some of the models and evaluation programs do not calculate importance measures for SSCs. Containment failure is the dominant factor in RRF and fault tree models can and have been developed for loss of containment. However, the models for some plants contain only frequencies for events leading up to the containment loss and not the cutsets for those events. Therefore, importances cannot be calculated for basic events leading up to the containment loss and ranking of those basic events must be done qualitatively.

2.0 INTRODUCTION

The BWR Owners' Group Committee on Integrated Risk-Based Regulation (IRBR) was established in 1992. One of the primary objectives of this Committee is to provide a mechanism for exchange of IRBR technology among participating utilities. An initial task of this Committee was to collect data on ranking of Systems, Structures, and Components (SSC) from each utility's plant PSA. Most utilities have performed PSAs as part of their Generic Letter 88-20 Individual Plant Examination (IPE) submittal.

The purpose of this report is to provide a summary discussion of different CDF importance measures and how they can be used to rank SSCs for use in IRBR. Data from the PSA of one of the survey plants was used to demonstrate the ranking schemes. It is recognized that the ranks of the basic events are dependent on the specific plant's PSA results and therefore may vary from plant to plant. These plant differences will be addressed in future IRBR Committee activities.

The IRBR Committee plans to demonstrate how these risk importance measures can be effectively used to establish priorities for SSCs in several different regulatory and operations applications. As work progresses, specific issues relating to the evaluation and implementation of importances will be addressed in these applications. The following is a listing of some of these issues:

- How should importances be used for win-win strategies?
- How should uncertainties be considered?
- What criteria should be used to separate important from unimportant contributors?
- How should the effects of component configurations and the status of other components in general be taken into account in calculating importances?
- How should the importances of multiple components and functions be evaluated?
- How should importances be utilized in developing risk management programs?

- How should importances be used in optimizing technical specifications, regulations, and operations?

- What are the dynamic aspects of importances which can cause importance values to change with different scenarios and time?

- What are the interactive aspects of importance which cause importances to change when components interact?

Initial applications are planned for prioritization of the testing of motor operated valves (MOVs), evaluation of operator actions contained in Emergency Procedure Guidelines (EPGs) and Accident Management Guidelines (AMGs), prioritization of plant work orders, and configuration control (i.e., control of "tag outs" and currently operable systems). These applications are intended to provide a broad spectrum of activities to test and address different issues relating to risk based regulation.

CAUTION

THE NUMERICAL METHODS FOR DETERMINING SSC IMPORTANCE SHOULD BE USED AS THE INITIAL INPUT FOR ANY EFFORT TO RANK OR GROUP SSCs BY RISK IMPORTANCE. THE NUMERICAL IMPORTANCE RESULTS ARE TO BE AUGMENTED AND VERIFIED BY SENSITIVITY STUDIES, QUALITATIVE REVIEWS, OPERATIONS/MAINTENANCE REVIEWS, AND ENGINEERING JUDGMENT TO PROVIDE CONFIDENCE IN THE RANKING.

3.0 SSC IMPORTANCE MEASURES

There are several measures used in the industry today to rank the importance of SSCs. The measures can be calculated at the system, train (subsystem), or component level. These measures are calculated for "average" plant conditions, and are therefore appropriate for decisions about maintenance programs, overall maintenance priorities, modifications, certain Technical Specifications requirements, and similar resource allocations. The level is limited by the degree of linking of the fault trees in the models. To obtain a better understanding of these measures, some of the more common importance measures used to rank SSCs in PSAs were calculated from data from one of the survey plants (designated as plant X). The total CDF for this plant was 2.60E-05/year. The model for this plant is a "linked model" containing initiating events as well as SSCs. There were a total of 429 basic events icluded in the core damage accident sequences. The first basic event in an accident sequence is the initiating event followed by component failures and other failure events that are necessary for core damage to occur. The following is a summary of the different types of basic events included in the plant X PSA:

Type of Basic Event	Number of Events
Initiating Event	24
Component/Hardware Failure	274
Common Cause Failure	68
Maintenance or Test Unavailability	24
Operator Error	25
Non-Recovery Factor or Probability	14
Total Basic Events	429

Approximately 2/3 of the basic events are single component failures. Most of the remaining basic events are caused by multiple component failures or maintenance of components. Operator error is the only type of basic event not related to component failure or maintenance. A more detailed description of the types of basic events is provided in Appendix Add A.

When using importance measures for particular types or families of basic events, two factors need to be addressed: 1) Basic events not included in the PSA models, and 2) basic events which may have been excluded from the final results by truncation limits used in the evaluation of models. These are amplified as follows:

1) In developing models, specific basic events may have been omitted because their function was not relevant to the sequence. Or they may have been incorporated in a "module" formed from an independent-sub-tree. In either event it is necessary to understand the details of the PSA models and insure that the basic events of interest are in the models.

2) In most evaluation programs truncation limits are set both in generating cutsets and again in evaluating the cutsets. In normal calculations of CDF, the truncation discounts basic events which do not contribute significantly to the results. If the importance of specific events is desired it is necessary to set truncation limits that will allow events of interest to appear in the end results. An alternate method is to set the unavailabilities of the events of interest to a high enough level to insure that they will appear in the cutsets. The evaluation of the cutsets can then be performed using a data base tailored to obtain the importance measures of interest. It is important to recognize that these importance measures are calculated for "basic events", not components. Often several basic events in the fault tree model are used to represent one component (i.e., Pump Fails to Start, Pump Fails to Run, Pump Out for Maintenance, etc). Properly determining "component" importance may involve working with several "basic events."

3.1 DEFINITIONS OF IMPORTANCE MEASURES

The following basic data were obtained for each basic event included in the plant X PSA:

SYMBOLS:

T = Base core damage frequency for all basic events

U = Failure probability (or unavailability) of individual basic event

T(0) = CDF with basic event assumed to never occur, (i.e., probability set equal to 0)

T(1) = CDF with basic event assumed to occur, (i.e., probability set equal to 1)

From the above basic PSA inputs the following importance measures can be calculated for each individual basic event:

a) Risk increase where basic event is assumed to occur (i.e., basic event probability set equal to 1).

Risk Increase = T(1) - T

b) Risk reduction where basic event is assumed never to occur (i.e., basic event probability set equal to 0).

Risk Decrease = T - T(0)

c) Fussell-Vesely (FV) importance is the fraction of the CDF which involves the basic event divided by the base CDF. In some PSAs this represents the sum of the CDF for the minimum cutsets containing the basic event divided by base CDF. A minimum cutset is defined as the smallest combination of failures (or basic events) which, if they all occur, will cause the top event (core damage) to occur.

$$FV = \{T - T(0)\}/T$$

d) Criticality (CRIT) importance is as follows:

$$CRIT = \{[T(1) - T(0)]*U\}/T = FV$$

e) Risk Reduction Worth (RRW) is the base CDF divided by CDF with U = 0.

$$RRW = T/T(0)$$

f) Birnbaum (BIRN) importance is as follows:

$$BIRN = T(1) - T(0) = CRIT*(T/U)$$

g) Risk Achievement Worth (RAW) is the CDF with U = 1 divided by base CDF.

$$RAW = T(1)/T$$

h) Cumulative % Risk Contribution is calculated by first ranking (sorting) the basic events by decreasing "Risk Decrease" or decreasing "F-V." The % risk reduction is the risk decrease divided by the sum of the risk decreases of all basic events. The cumulative % risk reduction is then the sum of the individual % risk reduction in order of their size. The number of SSCs included depends upon the total cumulative % of interest.

$$\% \text{ Risk Reduction} = \frac{\{T - T_i(0)\}}{\underset{j=1}{\overset{m}{S}} \{T - T_j(0)\}*100}$$

$$\text{Cumulative \% Risk Contribution} = \underset{i=1}{\overset{n}{S}} \{\% \text{ Risk Reduction}_i\}$$

where "n" is the number of SSCs required to obtain the cumulative % risk of interest.

4.0 APPLICATION OF IMPORTANCE MEASURES

The following basic input information from the plant X PSA is provided in spreadsheet format in Table Add-B1 of Appendix Add B. The presentation is in order of decreasing {T-T(0)} (decreasing "Risk Decrease").

Column

- A Basic Event Description and Type of Basic Event
- B Basic Event Code
- C Event Probability

Measures Related to Risk Reduction

- D CDF Where Event Does Not Occur
- E Risk Decrease

Measures Related to Risk Increase

- F CDF Where Event Occurs
- G Risk Increase

Using the above input data, the different importance measures given in Section 3.1 (except percent change in risk) were calculated for each basic event, ranked from high to low, and grouped according to the type of importance measure (either risk reduction or risk increase). In addition, the cumulative % risk contribution, as defined in Section 3.1, was calculated for each basic event. The calculations are presented in Table Add-B2 of Appendix Add B in the same order as Table Add-B1.

The first group of rankings in Table Add-B2 are related to risk reduction and includes the Fussell-Vesely, Criticality, and Risk Reduction Worth importance measures. The second group are related to risk increase and includes the Birnbaum, Risk Increase, and Risk Achievement Worth importance measures. It can be seen from Table Add-B2 that for risk reduction, ranking is nearly identical. For risk increase, correspondence is also very good for the first 200 entries in the ranking. This means that the precise importance measure chosen to evaluate risk reduction or risk increase may vary. Choice of any measure will result in a comparable component ranking. However, the rankings are significantly different between the two groups of importance measures. The reason for this difference is provided in the following discussion:

4.1 Risk Reduction Importance Measures

The importance measures related to risk reduction evaluate the effect on CDF when the basic event is assumed never to occur. This type ranking can be used to establish the priorities for the importance of SSCs in relation to CDF risks[a]. A high SSC ranking indicates that the SSC is a major contributor to the CDF risk and should receive the most attention for improvement.

This kind of importance measure helps in establishing priorities for modifications, corrective maintenance work, as well as identifying which components merit more frequent testing or replacement with more reliable components. A low SSC ranking beyond a specified criteria indicates that improving the SSC has a very little effect on the CDF. Table Add-2 provides a summary of the basic events from the plant X PSA that are ranked by risk reduction. Only six component failure events appear in the top 25 basic event ranking. Common cause failures, initiating events, and operator non-recovery events make up the balance of the top 25 basic events.

[a]Many SSCs are represented by only one basic event. For these, the basic event importance is equivalent to the component importance. For other components, like diesel-generators, the component importance is some combination of basic event importances (e.g., for fail-to-start, fail-to-run, etc). In this discussion, for simplicity, it will be assumed that basic event importance and component importance are equivalent.

4.2 Risk Increase Importance Measures

The risk increase measure provides the change in CDF when the basic event is assumed always to occur. This type of importance measure is used for three purposes. The first is to identify the risk insignificance of a basic event. This identifies which components could be removed from maintenance and testing programs, and which could be removed from Technical Specifications. A low SSC ranking implies the SSC has an insignificant effect on the CDF without regard to its occurrence probability. A high SSC ranking may require further evaluation of the SSC failure probability. A basic event, such as a common cause failure, an initiating event, or a structural failure which may a have negligible failure probability could have a high risk increase importance. Components with high risk increase importance are the components whose performance should not be allowed to deteriorate. The risk increase measure is also used when evaluating the effect on CDF when a system, train, or component is taken out of service to perform maintenance or test. When an SSC is found to have a low risk increase measure, this implies that when the SSC is taken out of service there is very little effect on CDF. Allowed out of service times should reflect this low risk significance.

Table Add-1 provides a summary of the basic events from the Plant X PSA that are ranked by risk increase. It can be seen that the top 25 basic events are due to common cause failures, initiating events, and one operator error. However, almost all of these 25 basic events have a low risk reduction ranking in Table Add-2 based on their low basic event probabilities. It is not surprising that common cause events have a high risk increase importance. Note also that when common cause events are excepted, component/hardware failures are the next single most important type of event.

Other observations can be made concerning the risk increase importance of the different type of PSA basic events. For example, only 11 individual component failures are included in the top 50 basic event ranking. Basic events due to maintenance and test are not ranked in the top 100 important basic events.

4.3 Cumulative % Risk Contribution

The cumulative % risk contribution importance measure is another method for evaluating the importance and non-importance of SSCs and other basic events. This importance measure provides an efficient method of identifying basic events that contribute to significant core damage risk. Table Add-3 provides a summary of the cumulative % risk contribution for the basic events given in the Plant X PSA. The same information is given in graphical form in Figure 1. It can be seen that the top 54 of the total 429 basic events contribute 90% of the total possible CDF improvement. Twenty-four (24) of these 54 events are individual component failures. It can also be seen that the bottom 263 out of the 429 basic events contribute less than 1% to the total CDF. This implies that at least 61% of the PSA basic events have an insignificant effect on the CDF.

4.4 Percent Change in Risk

This importance measure provides a realistic evaluation of the sensitivity of the changes in SSC failure probabilities on the CDF as opposed to setting the basic event probability equal to 0 or 1. This importance measure ranks the effect on CDF when the basic event failure probability is changed by a specified factor. If the basic event failure probability is changed by a factor f, the risk reduction importance measure times (f-1) provides the change in CDF.

4.5 Application Considerations

This study has revealed several items which should be considered by analysts performing, modifying, or utilizing PSA's in the future to enhance application of PSA results as a plant management tool:

a) Initiating events must be included as basic events in the PSA and any components within the initiating events need to be accounted for in any component importances.

b) High human error rates, recovery factors, maintenance events may mask true importance when relative importance measures are used.

c) Remember that conservatisms in modeling factors not related to the items being ranked become non-conservative when relative importances are used. Exzmple: if an operator action is modeled "conservatively" and then becomes 95% of the CDF, then no other components will contribute more than 5%. If operator error rate is a factor of 10 conservative, importance of other components will be under estimated in this case by a large factor (~10x). If a known significant conservatism exists, a lower definition of significant importance categories may need to be considered.

d) Modeling Risk Acheivement Worth is a major perturbation to the model, and will not be valid for many low importance components, because the model was not assembled with "guaranteed failures" (i.e., U = 1) in mind.

c) Be aware of software-specific pitfalls (i.e., unique approaches to importance calculations and Level 1 to Level 2 linking.)

f) The analyst must look at more than single issue (i.e., CDF).

g) The results group basic events into rough groups to de-emphasize risk and allow other factors to influence the group into which events are placed.

5.0 SYSTEM IMPORTANCE MEASURES

The same importance measures developed for PSA basic events can be applied at the system level. This analysis requires a good knowledge of the fault tree model and the inter-dependencies of support systems for the system being considered. In essence, the system is being treated as an independent module. The factor increase in CDF when the system is assumed to fail (probability set equal to 1), % decrease in CDF when the system is assumed never to fail (probability set equal to 0), and cumulative % risk contribution are presented in Table Add-4 for the systems included in the plant X PSA. The same importance measures are shown graphically in Figures 2, 3, and 4.

It can be seen from Figure 2 (risk increase) that for about half of the systems, the CDF changes significantly when the system is assumed to fail. The CDF changes by a factor of 500 when Reactor Protection System (RPS) is assumed to have failed. For the Residual Heat Removal Service Water (RHRSW) and Emergency Diesel Generator (EDG) systems, the CDF changes by about a factor of 200 when each system is assumed to have failed. Other systems have a negligible effect on CDF when they are assumed to have failed.

The same three systems having the greatest effect on CDF when assumed to have failed (RPS, RHRSW, and EDG) also have the highest importance for % CDF risk reduction (refer to Figure 3). Eleven (11) out of the 20 systems account for approximately 90% of the total CDF (refer to Figure 4). Four of the systems are insignificant contributors to CDF, (i.e., together they contribute less than 1% to the total CDF).

Other system importance measures can be developed by increasing the failure probabilities for selected groups of PSA basic events within the system. For example, the effect of the CDF can be evaluated when all failure probabilities of individual components within the system are doubled while keeping the failure probabilities of the remaining basic events within the system constant.

TABLE Add-1

CDF RISK INCREASE

RANK	CUM. NUMBER OF EVENTS	NUMBER OF BASIC EVENTS C	F	I	M	O	R
1-25	25	0	21	3	0	1	0
26-50	50	11	8	6	0	0	0
51-75	75	13	10	2	0	0	0
76-100	100	16	9	0	0	0	0
101-150	150	39	0	1	6	4	0
151-200	200	33	1	3	10	3	0
201-250	250	32	9	2	1	5	1
251-300	300	46	0	2	0	0	2
301-350	350	42	0	2	0	2	4
351-400	400	29	3	3	3	7	5
>401	429	13	7	0	4	3	2
TOTAL	429	274	68	24	24	25	14

C = COMPONENT/HARDWARE FAILURE
F = COMMON CAUSE FAILURE
I = INITIATING EVENT
M = UNAVAILABILITY DUE TO MAINTENANCE OR TEST
O = OPERATOR ERROR
R = RECOVERY FACTOR OR PROBABILITY

TABLE Add-2

CDF RISK REDUCTION

RANK	CUM NUMBER OF EVENTS	NUMBER OF BASIC EVENTS C	F	I	M	O	R
1-25	25	6	4	7	0	2	6
26-50	50	15	4	3	0	2	1
51-75	75	9	5	1	4	4	2
76-100	100	7	9	3	4	2	0
101-150	150	34	6	4	0	5	1
151-200	200	28	6	5	1	7	3
201-250	250	26	18	1	3	1	1
251-300	300	40	7	0	2	1	0
301-350	350	38	9	0	2	1	0
351-400	400	48	0	0	2	0	0
>401	429	23	0	0	6	0	0
TOTAL	429	274	68	24	24	25	14

C = COMPONENT/HARDWARE FAILURE
F = COMMON CAUSE FAILURE
I = INITIATING EVENT
M = UNAVAILABILITY DUE TO MAINTENANCE OR TEST
O = OPERATOR ERROR
R = RECOVERY FACTOR OR PROBABILITY

TABLE Add-3

CUMULATIVE CDF % RISK CONTRIBUTION

CUMULATIVE % RISK CONTRIBUTION	TOTAL NUMBER OF EVENTS	CUM. NUMBER OF EVENTS	NUMBER OF BASIC EVENTS					
			C	F	I	M	O	R
10%	1	1	0	0	0	0	0	1
20%	1	2	0	0	1	0	0	0
30%	1	3	0	0	0	0	0	1
40%	1	4	0	0	0	0	0	1
50%	1	5	0	0	0	0	0	1
60%	2	7	0	0	0	0	0	2
70%	4	11	0	2	1	0	1	0
80%	11	22	4	2	4	0	1	0
90%	32	54	20	4	4	1	2	1
95%	33	87	9	8	3	6	5	2
96%	12	99	4	6	1	1	0	0
97%	16	115	11	0	1	0	3	1
98%	20	135	11	4	3	0	2	0
99%	31	166	21	4	1	0	4	1
99.9%	130	296	84	27	5	6	5	3
100%	133	429	110	11	0	10	2	0
	429		274	68	24	24	25	14

C = COMPONENT/HARDWARE FAILURE
F = COMMON CAUSE FAILURE
I = INITIATING EVENT
M = UNAVAILABILITY DUE TO MAINTENANCE OR TEST
O = OPERATOR ERROR
R = RECOVERY FACTOR OR PROBABILITY

TABLE Add-4 - PLANT X SYSTEM RANKING

TOTAL CDF = 2.60E-05/YEAR

SAFETY FUNCTION	PLANT SYSTEM	FACTOR INCREASE IN CDF WHEN U = 1 {T(1)-T}/T	RANK	% DECREASE IN CDF WHEN U = 0 {T-T(0)}*100/T	RANK	CUM. % RISK CONTRIBUTION
CONT. HEAT REMOV.	RHRSW	223.08	2	24.2%	2	25.55%
CONT. HEAT REMOV.	MAIN CONDENSER	1.42	12	14.3%	6	62.60%
CONT. HEAT REMOV.	CONTAINMENT VENT	0.87	16	9.2%	10	87.57%
REACTIVITY	RPS	500.00	1	24.0%	3	38.16%
REACTIVITY	CRD HYDRAULIC	0.63	18	14.3%	7	70.12%
REACTIVITY	SLC	1.19	15	2.3%	14	97.29%
REACTIVITY	ARI	0.81	17	0.4%	18	99.76%
REACTIVITY	RPT	0.63	19	0.3%	19	99.92%
SUPPORT	EDGs	203.85	3	24.4%	1	12.83%
SUPPORT	INST. AIR	42.31	6	9.8%	9	82.73%
SUPPORT	DC POWER	35.38	7	3.8%	13	96.08%
SUPPORT	OFFSITE POWER	28.85	8	1.1%	17	99.55%
SUPPORT	SERVICE WATER	92.31	5	0.15%	20	100.00%
WATER INJECTION	HPCI	1.27	14	16.8%	4	46.99%
WATER INJECTION	RHR/LPCI	169.23	4	15.4%	5	55.09%
WATER INJECTION	RCIC	2.46	10	14.2%	8	77.58%
WATER INJECTION	CORE SPRAY	1.42	13	7.7%	11	91.62%
WATER INJECTION	ADS	< 0.38	20	4.7%	12	94.09%
WATER INJECTION	FEEDWATER	8.08	9	1.6%	16	98.98%
WATER INJECTION	CONDENSATE	1.54	11	1.6%	15	98.13%

FIGURE 1 CUMULATIVE % RISK CONTRIBUTION

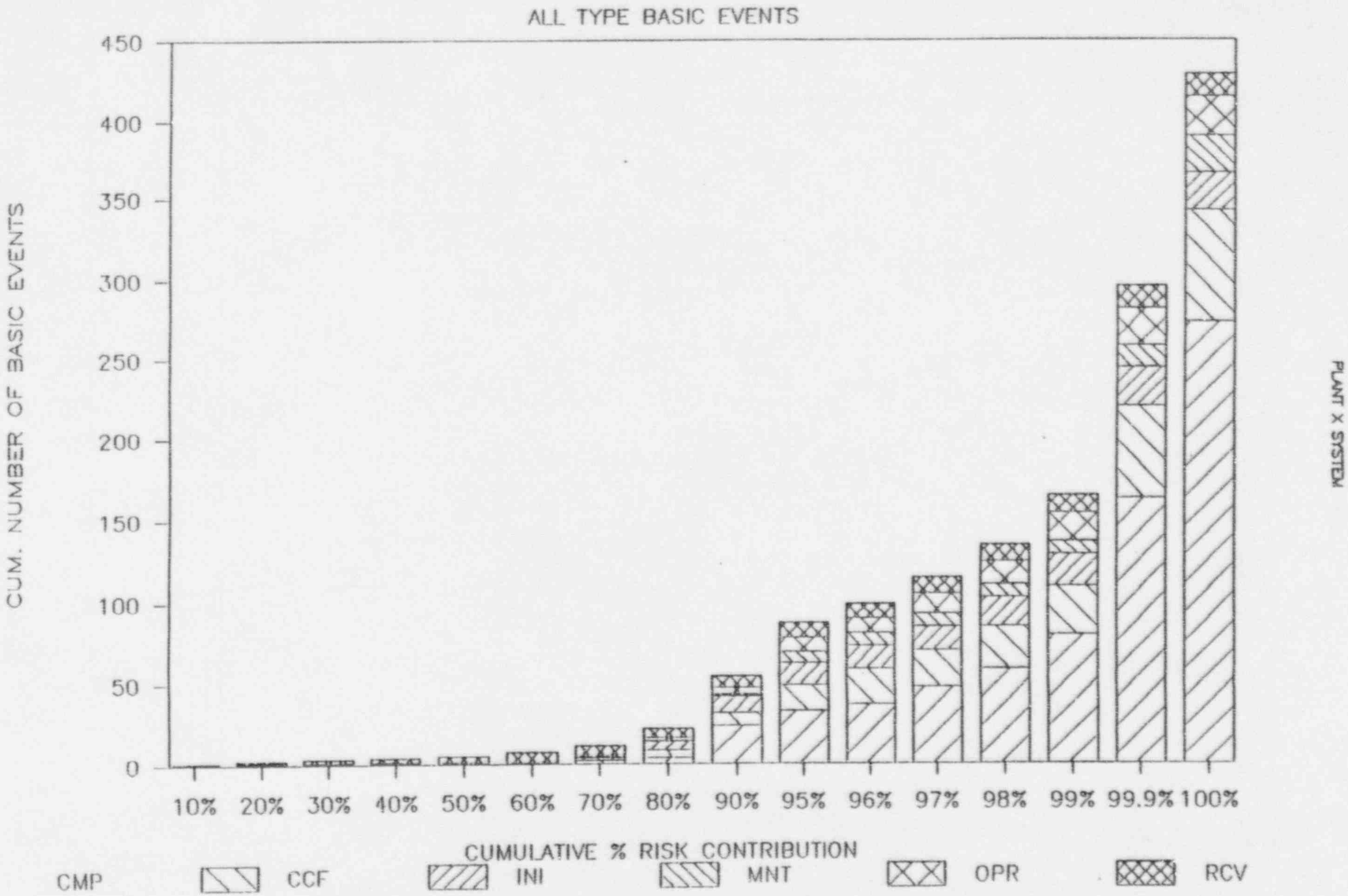


FIGURE 2

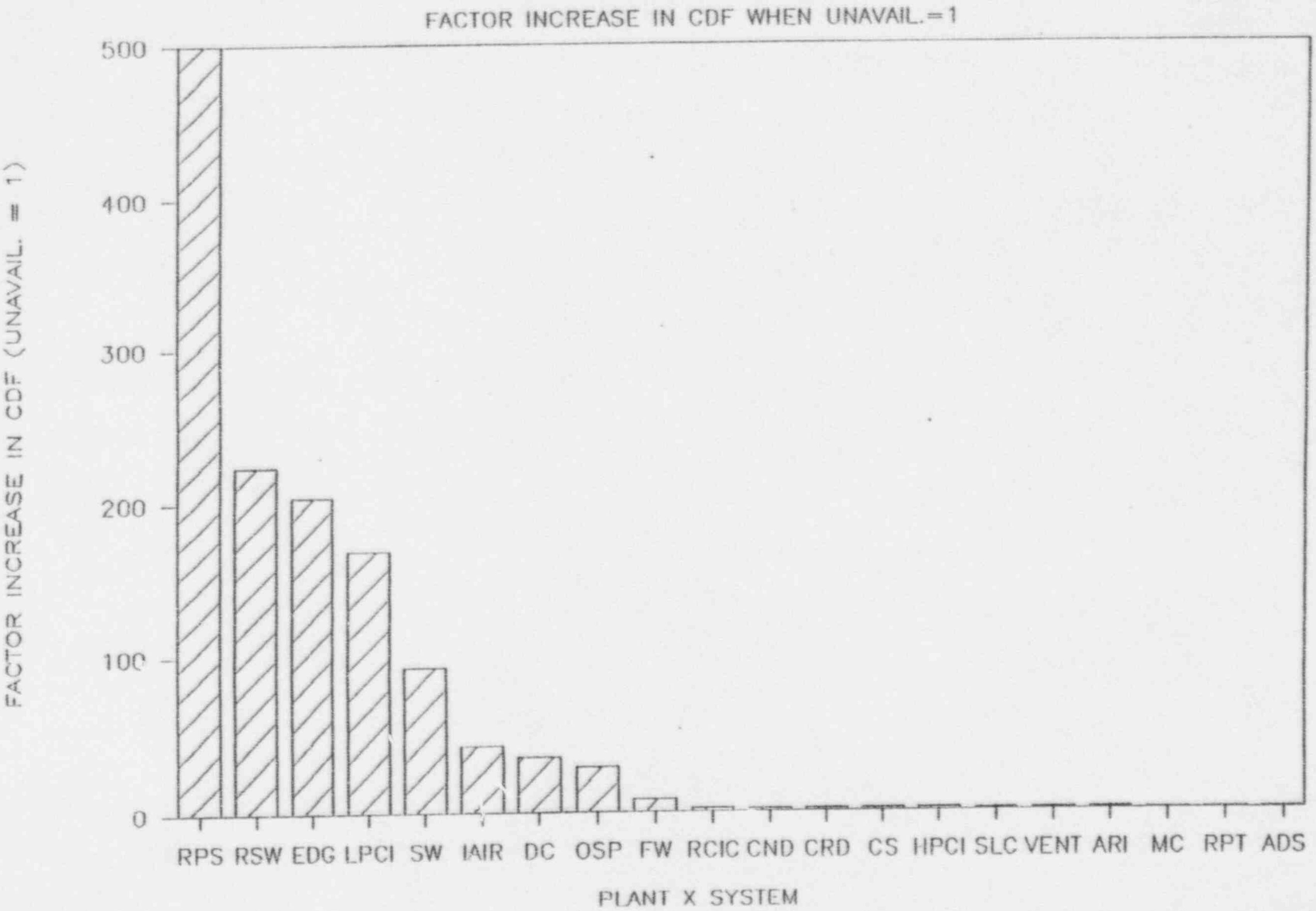

FACTOR INCREASE IN CDF WHEN UNAVAIL.=1
FACTOR INCREASE IN CDF (UNAVAIL. = 1)
500
400
300
200
100
0
RPS
RSW
EDG
LPCI
SW
IAIR
DC
OSP
FW
RCIC
CND
CRD
CS
HPCI
SLC
VENT
ARI
MC
RPT
ADS
PLANT X SYSTEM

