December 16, 2004

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SUBJECT: RECOMMENDATIONS OF THE MSPI PRA QUALITY TASK GROUP

As a result of NRC and stakeholder recommendations, the mitigating systems performance index (MSPI) probabilistic risk assessment (PRA) Quality Task Group was convened to resolve issues related to the quality required of a PRA for implementation of the MSPI. The task group has met four times since its inception in October, 2004.

The objectives of the Task Group were to:

- Provide guidance on the level of detail and the characteristics of the base PRA needed to support the MSPI implementation, using, as a basis, the supporting level requirements and capability categories of the ASME PRA Standard.

- Provide guidance on licensee and staff activities needed to demonstrate that the base PRA is technically adequate to support its use to support the MSPI application, addressing the use of RG 1.200, the roles of peer review and self-assessment, and guidance for determining the need for, and scope of, staff audit of the base PRA model.

- Provide recommendations on an approach to dealing with those PRA uncertainties, assumptions, and methodological issues that are known to affect MSPI significance levels.

- Review and revise recommendations based on experience with initial implementation.

- Provide resolution of those emergent PRA methodological issues that are discovered during the lead plant implementation of the MSPI.

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Attachment 1 to this memorandum is the membership of the Task Group. The Task Group recommendations associated with the first three bullets are included in a letter report included as Attachment 2. The letter report consists of two parts. The first part provides the recommendations, and the second is the basis document.

Basis of Task Group recommendations

The task group recommendations in this report are based on the collective experience of the task group members and on directly pertinent information made available to the group including the following:

- experience in performance of numerous PRAs and in the application of the results and insights from these PRAs.
- experience as writing group members or reviewers of the ASME PRA Standard
- experience as writing group members of Reg Guide 1.174 and Reg Guide 1.200.
- participants (both as NRC observers and industry reviewers) in numerous industry PRA peer reviews
- results from the MSPI pilot plant program, including the results of the numerous sensitivity studies which showed the effects of various PRA parameters on MSPI results.
- additional sensitivity studies, for example, the effects of truncation limits on MSPI results
- comparison of the results from the NRC's SPAR models with the results from the MSPI pilot plants, and where applicable, an analysis of the causes for the differences in the results.
- a review of PRAs and expert elicitation/deliberation of the PRA parameters that are important to MSPI (as documented in Section 2 of Part B of the letter report)
- comparison of the human error probabilities used in the licensee PRAs for the operator actions described in Section 2 of Part B of the letter report.

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Attachment 1

Task Group Membership

Michael Cheok	Assistant Branch Chief, Operating Experience Risk Analysis Branch, Office of Nuclear Reactor Research, U.S. NRC
Jeff Gabor	Vice President, Safety & reliability Group, ERIN Engineering and Research, Inc., West Chester, PA
Gareth Parry	Division of Systems Safety and Analysis, Office of Nuclear Reactor Regulation, U.S. NRC
D. William Stillwell	Supervisor, PRA Configuration Control and Assessment, South Texas Project Nuclear Operating COmpany
James Trapp	Branch Chief, Division of Reactor Projects, Region I, U.S. NRC

Attachment 2

MSPI PRA QUALITY TASK GROUP REPORT

MSPI PRA QUALITY TASK GROUP LETTER REPORT

Part A: Recommendations of the Mitigating Systems Performance Index (MSPI) PRA Quality Task Group

1 The MSPI application can be considered a Phase 2 application under the Commission's phased approach to PRA quality. The MSPI is an index that is based on an internal initiating events, full-power PRA, for which the ASME Standard has been written. The Standard has been endorsed by the staff in RG 1.200, which has been issued for trial use.

2 Licensees should assure that their PRA is of sufficient technical adequacy to support the MSPI application by:

- resolving the peer review Facts and Observations (F&Os) that are classified as being in category A or B (those that can have an impact on the PRA results), or demonstrate that not resolving them will not have an impact on the MSPI.

- performing a self assessment using the NEI-00-02 process as endorsed by Appendix B of RG 1.200 for the ASME PRA Standard supporting level requirements listed in Table 1.

3 Licensees should document their demonstration of their assurance of technical adequacy by:

including in the MSPI basis document:

- the results of, and resolution of any findings from, the self-assessment performed for the SRs identified in Table 1, taking into consideration Appendix B of RG 1.200, with particular attention to the notes in Table 1.
- for those significant F&Os not resolved, a justification for why not resolving them has no impact on the efficacy of the MSPI

and, in the archival documentation:

- a description of the resolution of the significant, i.e., the A and B category, F&Os identified by the peer review team.
- a description of the methods and data used to address the issues identified in Section 2 of the basis document.