FIGURE 3

% CDF RISK REDUCTION

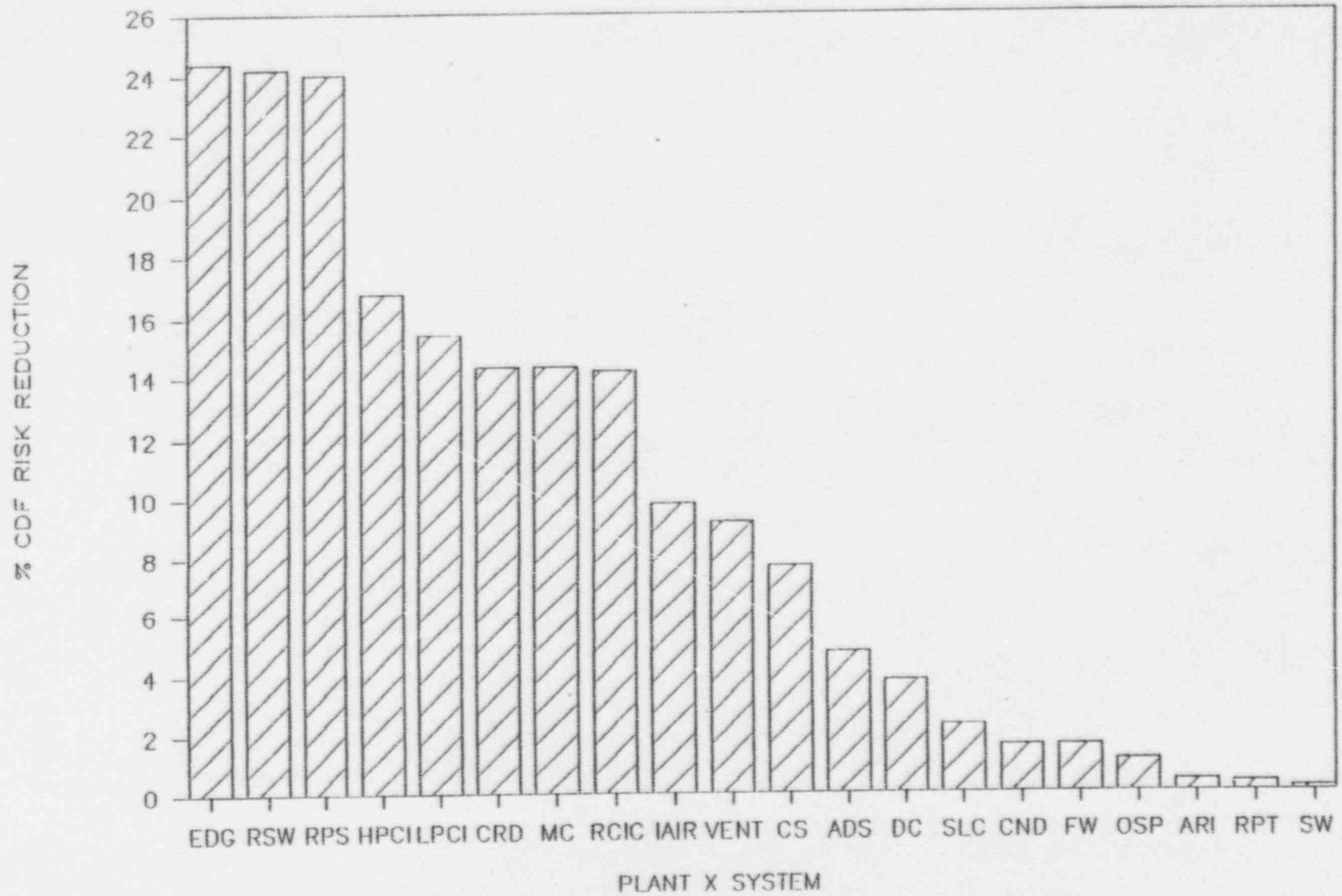
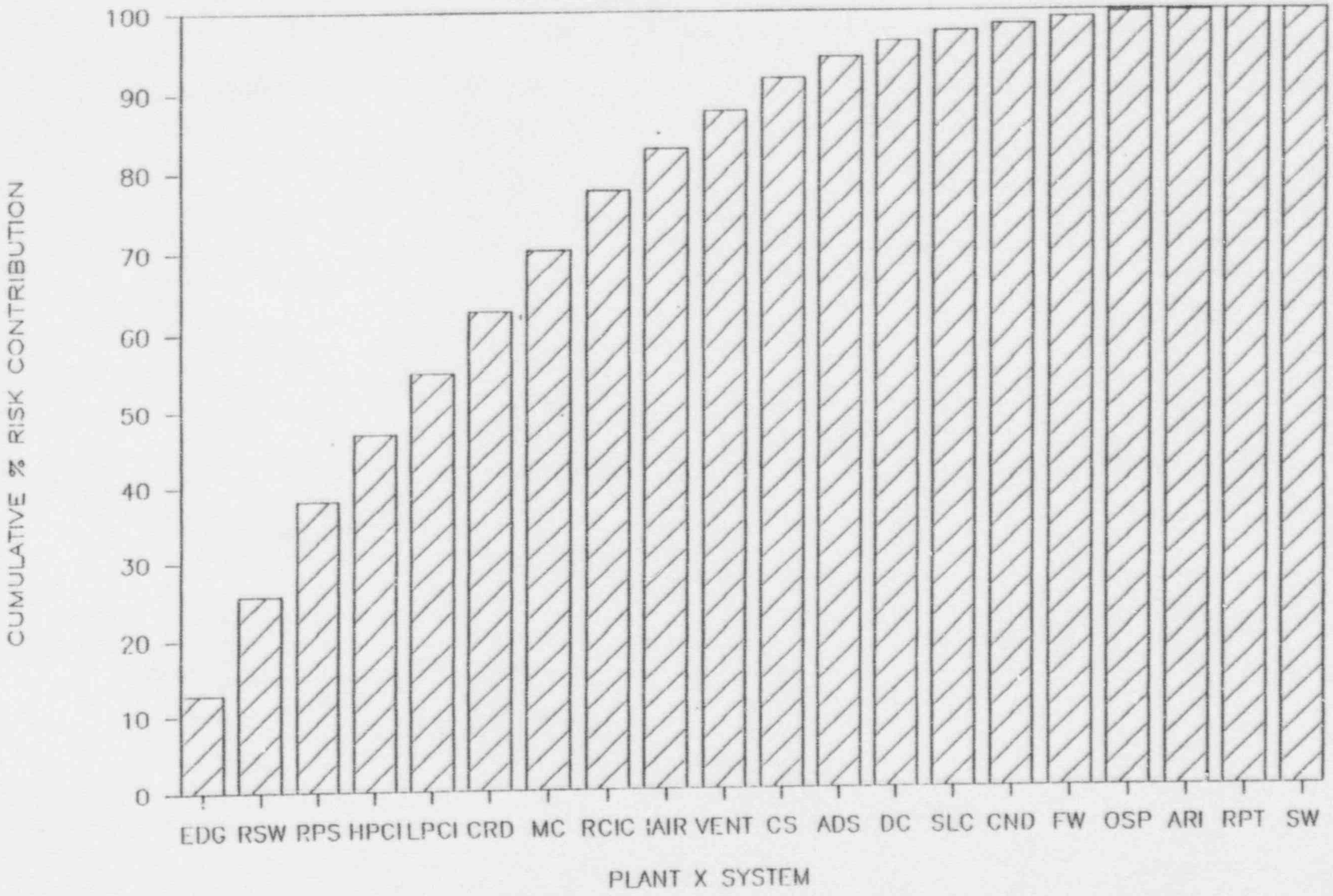


FIGURE 4

CUMMULATIVE % RISK CONTRIBUTION



APPENDIX Add A

DESCRIPTION OF TYPES OF BASIC EVENTS IN PLANT X PSA

APPENDIX Add A

Description of Types of Basic Events in Plant X PSA

Basic events are the primary elements of individual core damage accident sequences. The following types of basic events were included in the plant X core damage accident sequences:

1) Initiating event - these events are the initiators of the individual core damage accident sequences. Examples of initiating events include turbine trips, reactor isolation, loss of offsite power, pipe breaks, and other events that cause reactor shutdown,

2) Component or hardware failure - examples of these type events include pump failures, valve failures, electrical component or channel failures, and structural failures. In some cases a system failure is given as a basic event (e.g., loss of feedwater or room cooling).

3) Common cause failure - these events include failure of multiple components, trains, or systems due to a common cause. Examples of these type events include failure of two or more diesel generators, failure of AC or DC power supplies, and failure of two or more electrical control channels.

4) Maintenance unavailability - these events include system, train, or component unavailabilities due to maintenance or test. Examples include maintenance unavailabilities of diesel generators, pumps, valves, and electrical components.

5) Operator error - these events include operator errors that cause a component, train, or system to be unavailable and errors where an operator fails to take appropriate action. Examples include failure of an operator to restore equipment after test or maintenance and failure of an operator to initiate standby liquid control or failure to depressurize the reactor.

6) Non-recovery factor or probability - these events include failure to restore equipment after failure or loss due to other causes. Examples include failure to restore offsite power or diesel generators after a specified time interval.

APPENDIX Add B

PLANT X DATA

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
C = COMPONENT/HARDWARE FAILURE	274						
F = COMMON CAUSE FAILURE	68						
I = INITIATING EVENT	24						
M = UNAVAILABILITY DUE TO MAINTENANCE OR TEST	24						
O = OPERATOR ERROR	25						
R = RECOVERY FACTOR OR PROBABILITY	14						

	429						
OFFSITE POWER NON-RECOVERY AT 30 MINUTES	R	I	6.40E-01	1.27E-05	1.33E-05	3.35E-05	7.54E-06
LOSS OF OFFSITE POWER	I	TE	7.90E-03	1.28E-05	1.32E-05	1.69E-03	1.66E-03
OFFSITE POWER CONDITIONAL NON-RECOVERY AT 2 HOURS	R	II	4.50E-01	1.40E-05	1.20E-05	4.06E-05	1.46E-05
EDG NON-RECOVERY AT 2 HOURS	R	DG2	6.60E-01	1.41E-05	1.19E-05	3.22E-05	6.24E-06
OFFSITE POWER CONDITIONAL NON-RECOVERY AT 4 HOURS	R	III	5.30E-01	1.46E-05	1.14E-05	3.61E-05	1.01E-05
CONDITIONAL NON-RECOVERY OF OFFSITE AC POWER AT 6 HOURS	R	CETREC6	6.70E-01	1.47E-05	1.13E-05	3.15E-05	5.46E-06
EDG CONDITIONAL NON-RECOVERY AT 4 HOURS	R	DG3	7.10E-01	1.47E-05	1.13E-05	3.07E-05	4.68E-06
OPERATOR FAILS TO DEPRESSURIZE RX (45 MINUTES)	O	XRPVBLDWNY	1.00E-03	2.03E-05	5.72E-06	5.75E-03	5.72E-03
DIESEL GENERATOR COMMON CAUSE FAILURE TO RUN	F	ADLEDGXCCR	8.24E-04	2.17E-05	4.26E-06	5.20E-03	5.17E-03
RPS MECHANICAL FAILURE	F	CM	1.00E-05	2.35E-05	2.46E-06	2.43E-01	2.43E-01
INTERNAL FLOOD IN ZONE 12 (SERVICE WATER - T.B. 931'	I	F12	2.20E-05	2.36E-05	2.45E-06	1.11E-01	1.11E-01
INTERNAL FLOOD IN ZONE 4 (SERVICE WATER - R.B. > 896')	I	F4	2.10E-04	2.36E-05	2.42E-06	1.15E-02	1.15E-02
TURBINE TRIP	I	TT	1.80E-01	2.42E-05	1.81E-06	3.43E-05	8.32E-06
INTERNAL FLOOD IN ZONE 9 (SERVICE WATER - T.B. 911')	I	F9	7.60E-04	2.43E-05	1.73E-06	2.30E-03	2.27E-03
DG12 FAILS TO RUN	C	ADLDG12XXR	8.32E-03	2.47E-05	1.34E-06	1.86E-04	1.60E-04
DG11 FAILS TO RUN	C	ADLDG11XXR	8.32E-03	2.47E-05	1.34E-06	1.85E-04	1.59E-04
BREAKER B3304 FAILS TO CLOSE	C	ACBB3304XC	4.67E-03	2.48E-05	1.24E-06	2.91E-04	2.65E-04
COMMON CAUSE FAILURE OF EDGESW PUMP 11 AND 12 TO RUN	F	EPMP111ABR	2.40E-04	2.48E-05	1.21E-06	5.10E-03	5.07E-03
LOSS OF FW	I	TF	5.60E-02	2.50E-05	9.88E-07	4.26E-05	1.66E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
COMMON CAUSE FAILURE OF EDGESW PUMP 11 AND 12 TO START	F	EPMP111ABS	1.92E-04	2.50E-05	9.65E-07	5.04E-03	5.02E-03
OPERATOR FAILS TO INJECT SLC - TURB TRIP INITIATOR	O	SLCTOPY	4.00E-02	2.52E-05	8.22E-07	4.58E-05	1.98E-05
DG12 BREAKER 152-602 FAILS TO CLOSE	C	ACB152602C	4.67E-03	2.53E-05	7.44E-07	1.84E-04	1.58E-04
DG11 BREAKER 152-502 FAILS TO CLOSE	C	ACB152502C	4.67E-03	2.53E-05	7.41E-07	1.84E-04	1.58E-04
SRV FAILS TO CLOSE AS PRESSURE DROPS	C	XVRSRVXXXC	1.52E-02	2.53E-05	7.36E-07	7.36E-05	4.76E-05
MANUAL SHUTDOWN	I	THS	3.30E-01	2.53E-05	6.86E-07	2.73E-05	1.30E-06
MSIV CLOSURE	I	TM	7.20E-02	2.53E-05	6.81E-07	3.48E-05	8.84E-06
HPCI PUMP P-209 FAILS TO START	C	HPTP209XXS	1.48E-02	2.53E-05	6.60E-07	6.99E-05	4.39E-05
PROMPT NON-RECOVERY FACTOR FOR FW PUMPS	R	TFREC	1.10E-01	2.54E-05	6.24E-07	3.09E-05	4.94E-06
RCIC PUMP P-207 FAILS TO START	C	IPTP207XXS	1.36E-02	2.54E-05	5.93E-07	6.89E-05	4.29E-05
DG12 FAILS TO START	C	ADLDG12XXS	3.72E-03	2.54E-05	5.88E-07	1.83E-04	1.57E-04
DG11 FAILS TO START	C	ADLDG11XXS	3.72E-03	2.54E-05	5.85E-07	1.83E-04	1.57E-04
DIESEL GENERATOR COMMON CAUSE FAILURE TO START	F	ADLEDGXCCS	1.15E-04	2.54E-05	5.62E-07	4.91E-03	4.89E-03
COMMON CAUSE FACTOR FOR RPT CIRCUIT BREAKERS	F	CBBETA	1.00E-01	2.55E-05	4.97E-07	3.04E-05	4.42E-06
MEDIUM LOCA	I	S1	3.00E-04	2.55E-05	4.94E-07	1.67E-03	1.64E-03
HO-7 FAILS TO OPEN	C	HVFHO7STPN	1.15E-02	2.55E-05	4.91E-07	6.84E-05	4.24E-05
HO-8 FAILS TO OPERATE	C	HVFHO8XXXR	1.15E-02	2.55E-05	4.91E-07	6.84E-05	4.24E-05
OPERATOR DILUTES BORON BY FAILING TO CONTROL LEVEL	O	UH	1.00E-02	2.55E-05	4.84E-07	7.38E-05	4.78E-05
AUTO TRANSFER SWITCH 12 FAILED TO TRANSFER TO ALT SUPPLY	C	ASA12XXXXC	1.76E-03	2.55E-05	4.52E-07	2.83E-04	2.57E-04
FAILURE OF ACB 152-308 TO OPEN	C	ACB152308N	2.34E-03	2.56E-05	3.80E-07	1.88E-04	1.62E-04
FAILURE OF ACB 152-408 TO OPEN	C	ACB152408N	2.34E-03	2.56E-05	3.77E-07	1.87E-04	1.61E-04
RPS ELECTRICAL FAILURE	F	CE	2.00E-05	2.56E-05	3.77E-07	1.89E-02	1.89E-02
HPCI EGM FAILS TO OPERATE	C	HSCEGMXXXR	8.77E-03	2.56E-05	3.54E-07	6.60E-05	4.00E-05
EDGESW PUMP P-111A FAILS TO RUN	C	EPMP111AXR	2.16E-03	2.56E-05	3.51E-07	1.88E-04	1.62E-04
RCIC EGM FAILS TO OPERATE	C	ISCEGMXXXR	8.77E-03	2.57E-05	3.48E-07	6.53E-05	3.93E-05
EDGESW PUMP P-111B FAILS TO RUN	C	EPMP111BXR	2.16E-03	2.57E-05	3.46E-07	1.86E-04	1.60E-04
DG FAN VSF10 FAILS TO START	C	AFNVSF10XS	2.16E-03	2.57E-05	3.35E-07	1.81E-04	1.55E-04

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(O) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(O) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
DG FAN VSF9 FAILS TO START	C	AFNVSF9XXS	2.16E-03	2.57E-05	3.35E-07	1.81E-04	1.55E-04
OPERATOR FAILS TO INJECT SLC - MSIV CLOSURE INITIATOR	O	SLCMOPY	4.00E-02	2.57E-05	3.28E-07	3.38E-05	7.80E-06
PANEL Y20 BUS FAULT	F	ABSY20XXXG	8.01E-06	2.57E-05	3.22E-07	4.00E-02	4.00E-02
LARGE LOCA	I	A	7.00E-05	2.57E-05	3.17E-07	4.58E-03	4.55E-03
P-217 HPCI AUX. OIL PUMP FAILS TO START	C	HPMP217FTS	7.69E-03	2.57E-05	3.07E-07	6.55E-05	3.95E-05
CORE SPRAY PUMP P-208B FAILS TO RUN	C	CPMP208BXR	3.14E-03	2.57E-05	2.91E-07	1.18E-04	9.23E-05
HPCI SYSTEM UNAVAILABLE DUE TO TEST	M	HLOHPCIXXT	7.30E-03	2.57E-05	2.83E-07	6.45E-05	3.85E-05
FAILURE OF CONTACT 152-308 TO CLOSE	C	ACN152308C	1.76E-03	2.57E-05	2.81E-07	1.86E-04	1.60E-04
5 HOUR NON-REPAIR FACTOR FOR MACHINERY	R	REP5HR	8.00E-01	57E-05	2.78E-07	2.60E-05	0.00E+00
COMMON CAUSE FAILURE TO START OF HPCI AND RCIC PUMPS	F	HPT&CHPCCS	5.84E-04	2.57E-05	2.78E-07	4.99E-04	4.73E-04
EDGESW PUMP P-111A FAILS TO START	C	EPMP111AXS	1.73E-03	2.57E-05	2.78E-07	1.86E-04	1.60E-04
FAILURE OF CONTACT 152-408 TO CLOSE	C	ACN152408C	1.76E-03	2.57E-05	2.78E-07	1.84E-04	1.58E-04
EDGESW PUMP P-111B FAILS TO START	C	EPMP111BXS	1.73E-03	2.57E-05	2.73E-07	1.84E-04	1.58E-04
OPERATOR FAILS TO MANUALLY OPEN SV-4234/35 AND 593	O	NBOTTLCN2Y	5.00E-02	2.57E-05	2.65E-07	3.09E-05	4.94E-06
2 OF 8 VACUUM BREAKERS FAIL OPEN	F	ZVB2FAILXC	2.95E-04	2.57E-05	2.56E-07	8.92E-04	8.66E-04
OPERATOR FAILS TO INJECT SLC - LOFW INITIATOR	O	SLCFOPY	4.00E-02	2.57E-05	2.55E-07	3.22E-05	6.24E-06
OFF SITE POWER SYSTEM UNAVAILABLE (RANDOM-NOT INIT EVENT)	F	AOFFSITEXL	2.16E-04	2.57E-05	2.53E-07	1.20E-03	1.17E-03
DG 12 FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	ADLDG12XXZ	1.61E-03	2.58E-05	2.49E-07	1.80E-04	1.54E-04
DG 11 FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	ADLDG11XXZ	1.61E-03	2.58E-05	2.49E-07	1.80E-04	1.54E-04
FAILURE OF RPT BREAKER 11A TO OPEN	C	PCB11AXXXN	2.68E-02	2.58E-05	2.48E-07	3.51E-05	9.10E-06
FAILURE OF RPT BREAKER 11B TO OPEN	C	PCB11BXXXN	2.68E-02	2.58E-05	2.48E-07	3.51E-05	9.10E-06
COMMON CAUSE FAILURE OF ALL SRVS TO OPEN	F	XVR8SRVCCN	1.63E-04	2.58E-05	2.43E-07	1.52E-03	1.49E-03
DG12 OUT FOR TESTING	M	ADLDG12XXT	1.57E-03	2.58E-05	2.43E-07	1.80E-04	1.54E-04
DG11 OUT FOR TESTING	M	ADLDG11XXT	1.57E-03	2.58E-05	2.42E-07	1.80E-04	1.54E-04
MOV MO-1754 FAILS TO OPEN	C	CVMMO1754N	2.72E-03	2.58E-05	2.40E-07	1.14E-04	8.81E-05
45 MINUTE NON-RECOVERY FACTOR OUTSIDE CONT. ROOM	R	REC45OUT	2.50E-02	2.58E-05	2.30E-07	3.51E-05	9.10E-06
RCIC UNAVAILABLE DUE TO TEST	M	ILORCICXXT	6.16E-03	2.58E-05	2.29E-07	6.29E-05	3.69E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
SMALL LOCA	I	S2	8.00E-04	2.58E-05	2.23E-07	3.04E-04	2.78E-04
HI SUPPRESSION POOL LEVEL	F	TORUS2	1.00E+00	2.58E-05	2.19E-07	2.60E-05	0.00E+00
COMMON CAUSE FAILURE OF VSF 9 AND 10 TO START	F	AFNVSF910S	4.40E-05	2.58E-05	2.11E-07	4.81E-03	4.78E-03
LOSS OF CONDENSER VACUUM	I	TC	1.90E-02	2.58E-05	2.04E-07	3.64E-05	1.04E-05
CORE SPRAY PUMP P-208B FAILS TO START	C	CPMP208BXS	2.25E-03	2.58E-05	1.95E-07	1.12E-04	8.63E-05
INTERNAL FLOOD IN ZONE 1 (TORUS RING HEADER BREAK)	I	F1	4.80E-05	2.58E-05	1.91E-07	4.00E-03	3.98E-03
HPCI INJECTION TRAIN OUT FOR CORRECTIVE MAINTENANCE	M	HLOHPCIXCM	5.18E-03	2.58E-05	1.88E-07	6.21E-05	3.61E-05
OPERATOR FAILS TO CROSS TIE SERVICE WATER TO CONDENSER	O	FSWXTIEXXY	1.00E+00	2.58E-05	1.70E-07	2.60E-05	0.00E+00
DG12 OUT FOR CORRECTIVE MAINTENANCE	M	ADLDG12XCM	1.05E-03	2.58E-05	1.61E-07	1.79E-04	1.53E-04
DG11 OUT FOR CORRECTIVE MAINTENANCE	M	ADLDG11XCM	1.05E-03	2.58E-05	1.60E-07	1.79E-04	1.53E-04
COMMON CAUSE FAILURE OF CS AND RHR INJ MO VLVS TO OPEN	F	RVM3VALVEN	2.92E-05	2.58E-05	1.58E-07	5.43E-03	5.41E-03
UPS INV. Y71 INTERNAL FAULT	C	AIVY71XXXR	9.67E-03	2.59E-05	1.45E-07	4.08E-05	1.48E-05
SLC HANDSWITCH 11AS1 FAILS TO OPERATE	C	LSM11AS1XR	6.57E-03	2.59E-05	1.36E-07	4.65E-05	2.05E-05
ALL SIX RHR/CS PUMPS FAIL TO RUN	F	RPM6PUMPSR	2.45E-05	2.59E-05	1.29E-07	5.28E-03	5.25E-03
ALL SIX RHR/CS PUMPS FAIL TO START	F	RPM6PUMPSS	2.33E-05	2.59E-05	1.22E-07	5.28E-03	5.25E-03
LC 52-104 BREAKER 401 FAILS TO REMAIN CLOSED	C	ACB052401L	4.39E-05	2.59E-05	1.20E-07	2.76E-03	2.73E-03
LC TRX40 SUPPLY BREAKER 152-609 FAILS TO REMAIN CLOSED	C	ACB152609L	4.39E-05	2.59E-05	1.20E-07	2.76E-03	2.73E-03
COMMON CAUSE FAILURE OF FW 94-1 AND 94-2 TO OPEN	F	FVC941942N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
COMMON CAUSE FAILURE OF FW 94-1 AND FW 97-2 TO OPEN	F	FVC941972N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
COMMON CAUSE FAILURE OF FW 97-1 AND FW 94-2 TO OPEN	F	FVC971942N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
COMMON CAUSE FAILURE OF FW 97-1 AND FW 97-2 TO OPEN	F	FVC971972N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
REACTOR TRIP WITHOUT TURBINE TRIP	I	TWOTT	9.00E-02	2.59E-05	1.15E-07	2.70E-05	1.04E-06
RCIC UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	ILORCICXCM	3.53E-03	2.59E-05	1.15E-07	[illegible].85E-05	3.25E-05
REACTOR PRESSURE SW PS2-3-52 A&B COMMON CAUSE FAILURE	F	QSP52ABCCC	2.12E-05	2.59E-05	1.14E-07	5.[illegible]8E-03	5.36E-03
ESW B.S. 1980 PLUGGED	C	ESRBS1980F	7.20E-04	2.59E-05	1.12E-07	1.81E-04	1.55E-04
EDG LOOP B STRAINER PLUGGED	C	ESRBS2414F	7.20E-04	2.59E-05	1.11E-07	1.80E-04	1.54E-04
OPERATOR FAILS TO START FEEDPUMPS AFTER A TRANSIENT	O	FRFPOPERAY	2.80E-03	2.59E-05	1.08E-07	6.45E-05	3.85E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
CORRECTION FACTOR FOR NBOTTLEN2Y	R	N2CF	2.00E-02	2.59E-05	9.75E-08	3.07E-05	4.68E-06
OPERATOR DOES NOT OPEN RHRSW-RHR XTIE	O	WVHINXTIEY	7.50E-01	2.59E-05	9.59E-08	2.60E-05	0.00E+00
INTERNAL FLOOD IN ZONE 10 (WEST DIESEL GENERATOR ROOM)	I	F10	4.60E-05	2.59E-05	9.46E-08	2.08E-03	[illegible]
MOV MO-2036 FAILS TO OPEN	C	HVMMO2036N	2.92E-03	2.59E-05	9.39E-08	5.80E-05	[illegible]
MO-2061 FAILS TO OPEN	C	HVMMO2061N	2.92E-03	2.59E-05	9.39E-08	5.80E-05	3.20E-05
MO-2062 FAILS TO OPEN	C	HVMMO2062N	2.92E-03	2.59E-05	9.39E-08	5.80E-05	3.20E-05
MO-2067 FAILS TO OPEN	C	HVMMO2067N	2.92E-03	2.59E-05	9.39E-08	5.80E-05	3.20E-05
MO-2068 FAILS TO OPEN	C	HVMMO2068N	2.92E-03	2.59E-05	9.39E-08	5.80E-05	3.20E-05
MO-2100 FAILS TO OPEN	C	IVMMO2100N	2.92E-03	2.59E-05	9.00E-08	5.67E-05	3.07E-05
MO-2101 FAILS TO OPEN	C	IVMMO2101N	2.92E-03	2.59E-05	9.00E-08	5.67E-05	3.07E-05
MOV MO-2078 FAILS TO OPEN	C	IVMMO2078N	2.92E-03	2.59E-05	8.94E-08	5.64E-05	3.04E-05
MO-2096 FAILS TO OPEN	C	IVMMO2096N	2.92E-03	2.59E-05	8.94E-08	5.64E-05	3.04E-05
MO-2106 FAILS TO OPEN	C	IVMMO2106N	2.92E-03	2.59E-05	8.94E-08	5.64E-05	[illegible]
MO-2107 FAILS TO OPEN	C	IVMMO2107N	2.92E-03	2.59E-05	8.94E-08	5.64E-05	3.04E-05
OPERATOR FAILS TO DEPRESSURIZE RX (10 MINUTES)	O	XRPV10	2.00E-02	2.59E-05	8.92E-08	3.04E-05	4.42E-06
OPERATOR FAILS TO INJECT SLC - LOSS OF COND INITIATOR	O	SLCCOPY	4.00E-02	2.59E-05	8.66E-08	2.81E-05	2.08E-06
REFERENCE LEG LEAK INITIATING EVENT	I	SR	4.00E-03	2.59E-05	8.61E-08	4.73E-05	2.13E-05
INTERNAL FLOOD IN ZONE 2 (CONDESATE SERVICE WATER -	I	F2	1.70E-04	2.59E-05	8.19E-08	5.10E-04	4.84E-04
REFERENCE LEG LEAK COMMON CAUSE FACTOR	F	REFLEGBETA	1.00E-01	2.59E-05	7.93E-08	2.68E-05	7.80E-07
HPCI AUX OIL PUMP P-217 FAILS TO RUN	C	HPMP217FTR	2.40E-03	2.59E-05	7.28E-08	5.62E-05	3.02E-05
LOSS OF SERVICE WATER	I	TS	9.00E-04	2.59E-05	7.25E-08	1.07E-04	8.06E-05
SW 145 FAILS TO OPEN	C	FVHSW145XN	5.00E-01	2.59E-05	7.20E-08	2.60E-05	0.00E+00
SW 147 FAILS TO OPEN	C	FVHSW147XN	5.00E-01	2.59E-05	7.20E-08	2.60E-05	0.00E+00
125V DC BATTERY D11 AND D21 FAILURE DUE TO COMMON CAUSE	F	DBA125VCCR	9.80E-07	2.59E-05	6.99E-08	[illegible]	7.12E-02
RCIC MO-8 FAILS TO OPERATE	C	IVFHO8XXXR	2.36E-03	2.59E-05	6.71E-08	5.43E-05	2.83E-05
COMMON CAUSE FAILURE OF FW PP BRG OIL PUMPS TO RUN	F	FP11P12CCR	2.40E-04	2.59E-05	6.66E-08	3.02E-04	2.76E-04
MO-7 LIMIT SWITCH LS 3 FAILS TO CLOSE	C	HSL3XXMO7C	2.19E-03	2.59E-05	6.32E-08	5.49E-05	2.89E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
LIMIT SWITCH 4 OF MO-2061 FAILS TO CLOSE	C	HSL4X2061C	2.19E-03	2.59E-05	6.32E-08	5.49E-05	2.89E-05
LIMIT SWITCH 4 OF MO-2062 FAILS TO CLOSE	C	HSL4X2062C	2.19E-03	2.59E-05	6.32E-08	5.49E-05	2.89E-05
LIMIT SWITCH 7 OF MO-2036 FAILS TO CLOSE	C	HSL7X2036C	2.19E-03	2.59E-05	6.32E-08	5.49E-05	2.89E-05
COMMON CAUSE FAILURE TO RUN OF ALL COMPRESSORS	F	NCMC123CCR	1.40E-04	2.59E-05	6.21E-08	4.71E-04	4.45E-04
RELIEF VALVE RV-2056 FAILS OPEN	C	HVRRV2056L	2.16E-03	2.59E-05	6.21E-08	5.49E-05	2.89E-05
OPERATOR DOES NOT DEPRESS ARI PB 5A, B, C & D WHEN REQUIREO		PSM5ABCDXY	1.00E-03	2.59E-05	6.16E-08	8.76E-05	6.16E-05
LIMIT SWITCH 16 OF MO-2078 FAILS TO CLOSE	C	ISLLS16XXC	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LIMIT SWITCH 4 OF MO-2078 FAILS TO CLOSE	C	ISLLS4078C	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LIMIT SWITCH 4 OF MO-2096 FAILS TO CLOSE	C	ISLLS4096C	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LIMIT SWITCH 4 OF MO-2100 FAILS TO CLOSE	C	ISL42100XC	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LIMIT SWITCH 4 OF MO-2101 FAILS TO CLOSE	C	ISL42101XC	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LIMIT SWITCH 4 OF X06 FAILS TO CLOSE	C	ISLLS4X06C	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LIMIT SWITCH 4 OF X07 FAILS TO CLOSE	C	ISLLS4X07C	2.19E-03	2.59E-05	5.93E-08	5.30E-05	2.70E-05
LONG TERM BATTERY DEMAND (=1.0)	F	DURATION	1.00E+00	2.59E-05	5.85E-08	2.60E-05	0.00E+00
RV-2097 FAILS TO REMAIN CLOSED	C	IVRRV2097L	2.16E-03	2.59E-05	5.85E-08	5.30E-05	2.70E-05
FAILURE OF RELAY 102-5 TO ENERGIZE	C	ARE1025XXE	3.65E-04	2.59E-05	5.33E-08	1.72E-04	1.46E-04
FAILURE OF RELAY 102-6 TO ENERGIZE	C	ARE1026XXE	3.65E-04	2.59E-05	5.33E-08	1.72E-04	1.46E-04
FAILURE OF RELAY 183-5X TO ENERGIZE	C	ARE1835XXE	3.65E-04	2.59E-05	5.33E-08	1.72E-04	1.46E-04
FAILURE OF RELAY 183-6X TO ENERGIZE	C	ARE1836XXE	3.65E-04	2.59E-05	5.33E-08	1.72E-04	1.46E-04
HPCI SYSTEM NOT RESTORED AFTER TEST OR MAINTENANCE	O	HLOHPCIXXZ	1.86E-03	2.59E-05	5.20E-08	5.38E-05	2.78E-05
DG ROOM 11 LOUVERS FAIL TO OPEN	C	ADMDG11RMN	3.54E-04	2.59E-05	5.17E-08	1.72E-04	1.46E-04
DG ROOM 12 LOUVERS FAIL TO OPEN	C	ADMDG12RMN	3.54E-04	2.59E-05	5.17E-08	1.72E-04	1.46E-04
COMMON CAUSE FAILURE OF DG ROOM LOWERS TO OPEN	F	ADMDG1112N	1.10E-05	2.59E-05	5.15E-08	4.71E-03	4.68E-03
LOSS OF INSTRUMENT AIR	I	TIA	6.30E-03	2.60E-05	4.68E-08	3.33E-05	7.28E-06
FW 67-1 FAILS TO CLOSE	C	FVCFW671XC	1.57E-03	2.60E-05	4.50E-08	5.46E-05	2.86E-05
AUXILIARY OIL PUMP P61 FAILS TO START	C	GPMP61XXXS	9.59E-03	2.60E-05	4.37E-08	3.04E-05	4.42E-06
RCIC FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	ILORCICXXZ	1.75E-03	2.60E-05	4.24E-08	5.02E-05	2.42E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(O) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(O) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
FAILURE TO RESTORE SLC AFTER TEST OR MAINTENANCE	O	LLOSLCXXXZ	2.00E-03	2.60E-05	4.16E-08	4.68E-05	2.08E-05
LC TRANSFORMER TRX40 INTERNAL FAULT	C	ATWTRX40XG	1.56E-05	2.60E-05	4.16E-08	2.68E-03	2.65E-03
LC 103 BREAKER 52-301 FAILS TO REMAIN CLOSED	C	ACB052301L	4.39E-05	2.60E-05	4.03E-08	9.41E-04	9.15E-04
LC TRX30 SUPPLY BREAKER 152-509 FAILS TO REMAIN CLOSED	C	ACB152509L	4.39E-05	2.60E-05	4.03E-08	9.41E-04	9.15E-04
SW AUTOMATIC STRAINER CLOGGED	C	SSRAUTOSTF	7.20E-04	2.60E-05	3.90E-08	8.03E-05	5.43E-05
CONDITIONAL PROBABILITY OF OVERPRESSURE FAILURE IN DRYWELL	F	DW	9.90E-01	2.60E-05	3.77E-08	2.60E-05	0.00E+00
CONTAINMENT HEAT REMOVAL NON-RECOVERY	R	WREC48HRS	8.00E-02	2.60E-05	3.77E-08	2.65E-05	5.20E-07
COMMON CAUSE FAILURE OF ESW 1-1 AND 1-2 TO OPEN	F	EVCESW112N	8.04E-06	2.60E-05	3.74E-08	4.68E-03	4.65E-03
OPERATOR FAILS TO ALIGN CRD FOR ALT BORON INJECTION	O	LALTBORONY	1.00E-01	2.60E-05	3.74E-08	2.63E-05	2.60E-07
N2 TANK GAS LINE RELIEF VALVE FAILS TO REMAIN CLOSED	C	NVRNONAM1L	1.44E-04	2.60E-05	3.69E-08	2.83E-04	2.57E-04
N2 TANK LIQUID LINE RELIEF VALVE FAILS TO REMAIN CLOSED	C	NVRNONAM2L	1.44E-04	2.60E-05	3.69E-08	2.83E-04	2.57E-04
RV-3442 FAILS TO REMAIN CLOSED	C	NVRRV3442L	1.44E-04	2.60E-05	3.69E-08	2.83E-04	2.57E-04
RV-3443 FAILS TO REMAIN CLOSED	C	NVRRV3443L	1.44E-04	2.60E-05	3.69E-08	2.83E-04	2.57E-04
RV-3444 FAILS TO REMAIN CLOSED	C	NVRRV3444L	1.44E-04	2.60E-05	3.69E-08	2.83E-04	2.57E-04
OPERATOR FAILS TO INJECT SLC - LOOP INITIATOR	O	SLCLOPY	4.00E-02	2.60E-05	3.61E-08	2.68E-05	7.80E-07
FAILURE OF BREAKER 152-308 TO REMAIN CLOSED	C	ACB152308L	4.39E-05	2.60E-05	3.56E-08	8.37E-04	8.11E-04
30 MINUTE NON-RECOVERY FACTOR OUTSIDE CONT. ROOM	R	REC30OUT	1.20E-01	2.60E-05	3.41E-08	2.63E-05	2.60E-07
SV-7477 FAILS TO REMAIN OPEN	C	NVESV7477F	1.25E-04	2.60E-05	3.20E-08	2.83E-04	2.57E-04
NO HIGH DW PRESSURE	F	NOHIDW	1.00E+00	2.60E-05	3.17E-08	2.60E-05	0.00E+00
INTERNAL FLOOD IN ZONE 5 (SERVICE WATER - SE RHR ROOM)	I	F5	6.30E-04	2.60E-05	3.04E-08	7.44E-05	4.84E-05
CHECK VALVE XP-6 FAILS TO OPEN	C	LVCSLCXP6N	1.31E-03	2.60E-05	2.70E-08	4.68E-05	2.08E-05
CHECK VALVE XP-7 FAILS TO OPEN	C	LVCSLCXP7N	1.31E-03	2.60E-05	2.70E-08	4.68E-05	2.08E-05
MANUAL BYPASS SW Y83 FAILS TO REMAIN CLOSED	C	ASMY83XXXL	5.21E-04	2.60E-05	2.70E-08	7.80E-05	5.20E-05
BUS 16 FAULT	C	ABS16XXXXG	8.01E-06	2.60E-05	2.45E-08	3.09E-03	3.07E-03
FAILURE OF OPERATOR TO ADD WATER TO HOTWELL	O	HWMAKEUP	1.00E-01	2.60E-05	2.44E-08	2.63E-05	2.60E-07
INTERNAL FLOOD IN ZONE 11 (FIRE WATER - T.B. 931' WEST)	I	F11	3.70E-06	2.60E-05	2.39E-08	6.50E-03	6.47E-03
30 MINUTE NON-RECOVERY IN CONTROL ROOM	R	1030	3.00E-03	2.60E-05	2.25E-08	3.35E-05	7.54E-06

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
INTERNAL FLOOD IN ZONE 7 (SERVICE WATER - SW RHR ROOM)	I	F7	5.60E-04	2.60E-05	2.22E-08	6.55E-05	3.95E-05
LC 104 BUS FAULT	C	ABSLC104XG	8.01E-06	2.60E-05	2.14E-08	2.70E-03	2.68E-03
EDG B HX PLUGGED	C	EHXEDGBXXF	1.36E-04	2.60E-05	1.90E-08	1.65E-04	1.39E-04
EDGESW HX A PLUGGED	C	EHXEDGAXXF	1.36E-04	2.60E-05	1.90E-08	1.65E-04	1.39E-04
250V BATTERY 3 AND BATTERY 6 COMMON CAUSE FAILURE	F	DBA36CCCCR	9.80E-07	2.60E-05	1.79E-08	1.83E-02	1.83E-02
SIGNAL FROM FEEDWATER MASTER CONTROLLER FAILS LOW	C	FCKMASTERR	6.43E-05	2.60E-05	1.68E-08	2.86E-04	2.60E-04
FEEDWATER AUX OIL PUMP COMMON CAUSE FTS	F	FPMAOPCCXS	7.83E-04	2.60E-05	1.59E-08	4.63E-05	2.03E-05
LOOP A EDGESW FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	ELOOPAXXXZ	1.11E-04	2.60E-05	1.55E-08	1.65E-04	1.39E-04
LOOP B EDGESW FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	ELOOPBXXXZ	1.11E-04	2.60E-05	1.55E-08	1.65E-04	1.39E-04
RELAY 14A10B FAILS TO ENERGIZE	C	CRE14A10BE	3.65E-04	2.60E-05	1.54E-08	6.81E-05	4.21E-05
SW PUMP 13 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	SPMPMP13CM	5.07E-02	2.60E-05	1.48E-08	2.63E-05	2.60E-07
COMMON CAUSE FAILURE OF SLC PUMPS TO START	F	LPMP203CCS	6.83E-04	2.60E-05	1.42E-08	4.68E-05	2.08E-05
FAILURE OF DIESEL PANEL CONTACT TO CLOSE	C	ACN35G4FAC	9.79E-05	2.60E-05	1.34E-08	1.63E-04	1.37E-04
FAILURE OF DIESEL PANEL CONTACT TO CLOSE	C	ACN35G4FBC	9.79E-05	2.60E-05	1.34E-08	1.63E-04	1.37E-04
LOSS OF ONE 125VDC BUS	I	TD	1.20E-04	2.60E-05	1.32E-08	1.36E-04	1.10E-04
HPCI FILTER PLUGGED	C	HFLF217ABF	7.20E-04	2.60E-05	1.23E-08	4.32E-05	1.72E-05
PSD 3445 FAILS TO REMAIN CLOSED	C	NRD3445XXL	4.80E-05	2.60E-05	1.20E-08	2.76E-04	2.50E-04
ACB 152-408 FAILS TO REMAIN CLOSED	C	ACB152408L	4.39E-05	2.60E-05	1.17E-08	2.94E-04	2.68E-04
MO-2015 FAILS TO OPEN	C	RVCMO2015N	2.92E-03	2.60E-05	1.16E-08	2.99E-05	3.90E-06
BREAKER 52-302 FAILS TO REMAIN CLOSED	C	ACB52302XL	4.39E-05	2.60E-05	1.13E-08	2.83E-04	2.57E-04
COMMON CAUSE FAILURE OF CS AND RHR INJ CHK VLVS TO OPEN	F	RVC3VALVEN	2.19E-06	2.60E-05	1.12E-08	5.12E-03	5.10E-03
BREAKER 52-402 FAILS TO REMAIN CLOSED	C	ACB52402XL	4.39E-05	2.60E-05	1.10E-08	2.76E-04	2.50E-04
LC TRANSFORMER TRX30 INTERNAL FAULT	C	ATWTRX30XG	1.56E-05	2.60E-05	1.09E-08	7.25E-04	6.99E-04
VACUUM BREAKER AO-2382A FAILS TO CLOSE	C	ZVB2382AXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
VACUUM BREAKER AO-2382B FAILS TO CLOSE	C	ZVB2382BXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
VACUUM BREAKER AO-2382C FAILS TO CLOSE	C	ZVB2382CXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
VACUUM BREAKER AO-2382E FAILS TO CLOSE	C	ZVB2382EXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION		MEASURES RELATED TO RISK INCREASE	
				CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	ABSOLUTE DECREASE T - T(0) (E)	CDF WHERE EVENT OCCURS T(1) (F)	ABSOLUTE INCREASE T(1) - T (G)
VACUUM BREAKER AO-2382F FAILS TO CLOSE	C	ZVB2382FXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
VACUUM BREAKER AO-2382G FAILS TO CLOSE	C	ZVB2382GXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
VACUUM BREAKER AO-2382H FAILS TO CLOSE	C	ZVB2382HXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
VACUUM BREAKER AO-2382K FAILS TO CLOSE	C	ZVB2382KXC	9.38E-04	2.60E-05	9.96E-09	3.67E-05	1.07E-05
BREAKER 52-408 FAILS TO REMAIN CLOSED	C	ACB052408L	4.39E-05	2.60E-05	9.83E-09	2.50E-04	2.24E-04
AI 593 FAILS TO OPEN	C	NVHAI593XN	1.31E-03	2.60E-05	9.78E-09	3.35E-05	7.54E-06
AUXILIARY OIL PUMP P61 FAILS TO RUN	C	GPMP61XXXR	2.40E-03	2.60E-05	9.62E-09	2.99E-05	3.90E-06
BREAKER 52-308 FAILS TO REMAIN CLOSED	C	ACB052308L	4.39E-05	2.60E-05	9.44E-09	2.41E-04	2.15E-04
BATTERY COMMON CAUSE BETA FACTOR	F	DBATBETA	1.50E-01	2.60E-05	9.31E-09	2.60E-05	0.00E+00
RCIC Y STRAINER 4262 PLUGGED	C	ISRY4262XF	7.20E-04	2.60E-05	8.84E-09	3.82E-05	1.22E-05
CHECK VALVE ESW-1-1 FAILS TO OPEN	C	EVCESW11XN	6.51E-05	2.60E-05	8.74E-09	1.60E-04	1.34E-04
CHECK VALVE ESW-1-2 FAILS TO OPEN	C	EVCESW12XN	6.51E-05	2.60E-05	8.74E-09	1.60E-04	1.34E-04
REACTOR PRESSURE SENSORS PS-2-3-53 A&B COMMON CAUSE FAILUR	F	QSP53ABCCC	2.12E-05	2.60E-05	8.63E-09	4.34E-04	4.08E-04
BUS 15 FAULT	C	ABS15XXXXG	8.01E-06	2.60E-05	8.48E-09	1.08E-03	1.06E-03
COMMON MODE FAILURE OF REACTOR FEED PUMPS TO START	F	FPMP2ABCCS	5.00E-04	2.60E-05	8.27E-09	4.26E-05	1.66E-05
LC 103 BUS FAULT	C	ABSLC103XG	8.01E-06	2.60E-05	7.31E-09	9.39E-04	9.13E-04
COMMON CAUSE FAILURE OF ESW PUMPS P111 C/D TO START	F	EPMP111CDS	3.65E-04	2.60E-05	7.15E-09	4.55E-05	1.95E-05
CONDENSATE PUMP A BRNG. LUBE OIL PUMP FAILS TO RUN	C	FPMLOP11XR	2.16E-03	2.60E-05	6.92E-09	2.91E-05	3.12E-06
COMMON CAUSE FAILURE OF LEV TRANS 72 A,B,C,D	F	QTL72ABCDR	7.49E-06	2.60E-05	6.76E-09	9.31E-04	9.05E-04
BREAKER 52-404 FAILS TO REMAIN CLOSED	C	ACB052404L	4.39E-05	2.60E-05	6.58E-09	1.76E-04	1.50E-04
HPCI PUMP P-209 FAILS TO RUN	C	HPTP209XXR	4.60E-04	2.60E-05	6.42E-09	4.00E-05	1.40E-05
COND PUMP P-1B CORRECTIVE MAINTENANCE	M	FPMP1BXXCM	1.06E-02	2.60E-05	6.27E-09	2.65E-05	5.20E-07
OPERATOR INAPPROPRIATELY CROSS-TIE LC 104 TO LC 103	O	ACB309409Y	1.00E-02	2.60E-05	6.27E-09	2.65E-05	5.20E-07
COMMON CAUSE FAILURE OF SLC SQUIBS TO FIRE	F	LVX1114CCE	3.00E-04	2.60E-05	6.21E-09	4.68E-05	2.08E-05
LOOP A EDGESW OUT FOR CORRECTIVE MAINTENANCE	M	ELOOPAXXCM	4.52E-05	2.60E-05	5.85E-09	1.56E-04	1.30E-04
LOOP B EDGESW OUT FOR CORRECTIVE MAINTENANCE	M	ELOOPBXXCM	4.52E-05	2.60E-05	5.85E-09	1.56E-04	1.30E-04
BREAKER 52-304 FAILS TO REMAIN CLOSED	C	ACB052304L	4.39E-05	2.60E-05	5.69E-09	1.56E-04	1.30E-04

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
NON-RECOVERY FACTOR FOR AC POWER TO CRD PUMPS	R	CRDTEREC	1.00E-01	2.60E-05	5.67E-09	2.60E-05	0.00E+00
CONDENSATE PUMP COMMON MODE FAILURES	F	FPMP1ABCCR	2.23E-05	2.60E-05	5.59E-09	2.76E-04	2.50E-04
FILTER TO SA CONTROL PRESSURE SWITCHES PLUGGED	C	NFLC[illegible]NTRLF	7.20E-04	2.60E-05	5.49E-09	3.35E-05	7.54E-06
COMMON CAUSE FAILURE OF SV 3-142A AND B TO OPEN	F	PVE3142CCN	7.31E-05	2.60E-05	5.46E-09	1.01E-04	7.46E-05
LOSS OF DRYWELL COOLING	I	TDW	5.87E-03	2.60E-05	5.46E-09	2.70E-05	1.04E-06
COMMON CAUSE FAILURE TO RUN OF CORE SPRAY PUMPS	F	CPMP208CCR	3.50E-04	2.60E-05	5.10E-09	4.06E-05	1.46E-05
COMMON CAUSE FAILURE OF LEV TRANS 72 A AND B	F	QTL72ABXCR	5.62E-06	2.60E-05	4.91E-09	9.00E-04	8.74E-04
COMMON CAUSE FAILURE OF LEV TRANS 72 C,D	F	QTL72CDXCR	5.62E-06	2.60E-05	4.91E-09	9.00E-04	8.74E-04
COMMON CAUSE FAILURE TO START OF CORE SPRAY PUMPS	F	CPMP208CCS	3.37E-04	2.60E-05	4.89E-09	4.06E-05	1.46E-05
MANUAL BYPASS SW Y73 FAILS TO REMAIN CLOSED	C	ASMY73XXXL	5.21E-04	2.60E-05	4.81E-09	3.54E-05	9.36E-06
COMMON CAUSE FAILURE OF LEVEL TRANSMITTER 6-52A/B	F	FTL652ABXR	1.86E-05	2.60E-05	4.65E-09	2.76E-04	2.50E-04
COMMON CAUSE FAILURE OF ESW PUMPS P111 C/D TO RUN	F	EPMP111CDR	2.40E-04	2.60E-05	4.52E-09	4.47E-05	1.87E-05
COMMON CAUSE FAILURE OF FW 91-1 AND FW 91-2 TO OPEN	F	FVC911912N	1.73E-05	2.60E-05	4.34E-09	2.76E-04	2.50E-04
COMMON CAUSE FAILURE OF FW 91-1 AND FW 94-2 TO OPEN	F	FVC911942N	1.73E-05	2.60E-05	4.34E-09	2.76E-04	2.50E-04
COMMON CAUSE FAILURE OF FW 91-1 AND FW 97-2 TO OPEN	F	FVC911972N	1.73E-[illegible]	2.60E-05	4.34E-09	2.76E-04	2.50E-04
COMMON CAUSE FAILURE OF FW 94-1 AND FW 91-2 TO OPEN	F	FVC912941N	1.73E-05	2.60E-05	4.34E-09	2.76E-04	2.50E-04
COMMON CAUSE FAILURE OF FW 97-1 AND 91-2 TO OPEN	F	FVC912971N	1.73E-05	2.60E-05	4.34E-09	2.76E-04	2.50E-04
HPCI AOP P-217 RELAY 72/M FAILS TO ENERGIZE	C	HRE72M217E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2036 RELAY 72/2F FAILS TO ENERGIZE	C	HRE722F36E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2036 RELAY 72/2M FAILS TO ENERGIZE	C	HRE722M36E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2061 RELAY 72/1F FAILS TO ENERGIZE	C	HRE721F61E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2061 RELAY 72/2F FAILS TO ENERGIZE	C	HRE722F61E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2061 RELAY 72/2M FAILS TO ENERGIZE	C	HRE722M61E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2062 RELAY 72/1F FAILS TO ENERGIZE	C	HRE721F62E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2062 RELAY 72/1F FAILS TO ENERGIZE	C	HRE721F67E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2062 RELAY 72/2F FAILS TO ENERGIZE	C	HRE722F67E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2062 RELAY 72/2F FAILS TO ENERGIZE	C	HRE722F62E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
MO-2062 RELAY 72/2M FAILS TO ENERGIZE	C	HRE722M62E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2062 RELAY 72/2M FAILS TO ENERGIZE	C	HRE722M67E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2068 RELAY 72/2F FAILS TO ENERGIZE	C	HRE722F68E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
MO-2068 RELAY 72/2M FAILS TO ENERGIZE	C	HRE722M68E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
RELAY 23 181A FAILS TO ENERGIZE	C	HRE23181AE	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
RELAY 23AK1 FAILS TO ENERGIZE	C	HRE23AK1XE	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
RELAY 23AK2 FAILS TO ENERGIZE	C	HRE23AK2XE	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
RELAY 23AK23 FAILS TO ENERGIZE	C	HRE23AK23E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
RELAY 72/1F FAILS TO ENERGIZE	C	HRE721F36E	3.65E-04	2.60E-05	4.29E-09	3.77E-05	1.17E-05
RCIC PUMP P-207 FAILS TO RUN	C	IPTP207XXR	4.60E-04	2.60E-05	4.06E-09	3.48E-05	8.84E-06
COMMON CAUSE FAILURE TO RUN OF HPCI AND RCIC PUMPS	F	HPTRCHPCCR	1.92E-05	2.60E-05	3.90E-09	2.29E-04	2.03E-04
TRANSFORMER #11 INTERNAL FAULT	C	ATWTR11XXG	1.56E-05	2.60E-05	3.90E-09	2.76E-04	2.50E-04
CORE SPRAY TRAIN B OUT FOR CORRECTIVE MAINTENANCE	M	CLOTRNBXCM	1.60E-04	2.60E-05	3.74E-09	4.94E-05	2.34E-05
COMMON CAUSE FAILURE OF VSF 9 AND 10 TO RUN	F	AFNVSF910R	8.64E-07	2.60E-05	3.72E-09	4.34E-03	4.32E-03
FAILURE OF LEVEL TRANSMITTER 72B TO OPERATE	C	QTL2372BXR	6.26E-05	2.60E-05	3.64E-09	8.40E-05	5.80E-05
LIMIT SWITCH OAS/1 FAILS TO CLOSE (MO-1987)	C	RSLMO1987C	7.08E-03	2.60E-05	3.33E-09	2.65E-05	5.20E-07
RHRSW LOOP 2 OUT FOR CORRECTIVE MAINTENANCE	M	WLOOP2XXCM	6.85E-03	2.60E-05	3.22E-09	2.65E-05	5.20E-07
FAILURE OF SWITCH 10AS19B TO CLOSE	C	RSM10S19BC	6.57E-03	2.60E-05	3.09E-09	2.65E-05	5.20E-07
BATTERY 6 FUSE BLOWN	C	DFUBA6XXXL	3.60E-05	2.60E-05	3.02E-09	1.09E-04	8.35E-05
CONTACT 186-502 FAILS TO REMAIN CLOSED	C	ACN186502L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
DG 11 CONTROL SWITCH CONTACT FAILURE TO REMAIN CLOSED	C	ACNDG11CSL	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
DG 12 CONTROL SWITCH CONTACT FAILURE TO REMAIN CLOSED	C	ACNDG12CSL	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF 152-501 CONTACT TO REMAIN CLOSED	C	ACN152501L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF 152-511 CONTACT TO REMAIN CLOSED	C	ACN152511L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF 152-602 CONTACT TO REMAIN CLOSED	C	ACN152602L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF ACB 602 CONTACT TO REMAIN CLOSED	C	ACN186602L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF CONTACT 152-502 TO REMAIN CLOSED	C	ACN152502L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
FAILURE OF CONTACT 152-601 TO REMAIN CLOSED	C	ACN152601L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF CONTACT 152-610 TO REMAIN CLOSED	C	ACN152610L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF CONTROL SWITCH 152-502 CONTACT TO REMAIN CLOSED	C	ASM152502L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
FAILURE OF HANDSWITCH 152-602 CONTACT TO REMAIN CLOSED	C	ASM152602L	2.89E-05	2.60E-05	2.91E-09	1.27E-04	1.01E-04
SWITCH 14AS13B FAILS TO REMAIN CLOSED	C	CSM14S13BL	9.64E-05	2.60E-05	2.78E-09	5.49E-05	2.89E-05
COMMON CAUSE FAILURE TO OPEN OF MO-1753 AND MO-1754	F	CVM5354CCN	2.04E-04	2.60E-05	2.76E-09	3.95E-05	1.35E-05
CV-1729 FAILS TO OPEN	C	HVACV1729N	5.76E-03	2.60E-05	2.70E-09	2.65E-05	5.20E-07
CHECK VALVE AS 1-1 FAILS TO CLOSE	C	NVCAS11XXC	4.26E-04	2.60E-05	2.65E-09	3.22E-05	6.24E-06
FAILURE TO MANUALLY ALIGN THE CRD SYSTEM	O	JLOALIGNXY	4.20E-01	2.60E-05	2.51E-09	2.60E-05	0.00E+00
COMMON CAUSE FAILURE OF ESW 17 AND 18 TO OPEN	F	EVCESW178N	8.04E-06	2.60E-05	2.32E-09	3.15E-04	2.89E-04
COMMON CAUSE FAILURE OF ESW 23 AND 24 TO OPEN	F	EVCESW234N	8.04E-06	2.60E-05	2.32E-09	3.15E-04	2.89E-04
COMMON CAUSE FAILURE OF ESW 4-1 AND 4-2 TO OPEN	F	EVCESW412N	8.04E-06	2.60E-05	2.32E-09	3.15E-04	2.89E-04
FAILURE OF RELAY 14AK1B TO REMAIN ENERGIZED	C	CRE14AK1BF	7.20E-05	2.60E-05	2.09E-09	5.49E-05	2.89E-05
RELAY K101A FAILURE	C	QREK101AXE	3.65E-04	2.60E-05	2.07E-09	3.17E-05	5.72E-06
COMMON CAUSE FAILURE OF P-5A/B TO START	F	VPMP5ABCCS	6.57E-03	2.60E-05	2.03E-09	2.63E-05	2.60E-07
COMMON CAUSE FAILURE OF WASTE SAMPLE PUMPS TO START	F	VPM36ABCCS	6.57E-03	2.60E-05	2.03E-09	2.63E-05	2.60E-07
RELAY 13AK1 FAILS TO ENERGIZE	C	IRE13AK1XE	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 13AK2 FAILS TO ENERGIZE	C	IRE13AK2XE	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 721F FAILS TO ENERGIZE	C	IRE721F96E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 721F FAILS TO ENERGIZE	C	IRE721F00E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 721F FAILS TO ENERGIZE	C	IRE721F07E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 721F FAILS TO ENERGIZE	C	IRE721F78E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 721F FAILS TO ENERGIZE	C	IRE721F01E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 721F FAILS TO ENERGIZE	C	IRE721F06E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 722F FAILS TO ENERGIZE	C	IRE722F00E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 722F FAILS TO ENERGIZE	C	IRE722F78E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 722F FAILS TO ENERGIZE	C	IRE722F01E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
RELAY 722F FAILS TO ENERGIZE	C	IRE722F07E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 722F FAILS TO ENERGIZE	C	IRE722F06E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 722F FAILS TO ENERGIZE	C	IRE722F96E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 72M FAILS TO ENERGIZE	C	IRE72MX78E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 72M FAILS TO ENERGIZE	C	IRE72MX06E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 72M FAILS TO ENERGIZE	C	IRE72MX01E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 72M FAILS TO ENERGIZE	C	IRE72MX00E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 72M FAILS TO ENERGIZE	C	IRE72MX96E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
RELAY 72M FAILS TO ENERGIZE	C	IRE72MX07E	3.65E-04	2.60E-05	2.02E-09	3.15E-05	5.46E-06
BUS 13 FAULT	C	ABS13XXXXG	8.01E-06	2.60E-05	2.01E-09	2.76E-04	2.50E-04
BUS 14 FAULT	C	ABS14XXXXG	8.01E-06	2.60E-05	2.01E-09	2.76E-04	2.50E-04
MCC 31 BUS FAULT	C	ABSMCC31XG	8.01E-06	2.60E-05	2.01E-09	2.76E-04	2.50E-04
MCC 41 BUS FAULT	C	ABSMCC41XG	8.01E-06	2.60E-05	2.01E-09	2.76E-04	2.50E-04
CHECK VALVE ESW-4-2 FAILS TO OPEN	C	EVCESW42XN	6.51E-05	2.60E-05	1.95E-09	5.59E-05	2.99E-05
CORE SPRAY TRAIN B FAILURE TO RESTORE AFTER TEST OR MAINT	O	CLOTRNBXXZ	1.11E-04	2.60E-05	1.84E-09	4.26E-05	1.66E-05
COMMON CAUSE FACTOR FOR CRD PUMPS	F	CRDBETA	1.00E-01	2.60E-05	1.54E-09	2.60E-05	0.00E+00
CRD OUT FOR CORRECTIVE MAINTENANCE	M	JLOCRDXXCM	2.71E-02	2.60E-05	1.54E-09	2.60E-05	0.00E+00
COMMON CAUSE FAILURE OF LEV TRANS 72 A,B,C	F	QTL72ABCXR	1.87E-06	2.60E-05	1.31E-09	7.23E-04	6.97E-04
COMMON CAUSE FAILURE OF LEV TRANS 72 A,B,D	F	QTL72ABDCR	1.87E-06	2.60E-05	1.31E-09	7.23E-04	6.97E-04
COMMON CAUSE FAILURE OF LEV TRANS 72 A,C,D	F	QTL72ACDCR	1.87E-06	2.60E-05	1.31E-09	7.23E-04	6.97E-04
COMMON CAUSE FAILURE OF LEV TRANS 72 B,C,D	F	QTL72BCDCR	1.87E-06	2.60E-05	1.31E-09	7.23E-04	6.97E-04
COMMON CAUSE FAILURE TO RUN OF ALL THREE SW PUMPS	F	SPMP123CCR	5.18E-06	2.60E-05	1.30E-09	2.76E-04	2.50E-04
SW PUMP #11 FAILS TO RUN	C	SPMPUMP11R	9.74E-05	2.60E-05	1.24E-09	3.87E-05	1.27E-05
SW PUMP #12 FAILS TO RUN	C	SPMPUMP12R	9.74E-05	2.60E-05	1.24E-09	3.87E-05	1.27E-05
SWITCH 14AS13A FAILS TO REMAIN CLOSED	C	CSM14S13AL	9.64E-05	2.60E-05	1.23E-09	3.87E-05	1.27E-05
FW-94-2 FAILS TO OPEN	C	FVCFW942XN	1.40E-04	2.60E-05	1.21E-09	3.46E-05	8.58E-06
FW-97-2 FAILS TO OPEN	C	FVCFW972XN	1.40E-04	2.60E-05	1.21E-09	3.46E-05	8.58E-06