4 When a licensee's PRA is modified, those supporting requirements that are affected should be subjected to a further self-assessment to assure that the technical adequacy is maintained.

5 If there is an indication that the importance measures used as a basis for the MSPI may be outliers, the staff should review or audit a licensee's PRA, focusing on those supporting requirements in Table 1.

6 A process should be developed for the identification of outliers, that recognizes that variability can exist from modeling approaches as well as from plant design. Some

guidance is provided in Section 7 of the attached basis document. Development of this process should use the results of a cross-comparison of licensee importance measures, and the results of a comparison of SPAR model importance measures, for plant of similar design.

Table 1 ASME PRA Standard Supporting Requirements for Self-Assessment

Supporting Requirement	Comments
IE-A4 (Note 1)	Category II. Focus on plant specific initiators and special initiators, especially loss of DC bus, Loss of AC bus, or Loss of room cooling type initiators
IE-A7 (Note 2)	Category I in general. However, precursors to losses of cooling water systems in particular, e.g., from fouling of intake structures, may indicate potential failure mechanisms to be taken into account in the system analysis (IE-C6, 7, 8, 9)
IE-A9	Category II for plants that choose FTs to model support systems. Watch for IE frequencies that are substantially (e.g., more than 3 times) below generic values.
IE-C1 (Note 2)	Focus on LOOP frequency as a function of duration
IE-C2	Category II. Focus on LOOP and medium and small LOCA frequencies including stuck open PORVs
IE-C6 (Note 1)	For plants that choose FTs for support systems, attention to loss of cooling systems initiators.
IE-C9 (Note 1)	Category II for plants that choose FTs for support systems. Watch for IE frequencies that are substantially (i.e., more than 3 times) below generic values
AS-A3	Focus on credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A4	Focus on credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A5	Focus on credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A9 (Note 2)	Category II for MSPI systems and components and for systems such as CRD, fire water, SW cross-tie, recovery of FW
AS-A10	Category II in particular for alternate systems where the operator actions may be significantly different, e.g., more complex, more time limited.
AS-B3	Focus on credit for injection post-venting (NPSH issues, environmental survivability, etc.)
AS-B6	Focus on (a) time phasing in LOOP/SBO sequences, including battery depletion, and (c) adequacy of CRD as an adequate injection source.
SC-A4 (Note 1)	Focus on modeling of shared systems and cross-ties in multi-unit sites

Table 1 ASME PRA Standard Supporting Requirements for Self-Assessment

Supporting Requirement	Comments
SC-B1	Category II. Focus on proper application of the computer codes for T/H calculations, especially for LOCA, IORV, SORV, and F&B scenarios.
SC-C1	Category II
SY-A4 (Note 1)	Category II for MSPI systems and components
SY-A11	Focus on (d) modeling of shared systems
SY-A20 (Note 1)	Focus on credit for alternate injection systems, alternate seal cooling
SY-B1	Category I. Check that EDG, AFW, HPI, RHR CCFs are included
SY-B5	Focus on dependencies of support systems (especially cooling water systems) to the initiating events
SY-B9	Focus on credit for injection post-venting (NPSH issues, environmental survivability, etc.)
SY-B15	Focus on credit for injection post-venting (NPSH issues, environmental survivability, etc.)
HR-E1	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-E2	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-G1	Category II , though Category I for the critical HEPs would produce a more sensitive MSPI (i.e., fewer failures to change a color)
HR-G2 (Note 3)	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-G3 (Note 1)	Category I See note on HR-G1. Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-G5 (Note 1)	Category II See note on HR-G1.
HR-H2 (Note 3)	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR

Table 1 ASME PRA Standard Supporting Requirements for Self-Assessment

Supporting Requirement	Comments
HR-H3	The use of some systems may be treated as a recovery action in a PRA, even though the system may be addressed in the same procedure as a human action modeled in the accident sequence model (e.g., recovery of feedwater may be addressed in the same procedure as feed and bleed). Neglecting the cognitive dependency can significantly decrease the significance of the sequence.
DA-B1	Category I, but focus on service condition (clean vs untreated water) for SW systems
DA-C1	Focus on LOOP recovery
DA-C15 (Note 1)	Focus on recovery from LOSP and loss of SW events
DA-D1 (Note 1)	For BWRs with isolation condenser, focus on the likelihood of a stuck open SRV
QU-B2 (note 1)	Truncation limits should be chosen to be appropriate for F-V calculations. Based on sensitivity cases performed by the Office of Research [Ref. 8] the task group recommends that truncation limits be 5 to 6 orders of magnitude smaller than the base CDF.
QU-B3	This is an MSPI implementation concern and should be addressed in the guidance document. Truncation limits should be chosen to be appropriate for F-V calculations. Based on sensitivity cases performed by the Office of Research the task group recommends that truncation limits be 5 to 6 orders of magnitude smaller than the base CDF.
QU-D3	Understanding the differences between plant models, particularly as they affect the MSPI, is important for the proposed approach to the identification of outliers recommended by the task group.
QU-D5 (Note 1)	Category II for those who have used fault tree models to address support system initiators.
QU-E4 (Note 1)	Category II for the issues that directly affect the MSPI