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(O) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(O) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
CONDENSATE PUMP B BRNG. OIL PUMP FAILS TO RUN	C	FPMLOP12XR	2.16E-03	2.60E-05	1.17E-09	2.65E-05	5.20E-07
CHECK VALVE XP-3-1 FAILS TO OPEN	C	LVCXP31XXN	6.51E-03	2.60E-05	1.14E-09	2.63E-05	2.60E-07
CHECK VALVE XP-3-2 FAILS TO OPEN	C	LVCXP32XXN	6.51E-03	2.60E-05	1.14E-09	2.63E-05	2.60E-07
RELAY 420015 OPEN COIL FAILS TO ENERGIZE (420)	C	RRE420015E	3.65E-04	2.60E-05	1.11E-09	2.91E-05	3.12E-06
DG11 BREAKER 152-502 FAILS TO REMAIN CLOSED	C	ACB152502L	1.46E-05	2.60E-05	1.05E-09	9.80E-05	7.20E-05
DG12 BREAKER 152-602 FAILS TO REMAIN CLOSED	C	ACB152602L	1.46E-05	2.60E-05	1.05E-09	9.80E-05	7.20E-05
FEEDWATER PUMP P-2B CORRECTIVE MAINTENANCE	M	FPMP2BXXCM	1.30E-02	2.60E-05	9.49E-10	2.60E-05	0.00E+00
CHECK VALVE ESW-4-1 FAILS TO OPEN	C	EVCESW41XN	6.51E-05	2.60E-05	9.36E-10	4.03E-05	1.43E-05
RELAY 14AK1A DEENERGIZES	C	CRE14AK1AF	7.20E-05	2.60E-05	9.15E-10	3.87E-05	1.27E-05
BREAKER B4318 FAILS TO REMAIN CLOSED	C	ACBB4318XL	4.39E-05	2.60E-05	8.89E-10	4.63E-05	2.03E-05
SLC TANK HEATER FAILS	C	LHRSLCTNKR	6.00E-05	2.60E-05	8.76E-10	4.05E-05	1.46E-05
MO-2036 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	HCN721R36C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2036 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	HCN722R36C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2061 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	HCN721R61C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2061 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	HCN722R61C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2062 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	HCN721R62C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2062 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	HCN721R67C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2062 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	HCN722R62C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2062 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	HCN722R67C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2068 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	HCN722R68C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
MO-2068 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	HCN721R68C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
RELAY 23AK13 CONTACTS FAIL TO CLOSE	C	HCN23AK13C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
RELAY 23AK15 CONTACTS FAIL TO CLOSE ON LOW CST LEVEL	C	HCN23AK15C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
RELAY 23AK25 CONTACTS FAIL TO CLOSE ON HIGH TORUS LEVEL	C	HCN23AK25C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
RELAY 23AK27 CONTACTS FAIL TO CLOSE	C	HCN23AK27C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
RELAY CONTACT 23AK28 FAILS TO CLOSE	C	HCN23AK28C	9.79E-05	2.60E-05	8.48E-10	3.46E-05	8.58E-06
RV-3039 FAILS TO REMAIN CLOSED	C	WVRRV3039L	2.16E-03	2.60E-05	7.96E-10	2.63E-05	2.60E-07

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
DG FAN VSF10 FAILS TO RUN	C	AFNVSF10XR	1.40E-05	2.60E-05	7.85E-10	8.22E-05	5.62E-05
DG FAN VSF9 FAILS TO RUN	C	AFNVSF9XXR	1.40E-05	2.60E-05	7.85E-10	8.22E-05	5.62E-05
SLC PUMP P-203-A FAILS TO START	C	LPMP203AXS	5.53E-03	2.60E-05	7.77E-10	2.63E-05	2.60E-07
SLC PUMP P-203-B FAILS TO START	C	LPMP203BXS	5.53E-03	2.60E-05	7.77E-10	2.63E-05	2.60E-07
RELAY K113A FAILURE	C	QREK113AXE	3.65E-04	2.60E-05	7.57E-10	2.81E-05	2.08E-06
BATTERY D11 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	DBAD11XXCM	1.32E-05	2.60E-05	7.41E-10	8.22E-05	5.62E-05
BATTERY D21 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	DBAD21XXCM	1.32E-05	2.60E-05	7.41E-10	8.22E-05	5.62E-05
MCC 34 BUS FAULT	C	ABSMCC34XG	8.01E-06	2.60E-05	7.20E-10	1.16E-04	9.00E-05
MCC 44 BUS FAULT	C	ABSMCC44XG	8.01E-06	2.60E-05	7.20E-10	1.16E-04	9.00E-05
FAILURE OF WASTE SAMPLE PUMP B TO START	C	VPMP36BXXS	5.91E-02	2.60E-05	7.10E-10	2.60E-05	0.00E+00
PUMP P-5A FAILS TO START	C	VPMP5AXXXS	5.91E-02	2.60E-05	7.10E-10	2.60E-05	0.00E+00
PUMP P-5B FAILS TO START	C	VPMP5BXXXS	5.91E-02	2.60E-05	7.10E-10	2.60E-05	0.00E+00
WASTE SAMPLE PUMP A FAILS TO START	C	VPMP36AXXS	5.91E-02	2.60E-05	7.10E-10	2.60E-05	0.00E+00
CHARGER D70 RANDOM FAILURE	C	DBCD70XXXR	7.82E-05	2.60E-05	6.79E-10	3.46E-05	8.58E-06
CHARGER D80 RANDOM FAILURE	C	DBCD80XXXR	7.82E-05	2.60E-05	6.79E-10	3.46E-05	8.58E-06
AO 23-18 FAILS TO OPEN	C	HVCAO2318N	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
CHECK VALVE HPCI-10 FAILS TO OPEN	C	HVCHPCI10N	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
CHECK VALVE HPCI-18 FAILS TO OPEN	C	HVCHPCI18N	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
CHECK VALVE HPCI-9 FAILS TO OPEN	C	HVCHPCI09N	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
CHECK VALVE HPO-1 FAILS TO OPEN	C	HVCHPO1FTN	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
CHECK VALVE HPO-2 FAILS TO OPEN	C	HVCHPO2FTN	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
HPCI STEAM LINE DRAIN AND ALARM FAIL ON INITIAL START	C	HVMSLDALME	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
PRESSURE SWITCH PS-1 DOES NOT CLOSE ON LOW OIL PRESSURE	C	HSPPS1XFTC	7.31E-05	2.60E-05	6.34E-10	3.46E-05	8.58E-06
Y80 PANEL SUPPLY FUSE BLOWOUT	C	AFUY80XXXL	7.20E-05	2.60E-05	6.24E-10	3.46E-05	8.58E-06
AO-1579 FAILS TO REMAIN OPEN	C	SVAAO1579F	2.40E-06	2.60E-05	6.03E-10	2.76E-04	2.50E-04
CV 1470 FAILS TO REMAIN OPEN	C	NVACV1470F	2.40E-06	2.60E-05	6.03E-10	2.76E-04	2.50E-04
ISOLATION VALVE CV-1478 FAILS TO REMAIN OPEN	C	NVACV1478F	2.40E-06	2.60E-05	6.03E-10	2.76E-04	2.50E-04

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
PCV-3450A FAILS TO REMAIN OPEN	C	NVPV3450AF	2.40E-06	2.60E-05	6.03E-10	2.76E-04	2.50E-04
PCV-3450B FAILS TO REMAIN OPEN	C	NVPV3450BF	2.40E-06	2.60E-05	6.03E-10	2.76E-04	2.50E-04
FAILURE OF RELAY 95-7 TO ENERGIZE	C	ARE957XXXE	3.65E-04	2.60E-05	5.75E-10	2.76E-05	1.56E-06
FAILURE OF RELAY 95-8 TO ENERGIZE	C	ARE958XXXE	3.65E-04	2.60E-05	5.75E-10	2.76E-05	1.56E-06
HPCI-31 FAILS TO OPEN	C	HVCHPCI31N	6.51E-05	2.60E-05	5.64E-10	3.46E-05	8.58E-06
HPCI-32 FAILS TO OPEN	C	HVCHPCI32N	6.51E-05	2.60E-05	5.64E-10	3.46E-05	8.58E-06
CONDENSATE PUMP A FAILS TO RUN	C	FPMP1AXXXR	2.01E-04	2.60E-05	5.36E-10	2.86E-05	2.60E-06
2A FEEDWATER AUX OIL PUMP FAILS TO START	C	FPMP2AAOPS	7.05E-03	2.60E-05	4.19E-10	2.60E-05	0.00E+00
ESW PUMP P111 C FAILS TO START	C	EPMP111CXS	3.29E-03	2.60E-05	4.03E-10	2.60E-05	0.00E+00
ESW PUMP P111 D FAILS TO START	C	EPMP111DXS	3.29E-03	2.60E-05	4.03E-10	2.60E-05	0.00E+00
AIR COMPRESSOR #11 FAILS TO RUN	C	NCMCOMP11R	2.64E-03	2.60E-05	3.82E-10	2.63E-05	2.60E-07
COMPRESSOR 12 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	NCMCMP12CM	2.40E-02	2.60E-05	3.82E-10	2.60E-05	0.00E+00
COMPRESSOR 13 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	NCMCMP13CM	2.40E-02	2.60E-05	3.82E-10	2.60E-05	0.00E+00
D21 UNAVAILABLE BECAUSE OF CORRECTIVE MAINTENANCE	M	DDCD21XXCM	9.72E-06	2.60E-05	3.48E-10	6.19E-05	3.59E-05
PANEL D11 OUT FOR CORRECTIVE MAINTENANCE	M	DDCD11XXCM	9.72E-06	2.60E-05	3.48E-10	6.19E-05	3.59E-05
PANEL D111 OUT FOR CORRECTIVE MAINTENANCE	M	DDCD111XCM	9.72E-06	2.60E-05	3.48E-10	6.19E-05	3.59E-05
PANEL D211 OUT FOR CORRECTIVE MAINTENANCE	M	DDCD211XCM	9.72E-06	2.60E-05	3.48E-10	6.19E-05	3.59E-05
CHECK VALVE AO-13B FAILS TO OPEN	C	CVCAO13BXN	6.51E-05	2.60E-05	3.30E-10	3.09E-05	4.94E-06
CHECK VALVE CS-9-2 FAILS TO OPEN	C	CVCCS92XXN	6.51E-05	2.60E-05	3.30E-10	3.09E-05	4.94E-06
MCC 33A BUS FAULT	C	ABSMCC33AG	8.01E-06	2.60E-05	2.89E-10	6.19E-05	3.59E-05
MCC 43A BUS FAULT	C	ABSMCC43AG	8.01E-06	2.60E-05	2.89E-10	6.19E-05	3.59E-05
RV 1459A FAILS TO REMAIN CLOSED	C	NVR1459AXL	1.44E-04	2.60E-05	2.78E-10	2.78E-05	1.82E-06
RV 1459B FAILS TO REMAIN CLOSED	C	NVR1459BXL	1.44E-04	2.60E-05	2.78E-10	2.78E-05	1.82E-06
RV 1460A FAILS TO REMAIN CLOSED	C	NVR1460AXL	1.44E-04	2.60E-05	2.78E-10	2.78E-05	1.82E-06
RV 1460B FAILS TO REMAIN CLOSED	C	NVR1460BXL	1.44E-04	2.60E-05	2.78E-10	2.78E-05	1.82E-06
RV 7384 FAILS TO REMAIN CLOSED	C	NVR7384XXL	1.44E-04	2.60E-05	2.78E-10	2.78E-05	1.82E-06
RFP 2A FAILS TO START	C	FPMP2AXXXS	4.50E-03	2.60E-05	2.68E-10	2.60E-05	0.00E+00

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
ESW PUMP P111 D FAILS TO RUN	C	EPMP111DXR	2.16E-03	2.60E-05	2.63E-10	2.60E-05	0.00E+00
ESW PUMP P111C FAILS TO RUN	C	EPMP111CXR	2.16E-03	2.60E-05	2.63E-10	2.60E-05	0.00E+00
REACTOR LEVEL SENSOR LIS 2-3-672A FAILS TO CLOSE ON LOW	C	QSV672AXXC	7.31E-05	2.60E-05	2.63E-10	2.96E-05	3.64E-06
FAILURE OF PRESSURE SWITCH DPIS-1473	C	NSPPS1473C	1.31E-03	2.60E-05	2.37E-10	2.63E-05	2.60E-07
INST AIR DRYER PLUGGED	C	NFLIADRYRF	7.20E-04	2.60E-05	2.37E-10	2.63E-05	2.60E-07

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-02

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(O)/T (B)	RANK (C)	CRITICALITY (BIRNAU)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(O) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(O) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(O)/SUM (N)
C = COMPONENT/HARDWARE FAILURE 274														
F = COMMON CAUSE FAILURE 68														
I = INITIATING EVENT 24														
M = UNAVAILABILITY DUE TO MAINTENANCE OR TEST 24														
O = OPERATOR ERROR 25														
R = RECOVERY FACTOR OR PROBABILITY 14														
----- 429														
OFFSITE POWER NON-RECOVERY AT 30 MINUTES	R	0.51100	1	0.51264	1	2.045	1	2.08E-05	232	7.54E-06	323	1.29	324	9.29%
LOSS OF OFFSITE POWER	I	0.50800	2	0.50882	2	2.033	2	1.67E-03	36	1.66E-03	36	64.90	36	18.53%
OFFSITE POWER CONDITIONAL NON-RECOVERY AT 2 HOURS	R	0.46200	3	0.45990	4	1.859	3	2.66E-05	224	1.46E-05	245	1.56	245	26.93%
EDG NON-RECOVERY AT 2 HOURS	R	0.45800	4	0.46068	3	1.845	4	1.81E-05	241	6.24E-06	327	1.24	327	35.26%
OFFSITE POWER CONDITIONAL NON-RECOVERY AT 4 HOURS	R	0.43700	5	0.43831	5	1.776	5	2.15E-05	227	1.01E-05	283	1.39	283	43.20%
CONDITIONAL NON-RECOVERY OF OFFSITE AC POWER AT 6 HOURS	R	0.43300	6	0.43081	7	1.764	7	1.67E-05	244	5.46E-06	331	1.21	349	51.08%
EDG CONDITIONAL NON-RECOVERY AT 4 HOURS	R	0.43300	7	0.43523	6	1.764	6	1.59E-05	247	4.68E-06	356	1.18	357	58.95%
OPERATOR FAILS TO DEPRESSURIZE RX (45 MINUTES)	O	0.22000	8	0.22022	8	1.282	8	5.73E-03	13	5.72E-03	13	221.00	13	62.95%
DIESEL GENERATOR COMMON CAUSE FAILURE TO RUN	F	0.16400	9	0.16411	9	1.196	9	5.18E-03	18	5.17E-03	18	200.00	18	65.93%
RPS MECHANICAL FAILURE	F	0.09450	10	0.09359	11	1.104	10	2.43E-01	1	2.43E-01	1	9360.00	1	67.65%
INTERNAL FLOOD IN ZONE 12 (SERVICE WATER - T.B. 931'	I	0.09420	11	0.09392	10	1.104	11	1.11E-01	2	1.11E-01	2	4270.00	2	69.36%
INTERNAL FLOOD IN ZONE 4 (SERVICE WATER - R.B. > 896')	I	0.09310	12	0.09305	12	1.103	12	1.15E-02	7	1.15E-02	7	444.00	7	71.05%
TURBINE TRIP	I	0.06950	13	0.07011	13	1.075	13	1.01E-05	288	8.32E-06	320	1.32	320	72.32%
INTERNAL FLOOD IN ZONE 9 (SERVICE WATER - T.B. 911')	I	0.06640	14	0.06640	14	1.071	14	2.27E-03	34	2.27E-03	34	88.30	34	73.53%
DG12 FAILS TO RUN	C	0.05170	15	0.05168	15	1.055	15	1.62E-04	99	1.60E-04	100	7.16	100	74.47%
DG11 FAILS TO RUN	C	0.05140	16	0.05135	16	1.054	16	1.60E-04	102	1.59E-04	104	7.12	104	75.40%
BREAKER B3304 FAILS TO CLOSE	C	0.04760	17	0.04786	17	1.050	17	2.66E-04	64	2.65E-04	64	11.20	64	76.27%
COMMON CAUSE FAILURE OF EDGESW PUMP 11 AND 12 TO RUN	F	0.04670	18	0.04681	18	1.049	18	5.07E-03	20	5.07E-03	20	196.00	20	77.11%
LOSS OF FW	I	0.03800	19	0.03797	19	1.040	19	1.76E-05	242	1.66E-05	241	1.64	239	77.81%
COMMON CAUSE FAILURE OF EDGESW PUMP 11 AND 12 TO START	F	0.03710	20	0.03706	20	1.039	20	5.02E-03	21	5.02E-03	21	194.00	21	78.48%
OPERATOR FAILS TO INJECT SLC - TURB TRIP INITIATOR	O	0.03160	21	0.03166	21	1.033	21	2.06E-05	236	1.98E-05	235	1.75	235	79.05%
DG12 BREAKER 152-602 FAILS TO CLOSE	C	0.02860	22	0.02857	22	1.029	22	1.59E-04	105	1.58E-04	105	7.09	105	79.57%

TABLE Add-B2

CALCULATED IMPORTANCE MEASURES FOR PLANT X

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(0)/T (B)	RANK (C)	CRITICALITY (BIRNAU)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(0) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(0) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(0)/SUM (N)
DG11 BREAKER 152-502 FAILS TO CLOSE	C	0.02850	23	0.02843	23	1.029	23	1.58E-04	108	1.58E-04	108	7.06	108	80.09%
SRV FAILS TO CLOSE AS PRESSURE DROPS	C	0.02830	24	0.02825	24	1.029	24	4.83E-05	172	4.76E-05	172	2.83	172	80.61%
MANUAL SHUTDOWN	I	0.02640	25	0.02521	27	1.027	25	1.99E-06	369	1.30E-06	376	1.05	376	81.09%
MSIV CLOSURE	I	0.02620	26	0.02637	25	1.027	26	9.52E-06	289	8.84E-06	289	1.34	288	81.56%
HPCI PUMP P-209 FAILS TO START	C	0.02540	27	0.02539	26	1.026	27	4.46E-05	173	4.39E-05	173	2.69	173	82.03%
PROMPT NON-RECOVERY FACTOR FOR FW PUMPS	R	0.02400	28	0.02354	28	1.025	28	5.56E-06	333	4.94E-06	355	1.19	352	82.46%
RCIC PUMP P-207 FAILS TO START	C	0.02280	29	0.02275	29	1.023	29	4.35E-05	174	4.29E-05	174	2.65	174	82.88%
DG12 FAILS TO START	C	0.02260	30	0.02259	30	1.023	30	1.58E-04	109	1.57E-04	109	7.05	109	83.29%
DG11 FAILS TO START	C	0.02250	31	0.02252	31	1.023	31	1.57E-04	110	1.57E-04	110	7.03	110	83.70%
DIESEL GENERATOR COMMON CAUSE FAILURE TO START	F	0.02160	32	0.02162	32	1.022	32	4.89E-03	22	4.89E-03	22	189.00	22	84.09%
COMMON CAUSE FACTOR FOR RPT CIRCUIT BREAKERS	F	0.01910	33	0.01891	36	1.019	33	4.92E-06	357	4.42E-06	358	1.17	359	84.44%
MEDIUM LOCA	I	0.01900	34	0.01897	33	1.019	34	1.64E-03	37	1.64E-03	37	64.20	37	84.78%
MO-8 FAILS TO OPERATE	C	0.01890	35	0.01896	35	1.019	35	4.29E-05	175	4.24E-05	175	2.63	175	85.13%
MO-7 FAILS TO OPEN	C	0.01890	36	0.01896	34	1.019	36	4.29E-05	176	4.24E-05	176	2.63	176	85.47%
OPERATOR DILUTES BORON BY FAILING TO CONTROL LEVEL	O	0.01860	37	0.01859	37	1.019	37	4.83E-05	171	4.78E-05	171	2.84	171	85.81%
AUTO TRANSFER SWITCH 12 FAILED TO TRANSFER TO ALT SUPPLY	C	0.01740	38	0.01745	38	1.018	38	2.58E-04	65	2.57E-04	67	10.90	71	86.12%
FAILURE OF ACB 152-308 TO OPEN	C	0.01460	39	0.01461	39	1.015	39	1.62E-04	97	1.62E-04	97	7.23	97	86.39%
RPS ELECTRICAL FAILURE	F	0.01450	40	0.01452	40	1.015	41	1.89E-02	5	1.89E-02	5	727.00	5	86.65%
FAILURE OF ACB 152-408 TO OPEN	C	0.01450	41	0.01450	41	1.015	40	1.61E-04	100	1.61E-04	99	7.18	99	86.92%
HPCI EGM FAILS TO OPERATE	C	0.01360	42	0.01363	42	1.014	42	4.04E-05	178	4.00E-05	178	2.54	178	87.16%
EDGESW PUMP P-111A FAILS TO RUN	C	0.01350	43	0.01346	43	1.014	43	1.62E-04	98	1.62E-04	98	7.22	98	87.41%
RCIC EGM FAILS TO OPERATE	C	0.01340	44	0.01336	44	1.014	44	3.96E-05	180	3.93E-05	181	2.51	181	87.65%
EDGESW PUMP P-111B FAILS TO RUN	C	0.01330	45	0.01333	45	1.013	45	1.61E-04	101	1.60E-04	101	7.16	101	87.90%
DG FAN VSF9 FAILS TO START	C	0.01290	46	0.01294	46	1.013	46	1.56E-04	111	1.55E-04	111	6.98	112	88.13%
DG FAN VSF10 FAILS TO START	C	0.01290	47	0.01290	47	1.013	47	1.55E-04	113	1.55E-04	113	6.96	113	88.36%
OPERATOR FAILS TO INJECT SLC - MSIV CLOSURE INITIATOR	O	0.01260	48	0.01250	48	1.013	48	6.13E-06	325	7.80E-06	321	1.30	321	88.59%
PANEL Y20 BUS FAULT	F	0.01240	49	0.01233	49	1.013	49	4.00E-02	4	4.00E-02	4	1540.00	4	88.82%
LARGE LOCA	I	0.01220	50	0.01225	50	1.012	50	4.55E-03	26	4.55E-03	26	176.00	26	89.04%
P-217 HPCI AUX. OIL PUMP FAILS TO START	C	0.01180	51	0.01178	51	1.012	51	3.98E-05	179	3.95E-05	180	2.52	180	89.26%
CORE SPRAY PUMP P-208B FAILS TO RUN	C	0.01120	52	0.01118	52	1.011	52	9.26E-05	152	9.23E-05	152	4.55	152	89.46%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT		RISK REDUCTION RANKINGS						RISK INCREASE RANKINGS						
		FUSSELL-VESELY		CRITICALITY		RISK REDUCT. WORTH		BIRNBAUM		RISK INCREASE		RISK ACHIEVE. WORTH		CUM % RISK CONTRIBUTION
		T-T(0)/T	RANK	(BIRNBAUM)/T	RANK	T/T(0)	RANK	T(1)-T(0)	RANK	T(1)-T	RANK	T(1)/T	RANK	T-T(0)/SUM
(A)		(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
HPCI SYSTEM UNAVAILABLE DUE TO TEST	M	0.01090	53	0.01083	53	1.011	53	3.88E-05	182	3.85E-05	183	2.48	183	89.66%
FAILURE OF CONTACT 152-308 TO CLOSE	C	0.01080	54	0.01084	54	1.011	54	1.60E-04	103	1.60E-04	102	7.15	102	89.85%
EDGESW PUMP P-111A FAILS TO START	C	0.01070	55	0.01066	56	1.011	58	1.60E-04	104	1.60E-04	103	7.15	103	90.05%
FAILURE OF CONTACT 152-408 TO CLOSE	C	0.01070	56	0.01072	55	1.011	55	1.58E-04	106	1.58E-04	106	7.08	107	90.24%
5 HOUR NON-REPAIR FACTOR FOR MACHINERY	R	0.01070	57	0.00856	74	1.011	56	2.78E-07	392	0.00E+00	423	1.00	404	90.44%
COMMON CAUSE FAILURE TO START OF HPCI AND RCIC PUMPS	F	0.01070	58	0.01064	57	1.011	57	4.73E-04	55	4.73E-04	55	19.20	55	90.63%
EDGESW PUMP P-111B FAILS TO START	C	0.01050	59	0.01054	58	1.011	59	1.58E-04	107	1.58E-04	107	7.08	106	90.82%
OPERATOR FAILS TO MANUALLY OPEN SV-4234/35 AND 593	O	0.01020	60	0.01001	59	1.010	60	5.21E-06	354	4.94E-06	354	1.19	355	91.01%
2 OF 8 VACUUM BREAKERS FAIL OPEN	F	0.00983	61	0.00983	61	1.010	61	8.66E-04	47	8.66E-04	47	34.30	47	91.19%
OPERATOR FAILS TO INJECT SLC - LOFW INITIATOR	O	0.00982	62	0.00999	60	1.010	62	6.50E-06	330	6.24E-06	329	1.24	328	91.37%
OFF SITE POWER SYSTEM UNAVAILABLE (RANDOM-NOT INIT EVENT)	F	0.00972	63	0.00972	62	1.010	63	1.17E-03	39	1.17E-03	39	46.00	39	91.54%
DG 12 FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	0.00957	64	0.00958	65	1.010	64	1.55E-04	114	1.54E-04	114	6.94	114	91.72%
DG 11 FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	0.00956	65	0.00956	66	1.010	65	1.54E-04	115	1.54E-04	115	6.93	116	91.89%
FAILURE OF RPT BREAKER 11A TO OPEN	C	0.00955	66	0.00964	63	1.010	67	9.35E-06	291	9.10E-06	285	1.35	287	92.06%
FAILURE OF RPT BREAKER 11B TO OPEN	C	0.00955	67	0.00964	64	1.010	66	9.35E-06	292	9.10E-06	286	1.35	285	92.24%
COMMON CAUSE FAILURE OF ALL SRVS TO OPEN	F	0.00935	68	0.00934	67	1.009	68	1.49E-03	38	1.49E-03	38	58.30	38	92.41%
DG12 OUT FOR TESTING	M	0.00933	69	0.00932	68	1.009	69	1.54E-04	116	1.54E-04	116	6.93	115	92.58%
DG11 OUT FOR TESTING	M	0.00931	70	0.00931	69	1.009	70	1.54E-04	117	1.54E-04	117	6.92	117	92.75%
MOV MO-1754 FAILS TO OPEN	C	0.00924	71	0.00925	70	1.009	71	8.84E-05	155	8.81E-05	155	4.39	155	92.91%
45 MINUTE NON-RECOVERY FACTOR OUTSIDE CONT. ROOM	R	0.00886	72	0.00897	71	1.009	72	9.33E-06	293	9.10E-06	287	1.35	286	93.08%
RCIC UNAVAILABLE DUE TO TEST	M	0.00879	73	0.00880	72	1.009	73	3.71E-05	184	3.69E-05	184	2.42	184	93.24%
SMALL LOCA	I	0.00856	74	0.00857	73	1.009	74	2.78E-04	61	2.78E-04	61	11.70	61	93.39%
HI SUPPRESSION POOL LEVEL	F	0.00841	75	0.00841	75	1.008	75	2.19E-07	404	0.00E+00	424	1.00	417	93.54%
COMMON CAUSE FAILURE OF VSF 9 AND 10 TO START	F	0.00811	76	0.00810	76	1.008	76	4.78E-03	23	4.78E-03	23	185.00	23	93.69%
LOSS OF CONDENSER VACUUM	I	0.00784	77	0.00775	77	1.008	77	1.06E-05	287	1.04E-05	282	1.40	282	93.83%
CORE SPRAY PUMP P-208B FAILS TO START	C	0.00749	78	0.00749	78	1.008	78	8.65E-05	156	8.63E-05	156	4.32	156	93.97%
INTERNAL FLOOD IN ZONE 1 (TORUS RING HEADER BREAK)	I	0.00735	79	0.00734	79	1.007	79	3.98E-03	28	3.98E-03	28	154.00	28	94.10%
HPCI INJECTION TRAIN OUT FOR CORRECTIVE MAINTENANCE	M	0.00722	80	0.00724	80	1.007	80	3.63E-05	185	3.61E-05	185	2.39	185	94.24%
OPERATOR FAILS TO CROSS TIE SERVICE WATER TO CONDENSER	O	0.00653	81	0.00653	81	1.007	81	1.70E-07	405	0.00E+00	415	1.00	423	94.35%
DG12 OUT FOR CORRECTIVE MAINTENANCE	M	0.00618	82	0.00618	82	1.006	82	1.53E-04	119	1.53E-04	119	6.88	119	94.47%

INPUTS FROM PLANT X

TABLE Add-B1

BASE CORE DAMAGE FREQUENCY T = 2.60E-05/YEAR

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		BASIC EVENT CODE (B)	EVENT PROBABILITY (C)	MEASURES RELATED TO RISK REDUCTION: CDF WHERE EVENT DOES NOT OCCUR T(0) (D)	MEASURES RELATED TO RISK REDUCTION: ABSOLUTE DECREASE T - T(0) (E)	MEASURES RELATED TO RISK INCREASE: CDF WHERE EVENT OCCURS T(1) (F)	MEASURES RELATED TO RISK INCREASE: ABSOLUTE INCREASE T(1) - T (G)
SMALL LOCA	I	S2	8.00E-04	2.58E-05	2.23E-07	3.04E-04	2.78E-04
HI SUPPRESSION POOL LEVEL	F	TORUS2	1.00E+00	2.58E-05	2.19E-07	2.60E-05	0.00E+00
COMMON CAUSE FAILURE OF VSF 9 AND 10 TO START	F	AFNVSF910S	4.40E-05	2.58E-05	2.11E-07	4.81E-03	4.78E-03
LOSS OF CONDENSER VACUUM	I	TC	1.90E-02	2.58E-05	2.04E-07	3.64E-05	1.04E-05
CORE SPRAY PUMP P-208B FAILS TO START	C	CPMP208BXS	2.25E-03	2.58E-05	1.95E-07	1.12E-04	8.63E-05
INTERNAL FLOOD IN ZONE 1 (TORUS RING HEADER BREAK)	I	F1	4.80E-05	2.58E-05	1.91E-07	4.00E-03	3.98E-03
HPCI INJECTION TRAIN OUT FOR CORRECTIVE MAINTENANCE	M	HLOHPCIXCM	5.18E-03	2.58E-05	1.88E-07	6.21E-05	3.61E-05
OPERATOR FAILS TO CROSS TIE SERVICE WATER TO CONDENSER	O	FSWXTIEXXY	1.00E+00	2.58E-05	1.70E-07	2.60E-05	0.00E+00
DG12 OUT FOR CORRECTIVE MAINTENANCE	M	ADLDG12XCM	1.05E-03	2.58E-05	1.61E-07	1.79E-04	1.53E-04
DG11 OUT FOR CORRECTIVE MAINTENANCE	M	ADLDG11XCM	1.05E-03	2.58E-05	1.60E-07	1.79E-04	1.53E-04
COMMON CAUSE FAILURE OF CS AND RHR INJ MO VLVS TO OPEN	F	RVM3VALVEN	2.92E-05	2.58E-05	1.58E-07	5.43E-03	5.41E-03
UPS INV. Y71 INTERNAL FAULT	C	AIVY71XXXR	9.67E-03	2.59E-05	1.45E-07	4.08E-05	1.48E-05
SLC HANDSWITCH 11AS1 FAILS TO OPERATE	C	LSM11AS1XR	6.57E-03	2.59E-05	1.36E-07	4.65E-05	2.05E-05
ALL SIX RHR/CS PUMPS FAIL TO RUN	F	RPM6PUMPSR	2.45E-05	2.59E-05	1.29E-07	5.28E-03	5.25E-03
ALL SIX RHR/CS PUMPS FAIL TO START	F	RPM6PUMPSS	2.33E-05	2.59E-05	1.22E-07	5.28E-03	5.25E-03
LC 52-104 BREAKER 401 FAILS TO REMAIN CLOSED	C	ACB052401L	4.39E-05	2.59E-05	1.20E-07	2.76E-03	2.73E-03
LC TRX40 SUPPLY BREAKER 152-609 FAILS TO REMAIN CLOSED	C	ACB152609L	4.39E-05	2.59E-05	1.20E-07	2.76E-03	2.73E-03
COMMON CAUSE FAILURE OF FW 94-1 AND 94-2 TO OPEN	F	FVC941942N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
COMMON CAUSE FAILURE OF FW 94-1 AND FW 97-2 TO OPEN	F	FVC941972N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
COMMON CAUSE FAILURE OF FW 97-1 AND FW 94-2 TO OPEN	F	FVC971942N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
COMMON CAUSE FAILURE OF FW 97-1 AND FW 97-2 TO OPEN	F	FVC971972N	1.73E-05	2.59E-05	1.18E-07	6.81E-03	6.79E-03
REACTOR TRIP WITHOUT TURBINE TRIP	I	TWOTT	9.00E-02	2.59E-05	1.15E-07	2.70E-05	1.04E-06
RCIC UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	ILORCICXCM	3.53E-03	2.59E-05	1.15E-07	5.85E-05	3.25E-05
REACTOR PRESSURE SW PS2-3-52 A&B COMMON CAUSE FAILURE	F	QSP52ABCCC	2.12E-05	2.59E-05	1.14E-07	5.38E-03	5.36E-03
ESW B.S. 1980 PLUGGED	C	ESRBS1980F	7.20E-04	2.59E-05	1.12E-07	1.81E-04	1.55E-04
EDG LOOP B STRAINER PLUGGED	C	ESRBS2414F	7.20E-04	2.59E-05	1.11E-07	1.80E-04	1.54E-04
OPERATOR FAILS TO START FEEDPUMPS AFTER A TRANSIENT	O	FRFPOPERAY	2.80E-03	2.59E-05	1.08E-07	6.45E-05	3.85E-05

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS						RISK INCREASE RANKINGS						
		FUSSELL-VESELY		CRITICALITY		RISK REDUCT. WORTH		BIRNBAUM		RISK INCREASE		RISK ACHIEVE. WORTH		CUM % RISK CONTRIBUTION
		T-T(0)/T (B)	RANK (C)	(BIRN*U)/T (D)	RANK (E)	T/T(0) (F)	RANK (G)	T(1)-T(0) (H)	RANK (I)	T(1)-T (J)	RANK (K)	T(1)/T (L)	RANK (M)	T-T(0)/SUM (N)
MO-2107 FAILS TO OPEN	C	0.00344	113	0.00343	113	1.003	111	3.05E-05	200	3.04E-05	203	2.17	201	96.87%
MO-2096 FAILS TO OPEN	C	0.00344	114	0.00343	111	1.003	112	3.05E-05	203	3.04E-05	201	2.17	200	96.94%
OPERATOR FAILS TO DEPRESSURIZE RX (10 MINUTES)	O	0.00343	115	0.00347	108	1.003	115	4.51E-06	359	4.42E-06	360	1.17	360	97.00%
OPERATOR FAILS TO INJECT SLC - LOSS OF COND INITIATOR	O	0.00333	116	0.00333	115	1.003	116	2.17E-06	367	2.08E-06	368	1.08	368	97.06%
REFERENCE LEG LEAK INITIATING EVENT	I	0.00331	117	0.00329	117	1.003	117	2.14E-05	228	2.13E-05	226	1.82	226	97.12%
INTERNAL FLOOD IN ZONE 2 (CONDESATE SERVICE WATER -	I	0.00315	118	0.00316	118	1.003	118	4.84E-04	54	4.84E-04	54	19.60	54	97.18%
REFERENCE LEG LEAK COMMON CAUSE FACTOR	F	0.00305	119	0.00331	116	1.003	119	8.59E-07	379	7.80E-07	379	1.03	380	97.23%
HPCI AUX OIL PUMP P-217 FAILS TO RUN	C	0.00280	120	0.00279	120	1.003	120	3.02E-05	204	3.02E-05	204	2.16	204	97.28%
LOSS OF SERVICE WATER	I	0.00279	121	0.00279	119	1.003	121	8.07E-05	158	8.06E-05	158	4.10	158	97.33%
SW 147 FAILS TO OPEN	C	0.00277	122	0.00139	167	1.003	123	7.20E-08	408	0.00E+00	417	1.00	421	97.38%
SW 145 FAILS TO OPEN	C	0.00277	123	0.00139	166	1.003	122	7.20E-08	407	0.00E+00	416	1.00	411	97.43%
125V DC BATTERY D11 AND D21 FAILURE DUE TO COMMON CAUSE	F	0.00269	124	0.00268	122	1.003	124	7.12E-02	3	7.12E-02	3	2740.00	3	97.48%
RCIC MO-8 FAILS TO OPERATE	C	0.00258	125	0.00258	123	1.003	125	2.84E-05	214	2.83E-05	214	2.09	214	97.53%
COMMON CAUSE FAILURE OF FW PP BRG OIL PUMPS TO RUN	F	0.00256	126	0.00254	124	1.003	126	2.76E-04	62	2.76E-04	62	11.60	62	97.58%
LIMIT SWITCH 4 OF MO-2062 FAILS TO CLOSE	C	0.00243	127	0.00244	127	1.002	129	2.89E-05	206	2.89E-05	210	2.11	210	97.62%
LIMIT SWITCH 7 OF MO-2036 FAILS TO CLOSE	C	0.00243	128	0.00244	126	1.002	130	2.89E-05	209	2.89E-05	211	2.11	212	97.66%
MO-7 LIMIT SWITCH LS 3 FAILS TO CLOSE	C	0.00243	129	0.00244	125	1.002	127	2.89E-05	208	2.89E-05	208	2.11	206	97.71%
LIMIT SWITCH 4 OF MO-2061 FAILS TO CLOSE	C	0.00243	130	0.00244	128	1.002	128	2.89E-05	207	2.89E-05	209	2.11	211	97.75%
RELIEF VALVE RV-2056 FAILS OPEN	C	0.00239	131	0.00240	129	1.002	132	2.89E-05	210	2.89E-05	212	2.11	208	97.80%
COMMON CAUSE FAILURE TO RUN OF ALL COMPRESSORS	F	0.00239	132	0.00239	130	1.002	131	4.45E-04	56	4.45E-04	56	18.10	56	97.84%
OPERATOR DOES NOT DEPRESS ARI PB 5A, B, C & D WHEN REQUIRED	O	0.00237	133	0.00237	131	1.002	133	6.17E-05	162	6.16E-05	162	3.37	162	97.88%
LIMIT SWITCH 4 OF MO-2078 FAILS TO CLOSE	C	0.00228	134	0.00228	135	1.002	139	2.71E-05	220	2.70E-05	219	2.04	221	97.92%
LIMIT SWITCH 4 OF X06 FAILS TO CLOSE	C	0.00228	135	0.00228	132	1.002	136	2.71E-05	217	2.70E-05	221	2.04	222	97.97%
LIMIT SWITCH 16 OF MO-2078 FAILS TO CLOSE	C	0.00228	136	0.00228	137	1.002	138	2.71E-05	222	2.70E-05	218	2.04	223	98.01%
LIMIT SWITCH 4 OF X07 FAILS TO CLOSE	C	0.00228	137	0.00228	133	1.002	135	2.71E-05	218	2.70E-05	222	2.04	220	98.05%
LIMIT SWITCH 4 OF MO-2096 FAILS TO CLOSE	C	0.00228	138	0.00228	134	1.002	137	2.71E-05	221	2.70E-05	220	2.04	217	98.09%
LIMIT SWITCH 4 OF MO-2100 FAILS TO CLOSE	C	0.00228	139	0.00228	136	1.002	140	2.71E-05	216	2.70E-05	216	2.04	216	98.13%
LIMIT SWITCH 4 OF MO-2101 FAILS TO CLOSE	C	0.00228	140	0.00228	138	1.002	134	2.71E-05	219	2.70E-05	217	2.04	219	98.17%
RV-2097 FAILS TO REMAIN CLOSED	C	0.00225	141	0.00225	139	1.002	141	2.71E-05	223	2.70E-05	223	2.04	218	98.21%
LONG TERM BATTERY DEMAND (=1.0)	F	0.00225	142	0.00225	140	1.002	142	5.85E-08	409	0.00E+00	406	1.00	408	98.26%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(O)/T (B)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(O) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(O) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(O)/SUM (N)
FAILURE OF RELAY 102-5 TO ENERGIZE	C	0.00205	143	0.00206	143	1.002	143	1.46E-04	122	1.46E-04	124	6.63	123	98.29%
FAILURE OF RELAY 102-6 TO ENERGIZE	C	0.00205	144	0.00206	144	1.002	144	1.46E-04	123	1.46E-04	125	6.63	125	98.33%
FAILURE OF RELAY 183-6X TO ENERGIZE	C	0.00205	145	0.00206	142	1.002	146	1.46E-04	124	1.46E-04	127	6.63	122	98.37%
FAILURE OF RELAY 183-5X TO ENERGIZE	C	0.00205	146	0.00206	141	1.002	145	1.46E-04	125	1.46E-04	126	6.63	126	98.40%
HPCI SYSTEM NOT RESTORED AFTER TEST OR MAINTENANCE	O	0.00200	147	0.00199	145	1.002	147	2.79E-05	215	2.78E-05	215	2.07	215	98.44%
DG ROOM 11 LOUVERS FAIL TO OPEN	C	0.00199	148	0.00199	147	1.002	148	1.46E-04	127	1.46E-04	122	6.63	124	98.48%
DG ROOM 12 LOUVERS FAIL TO OPEN	C	0.00199	149	0.00199	146	1.002	149	1.46E-04	126	1.46E-04	123	6.63	127	98.51%
COMMON CAUSE FAILURE OF DG ROOM LOWERS TO OPEN	F	0.00198	150	0.00198	148	1.002	150	4.68E-03	24	4.68E-03	24	181.00	24	98.55%
LOSS OF INSTRUMENT AIR	I	0.00180	151	0.00178	149	1.002	151	7.33E-06	329	7.28E-06	326	1.28	326	98.58%
FW 67-1 FAILS TO CLOSE	C	0.00173	152	0.00173	150	1.002	152	2.86E-05	213	2.86E-05	213	2.10	213	98.61%
AUXILIARY OIL PUMP P61 FAILS TO START	C	0.00168	153	0.00165	152	1.002	153	4.46E-06	360	4.42E-06	359	1.17	358	98.64%
RCIC FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	0.00163	154	0.00163	153	1.002	154	2.42E-05	225	2.42E-05	224	1.93	224	98.67%
LC TRANSFORMER TRX40 INTERNAL FAULT	C	0.00160	155	0.00159	155	1.002	155	2.65E-03	33	2.65E-03	33	103.00	33	98.70%
FAILURE TO RESTORE SLC AFTER TEST OR MAINTENANCE	O	0.00160	156	0.00160	154	1.002	156	2.08E-05	229	2.08E-05	227	1.80	229	98.73%
LC 103 BREAKER 52-301 FAILS TO REMAIN CLOSED	C	0.00155	157	0.00155	157	1.002	158	9.15E-04	42	9.15E-04	41	36.20	41	98.76%
LC TRX30 SUPPLY BREAKER 152-509 FAILS TO REMAIN CLOSED	C	0.00155	158	0.00155	156	1.002	157	9.15E-04	41	9.15E-04	42	36.20	42	98.79%
SW AUTOMATIC STRAINER CLOGGED	C	0.00150	159	0.00151	158	1.002	159	5.44E-05	168	5.43E-05	168	3.09	168	98.82%
CONTAINMENT HEAT REMOVAL NON-RECOVERY	R	0.00145	160	0.00172	151	1.001	161	5.58E-07	381	5.20E-07	387	1.02	386	98.84%
CONDITIONAL PROBABILITY OF OVERPRESSURE FAILURE IN DRYWELL	F	0.00145	161	0.00144	160	1.001	160	3.77E-08	410	0.00E+00	407	1.00	410	98.87%
OPERATOR FAILS TO ALIGN CRD FOR ALT BORON INJECTION	O	0.00144	162	0.00114	174	1.001	163	2.97E-07	389	2.60E-07	390	1.01	389	98.89%
COMMON CAUSE FAILURE OF ESW 1-1 AND 1-2 TO OPEN	F	0.00144	163	0.00144	159	1.001	162	4.65E-03	25	4.65E-03	25	180.00	25	98.92%
N2 TANK LIQUID LINE RELIEF VALVE FAILS TO REMAIN CLOSED	C	0.00142	164	0.00143	164	1.001	165	2.57E-04	69	2.57E-04	70	10.90	69	98.95%
RV-3444 FAILS TO REMAIN CLOSED	C	0.00142	165	0.00143	165	1.001	168	2.57E-04	71	2.57E-04	73	10.90	70	98.97%
RV-3442 FAILS TO REMAIN CLOSED	C	0.00142	166	0.00143	163	1.001	166	2.57E-04	68	2.57E-04	71	10.90	67	99.00%
N2 TANK GAS LINE RELIEF VALVE FAILS TO REMAIN CLOSED	C	0.00142	167	0.00143	161	1.001	167	2.57E-04	70	2.57E-04	69	10.90	66	99.02%
RV-3443 FAILS TO REMAIN CLOSED	C	0.00142	168	0.00143	162	1.001	164	2.57E-04	67	2.57E-04	72	10.90	73	99.05%
OPERATOR FAILS TO INJECT SLC - LOOP INITIATOR	O	0.00139	169	0.00126	170	1.001	169	8.16E-07	380	7.80E-07	380	1.03	379	99.07%
FAILURE OF BREAKER 152-308 TO REMAIN CLOSED	C	0.00137	170	0.00137	168	1.001	170	8.11E-04	48	8.11E-04	48	32.20	48	99.10%
30 MINUTE NON-RECOVERY FACTOR OUTSIDE CONT. ROOM	R	0.00131	171	0.00136	169	1.001	171	2.94E-07	390	2.60E-07	398	1.01	395	99.12%
SV-7477 FAILS TO REMAIN OPEN	C	0.00123	172	0.00124	171	1.001	172	2.57E-04	72	2.57E-04	68	10.90	68	99.15%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)	Type	RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(O)/T (B)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(O) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(O) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(O)/SUM (N)
NO HIGH DW PRESSURE	F	0.00122	173	0.00122	172	1.001	173	3.17E-08	411	0.00E+00	422	1.00	429	99.17%
INTERNAL FLOOD IN ZONE 5 (SERVICE WATER - SE RHR ROOM)	I	0.00117	174	0.00117	173	1.001	174	4.84E-05	170	4.84E-05	170	2.86	170	99.19%
MANUAL BYPASS SW Y83 FAILS TO REMAIN CLOSED	C	0.00104	175	0.00104	178	1.001	175	5.20E-05	169	5.20E-05	169	3.00	169	99.21%
CHECK VALVE XP-6 FAILS TO OPEN	C	0.00104	176	0.00105	177	1.001	176	2.08E-05	230	2.08E-05	229	1.80	231	99.23%
CHECK VALVE XP-7 FAILS TO OPEN	C	0.00104	177	0.00105	176	1.001	177	2.08E-05	231	2.08E-05	230	1.80	228	99.25%
BUS 16 FAULT	C	0.00094	178	0.00095	179	1.001	178	3.07E-03	29	3.07E-03	29	119.00	29	99.26%
FAILURE OF OPERATOR TO ADD WATER TO HOTWELL	O	0.00094	179	0.00109	175	1.001	179	2.84E-07	391	2.60E-07	389	1.01	393	99.28%
INTERNAL FLOOD IN ZONE 11 (FIRE WATER - T.B. 931' WEST)	I	0.00092	180	0.00092	180	1.001	180	6.47E-03	12	6.47E-03	12	250.00	12	99.30%
30 MINUTE NON-RECOVERY IN CONTROL ROOM	R	0.00086	181	0.00087	181	1.001	181	7.56E-06	326	7.54E-06	322	1.29	322	99.31%
INTERNAL FLOOD IN ZONE 7 (SERVICE WATER - SW RHR ROOM)	I	0.00085	182	0.00085	182	1.001	182	3.95E-05	181	3.95E-05	179	2.52	179	99.33%
LC 104 BUS FAULT	C	0.00082	183	0.00083	183	1.001	183	2.68E-03	32	2.68E-03	32	104.00	32	99.34%
EDG B HX PLUGGED	C	0.00073	184	0.00073	185	1.001	184	1.39E-04	129	1.39E-04	129	6.36	129	99.36%
EDGESW HX A PLUGGED	C	0.00073	185	0.00073	184	1.001	185	1.39E-04	128	1.39E-04	128	6.36	128	99.37%
250V BATTERY 3 AND BATTERY 6 COMMON CAUSE FAILURE	F	0.00069	186	0.00069	186	1.001	186	1.83E-02	6	1.83E-02	6	704.00	6	99.38%
SIGNAL FROM FEEDWATER MASTER CONTROLLER FAILS LOW	C	0.00065	187	0.0006[illegible]	187	1.001	187	2.60E-04	65	2.60E-04	65	11.00	65	99.39%
FEEDWATER AUX OIL PUMP COMMON CAUSE FTS	F	0.00061	188	0.00061	188	1.001	188	2.03E-05	237	2.03E-05	234	1.78	233	99.40%
LOOP B EDGESW FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	0.00060	189	0.00060	189	1.001	190	1.39E-04	131	1.39E-04	131	6.36	131	99.42%
LOOP A EDGESW FAILURE TO RESTORE AFTER TEST OR MAINTENANCE	O	0.00060	190	0.00060	190	1.001	189	1.39E-04	130	1.39E-04	130	6.36	130	99.43%
RELAY 14A10B FAILS TO ENERGIZE	C	0.00059	191	0.00059	191	1.001	191	4.21E-05	177	4.21E-05	177	2.62	177	99.44%
SW PUMP 13 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	0.00057	192	0.00054	193	1,001	192	2.75E-07	393	2,60E-07	399	1.01	400	99.45%
COMMON CAUSE FAILURE OF SLC PUMPS TO START	F	0.00055	193	0.00055	192	1.001	193	2.08E-05	233	2.08E-05	228	1.80	227	99.46%
FAILURE OF DIESEL PANEL CONTACT TO CLOSE	C	0.00052	194	0.00052	194	1.001	195	1.37E-04	132	1.37E-04	132	6.28	133	99.47%
FAILURE OF DIESEL PANEL CONTACT TO CLOSE	C	0.00052	195	0.00052	195	1.001	194	1.37E-04	133	1.37E-04	133	6.28	132	99.48%
LOSS OF ONE 125VDC BUS	I	0.00051	196	0.00051	196	1.001	196	1.10E-04	139	1.10E-04	139	5.23	139	99.49%
HPCI FILTER PLUGGED	C	0.00047	197	0.00048	197	1.000	197	1.72E-05	243	1.72E-05	238	1.66	238	99.49%
PSD 3445 FAILS TO REMAIN CLOSED	C	0.00046	198	0.00046	198	1.000	198	2.50E-04	74	2.50E-04	87	10.60	93	99.50%
ACB 152-408 FAILS TO REMAIN CLOSED	C	0.00045	199	0.00045	199	1.000	199	2.68E-04	63	2.68E-04	63	11.30	63	99.51%
MO-2015 FAILS TO OPEN	C	0.00045	200	0.00044	200	1.000	200	3.91E-06	361	3.90E-06	362	1.15	362	99.52%
BREAKER 52-302 FAILS TO REMAIN CLOSED	C	0.00043	201	0.00043	201	1.000	201	2.57E-04	73	2.57E-04	66	10.90	72	99.53%
COMMON CAUSE FAILURE OF CS AND RHR INJ CHK VLVS TO OPEN	F	0.00043	202	0.00043	202	1.000	202	5.10E-03	19	5.10E-03	19	197.00	19	99.53%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(0)/T (B)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(0) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(0) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(0)/SUM (N)
BREAKER 52-402 FAILS TO REMAIN CLOSED	C	0.00042	203	0.00042	203	1.000	203	2.50E-04	75	2.50E-04	78	10.60	84	99.54%
LC TRANSFORMER TRX30 INTERNAL FAULT	C	0.00042	204	0.00042	204	1.000	204	6.99E-04	49	6.99E-04	49	27.90	49	99.55%
VACUUM BREAKER AO-2382E FAILS TO CLOSE	C	0.00038	205	0.00038	212	1.000	209	1.07E-05	281	1.07E-05	277	1.41	276	99.56%
VACUUM BREAKER AO-2382A FAILS TO CLOSE	C	0.00038	206	0.00038	211	1.000	205	1.07E-05	283	1.07E-05	274	1.41	274	99.56%
VACUUM BREAKER AO-2382F FAILS TO CLOSE	C	0.00038	207	0.00038	208	1.000	211	1.07E-05	285	1.07E-05	278	1.41	275	99.57%
VACUUM BREAKER AO-2382C FAILS TO CLOSE	C	0.00038	208	0.00038	209	1.000	208	1.07E-05	282	1.07E-05	276	1.41	281	99.58%
VACUUM BREAKER AO-2382B FAILS TO CLOSE	C	0.00038	209	0.00038	210	1.000	210	1.07E-05	280	1.07E-05	275	1.41	278	99.58%
VACUUM BREAKER AO-2382G FAILS TO CLOSE	C	0.00038	210	0.00038	205	1.000	212	1.07E-05	286	1.07E-05	279	1.41	280	99.59%
VACUUM BREAKER AO-2382K FAILS TO CLOSE	C	0.00038	211	0.00038	206	1.000	207	1.07E-05	279	1.07E-05	281	1.41	277	99.60%
VACUUM BREAKER AO-2382H FAILS TO CLOSE	C	0.00038	212	0.00038	207	1.000	206	1.07E-05	284	1.07E-05	280	1.41	279	99.61%
BREAKER 52-408 FAILS TO REMAIN CLOSED	C	0.00038	213	0.00038	214	1.000	213	2.24E-04	94	2.24E-04	94	9.60	94	99.61%
AI 593 FAILS TO OPEN	C	0.00038	214	0.00038	213	1.000	214	7.55E-06	327	7.54E-06	325	1.29	323	99.62%
AUXILIARY OIL PUMP P61 FAILS TO RUN	C	0.00037	215	0.00036	216	1.000	215	3.91E-06	362	3.90E-06	361	1.15	361	99.63%
BREAKER 52-308 FAILS TO REMAIN CLOSED	C	0.00036	216	0.00036	215	1.000	216	2.15E-04	95	2.15E-04	95	9.27	95	99.63%
BATTERY COMMON CAUSE BETA FACTOR	F	0.00036	217	0.00005	333	1.000	217	9.31E-09	412	0.00E+00	405	1.00	403	99.64%
RCIC Y STRAINER 4262 PLUGGED	C	0.00034	218	0.00034	217	1.000	218	1.22E-05	259	1.22E-05	254	1.47	254	99.65%
CHECK VALVE ESW-1-1 FAILS TO OPEN	C	0.00034	219	0.00034	219	1.000	219	1.34E-04	134	1.34E-04	134	6.16	134	99.65%
CHECK VALVE ESW-1-2 FAILS TO OPEN	C	0.00034	220	0.00034	218	1.000	220	1.34E-04	135	1.34E-04	135	6.16	135	99.66%
REACTOR PRESSURE SENSORS PS-2-3-53 A&B COMMON CAUSE FAILUR	F	0.00033	221	0.00033	220	1.000	221	4.08E-04	57	4.08E-04	57	16.70	57	99.66%
BUS 15 FAULT	C	0.00033	222	0.00033	221	1.000	222	1.06E-03	40	1.06E-03	40	41.70	40	99.67%
COMMON MODE FAILURE OF REACTOR FEED PUMPS TO START	F	0.00032	223	0.00032	222	1.000	223	1.66E-05	245	1.66E-05	240	1.64	241	99.68%
LC 103 BUS FAULT	C	0.00028	224	0.00028	223	1.000	224	9.13E-04	43	9.13E-04	43	36.10	43	99.68%
COMMON CAUSE FAILURE OF ESW PUMPS P111 C/D TO START	F	0.00028	225	0.00027	224	1.000	225	1.95E-05	239	1.95E-05	236	1.75	236	99.69%
CONDENSATE PUMP A BRNG. LUBE OIL PUMP FAILS TO RUN	C	0.00027	226	0.00026	226	1.000	226	3.13E-06	364	3.12E-06	364	1.12	364	99.69%
COMMON CAUSE FAILURE OF LEV TRANS 72 A,B,C,D	F	0.00026	227	0.00026	225	1.000	227	9.05E-04	44	9.05E-04	44	35.80	44	99.69%
BREAKER 52-404 FAILS TO REMAIN CLOSED	C	0.00025	228	0.00025	227	1.000	228	1.50E-04	121	1.50E-04	121	6.76	121	99.70%
HPCI PUMP P-209 FAILS TO RUN	C	0.00025	229	0.00025	228	1.000	229	1.40E-05	253	1.40E-05	248	1.54	248	99.70%
OPERATOR INAPPROPRIATELY CROSS-TIE LC 104 TO LC 103	O	0.00024	230	0.00020	238	1.000	230	5.26E-07	382	5.20E-07	381	1.02	384	99.71%
COND PUMP P-1B CORRECTIVE MAINTENANCE	M	0.00024	231	0.00021	234	1.000	231	5.26E-07	383	5.2[illegible]07	383	1.02	382	99.71%
COMMON CAUSE FAILURE OF SLC SQUIBS TO FIRE	F	0.00024	232	0.00024	229	1.000	232	2.08E-05	234	2.08E-05	231	1.80	230	99.72%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(0)/T (B)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(0) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(0) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(0)/SUM (N)
LOOP A EDGESW OUT FOR CORRECTIVE MAINTENANCE	M	0.00023	233	0.00023	232	1.000	234	1.30E-04	136	1.30E-04	137	5.99	136	99.72%
LOOP B EDGESW OUT FOR CORRECTIVE MAINTENANCE	M	0.00023	234	0.00023	231	1.000	233	1.30E-04	137	1.30E-04	138	5.99	138	99.73%
BREAKER 52-304 FAILS TO REMAIN CLOSED	C	0.00022	235	0.00022	233	1.000	235	1.30E-04	138	1.30E-04	136	5.99	137	99.73%
NON-RECOVERY FACTOR FOR AC POWER TO CRD PUMPS	R	0.00022	236	0.00002	394	1.000	236	5.67E-09	413	0.00E+00	404	1.00	428	99.73%
CONDENSATE PUMP COMMON MODE FAILURES	F	0.00022	237	0.00021	235	1.000	237	2.50E-04	76	2.50E-04	80	10.60	76	99.74%
FILTER TO SA CONTROL PRESSURE SWITCHES PLUGGED	C	0.00021	238	0.00021	237	1.000	238	7.55E-06	328	7.54E-06	324	1.29	325	99.74%
LOSS OF DRYWELL COOLING	I	0.00021	239	0.00024	230	1.000	240	1.05E-06	378	1.04E-06	377	1.04	378	99.74%
COMMON CAUSE FAILURE OF SV 3-142A AND B TO OPEN	F	0.00021	240	0.00021	236	1.000	239	7.46E-05	159	7.46E-05	159	3.87	159	99.75%
COMMON CAUSE FAILURE TO RUN OF CORE SPRAY PUMPS	F	0.00020	241	0.00020	239	1.000	241	1.46E-05	249	1.46E-05	243	1.56	244	99.75%
COMMON CAUSE FAILURE OF LEV TRANS 72 A AND B	F	0.00019	242	0.00019	240	1.000	243	8.74E-04	46	8.74E-04	45	34.60	46	99.76%
COMMON CAUSE FAILURE OF LEV TRANS 72 C,D	F	0.00019	243	0.00019	241	1.000	242	8.74E-04	45	8.74E-04	46	34.60	45	99.76%
COMMON CAUSE FAILURE TO START OF CORE SPRAY PUMPS	F	0.00019	244	0.00019	242	1.000	244	1.46E-05	250	1.46E-05	244	1.56	243	99.76%
MANUAL BYPASS SW Y73 FAILS TO REMAIN CLOSED	C	0.00019	245	0.00019	243	1.000	245	9.36E-06	290	9.36E-06	284	1.36	284	99.77%
COMMON CAUSE FAILURE OF LEVEL TRANSMITTER 6-52A/B	F	0.00018	246	0.00018	244	1.000	246	2.50E-04	77	2.50E-04	81	10.60	88	99.77%
COMMON CAUSE FAILURE OF ESW PUMPS P111 C/D TO RUN	F	0.00017	247	0.00017	245	1.000	247	1.87E-05	240	1.87E-05	237	1.72	237	99.77%
COMMON CAUSE FAILURE OF FW 91-1 AND FW 94-2 TO OPEN	F	0.00017	248	0.00017	246	1.000	252	2.50E-04	78	2.50E-04	83	10.60	92	99.78%
COMMON CAUSE FAILURE OF FW 91-1 AND FW 91-2 TO OPEN	F	0.00017	249	0.00017	247	1.000	250	2.50E-04	82	2.50E-04	82	10.60	78	99.78%
COMMON CAUSE FAILURE OF FW 94-1 AND FW 91-2 TO OPEN	F	0.00017	250	0.00017	250	1.000	248	2.50E-04	80	2.50E-04	85	10.60	91	99.78%
COMMON CAUSE FAILURE OF FW 91-1 AND FW 97-2 TO OPEN	F	0.00017	251	0.00017	248	1.000	251	2.50E-04	81	2.50E-04	84	10.60	82	99.78%
COMMON CAUSE FAILURE OF FW 97-1 AND 91-2 TO OPEN	F	0.00017	252	0.00017	249	1.000	249	2.50E-04	79	2.50E-04	86	10.60	77	99.79%
MO-2061 RELAY 72/2M FAILS TO ENERGIZE	C	0.00017	253	0.00016	253	1.000	260	1.17E-05	278	1.17E-05	269	1.45	268	99.79%
RELAY 23AK23 FAILS TO ENERGIZE	C	0.00017	254	0.00016	255	1.000	268	1.17E-05	272	1.17E-05	257	1.45	261	99.79%
MO-2061 RELAY 72/1F FAILS TO ENERGIZE	C	0.00017	255	0.00016	256	1.000	255	1.17E-05	268	1.17E-05	260	1.45	266	99.80%
MO-2068 RELAY 72/2M FAILS TO ENERGIZE	C	0.00017	256	0.00016	266	1.000	254	1.17E-05	267	1.17E-05	272	1.45	269	99.80%
MO-2036 RELAY 72/2F FAILS TO ENERGIZE	C	0.00017	257	0.00016	258	1.000	265	1.17E-05	264	1.17E-05	263	1.45	256	99.80%
RELAY 23AK2 FAILS TO ENERGIZE	C	0.00017	258	0.00016	268	1.000	264	1.17E-05	269	1.17E-05	258	1.45	255	99.81%
MO-2062 RELAY 72/2F FAILS TO ENERGIZE	C	0.00017	259	0.00016	260	1.000	269	1.17E-05	277	1.17E-05	265	1.45	263	[illegible]
MO-2062 RELAY 72/1F FAILS TO ENERGIZE	C	0.00017	260	0.00016	264	1.000	256	1.17E-05	265	1.17E-05	261	1.45	273	[illegible]
MO-2062 RELAY 72/2M FAILS TO ENERGIZE	C	0.00017	261	0.00016	251	1.000	266	1.17E-05	270	1.17E-05	270	1.45	257	[illegible]
MO-2062 RELAY 72/2M FAILS TO ENERGIZE	C	0.00017	262	0.00016	262	1.000	270	1.17E-05	263	1.17E-05	271	1.45	265	[illegible]