Note 1: NEI-00-02 self-assessment action; no RG 1.200 qualification or clarification

Note 2: No NEI-00-02 self-assessment action; RG 1.200 qualification or clarification

Note 3: NEI-00-02 self-assessment action and RG 1.200 qualification or clarification

MSPI PRA QUALITY TASK GROUP LETTER REPORT
Part B: BASIS DOCUMENT

1 Introduction

This report documents the recommendations of the mitigating systems performance index (MSPI) probabilistic risk assessment (PRA) Quality Task Group, which, following NRC and stakeholder recommendations, was convened to resolve issues related to PRA quality prior to implementation of the MSPI. The task group charter is included as Appendix A.

The task group recommendations in this report are based on the collective experience of the task group members and on directly pertinent information made available to the group including the following:

- experience in performance of numerous PRAs and in the application of the results and insights from these PRAs.
- experience as writing group members or reviewers of the ASME PRA Standard
- experience as writing group members of Reg Guide 1.174 and Reg Guide 1.200.
- participants (NRC observers and industry reviewers) in numerous industry PRA peer reviews
- results from the MSPI pilot plant program, including the results of the numerous sensitivity studies which showed the effects of various PRA parameters on MSPI results.
- additional sensitivity studies, for example, the effects of truncation limits on MSPI results
- comparison of the results from the NRC's SPAR models with the results from the MSPI pilot plants, and where applicable, an analysis of the causes for the differences in the results.
- a review of PRAs and expert elicitation/deliberation of the PRA parameters that are important to MSPI (as documented in Section 2)
- comparison of the human error probabilities used in the licensee PRAs for the operator actions described in Section 2.

In RG 1.174 [Ref. 1] and in RG 1.200 [Ref.2], the PRA quality required for an application is defined in terms of the scope of the PRA, its level of detail, and its technical adequacy. Consistent with the definition of the MSPI, the scope of PRA required for the MSPI application is a level 1 PRA at full power. A standard to support the scope of PRA required has been prepared by ASME [Ref. 3], and endorsed in RG 1.200 which has been issued for trial use. Therefore, the MSPI application can be classified as a Phase 2 type application in the Commission's Phased Approach to PRA quality [Ref.4], in which RG 1.200 is the vehicle for demonstrating the adequacy of the PRA for the MSPI application.

When applying RG 1.200, it is a prerequisite that the supporting level requirements (SRs) and the associated capability category necessary to support the application be identified. Essentially it is necessary to have confidence that the structure of the PRA model is such that it is reasonably complete in addressing significant contributors, and correctly captures the various functional and inter-system dependencies to the extent required to support the accuracy necessary for the MSPI.

Even if a PRA meets the requirements of the Standard at the specified capability categories, there will still be variability in the methods used by different licensees for dealing with certain issues, e.g., the assessment of human error probabilities. Some of this will not have a significant impact on the MSPI values. However, there is a subset of issues that can have a direct and potentially significant impact on the importance of specific MSPI systems. Of particular concern are those PRA features whose treatment may vary significantly from licensee to licensee. From the NRC's perspective, the concern is with those issues that have the potential for inappropriate modeling that drives down the significance of an MSPI system, i.e., artificially lowers its FV or Birnbaum importance. In Section 2, those features of the PRA model that have an influence on the importance of the system with respect to core damage frequency (CDF) are identified.

Section 3 provides the Task Group's assessment of the ASME standard capability categories required to support the MSPI function. This assessment is based on the task group's assessment of the sensitivity of the MSPI to various aspects of PRA modeling, based on their collective experience with performing and reviewing PRAs, supplemented by the insights from Reference 5.