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(0)/T (B)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(0) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(0) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(0)/SUM (N)
MO-2068 RELAY 72/2F FAILS TO ENERGIZE	C	0.00017	263	0.00016	263	1.000	261	1.17E-05	260	1.17E-05	267	1.45	262	99.82%
RELAY 72/1F FAILS TO ENERGIZE	C	0.00017	264	0.00016	254	1.000	271	1.17E-05	271	1.17E-05	259	1.45	267	99.82%
MO-2062 RELAY 72/2F FAILS TO ENERGIZE	C	0.00017	265	0.00016	252	1.000	262	1.17E-05	274	1.17E-05	266	1.45	271	99.83%
RELAY 23 181A FAILS TO ENERGIZE	C	0.00017	266	0.00016	257	1.000	258	1.17E-05	266	1.17E-05	255	1.45	272	99.83%
RELAY 23AK1 FAILS TO ENERGIZE	C	0.00017	267	0.00016	259	1.000	263	1.17E-05	262	1.17E-05	256	1.45	264	99.83%
MO-2036 RELAY 72/2M FAILS TO ENERGIZE	C	0.00017	268	0.00016	261	1.000	267	1.17E-05	261	1.17E-05	268	1.45	259	99.84%
HPCI AOP P-217 RELAY 72/M FAILS TO ENERGIZE	C	0.00017	269	0.00016	269	1.000	259	1.17E-05	275	1.17E-05	273	1.45	260	99.84%
MO-2062 RELAY 72/1F FAILS TO ENERGIZE	C	0.00017	270	0.00016	267	1.000	253	1.17E-05	276	1.17E-05	262	1.45	270	99.84%
MO-2061 RELAY 72/2F FAILS TO ENERGIZE	C	0.00017	271	0.00016	265	1.000	257	1.17E-05	273	1.17E-05	264	1.45	258	99.84%
RCIC PUMP P-207 FAILS TO RUN	C	0.00016	272	0.00016	270	1.000	272	8.84E-06	294	8.84E-06	288	1.34	289	99.85%
TRANSFORMER #11 INTERNAL FAULT	C	0.00015	273	0.00015	272	1.000	273	2.50E-04	83	2.50E-04	79	10.60	80	99.85%
COMMON CAUSE FAILURE TO RUN OF HPCI AND RCIC PUMPS	F	0.00015	274	0.00015	271	1.000	274	2.03E-04	96	2.03E-04	96	8.81	96	99.85%
CORE SPRAY TRAIN B OUT FOR CORRECTIVE MAINTENANCE	M	0.00014	275	0.00014	273	1.000	275	2.34E-05	226	2.34E-05	225	1.90	225	99.86%
COMMON CAUSE FAILURE OF VSF 9 AND 10 TO RUN	F	0.00014	276	0.00014	274	1.000	276	4.32E-03	27	4.32E-03	27	167.00	27	99.86%
FAILURE OF LEVEL TRANSMITTER 72B TO OPERATE	C	0.00014	277	0.00014	276	1.000	277	5.80E-05	163	5.80E-05	163	3.23	163	99.86%
LIMIT SWITCH OAS/1 FAILS TO CLOSE (MO-1987)	C	0.00013	278	0.00014	275	1.000	278	5.23E-07	384	5.20E-07	384	1.02	383	99.86%
RHRSW LOOP 2 OUT FOR CORRECTIVE MAINTENANCE	M	0.00012	279	0.00014	277	1.000	279	5.23E-07	385	5.20E-07	386	1.02	385	99.87%
FAILURE OF SWITCH 10AS19B TO CLOSE	C	0.00012	280	0.00013	278	1.000	280	5.23E-07	386	5.20E-07	385	1.02	387	99.87%
BATTERY 6 FUSE BLOWN	C	0.00012	281	0.00012	280	1.000	281	8.35E-05	157	8.35E-05	157	4.21	157	99.87%
DG 11 CONTROL SWITCH CONTACT FAILURE TO REMAIN CLOSED	C	0.00011	282	0.00011	292	1.000	288	1.01E-04	147	1.01E-04	148	4.88	140	99.87%
CONTACT 186-502 FAILS TO REMAIN CLOSED	C	0.00011	283	0.00011	289	1.000	287	1.01E-04	145	1.01E-04	146	4.88	143	99.87%
FAILURE OF 152-511 CONTACT TO REMAIN CLOSED	C	0.00011	284	0.00011	285	1.000	286	1.01E-04	149	1.01E-04	142	4.88	149	99.88%
FAILURE OF CONTACT 152-502 TO REMAIN CLOSED	C	0.00011	285	0.00011	291	1.000	292	1.01E-04	140	1.01E-04	141	4.88	142	99.88%
FAILURE OF 152-501 CONTACT TO REMAIN CLOSED	C	0.00011	286	0.00011	287	1.000	290	1.01E-04	148	1.01E-04	140	4.88	150	99.88%
FAILURE OF ACB 602 CONTACT TO REMAIN CLOSED	C	0.00011	287	0.00011	290	1.000	285	1.01E-04	143	1.01E-04	147	4.88	148	99.88%
FAILURE OF CONTACT 152-601 TO REMAIN CLOSED	C	0.00011	288	0.00011	282	1.000	282	1.01E-04	146	1.01E-04	143	4.88	144	99.88%
DG 12 CONTROL SWITCH CONTACT FAILURE TO REMAIN CLOSED	C	0.00011	289	0.00011	284	1.000	284	1.01E-04	142	1.01E-04	149	4.88	141	99.89%
FAILURE OF CONTACT 152-610 TO REMAIN CLOSED	C	0.00011	290	0.00011	286	1.000	289	1.01E-04	150	1.01E-04	145	4.88	146	99.89%
FAILURE OF CONTROL SWITCH 152-502 CONTACT TO REMAIN CLOSED	C	0.00011	291	0.00011	288	1.000	293	1.01E-04	151	1.01E-04	150	4.88	145	99.89%
FAILURE OF 152-602 CONTACT TO REMAIN CLOSED	C	0.00011	292	0.00011	281	1.000	291	1.01E-04	144	1.01E-04	144	4.88	151	99.89%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT		RISK REDUCTION RANKINGS						RISK INCREASE RANKINGS						
		FUSSELL-VESELY		CRITICALITY		RISK REDUCT. WORTH		BIRNBAUM		RISK INCREASE		RISK ACHIEVE. WORTH		CUM % RISK CONTRIBUTION
		T-T(0)/T	RANK	(BIRN*U)/T	RANK	T/T(0)	RANK	T(1)-T(0)	RANK	T(1)-T	RANK	T(1)/T	RANK	T-T(0)/SUM
(A)		(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
FAILURE OF HANDSWITCH 152-602 CONTACT TO REMAIN CLOSED	C	0.00011	293	0.00011	283	1.000	283	1.01E-04	141	1.01E-04	151	4.88	147	99.89%
SWITCH 14AS13B FAILS TO REMAIN CLOSED	C	0.00011	294	0.00011	293	1.000	294	2.89E-05	211	2.89E-05	207	2.11	209	99.90%
COMMON CAUSE FAILURE TO OPEN OF MO-1753 AND MO-1754	F	0.00011	295	0.00011	294	1.000	295	1.35E-05	254	1.35E-05	249	1.52	249	99.90%
CV-1729 FAILS TO OPEN	C	0.00010	296	0.00012	279	1.000	296	5.23E-07	387	5.20E-07	388	1.02	381	99.90%
CHECK VALVE AS 1-1 FAILS TO CLOSE	C	0.00010	297	0.00010	295	1.000	297	6.24E-06	331	6.24E-06	328	1.24	329	99.90%
FAILURE TO MANUALLY ALIGN THE CRD SYSTEM	O	0.00010	298	0.00004	346	1.000	298	2.51E-09	414	0.00E+00	418	1.00	415	99.90%
COMMON CAUSE FAILURE OF ESW 17 AND 18 TO OPEN	F	0.00009	299	0.00009	298	1.000	300	2.89E-04	58	2.89E-04	58	12.10	59	99.90%
COMMON CAUSE FAILURE OF ESW 4-1 AND 4-2 TO OPEN	F	0.00009	300	0.00009	296	1.000	301	2.89E-04	59	2.89E-04	60	12.10	58	99.91%
COMMON CAUSE FAILURE OF ESW 23 AND 24 TO OPEN	F	0.00009	301	0.00009	297	1.000	299	2.89E-04	60	2.89E-04	59	12.10	60	99.91%
FAILURE OF RELAY 14AK1B TO REMAIN ENERGIZED	C	0.00008	302	0.00008	300	1.000	302	2.89E-05	212	2.89E-05	206	2.11	207	99.91%
RELAY K101A FAILURE	C	0.00008	303	0.00008	299	1.000	303	5.72E-06	332	5.72E-06	330	1.22	330	99.91%
COMMON CAUSE FAILURE OF WASTE SAMPLE PUMPS TO START	F	0.00008	304	0.00007	328	1.000	304	2.62E-07	394	2.60E-07	400	1.01	396	99.91%
COMMON CAUSE FAILURE OF P-5A/B TO START	F	0.00008	305	0.00007	327	1.000	305	2.62E-07	395	2.60E-07	401	1.01	392	99.91%
RELAY 72M FAILS TO ENERGIZE	C	0.00008	306	0.00008	320	1.000	312	5.46E-06	348	5.46E-06	347	1.21	348	99.92%
RELAY 722F FAILS TO ENERGIZE	C	0.00008	307	0.00008	317	1.000	316	5.46E-06	344	5.46E-06	345	1.21	333	99.92%
RELAY 721F FAILS TO ENERGIZE	C	0.00008	308	0.00008	309	1.000	307	5.46E-06	338	5.46E-06	338	1.21	342	99.92%
RELAY 72M FAILS TO ENERGIZE	C	0.00008	309	0.00008	323	1.000	308	5.46E-06	352	5.46E-06	349	1.21	345	99.92%
RELAY 72M FAILS TO ENERGIZE	C	0.00008	310	0.00008	311	1.000	318	5.46E-06	349	5.46E-06	350	1.21	347	99.92%
RELAY 722F FAILS TO ENERGIZE	C	0.00008	311	0.00008	319	1.000	324	5.46E-06	342	5.46E-06	341	1.21	341	99.92%
RELAY 722F FAILS TO ENERGIZE	C	0.00008	312	0.00008	313	1.000	317	5.46E-06	345	5.46E-06	343	1.21	351	99.92%
RELAY 13AK1 FAILS TO ENERGIZE	C	0.00008	313	0.00008	322	1.000	320	5.46E-06	340	5.46E-06	332	1.21	334	99.93%
RELAY 72M FAILS TO ENERGIZE	C	0.00008	314	0.00008	315	1.000	313	5.46E-06	335	5.46E-06	346	1.21	336	99.93%
RELAY 721F FAILS TO ENERGIZE	C	0.00008	315	0.00008	321	1.000	306	5.46E-06	334	5.46E-06	336	1.21	331	99.93%
RELAY 722F FAILS TO ENERGIZE	C	0.00008	316	0.00008	306	1.000	323	5.46E-06	339	5.46E-06	344	1.21	343	99.93%
RELAY 721F FAILS TO ENERGIZE	C	0.00008	317	0.00008	308	1.000	314	5.46E-06	346	5.46E-06	334	1.21	337	99.93%
RELAY 722F FAILS TO ENERGIZE	C	0.00008	318	0.00008	310	1.000	315	5.46E-06	353	5.46E-06	342	1.21	335	99.93%
RELAY 72M FAILS TO ENERGIZE	C	0.00008	319	0.00008	312	1.000	319	5.46E-06	347	5.46E-06	351	1.21	346	99.93%
RELAY 72M FAILS TO ENERGIZE	C	0.00008	320	0.00008	314	1.000	325	5.46E-06	343	5.46E-06	348	1.21	350	99.94%
RELAY 13AK2 FAILS TO ENERGIZE	C	0.00008	321	0.00008	316	1.000	310	5.46E-06	350	5.46E-06	333	1.21	344	99.94%
RELAY 721F FAILS TO ENERGIZE	C	0.00008	322	0.00008	318	1.000	322	5.46E-06	351	5.46E-06	339	1.21	339	99.94%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS						RISK INCREASE RANKINGS						
		FUSSELL-VESELY		CRITICALITY		RISK REDUCT. WORTH		BIRNBAUM		RISK INCREASE		RISK ACHIEVE. WORTH		CUM % RISK CONTRIBUTION
		T-T(0)/T (B)	RANK (C)	(BIRN*U)/T (D)	RANK (E)	T/T(0) (F)	RANK (G)	T(1)-T(0) (H)	RANK (I)	T(1)-T (J)	RANK (K)	T(1)/T (L)	RANK (M)	T-T(0)/SUM (N)
RELAY 722F FAILS TO ENERGIZE	C	0.00008	323	0.00008	305	1.000	311	5.46E-06	336	5.46E-06	340	1.21	338	99.94%
RELAY 721F FAILS TO ENERGIZE	C	0.00008	324	0.00008	324	1.000	309	5.46E-06	337	5.46E-06	337	1.21	340	99.94%
RELAY 721F FAILS TO ENERGIZE	C	0.00008	325	0.00008	307	1.000	321	5.46E-06	341	5.46E-06	335	1.21	332	99.94%
MCC 31 BUS FAULT	C	0.00008	326	0.00008	301	1.000	328	2.50E-04	84	2.50E-04	76	10.60	79	99.94%
BUS 13 FAULT	C	0.00008	327	0.00008	304	1.000	326	2.50E-04	85	2.50E-04	74	10.60	75	99.94%
MCC 41 BUS FAULT	C	0.00008	328	0.00008	302	1.000	327	2.50E-04	87	2.50E-04	77	10.60	87	99.95%
BUS 14 FAULT	C	0.00008	329	0.00008	303	1.000	329	2.50E-04	86	2.50E-04	75	10.60	74	99.95%
CHECK VALVE ESW-4-2 FAILS TO OPEN	C	0.00008	330	0.00007	325	1.000	330	2.99E-05	205	2.99E-05	205	2.15	205	99.95%
CORE SPRAY TRAIN B FAILURE TO RESTORE AFTER TEST OR MAINT	O	0.00007	331	0.00007	326	1.000	331	1.66E-05	246	1.66E-05	239	1.64	240	99.95%
COMMON CAUSE FACTOR FOR CRD PUMPS	F	0.00006	332	0.00001	415	1.000	333	1.54E-09	415	0.00E+00	403	1.00	414	99.95%
CRD OUT FOR CORRECTIVE MAINTENANCE	M	0.00006	333	0.00000	420	1.000	332	1.54E-09	416	0.00E+00	419	1.00	412	99.95%
COMMON CAUSE FAILURE OF LEV TRANS 72 A,B,C	F	0.00005	334	0.00005	335	1.000	337	6.97E-04	52	6.97E-04	50	27.80	53	99.95%
COMMON CAUSE FAILURE OF LEV TRANS 72 A,C,D	F	0.00005	335	0.00005	337	1.000	336	6.97E-04	50	6.97E-04	52	27.80	52	99.95%
COMMON CAUSE FAILURE OF LEV TRANS 72 B,C,D	F	0.00005	336	0.00005	336	1.000	334	6.97E-04	53	6.97E-04	53	27.80	51	99.96%
COMMON CAUSE FAILURE OF LEV TRANS 72 A,B,D	F	0.00005	337	0.00005	334	1.000	335	6.97E-04	51	6.97E-04	51	27.80	50	99.96%
COMMON CAUSE FAILURE TO RUN OF ALL THREE SW PUMPS	F	0.00005	338	0.00005	338	1.000	338	2.50E-04	88	2.50E-04	92	10.60	81	99.96%
SW PUMP #11 FAILS TO RUN	C	0.00005	339	0.00005	340	1.000	339	1.27E-05	256	1.27E-05	252	1.49	250	99.96%
SW PUMP #12 FAILS TO RUN	C	0.00005	340	0.00005	339	1.000	340	1.27E-05	255	1.27E-05	253	1.49	252	99.96%
SWITCH 14AS13A FAILS TO REMAIN CLOSED	C	0.00005	341	0.00005	341	1.000	341	1.27E-05	257	1.27E-05	251	1.49	253	99.96%
FW-94-2 FAILS TO OPEN	C	0.00005	342	0.00005	342	1.000	343	8.58E-06	296	8.58E-06	293	1.33	318	99.96%
FW-97-2 FAILS TO OPEN	C	0.00005	343	0.00005	343	1.000	342	8.58E-06	295	8.58E-06	294	1.33	307	99.96%
CONDENSATE PUMP B BRNG. OIL PUMP FAILS TO RUN	C	0.00005	344	0.00004	345	1.000	344	5.21E-07	388	5.20E-07	382	1.02	388	99.96%
CHECK VALVE XP-3-2 FAILS TO OPEN	C	0.00004	345	0.00007	329	1.000	346	2.61E-07	397	2.60E-07	394	1.01	397	99.96%
CHECK VALVE XP-3-1 FAILS TO OPEN	C	0.00004	346	0.00007	330	1.000	345	2.61E-07	396	2.60E-07	393	1.01	391	99.96%
RELAY 420015 OPEN COIL FAILS TO ENERGIZE (420)	C	0.00004	347	0.00004	344	1.000	347	3.12E-06	365	3.12E-06	365	1.12	365	99.96%
DG11 BREAKER 152-502 FAILS TO REMAIN CLOSED	C	0.00004	348	0.00004	348	1.000	348	7.20E-05	160	7.20E-05	160	3.77	160	99.97%
DG12 BREAKER 152-602 FAILS TO REMAIN CLOSED	C	0.00004	349	0.00004	347	1.000	349	7.20E-05	161	7.20E-05	161	3.77	161	99.97%
FEEDWATER PUMP P-2D CORRECTIVE MAINTENANCE	M	0.00004	350	0.00000	421	1.000	350	9.49E-10	417	0.00E+00	414	1.00	420	99.97%
CHECK VALVE ESW-4-1 FAILS TO OPEN	C	0.00004	351	0.00004	349	1.000	351	1.43E-05	252	1.43E-05	247	1.55	247	99.97%
RELAY 14AK1A DEENERGIZES	C	0.00004	352	0.00004	350	1.000	352	1.27E-05	258	1.27E-05	250	1.49	251	99.97%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(O)/T (B)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(O) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(O) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(O)/SUM (N)
BREAKER B4318 FAILS TO REMAIN CLOSED	C	0.00003	353	0.00003	351	1.000	353	2.03E-05	238	2.03E-05	233	1.78	234	99.97%
SLC TANK HEATER FAILS	C	0.00003	354	0.00003	352	1.000	354	1.46E-05	251	1.46E-05	246	1.56	246	99.97%
MO-2062 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	0.00003	355	0.00003	356	1.000	360	8.58E-06	297	8.58E-06	303	1.33	306	99.97%
MO-2062 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	0.00003	356	0.00003	367	1.000	365	8.58E-06	299	8.58E-06	302	1.33	294	99.97%
MO-2062 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	0.00003	357	0.00003	360	1.000	362	8.58E-06	302	8.58E-06	307	1.33	293	99.97%
RELAY 23AK27 CONTACTS FAIL TO CLOSE	C	0.00003	358	0.00003	363	1.000	356	8.58E-06	308	8.58E-06	298	1.33	304	99.97%
MO-2036 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	0.00003	359	0.00003	361	1.000	366	8.58E-06	310	8.58E-06	305	1.33	298	99.97%
MO-2068 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	0.00003	360	0.00003	366	1.000	367	8.58E-06	298	8.58E-06	304	1.33	308	99.97%
MO-2068 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	0.00003	361	0.00003	362	1.000	368	8.58E-06	311	8.58E-06	309	1.33	311	99.97%
RELAY 23AK25 CONTACTS FAIL TO CLOSE ON HIGH TORUS LEVEL	C	0.00003	362	0.00003	365	1.000	363	8.58E-06	300	8.58E-06	297	1.33	292	99.97%
RELAY 23AK15 CONTACTS FAIL TO CLOSE ON LOW CST LEVEL	C	0.00003	363	0.00003	364	1.000	359	8.58E-06	303	8.58E-06	296	1.33	296	99.97%
MO-2061 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	0.00003	364	0.00003	358	1.000	369	8.58E-06	306	8.58E-06	301	1.33	314	99.98%
RELAY 23AK13 CONTACTS FAIL TO CLOSE	C	0.00003	365	0.00003	357	1.000	357	8.58E-06	309	8.58E-06	295	1.33	310	99.98%
MO-2036 RELAY 72/1R CONTACTS FAIL TO CLOSE	C	0.00003	366	0.00003	354	1.000	355	8.58E-06	305	8.58E-06	300	1.33	317	99.98%
MO-2061 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	0.00003	367	0.00003	355	1.000	361	8.58E-06	301	8.58E-06	306	1.33	302	99.98%
MO-2062 RELAY 72/2R CONTACTS FAIL TO CLOSE	C	0.00003	368	0.00003	353	1.000	364	8.58E-06	307	8.58E-06	308	1.33	290	99.98%
RELAY CONTACT 23AK28 FAILS TO CLOSE	C	0.00003	369	0.00003	359	1.000	358	8.58E-06	304	8.58E-06	299	1.33	316	99.98%
RV-3039 FAILS TO REMAIN CLOSED	C	0.00003	370	0.00002	395	1.000	370	2.61E-07	398	2.60E-07	402	1.01	394	99.98%
DG FAN VSF10 FAILS TO RUN	C	0.00003	371	0.00003	369	1.000	372	5.62E-05	165	5.62E-05	164	3.16	166	99.98%
DG FAN VSF9 FAILS TO RUN	C	0.00003	372	0.00003	368	1.000	371	5.62E-05	164	5.62E-05	165	3.16	167	99.98%
SLC PUMP P-203-B FAILS TO START	C	0.00003	373	0.00006	332	1.000	373	2.61E-07	400	2.60E-07	392	1.01	398	99.98%
SLC PUMP P-203-A FAILS TO START	C	0.00003	374	0.00006	331	1.000	374	2.61E-07	399	2.60E-07	391	1.01	402	99.98%
RELAY K113A FAILURE	C	0.00003	375	0.00003	370	1.000	375	2.08E-06	368	2.08E-06	367	1.08	367	99.98%
BATTERY D11 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	0.00003	376	0.00003	372	1.000	376	5.62E-05	167	5.62E-05	166	3.16	165	99.98%
BATTERY D21 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	0.00003	377	0.00003	371	1.000	377	5.62E-05	166	5.62E-05	167	3.16	164	99.98%
MCC 44 BUS FAULT	C	0.00003	378	0.00003	373	1.000	379	9.00E-05	154	9.00E-05	154	4.46	153	99.98%
MCC 34 BUS FAULT	C	0.00003	379	0.00003	374	1.000	378	9.00E-05	153	9.00E-05	153	4.46	154	99.98%
WASTE SAMPLE PUMP A FAILS TO START	C	0.00003	380	0.00000	417	1.000	380	7.10E-10	418	0.00E+00	425	1.00	405	99.98%
PUMP P-5A FAILS TO START	C	0.00003	381	0.00000	419	1.000	381	7.10E-10	419	0.00E+00	427	1.00	413	99.98%
FAILURE OF WASTE SAMPLE PUMP B TO START	C	0.00003	382	0.00000	418	1.000	382	7.10E-10	420	0.00E+00	426	1.00	406	99.98%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT (A)		RISK REDUCTION RANKINGS: FUSSELL-VESELY T-T(D)/T (E)	RANK (C)	CRITICALITY (BIRN*U)/T (D)	RANK (E)	RISK REDUCT. WORTH T/T(D) (F)	RANK (G)	RISK INCREASE RANKINGS: BIRNBAUM T(1)-T(D) (H)	RANK (I)	RISK INCREASE T(1)-T (J)	RANK (K)	RISK ACHIEVE. WORTH T(1)/T (L)	RANK (M)	CUM % RISK CONTRIBUTION T-T(D)/SUM (N)
PUMP P-5B FAILS TO START	C	0.00003	383	0.00000	416	1.000	383	7.10E-10	421	0.00E+00	428	1.00	416	99.99%
CHARGER D80 RANDOM FAILURE	C	0.00003	384	0.00003	376	1.000	385	8.58E-06	312	8.58E-06	292	1.33	319	99.99%
CHARGER D70 RANDOM FAILURE	C	0.00003	385	0.00003	377	1.000	384	8.58E-06	313	8.58E-06	291	1.33	313	99.99%
CHECK VALVE HPO-2 FAILS TO OPEN	C	0.00002	386	0.00002	384	1.000	392	8.58E-06	320	8.58E-06	318	1.33	315	99.99%
CHECK VALVE HPO-1 FAILS TO OPEN	C	0.00002	387	0.00002	381	1.000	390	8.58E-06	316	8.58E-06	317	1.33	312	99.99%
CHECK VALVE HPCI-18 FAILS TO OPEN	C	0.00002	388	0.00002	382	1.000	386	8.58E-06	314	8.58E-06	314	1.33	299	99.99%
CHECK VALVE HPCI-9 FAILS TO OPEN	C	0.00002	389	0.00002	379	1.000	388	8.58E-06	318	8.58E-06	312	1.33	291	99.99%
PRESSURE SWITCH PS-1 DOES NOT CLOSE ON LOW OIL PRESSURE	C	0.00002	390	0.00002	380	1.000	389	8.58E-06	321	8.58E-06	310	1.33	309	99.99%
CHECK VALVE HPCI-10 FAILS TO OPEN	C	0.00002	391	0.00002	385	1.000	391	8.58E-06	317	8.58E-06	313	1.33	305	99.99%
HPCI STEAM LINE DRAIN AND ALARM FAIL ON INITIAL START	C	0.00002	392	0.00002	378	1.000	393	8.58E-06	315	8.58E-06	319	1.33	301	99.99%
AO 23-18 FAILS TO OPEN	C	0.00002	393	0.00002	383	1.000	387	8.58E-06	319	8.58E-06	311	1.33	297	99.99%
Y80 PANEL SUPPLY FUSE BLOWOUT	C	0.00002	394	0.00002	386	1.000	394	8.58E-06	322	8.58E-06	290	1.33	295	99.99%
CV 1470 FAILS TO REMAIN OPEN	C	0.00002	395	0.00002	390	1.000	395	2.50E-04	91	2.50E-04	88	10.60	85	99.99%
ISOLATION VALVE CV-1478 FAILS TO REMAIN OPEN	C	0.00002	396	0.00002	389	1.000	399	2.50E-04	89	2.50E-04	89	10.60	89	99.99%
PCV-3450A FAILS TO REMAIN OPEN	C	0.00002	397	0.00002	391	1.000	398	2.50E-04	90	2.50E-04	90	10.60	90	99.99%
PCV-3450B FAILS TO REMAIN OPEN	C	0.00002	398	0.00002	387	1.000	397	2.50E-04	93	2.50E-04	91	10.60	83	99.99%
AO-1579 FAILS TO REMAIN OPEN	C	0.00002	399	0.00002	388	1.000	396	2.50E-04	92	2.50E-04	93	10.60	86	99.99%
FAILURE OF RELAY 95-7 TO ENERGIZE	C	0.00002	400	0.00002	393	1.000	401	1.56E-06	376	1.56E-06	374	1.06	375	99.99%
FAILURE OF RELAY 95-8 TO ENERGIZE	C	0.00002	401	0.00002	392	1.000	400	1.56E-06	375	1.56E-06	375	1.06	374	99.99%
HPCI-32 FAILS TO OPEN	C	0.00002	402	0.00002	396	1.000	402	8.58E-06	323	8.58E-06	316	1.33	300	99.99%
HPCI-31 FAILS TO OPEN	C	0.00002	403	0.00002	397	1.000	403	8.58E-06	324	8.58E-06	315	1.33	303	99.99%
CONDENSATE PUMP A FAILS TO RUN	C	0.00002	404	0.00002	398	1.000	404	2.60E-06	366	2.60E-06	366	1.10	366	99.99%
2A FEEDWATER AUX OIL PUMP FAILS TO START	C	0.00002	405	0.00000	424	1.000	405	4.19E-10	422	0.00E+00	412	1.00	426	99.99%
ESW PUMP P111 D FAILS TO START	C	0.00002	406	0.00000	426	1.000	406	4.03E-10	423	0.00E+00	411	1.00	407	100.00%
ESW PUMP P111 C FAILS TO START	C	0.00002	407	0.00000	425	1.000	407	4.03E-10	424	0.00E+00	409	1.00	419	100.00%
COMPRESSOR 13 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	0.00001	408	0.00000	422	1.000	408	3.82E-10	426	0.00E+00	421	1.00	409	100.00%
COMPRESSOR 12 UNAVAILABLE DUE TO CORRECTIVE MAINTENANCE	M	0.00001	409	0.00000	423	1.000	409	3.82E-10	425	0.00E+00	420	1.00	425	100.00%
AIR COMPRESSOR #11 FAILS TO RUN	C	0.00001	410	0.00003	375	1.000	410	2.60E-07	401	2.60E-07	395	1.01	390	100.00%
PANEL D211 OUT FOR CORRECTIVE MAINTENANCE	M	0.00001	411	0.00001	402	1.000	413	3.59E-05	186	3.59E-05	190	2.38	187	100.00%
PANEL D111 OUT FOR CORRECTIVE MAINTENANCE	M	0.00001	412	0.00001	401	1.000	411	3.59E-05	187	3.59E-05	188	2.38	189	100.00%

CALCULATED IMPORTANCE MEASURES FOR PLANT X

TABLE Add-B2

BASIC EVENT DESCRIPTION AND TYPE OF BASIC EVENT		RISK REDUCTION RANKINGS						RISK INCREASE RANKINGS						
		FUSSELL-VESELY		CRITICALITY		RISK REDUCT. WORTH		BIRNBAUM		RISK INCREASE		RISK ACHIEVE. WORTH		CUM % RISK CONTRIBUTION
		T-T(0)/T	RANK	(BIRN*U)/T	RANK	T/T(0)	RANK	T(1)-T(0)	RANK	T(1)-T	RANK	T(1)/T	RANK	T-T(0)/SUM
(A)		(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
D21 UNAVAILABLE BECAUSE OF CORRECTIVE MAINTENANCE	M	0.00001	413	0.00001	400	1.000	412	3.59E-05	188	3.59E-05	191	2.38	186	100.00%
PANEL D11 OUT FOR CORRECTIVE MAINTENANCE	M	0.00001	414	0.000C1	399	1.000	414	3.59E-05	189	3.59E-05	189	2.38	190	100.00%
CHECK VALVE CS-9-2 FAILS TO OPEN	C	0.00001	415	0.00001	404	1.000	415	4.94E-06	355	4.94E-06	353	1.19	354	100.00%
CHECK VALVE AO-13B FAILS TO OPEN	C	0.00001	416	0.00001	405	1.000	416	4.94E-06	356	4.94E-06	352	1.19	353	100.00%
MCC 33A BUS FAULT	C	0.00001	417	0.00001	406	1.000	417	3.59E-05	190	3.59E-05	186	2.38	191	100.00%
MCC 43A BUS FAULT	C	0.00001	418	0.00001	407	1.000	418	3.59E-05	191	3.59E-05	187	2.38	188	100.00%
RV 7384 FAILS TO REMAIN CLOSED	C	0.00001	419	0.00001	409	1.000	421	1.82E-06	372	1.82E-06	373	1.07	370	100.00%
RV 1459A FAILS TO REMAIN CLOSED	C	0.00001	420	0.00001	410	1.000	420	1.82E-06	374	1.82E-06	369	1.07	373	100.00%
RV 1460A FAILS TO REMAIN CLOSED	C	0.00001	421	0.00001	412	1.000	422	1.82E-06	371	1.82E-06	371	1.07	371	100.00%
RV 1460B FAILS TO REMAIN CLOSED	C	0.00001	422	0.00001	413	1.000	419	1.82E-06	373	1.82E-06	372	1.07	369	100.00%
RV 1459B FAILS TO REMAIN CLOSED	C	0.00001	423	0.00001	411	1.000	423	1.82E-06	370	1.82E-06	370	1.07	372	100.00%
RFP 2A FAILS TO START	C	0.00001	424	0.00000	427	1.000	424	2.68E-10	427	0.00E+00	413	1.00	418	100.00%
ESW PUMP P111 D FAILS TO RUN	C	0.00001	425	0.00000	428	1.000	427	2.63E-10	428	0.00E+00	410	1.00	424	100.00%
ESW PUMP P111C FAILS TO RUN	C	0.00001	426	0.00000	429	1.000	426	2.63E-10	429	0.00E+00	408	1.00	422	100.00%
REACTOR LEVEL SENSOR LIS 2-3-672A FAILS TO CLOSE ON LOW	C	0.00001	427	0.00001	408	1.000	425	3.64E-06	363	3.64E-06	363	1.14	363	100.00%
FAILURE OF PRESSURE SWITCH DPIS-1473	C	0.00001	428	0.00001	403	1.000	429	2.60E-07	402	2.60E-07	397	1.01	399	100.00%
INST AIR DRYER PLUGGED	C	0.00001	429	0.00001	414	1.000	428	2.60E-07	403	2.60E-07	396	1.01	401	100.00%

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

January 13, 1995

Mr. Robert A. Pinelli, Chairman
BWR Owners' Group
c/o GPU Nuclear
MCC Building E
One Upper Pond Road
Parsippany, NJ 07054

SUBJECT: BWR OWNERS' GROUP TOPICAL REPORT NEDC-32264, "APPLICATION OF PROBABILISTIC SAFETY ASSESSMENT TO GENERIC LETTER 89-10 IMPLEMENTATION," REVISION 1, AUGUST 1994

Dear Mr. Pinelli:

By letter dated September 10, 1994, you submitted the subject report and requested that it be reviewed by the staff to determine its adequacy as a topical report to be utilized by BWR Owners' Group (BWROG) members in their implementation of Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." The report presents a methodology for risk-based prioritization of motor-operated valves (MOVs) within the scope of GL 89-10, and the application of this methodology to the ranking of MOVs at several boiling water reactor (BWR) nuclear plants. The report intends to allow the ranking of MOVs for both the initial and periodic verification of MOV design-basis capability. The staff has reviewed your report and their comments are provided in the Attachment, together with a request for additional information needed by the staff to complete their evaluation.

We would be pleased to meet with you to discuss our comments, if you desire. You are encouraged to revise the topical report, reflecting the staff comments and providing the requested additional information, and re-submit it for staff review. If you have any questions regarding this subject, please contact Allen Hansen at (301) 415-1390.

Sincerely,

Ashok C. Thadani, Associate Director
for Technical Assessment
Office of Nuclear Reactor Regulation

Attachment: Staff Comments and Request for Additional Information

Attachment

STAFF COMMENTS AND REQUEST FOR ADDITIONAL INFORMATION ON BWR OWNERS' GROUP TOPICAL REPORT NEDC-32264, "APPLICATION OF PROBABILISTIC SAFETY ASSESSMENT TO GENERIC LETTER 89-10 IMPLEMENTATION," REVISION 1

COMMENTS

Initial MOV Design-Basis Capability Verification

With regard to the initial testing conducted under GL 89-10, licensees may prioritize their MOVs for testing within their schedule commitments by means such as the BWROG methodology. However, Supplement 6 to GL 89-10 provides guidance for licensees planning to justify an extension of the schedule to complete the initial verification of design-basis capability of GL 89-10 MOVs beyond the committed completion date. In Supplement 6, the staff indicates that licensees should have all MOVs set up with best available test data as part of their justification for a GL 89-10 schedule extension. Also, as discussed in Supplement 6, the staff does not consider the use of risk importance information as the sole basis to delete MOVs from the GL 89-10 program to be appropriate. Instead, a deterministic approach, supplemented by risk importance data, should be used.

Periodic MOV Design-Basis Capability Verification

The frequency of periodic verification of MOV design-basis capability should be based on both risk and deterministic considerations, rather than by risk alone. The relative risk significance of individual safety-related MOVs will suggest differences in the length of time between verifications of their design-basis capability. However, since there is presently no quantitative link between a testing interval and a change in MOV reliability, it is not possible to calculate the appropriate periodic design-basis capability verification interval from an MOV's risk importance. Licensees must have confidence that each safety-related MOV is capable of performing its safety function over the entire interval between verifications of design-basis capability. Therefore, licensees should ensure that both the risk- and deterministic-based criteria for the frequencies for periodic verification of MOV design-basis capability are satisfied.

The staff agrees in principle with the BWROG methodology to rank safety-related MOVs by their relative risk significance. The use of risk ranking would be beneficial in directing licensee resources to the components whose failure could have the most impact on overall plant risk. However, the staff has several concerns regarding the implementation of the BWROG methodology. Among these concerns are the variability of the number of valves in the several ranking categories among plants that are similar (for example, plants identified in the BWROG report as BWRs A, B and D). This raises questions regarding the uniformity of IPE methodology (for example, human error probability and success criteria); the limited scope of the IPEs with respect to shutdown conditions, seismic events, fires and external floods; issues with respect to the adequacy of plant-specific probability data; and questions of how future plant modifications would affect the IPEs and the validity of the current rankings.

The results of the pilot studies described in the topical report could be combined into one common list of MOVs. The MOVs could then be grouped into two categories of high and low risk, with a reasonable balance in the size of the groups. Individual licensees would ensure that these two categories are applicable to their facilities using the BWROG methodology (which includes an expert panel review). Licensees would be expected to justify any significant deviations from a composite BWROG high and low risk MOV list, and to re-evaluate the list following significant plant modifications or procedure changes.

Until confidence is obtained in the BWROG methodology, this risk-based periodic verification interval should be limited to a relatively modest period of time (such as 5 years for high risk MOVs and 10 years for low risk MOVs). After determining a suggested risk-based periodic verification frequency, licensees will need to perform a deterministic evaluation of MOV output capability and requirements to ensure that safety-related MOVs remain operable over the entire periodic verification interval. In addition, licensees should continue to evaluate the maintenance experience with these MOVs, and update the periodic verification frequency and maintenance practices accordingly. The staff believes that changes to the periodic verification interval or the valve categorization should be done carefully and deliberately.

REQUESTED ADDITIONAL INFORMATION

(1) Where a licensee might apply the BWROG methodology to extend its schedule for completing the initial design-basis verification of safety-related MOVs, identify how a deterministic approach will be integrated into the proposed methodology.

(2) State how a combination of deterministic and risk approaches will be utilized to determine the appropriate periodic verification frequency to ensure MOV capability.

(3) Discuss the variability among similar plants of the specific valves in the three categories, and the extent to which the variability is attributed to actual plant differences, to differences in IPE scope and methodologies, and to the use of relative ranking (that is, fraction of the core damage frequency) at each plant. Discuss the extent to which the use of only two priority groups would provide more uniform rankings from plant to plant.

(4) Provide steps which will be taken to properly account for the effects of future plant modifications on the valve rankings.

(5) The state of knowledge may cause the licensee to change the valve categorization process or periodic verification interval. Discuss the approach for assessing new information and making these changes.

ADDENDUM 3

BWR OWNERS' GROUP

Robert A. Pinelli, Chairman
Tel: (201) 316-7155

c/o GPU Nuclear • MCC Building E • One Upper Pond Road • Parsippany, NJ 07054 • Fax (201) 3:6-7814

BWROG95-95075
September 8, 1995

U.S. Nuclear Regulatory commission
Mail Stop 12G-18
Washington, DC 20555

Attention: Ashok Thadani

Subject: **BWR OWNERS' GROUP REPORT "APPLICATION OF PROBABILISTIC SAFETY ASSESSMENT TO GENERIC LETTER 89-10 IMPLEMENTATION"**

By letter dated January 13, 1995, you provided comments and a request for additional information (RAI) on the subject report. The comments have been evaluated by the BWR Owners' Group (BWROG) Integrated Risk Based Regulation (IRBR) Committee. Please find attached a revised Section 3 (formerly Section 4) to NEDC 32264. "Application Of Probabilistic Safety Assessment To Generic Letter 89-10." An expedited review and approval is requested. An SER is needed by September 29, 1995.

The BWROG IRBR Committee has worked closely with your staff to understand their concerns. Because of this working relationship on a "first of a kind" risk based regulatory product, our request for an SER by September 29, 1995 is appropriate. We want to thank your staff for their efforts and patience in the long review process of this report.

Probabilistic Safety Assessment (PSA) insights gained from this report can be a beneficial tool for Generic Letter (GL) closure when combined with the deterministic insights from GL89-10 program. Without decreasing the scope of GL 89-10, this report uses PSA insights to strengthen the GL 89-10 effort by:

1. Identifying risk significant MOVs appropriate to monitor along with valves in the program.

2. Recommending resting intervals consistent with their risk significance.

3. Providing a basis to develop a reliability versus test interval correlation , and

4. Conserving NRC and industry resources on low risk MOVs.

On March 21, 1995 the BWR Owners' Group Integrated Risk Based Regulation Committee met with members of your staff to discuss the subject report and RAI. It was agreed that the RAI, the BWROG responses to the RAI (this revised Section 3), and the SER will be bound into the BWR Owners' Group report which will then be reissued.

If you have any questions regarding this subject, please contact Ms Sharon Mahler (Southern Nuclear Operating Company), IRBR Committee Chairman at (205) 868-5961, Bob Kirchner (Niagara Mohawk Power Corporation) Task Chairman at (315) 349-7323 or Rick Hill (GENE), BWROG Project Manager at (408) 925-5388.

Sincerely,

R.A. Pinelli, Chairman
BWR Owners' Group

Attachment

cc: K.P. Donovan, BWROG Vice Chairman
BWR Owners' Group Primary Representatives
Integrated Risk Based Regulation Committee
S.J. Stark, GE
R.A. Hill, GE

3.0 Additional Methodology Considerations

This section discusses additional considerations that must be evaluated during the application of this report. These additional considerations were identified by the NRC Staff during the review of this report.

3.1 The Scope of GL 89-10 Versus the Scope of PSA Analyses

PSA should not be the sole basis to delete MOVs from the GL 89-10 program. MOVs can be removed from the GL 89-10 program by reclassifying their safety-related active status. This should be accomplished with the 10 CFR 50.59 process. To the extent that PSA can support the 10 CFR 50.59 process, it should be used. The methodology in this report does not address eliminating valves from the GL 89-10 program. GL 89-10 and Supplements provide guidance on GL 89-10 program scope and mechanisms for removing valves from the program.

The use of plant-specific IPE models to evaluate MOV safety significance and to prioritize testing frequencies are desirable applications of the PSA studies. However, additional deterministic considerations must be made when applying the probabilistic evaluation results to the implementation of a GL 89-10 test program. This is due to the differing approaches between and scopes of GL 89-10 PSA studies and GL 89-10 MOV programs. By considering the insights from both PSA and deterministic analyses, the strengths of both can be balanced such that the GL 89-10 program is most effective.

The approach of the GL 89-10 MOV program was to address MOVs in safety-related piping systems and establish their design basis functions and service conditions based on worst case licensing basis conditions. IPE studies, on the other hand, consider all available systems and components and use best estimate service conditions and success criteria. Instead of deterministic single failure criterion, PSAs consider multiple failures in a probabilistic manner. These differences may result in: 1) GL 89-10 MOVs not being modeled in the PSA, 2) the PSA may identify non safety-related but safety-significant MOVs in the IPE model that are not included in the GL 89-10 MOV program, 3) and it is likely that some GL 89-10 MOVs have little or no safety significance in the PSA.

Plant-specific IPEs generally evaluate accidents leading to core damage (and significant radioactivity release) and assesses system performance to determine the likelihood of system operation to preclude or mitigate core damage and significant radioactivity release events. In the case of a PSA developed for an IPE, the scope of the PSA model is generally limited to accidents or events initiated by internal events such as plant transients and loss of coolant accidents.

External events can lead to abnormal events at nuclear power plants. In response to these events, plants must maintain the same functions as those analyzed in the IPE. As such, the same systems important in the internal events only IPE will also be important in the IPE for External Events (IPEEE), see Section 1.3.5 of this report. It is expected that

MOV safety significance rankings will not significantly change based on IPEEE. If they do, the IPEEE feedback to the Maintenance Rule will assure continued risk grouping is adequate. During the expert panel review, as described in Section 1.3.6 of this report, the effects of external events should be considered.

In addition the PSA generally considers only events while the plant is at power operation (Modes 1 and 2). Consideration of safety significant MOVs during Modes 3, 4 and 5 should be accomplished during the expert panel review.

3.2 Integration of Probabilistic and Deterministic Methods of Ranking MOVs

The methodology in this report describes an expert panel contribution, which is a process by which the deterministic approach is blended with PSA analyses to achieve an overall evaluation of risk significance. Instructions relative to this expert panel review are found in Section 1.3.6 of this report. In addition, expert panel guidance can be found in the Maintenance Rule Guidance as well as other documents.

Since the licensee must maintain equipment operability and follow GL 89-10 guidance, deterministic criteria and analysis are required. By integrating the PSA approach into existing programs, a balance can be maintained between the two methodologies. In this manner, PSA can be used as another tool for issue resolution.

Based on the information gathered by Plants A through E in conducting Tasks 1 through 7 a list of valves has been assembled to assist the expert panel in their evaluation of MOV risk rankings. This list is presented in the following table and represents a composite of the valve functions which were categorized as "High Risk" for Plants A through E, after incorporating the inputs from the expert panel review. It is recommended that if a licensee's "High Risk" category from the PSA analysis does not contain these valves, the expert panel consider them as part of their evaluation and provide appropriate documentation of the basis for the final disposition.

BWROG Composite List Of "High Risk" Ranked Valves

HPCI (HPCS) Injection Valve	RCIC Lube Oil Cooling
HPCI Steam Inlet Valve	RCIC Steam Line Isolation
HPCI (HPCS) Torus Suction	RHR Torus Cooling, Spray and Test Valves
HPCI Steam Line Isolation	RHR Heat Exchanger Service Water Supply
HPCI Lube Oil Cooling	RHR Shutdown Cooling Suction from Vessel
RCIC Injection Valve	Containment Isolation - Equipment Drains
RCIC Steam Inlet Valve	CS/LPCI (LPCS) Injection
RCIC Torus Suction	

Service Water Pump Discharge	Service Water - Diesel Generator Jacket Coolers
Service Water Train Discharge	RBCCW Drywell Supply/Return isolation*
Service Water Non-essential Load Isolation	

* These valves were classified as "high based on seismic and high energy line break considerations

3.3 Design Basis Capability and Verification

GL 89-10 requires that all licensees perform initial testing by June 1994. In GL 89-10, Supplement 6, the NRC provided guidance for utilities that required a schedule extension. As part of the justification for extension, the guidance suggested that the licensee set up all valves with the best available information by June 1994. In addition, PSAs showed that the risk significance of delaying full testing of less important valves was minimal. In this regard, PSA provides a very powerful additional justification for a schedule extension that augments the Supplement 6 information. Thus, schedule extension for a number of low risk MOVs, provided they are set up with the best available information prior to June 1994, is fully justifiable.

It is recognized for most BWR utilities, safety significance ranking of MOVs relative to initial design basis verification is no longer applicable. Nevertheless, this report presents the methodology for initial verification which it could be valuable for future applications. Based on the discussion with the NRC Staff during the development of this report, the report was modified with a footnote to Table 3 which addressed initial verification.

The licensee is responsible for maintaining operability of components in the plant. The methodology in this report suggests an approach for establishing risk based testing intervals. This methodology is not intended to relieve a licensee of responsibility to maintain MOV design basis capability. It is expected that a licensee will demonstrate that GL 89-10 MOVs are capable over the entire duration between tests regardless of risk significance.

3.4 Testing Intervals

There are currently insufficient data available to establish a quantitative link between testing intervals and MOV reliability. The methodology in this report does not attempt to describe such a process. Rather it has been demonstrated that regardless of specific MOV reliability, there is minimal risk associated with the intervals recommended.

In addition, testing at the intervals recommended in the report will provide the industry with data regarding the time-dependent reliability of MOVs. If the testing intervals are not varied, information will not be developed to establish a link between test interval and reliability. If short intervals are selected for risk significant valves, the safety significance of testing intervals will be small.

Additional "margin" in the methodology is the realization that testing will be performed continually. Even a selection of low risk valves will be tested at any given time. With that in mind, any failures would be investigated and insights applied to other valves.

In the January 10, 1995 letter, the NRC Staff suggested the use of a low category verification frequency of ten years. In GL 89-10, a frequency of five years was used as a base. The valves in the low category ranged from a factor of ten to one hundred lower risk significance. The methodology in this report specifies a factor of three to be applied to the five year frequency for the low importance valve verification frequency (or 15 years). The frequency of the medium valves then became the mid-point between the other two frequencies.

Once the risk rankings are achieved and reviewed by the expert panel, the high, medium and low risk valves should then be reviewed by the GL 89-10 program manager to determine the appropriate periodic verification frequency. The GL 89-10 Program Manager may assign a more frequent periodic verification interval to certain medium and low risk valves based on deterministic considerations. Factors should include, but are not limited to, the results of the design basis review, operational importance, service conditions, margin available, and valve performance history. In addition, valves of a design type, or group, that has no family members in the high risk category could be placed in a higher test frequency bin. Thus, at least one valve in each group would be tested with higher frequency to provide data relevant to the whole group. This adjustment is one of several that the GL 89-10 program manager may adopt in augmenting his program with PSA based methods described in this report. Additionally, it should be pointed out that conservatively short MOV testing intervals are likely to lead to a risk increase. If too much time is expended on risk-neutral MOVs, opportunities for more significant plant maintenance are lost. To illustrate how risk rankings would be combined with deterministic considerations to arrive at final periodic verification intervals the following example is provided. This example illustrates how deterministic criteria could be combined with risk insights by the GL 89-10 Program Manager to establish testing intervals.

TABLE 5 TEST INTERVAL ASSIGNMENT DATA

Valve Description	Valve ID	PSA Rank	Valve Group[1]	Thrust Margin[2,5]	Service Conditions[3]	Test Interval Rank[4,5,6]	Comments
HPCI injection	1	H	1	30%	Nominal	A (2 cycles)	
Containment isolation	2	H	2	5%	Nominal	A (1 cycle)	Raised to 1 cycle based on PSA and low margin
RHR torus cooling test	3	M	1	15%	Nominal	B (4 cycles)	
SW Pump Discharge	4	L	4	10%	Harsh (often used)	B (3 cycles)	Raised based on margin and service conditions
HPCI CST Suction	5	L	1	5%	Nominal	A (2 cycles)	Raised based on low margin.
Main Steam line drain isolation	6	L	2	15%	Nominal	C (7 cycles)	
RCIC Injection	7	H	4	10%	Nominal	A (2 cycles)	
RHR SW HX supply	8	M	4	20%	Nominal	B (4 cycles)	
Cooling supply to recombiner	9	L	3	10%	Nominal	B (3 cycles)	Raised to ensure group 3 valves are represented in higher test frequency bins

[1] Valve group defined by valve design, manufacturer, size, etc.

[2] Thrust Margin is based on an as-left thrust at torque switch trip compared to the minimum required thrust at design basis conditions including the reduction in margin based on uncertainties such as test instrument uncertainty, equipment repeatability, load sensitive behavior, time related performance degradation, and other deterministic considerations which are outside the scope of this document.

[3] Service conditions are based on the valve use (strokes /year), environmental conditions, etc

[4] Test interval rank - A = a test interval of every 1-2 fuel cycles (18 month cycles)
B = a test interval of every 3-4 fuel cycles
C = a test interval of every 5-7 fuel cycles

[5] Thrust margin values presented are for example purposes only. As stated in Section 3.3, the licensee must demonstrate that MOVs are capable over the test interval regardless of risk significance. This includes consideration of the amount of margin; potential time related degradation; uncertainties such as measurement uncertainty, equipment repeatability, and load sensitive behavior; and other deterministic considerations which are addressed in other industry guidance and are outside the scope of this document.

[6] Until additional performance data are available, a maximum test interval of 10 years has been discussed by the industry and the NRC.

3.5 Changes in Plant Design or State of Knowledge of Valve Categorization

For licensees who have a "living PSA", the best way to evaluate the potential for changes in valve rankings over time is to re-evaluate the GL 89-10 valves during each PSA update. This could be accomplished using the updated model and re-generating each MOVs importance measures.

Licensees who do not maintain their PSA can maintain GL 89-10 lists. The expert panel can be re-convened to review plant changes since the original evaluation. This review will be adequate to ensure that valve rankings accurately reflect the relative importance of each MOV. In addition to re-convening the expert panel, the Maintenance Rule requires tracking of equipment performance relative to the safety significance of that equipment. Thus, through the application of the expert panel review and Maintenance Rule, the effects of future plant modifications on valve rankings will be properly considered.

It is beyond the scope of the MOV ranking significance methodology presented in this report to establish licensee administrative criteria or requirements to assess revision to MOV periodic verification intervals based on new information. The user of this methodology should, however, consider the potential change of risk importance of MOVs as a result of plant modifications and introduction of new PSA technology/methods. The Maintenance Rule as well as the GL 89-10 programs should provide such a mechanism.

3.6 Other Considerations

The NRC staff raised a suggestion to use two categories of high and low versus three categories of high, medium, and low. Eliminating the medium category has several negative features relative to achieving the most complete approach to verification. These are:

- Adding more MOVs to the high risk category that belong in the medium category does not significantly improve plant safety. The high risk group was defined so that it would contain 99% of the core damage frequency contribution of MOVs. During the development of the BWR Owners' Group report, a Fussell-Vesely boundary of 0.1 was considered for the high risk category. However, to minimize concerns about data, human error, etc., the boundary for the high risk category was set at 0.01.

- With the use of three categories, plants will be able to collect MOV verification data more frequently (the medium category has a more frequent periodic verification requirement than the low category) and provide a broader data base to feedback into the MOV program relative to potential time dependent degradation of MOVs.

- The use of three categories (high, medium, and low risk significance) makes risk significance ranking less sensitive to potential changes in PSA. It is less likely for valves to switch between high and low categories if a medium category is present to demonstrate a moderate risk impact.

- The use of three groups minimizes the effect of valves whose importance is close to risk group cutoffs. For example, a valve just below the high risk cutoff would be classified a low in a two group scheme. In this case, the medium group effectively captures the valve's importance. Thus, the effect of valves on the "cusp" is minimum.

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

February 27, 1996

Mr. Kevin P. Donovan, Chairman
Boiling Water Reactor Owners' Group
c/o Centerior Energy
Perry Nuclear Station
Mail Code A210
10 Center Road
Perry, OH 44081

SUBJECT: BWR OWNERS' GROUP TOPICAL REPORT NEDC 32264, "APPLICATION OF PROBABILISTIC SAFETY ASSESSMENT TO GENERIC LETTER 89-10 IMPLEMENTATION" (REVISION 2)

Dear Mr. Donovan:

The NRC staff has completed its review of the subject topical report submitted by the BWR Owners' Group on September 10, 1994. The staff has found that the methodology in the topical report can effectively rank the motor-operated valves (MOVs) in programs established in response to Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," with respect to their relative importance to core damage frequency, and that appropriate considerations regarding other consequences can be added by an expert panel.

The staff considers the methodology acceptable for this application because the plant-specific IPE-based insights are supplemented by generic insights and expert review involving additional considerations, such as external events and shutdown issues. In addition, use of the MOV rankings is in combination with deterministic restrictions that prevent neglect of the least risk-significant valves. Further, licensees remain bound by the requirements in their code-of-record regarding stroke-time inservice testing, as supplemented by the additional measures they establish pursuant to their GL 89-10 commitments.

The BWR Owners' Group states that, until additional performance data are available, a maximum test interval of 10 years has been discussed by the industry and the NRC. The staff agrees with this condition of a maximum test interval of 10 years based on current knowledge and experience. In addition to this maximum test interval, where a selected test interval extends beyond five years, the licensee must evaluate information obtained from valve testing conducted during the first five-year time period to validate assumptions made in justifying the longer test interval. Based on performance and test experience obtained during the initial interval, a licensee may be able to justify lengthened MOV periodic verification intervals.

The accepted version of the topical report must incorporate this letter and the enclosed safety evaluation.

Sincerely,

Brian W. Sheron

Brian W. Sheron, Director
Division of Engineering
Office of Nuclear Reactor Regulation

Enclosure: Safety Evaluation

cc w/enclosure: M. Sarram, NEI
J. Pelletier, ASME

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION OF BWR OWNERS' GROUP TOPICAL REPORT NEDC 32264 (REVISION 2), "APPLICATION OF PROBABILISTIC SAFETY ASSESSMENT TO GENERIC LETTER 89-10 IMPLEMENTATION"

1.0 INTRODUCTION

By letter dated September 10, 1994, the Boiling Water Reactor (BWR) Owners' Group submitted for NRC staff review Revision 1 to BWR Owners' Group Topical Report NEDC 32264, "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation." The report presents a methodology for risk-based prioritization of motor-operated valves (MOVs) within the scope of Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and the application of this methodology to the ranking of MOVs at several BWR nuclear plants. Following meetings between the NRC staff and members of the BWR Owners' Group, the staff provided comments and requested additional information in a letter dated January 13, 1995, from Ashok C. Thadani, Associate Director for Technical Assessment, Office of Nuclear Reactor Regulation, to Robert A. Pinelli of the BWR Owners' Group. On September 8, 1995, the BWR Owners' Group provided a revised section as Revision 2 to the topical report in response to the staff's comments and request for additional information. The staff's review and evaluation of the topical report are provided in this safety evaluation.

2.0 BACKGROUND

Probabilistic risk assessment (PRA) models generally assume that there are no unidentified systematic design/installation problems that will cause systems (or multiple systems) to fail to fulfill their intended functions under design-basis conditions. However, in 1989 the staff issued GL 89-10 to resolve concerns raised as a result of poor performance of MOVs at nuclear plants and weaknesses in the design, setup and testing of MOVs. These MOV capability problems had not been recognized because surveillance testing was typically performed under minimally demanding conditions. Therefore, the failure rates of MOVs under the more-demanding design-basis conditions might not be reflected in the data used in a licensee's PRA models, and the potential for simultaneous failure of multiple MOVs in multiple systems might not have been considered for accident sequences that produce the more demanding conditions. Thus, the existing solutions of the Individual Plant Evaluation (IPE) models (specifically, the dominant cutsets provided in the IPE submittals) might not include representation of the MOV performance problems addressed by GL 89-10.

A direct approach for evaluating the risk associated with the GL 89-10 failure mechanisms would involve (1) modification of the PRA logic models to specifically consider which sequences create the more demanding conditions that could lead to those failure mechanisms, and (2) use of appropriately higher failure rates for the MOVs in those

ENCLOSURE

sequences. Solution of the revised model would provide results that would reflect for each MOV the risk associated with the potential for failure due to the MOV issues that led to GL 89-10. However, this approach would require extensive modification of the event trees and fault trees in the models and resolving the logic model to obtain the new dominant cutsets.

Because the goal of the BWR Owners' Group risk assessment for GL 89-10 implementation is to develop a relative ranking of the MOVs according to their potential risk contributions rather than to evaluate the absolute value of the risk contribution, it is possible to gain sufficient risk insights with less rigorous, and thus less costly, methods. Also, because the goal is to establish a small number of risk categories rather than to establish the exact rank order of the risk contribution for each MOV, the methodology need not have the level of precision provided by the direct modeling approach.

The alternative and less costly approach proposed by the BWR Owners' Group involves the use of importance measure (IM) methodology. Various IMs have been developed and described in the literature to assist in obtaining insights from PRA results. The proposed approach extends the application of these measures in a manner that is appropriate to address the MOV issues that led to GL 89-10.

3.0 NRC STAFF ACTION

The NRC staff reviewed the topical report with respect to both the schedule for the initial verification of MOV design-basis capability in response to GL 89-10 and for the periodic verification of MOV design-basis capability. The staff reviewed the methodology presented in the topical report for its reliability in appropriately ranking the safety-related MOVs in a BWR nuclear plant. The staff reviewed the discussion in the topical report regarding assurance that safety-related MOVs are capable of performing their safety functions. Finally, the staff reviewed the topical report for consideration of both MOV risk ranking and operational capability in establishing appropriate intervals for periodically verifying the design-basis capability of safety-related MOVs at BWR nuclear plants.

4.0 COMMENTS ON TOPICAL REPORT AND ITS RESULTS

4.1 General

With regard to the initial testing conducted under GL 89-10, licensees may prioritize their MOVs for testing within their schedule commitments. Supplement 6 to GL 89-10 provides guidance for licensees planning to justify an extension of the schedule to complete the initial verification of design-basis capability of GL 89-10 MOVs beyond the committed completion date. In Supplement 6, the staff indicates that licensees are expected to have all MOVs set up with best available test data as part of their justification for a GL 89-10 schedule extension. A licensee must ensure that its use of the BWR Owners' Group methodology

described in the topical report as part of a GL 89-10 schedule extension justification is consistent with Supplement 6 to GL 89-10 and the comments in this safety evaluation. Also, as discussed in Supplement 6, the staff does not consider the use of risk importance information as the sole basis to delete MOVs from the GL 89-10 program to be appropriate. However, the deterministic approach may be supplemented by risk importance data.

Deterministic considerations in establishing the frequency of periodic verification of MOV design-basis capability may be supplemented by risk considerations. In GL 89-10, the staff recommended a periodic verification frequency of five years or three refueling outages unless a longer interval is justified. The relative risk significance of individual safety-related MOVs may suggest differences in the length of time between verifications of their design-basis capability. Licensees must have confidence that each safety-related MOV is capable of performing its safety function over the entire interval between verifications of design-basis capability. Therefore, licensees must ensure that both the risk- and deterministic-based criteria for the frequencies for periodic verification of MOV design-basis capability are satisfied. In Footnote 6 of Table 5 provided in Section 3.0 of Revision 2 of the topical report, the BWR Owners' Group states that, until additional performance data are available, a maximum test interval of 10 years has been discussed by the industry and the NRC. The NRC staff agrees with this condition of a maximum test interval of 10 years based on current knowledge and experience. In addition to this maximum test interval, where a selected test interval extends beyond five years, the licensee must evaluate information obtained from valve testing conducted during the first five-year time period to validate assumptions made in justifying the longer test interval. As experience is gained, licensees may be able to justify longer intervals.

4.2 Probabilistic Methodology

The topical report discusses the need for the probabilistic risk analysts who conduct this process to be thoroughly familiar with the PRA, its assumptions, modelling techniques and results. The report discusses the need to identify and appropriately address MOVs that are within the scope of GL 89-10 but not explicitly modelled in the PRA. Some of these MOVs were omitted in the original PRA analysis because they were thought to contribute negligibly to the results, while others are implicitly included in modelling of initiating events, human errors, and modularized or "super" components. The topical report also addresses the need to consider the role of MOVs in the containment (level 2) models as well as the core damage (level 1) models, and to include considerations of external events and shutdown conditions.

4.2.1 Use of Importance Measures for Ranking MOVs by Relative Risk Contribution

There are two basic types of insights to consider in ranking the risk significance of basic events in PRAs. One is the fraction of the total

result (e.g., core damage frequency) that involves the basic event, given that it has its nominal failure rate. This insight is provided by the Fussell-Vesely and Risk Reduction type importance measures. The other insight is the effect on the total result that occurs when the basic event is assumed to always be a failure. This insight is provided by the Risk Increase (or Achievement) type importance measures. For a specific basic event, the ratio between these two types of importance measures is the nominal failure rate of that basic event. However, for PRAs that use generic data, basic events for failures of individual MOVs to change position will all have the same value. Therefore, the ranking of individual MOVs will be the same by either type of importance measure when the PRA uses the same generic data for all such basic events. However, when groups of MOVs are assumed to fail together, this may not be the case.

These importance measures can (conceptually) be applied to several levels of PRA results, including core damage frequency, frequency of specific major release categories, early fatalities, and total population dose. MOVs that are highly significant with respect to one level of PRA results may not be significant with respect to other levels. Because not all of the IPEs go beyond quantification of core damage frequency in an integrated fashion, the methodology described here addresses only level 1 analyses. However, for PRAs that quantify the sequence frequency of various types of radioactive material releases, and for those that quantify public health consequences, this methodology can be explicitly applied to those levels, as well. Because IPEs generally do not explicitly integrate the level 1 and level 2 analyses or beyond, the expert panel must consider in a qualitative manner the impact of MOV performance on containment bypass and radioactive material release.

As indicated above, the staff issued GL 89-10 as a result of poor performance observed in MOVs at nuclear plants and concerns regarding MOV design, setup and testing. Further, preoperational and surveillance testing typically do not simulate the operational requirements of the design-basis conditions for MOVs. These weaknesses in MOV design, setup and testing constituted a common-cause failure mechanism among MOVs in different systems as well as in the redundant trains of individual systems. However, PRAs do not model the potential for common-cause failures of components in different systems. The staff notes that the topical report discusses the results of trial applications of the proposed methodology and various "sensitivity studies" at five plants, and the report concludes that the results of the sensitivity studies indicated little effect from multiple common cause failures (CCFs) on the final ranking of the MOVs. The staff does not agree that this conclusion can be generalized to the degree stated in the topical report, that "multi-component, inter-system CCFs will not affect the identification or ranking of the MOVs..."

Therefore, if the MOV design, setup, and test concerns that led to the issuance of GL 89-10 have not been resolved for the specific facility, a method for ranking the MOVs must consider this unmodelled aspect. Once

initial testing has been completed, it is assumed that the failure probabilities of the MOVs are as originally modelled in the PRAs. For this reason, the topical report provides separate ranking methodologies for the initial testing and the periodic verification testing programs.

4.2.1.1 Importance Calculations for Initial Testing

In order to properly rank MOVs for initial testing, the potential for programmatic inadequacy in the MOV design, setup and test practices to cause failure of MOVs in multiple systems during a single accident sequence must be addressed. The common-cause failure modelling that is included in the PRAs generally is limited to consideration of like components in the redundant trains of single systems. In order to address common-cause failures in multiple systems, cutsets must be obtained that contain the groups of MOVs that, if failed together, would substantially increase the core damage frequency. These cutsets usually are not included in the dominant cutsets because the assumed probability of MOV failure to change position is so low ($\approx 10^{-3}$/demand) that the cutsets with multiple MOV failures have frequencies below the truncation value for the solution process. To obtain these cutsets, the failure rates of the MOVs must first be set to high values and then the logic models must be solved for new cutsets. A value of 0.3 or 0.5 is good for this solution, because it will allow individual cutsets containing large numbers of MOVs to exceed the truncation value, but will not make the probability of success so low that it forces other sequences (that involve the success of these events) to drop below the truncation value. Once these cutsets are obtained, the failure probabilities for the MOV basic events can be returned to their nominal values, taking care not to lose any cutsets by truncating successive reevaluations on the basis of cutset frequency.

In concept, these cutsets could be used to evaluate various combinations of MOV failures to determine the significance of each combination. However, the topical report suggests a less burdensome approach. First, the risk reduction and risk increase importance measures are calculated in the normal way for individual MOVs, with their failure probabilities set at nominal values. Those that satisfy the criteria for high ranking are designated as such. Then, the failure probabilities for the MOVs that have *not* been so designated are all increased to 1.0 and the cutsets are requantified. If these remaining MOVs contain combinations whose failure can substantially increase the core damage frequency (CDF), the requantified CDF will be substantially increased above the nominal value, and the risk reduction importance for the MOVs with respect to this requantified CDF will reveal which MOVs are contributing to the increase. If there is a substantial increase in CDF, contributing MOVs are designated as high-ranked MOVs, and their failure probabilities are returned to the nominal value. The cutsets are requantified again with only the remaining undesignated MOVs at the high failure probabilities, to demonstrate that there are no remaining combinations of MOV failures that create a substantially elevated CDF. If there are still such combinations of MOVs, the process is repeated until they have been determined and designated.

It is unlikely that this process will have to be repeated, but it is conceptually possible that setting the failure probabilities of some MOVs to 1.0 will prevent the detection of other combinations that are also important. For example, if a combination of MOV failures that render high pressure injection nonfunctional is given a probability of 1.0, then the probability of reaching a point in an accident sequence that requires high pressure recirculation will be zero, and that quantification of the cutsets will be completely insensitive to combinations of MOVs whose failure could lead to an inability to provide high pressure recirculation. Because some computer programs used for cutset manipulation perform Boolian reduction on the cutsets, proper execution of this technique requires care to ensure that cutsets are not being lost during successive manipulations.

With these cautions in mind, the methodology presented in the topical report can provide the appropriate risk insights for use by the expert panel.

4.2.1.2 Importance Calculations for Periodic Verification Testing

Once the initial GL 89-10 testing program has been completed, the potential for intersystem common-cause failure of MOVs is assumed to have been addressed and eliminated as a significant concern. Under these circumstances, the risk significance of the MOVs may be ranked on an individual basis. As previously discussed, the use of either type (risk reduction or risk increase) importance measure will produce the same ranking for individual MOVs when the same generic failure rate is used for all MOVs in the PRA.

The topical report recommends use of the Fussell-Vesely or Risk Reduction Ratio importance measure for ranking individual MOVs. The staff believes that this can produce the appropriate insights for use by the expert panel. Where intrasystem common-cause failure of MOVs is modelled in the PRA, ranking the PRA common-cause basic event will provide an additional insight on the importance of groups of MOVs serving the same functions. If a common-cause event is highly ranked, the panel must ensure that at least one of the MOVs represented by the common-cause basic event is included in the high group to minimize the potential for their common failure due to the issues addressed by GL 89-10 programs.

4.2.2 Accuracy of the IPE/PRA

Although each U.S. nuclear power plant has performed an IPE in the form of a probabilistic safety assessment, the NRC has not yet reviewed these analyses in sufficient detail to accept them for direct use in regulatory decisions without additional plant- and issue-specific review. The reviews conducted by the staff to date indicate that, in addition to real differences in results that are caused by differences in plant design and operating practices, there may be significant differences caused by differing assumptions and modelling techniques.

The five pilot studies contained in the appendices to the topical report indicate substantial differences in the lists of high and medium ranked MOVs for plants that are rather similar in design. In order to provide assurance that these differences are appropriate, the BWR Owners' Group has included a list of MOVs that, if not present in the high or medium risk groups at a specific plant, must be reviewed by the licensee's expert panel to ensure the reasons that they do not appear in those groups are understood and appropriate, and that the reasons are documented by the licensee. Considering the end use of the insights provided by this methodology, this is an appropriate level of review of the accuracy of the probabilistic basis. This conclusion is based on two factors. First, the purpose of this methodology is to divide the list of MOVs within the scope of GL 89-10 into a small number of importance groups, rather than to accurately compute the absolute risk significance of each valve. Second, the valves in all of the importance groups will be subject to deterministic restrictions on their test schedules that preclude neglect of the least-significant valves.

4.2.3 Considerations for Expert Panel

The actual production of the MOV testing schedule must be accomplished by a panel that includes personnel with additional expertise in the areas of plant design, operations, maintenance, probabilistic risk assessments, and in-service testing. The ranking and scheduling processes must assure that the assumptions and conclusions of the panel are based on an integrated assessment of both the traditional deterministic engineering and systems analyses as well as the risk insights derived from the PRA. The topical report discusses several issues that must be addressed qualitatively or for which additional knowledge is required for quantitative assessment. These include identification of "hidden" contributions of particular MOV failures to specific basic events in the PRA, consideration of level 2 issues, and consideration of the effects of MOV failures during shutdown and with respect to external events such as fires, floods and earthquakes.

In addition to those mentioned in the report, two additional issues must be considered by the panel. The first issue concerns interchanging functions of MOVs, as is sometimes done between the pump discharge valve and the injection valve on an emergency core cooling system (ECCS) pump injection line. Normally, the injection valve is closed and must open for the ECCS function, while the discharge valve is normally open (but still receives a signal to open). However, when there is concern about the operability of the injection valve, some plants have opened that valve and closed the pump discharge valve. In this configuration, the pump discharge valve has the risk significance of the injection valve and vice versa.

The second issue concerns the changes that can occur in component importances as plant operating configurations change (i.e., equipment comes in and out of service). PRAs generally assume that maintenance outages of equipment occur randomly and, therefore, overlaps of equipment outages that can cause changes in relative importances are

random. Actual plant-specific maintenance practices, such as rolling periodic on-line maintenance schedules, can introduce systemic effects that result in more or less overlap of equipment outages and result in importance rankings that are different from those that would exist if these systemic effects were not present. Whether this results in an increase or decrease in the actual importance level of any particular component compared to that estimated by the PRA assuming outages are random, depends on the licensee's sensitivity to avoiding concurrent outages of pieces of equipment that would substantially increase the accident frequency.

The Maintenance Rule which becomes effective July 10, 1996, requires licensees to assess the total plant equipment that is out of service to determine the overall effect on performance of safety functions when conducting preventative maintenance. This will ensure that the licensee will account for potential increases in risk resulting from overlaps in equipment outages during the actual performance of testing. Actual maintenance practices must be considered by expert panels when establishing relative risk importance of different MOVs for the purposes of prioritizing maintenance and testing activities for GL 89-10 implementation. If actual maintenance practices are different from those modeled in the PRA used to provide risk insights to the expert panel, this information must be presented to the panel along with an assessment of the potential impact of these differences on the relative risk importance rankings derived from the PRA.

4.3 Deterministic Capability Evaluation

In Section 3.3 of Revision 2 to the topical report, the BWR Owners' Group notes that licensees are responsible for maintaining operability of components and that the topical report methodology is not intended to relieve a licensee of responsibility to maintain MOV design-basis capability. The BWR Owners' Group states that it is expected that a licensee will demonstrate that GL 89-10 MOVs are capable over the entire duration between tests regardless of risk significance. The licensee is expected to use accepted best-available methods and data, in determining MOV capability margin and performance degradation rates to provide a high level of assurance that safety-related MOVs will remain capable of performing their safety functions over the periodic verification interval. Section 3.4 of Revision 2 to the topical report provides additional information on deterministic considerations in establishing periodic test intervals.

MOVs are typically grouped by type and service environment, and representative MOVs from each group are retested at the highest frequency to ensure that the projections of operability are accurate. It might be desirable to leave some MOVs untested for the longest periods they are expected to remain operable so that data can be acquired on the actual deterioration as a function of time. This reduces the testing burden and permits the adjustment of the periodic verification test schedules to further reduce burden as confidence is

gained in the projections of time that adequate margin will remain for each MOV group.

5.0 STAFF FINDINGS

The staff finds that the methodology used in the topical report can effectively rank the MOVs in the GL 89-10 program with respect to their relative importance to core damage frequency, and that appropriate considerations with respect to other consequences can be added by an expert panel. The staff approves use of the BWR Owners' Group methodology for ranking MOVs subject to the cautions and considerations described in this safety evaluation.

For this specific application, the staff considers it acceptable for licensees to rely on their IPE studies to support the ranking of MOVs when used together with expert panel review and deterministic constraints, based on the following considerations: The relative risk ranking methodology supplements the plant-specific IPE-based insights by generic insights and expert review involving additional considerations such as external events, level 2 and shutdown issues. In addition, the use of the rankings is in combination with deterministic restrictions that prevent neglect of the least risk-significant MOVs.

The BWR Owners' Group states that, until additional performance data are available, a maximum test interval of 10 years has been discussed by the industry and the NRC. The NRC staff agrees with this condition of a maximum test interval of 10 years based on current knowledge and experience. In addition to this maximum test interval, where a selected test interval extends beyond five years, the licensee must evaluate information obtained from valve testing conducted during the first five-year time period to validate assumptions made in justifying the longer test interval. Based on performance and test experience obtained during the initial interval, a licensee may be able to justify lengthened MOV periodic verification intervals.

6.0 APPLICABILITY OF THIS SAFETY EVALUATION REPORT

The use of PRA for GL 89-10 implementation is considered a pilot application in the Commission's agency-wide PRA Implementation Plan. The use of PRA/IPE, the risk ranking methodology, and the expert panel process has been justified for this application as described in the BWR Owners' Group Topical Report NEDC-32264, "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation." The NRC staff is currently reviewing uses of PRA and various risk ranking methodologies for several other regulatory applications and is developing application-specific, or where practical, generic regulatory guidance. Therefore, absent additional NRC staff evaluation and/or final guidance development, the conclusions in this safety evaluation are applicable only to the specific application described in the aforementioned topical report. Further, licensees remain bound by the requirements in their code-of-record regarding stroke-time inservice testing, as supplemented by the additional measures they establish to

ensure that MOV design-basis capability is maintained pursuant to their GL 89-10 commitments.

Principal Contributors:
Steven M. Long, NRR
Thomas G. Scarbrough, NRR