Section 4 discusses the group's recommendations on how a licensee should demonstrate that a PRA has sufficient technical adequacy to support its use for MSPI, using, as a basis, the assessment provided in Table 3-1. The requirements of the ASME Standard that deal with those features identified in Section 2 should be given particular attention. Since the Standard is not prescriptive in many of these areas, the aim should be to demonstrate that the particular approach used by the licensee is acceptable, and that it does not unduly decrease the importance of any of the systems by increasing significantly the number of failures needed to create a change in color in the MSPI.

Section 5 discusses the issue of an expected variability in the sensitivity of the MSPI due to variations in modeling between licensees. Section 6 provides recommendations for documentation, and Section 7 on staff review. Section 8 provides the references.

2 Identification of Significant Issues

The approach taken is the following. Those significant CDF sequences in which failures of the MSPI systems appear are identified. For the purpose of this analysis the sequences are discussed at a relatively high level, corresponding to functional or systemic description. It is these sequences that directly impact the Birnbaum importance of the system/components, since it is the absolute value of the change in CDF resulting from failures of those system components that is important.

BWR MSPI Systems

The MSPI systems for BWRs are:

Emergency ac power
HPCI/HPCS/FWCI
RCIC/isolation condenser
RHR
cooling water (SW/ESW/RBCCW)

Emergency ac power

The system is modeled in the loss of offsite power (LOOP) event tree. Sequences initiated by LOOP, and involving failure of the ac power system, including the station blackout (SBO) sequences, are usually significant contributors to core damage. The sequences typically involve the assessment of the convolution of the progression to core damage as a result of inventory boil off and the recovery of an ac power source. The frequencies of these accident sequences are a function of the frequency of the loss of offsite power initiating event, the derivation of the various time windows for recovery of offsite power, the probability of recovery of ac power as a function of time, including credit taken for cross-tie between units and use of alternate on- or off-site sources (e.g., combustion gas turbines), and the failure probabilities and the common cause failure (CCF) probability(ies) of the diesels themselves. Partial station blackout sequences (i.e., those with one or more diesel generators operating) will involve the usual complement of makeup and heat removal sequences. The most significant issues affecting the evaluation of the MSPI for the emergency ac power system are:

- assessment of the frequency of offsite power as a function of duration
- credit taken for recovery of ac power, including:
  - recovery of offsite power
  - cross-tie with sister unit
    - typically dominated by human error
  - availability of alternate sources, e.g., combustion gas turbine, including consideration of operator action
- time windows for recovery based on factors such as;
  - battery depletion (including credit for load shedding)
  - room heat up
  - HCTL (heat capacity temperature limit) implications
- CCF probabilities of diesel generators and the SBO injection systems (typically HPCI and RCIC)
- for the special case of BWRs with isolation condenser, the likelihood of a stuck open SRV

HPCI/HPCS/FWCI

HPCI: In core damage sequences of transient event trees failure of HPCI is either coupled with failure of other high pressure injection systems (RCIC, recovery of feedwater, CRD) and failure of depressurization, or failure of other high pressure injection systems and failure of low pressure injection. The importance of HPCI is affected by the credit taken for additional injection systems (over and above RCIC). For example, taking credit for firewater (as an additional low pressure system) or CRD or recovery of feedwater (as a high pressure system) can lessen the importance of HPCI.

In the LOOP/SBO tree a significant function of HPCI is to provide a delay to give time to recover the offsite power. Therefore, the modeling of recovery of offsite power in the short term (given that HPCI has failed), the frequency of LOOP, and the CCF probability of the diesels and the station batteries all have an impact on the importance of HPCI.

HPCI importance is therefore affected by:

- transient frequencies
- HEP for depressurization
- Credit for motor-driven feedwater pumps
- Credit for alternate injection systems (e.g., fire water, SW cross-tie, CRD, recovery of feedwater)
- LOOP frequency, CCF of diesels and batteries, and the factors associated with the short time recovery of ac power given a LOOP

In addition, the MSPI pilot study found that assumptions concerning the necessity of the valves in the minimum flow bypass line to close to ensure sufficient flow may be significant. However, this is probably more of a scope issue related to what active components should be included rather than a numerical impact on the MSPI itself.

HPCS: This closely follows HPCI.

FWCI: For BWRs with an isolation condenser, the FWCI is the high pressure injection system used in case of failure of the isolation condenser. Credit for the IC will impact the MSPI.

RCIC/IC

RCIC: The importance of RCIC should fairly closely parallel that of HPCI. For plants with a HPCS, the credit taken for cross-tie of the Div III diesel to other buses may reduce its significance on SBO sequences.

IC: The IC will appear in sequences combined with failure of FWCI or power conversion system (PCS) and failure to depressurize or failure of LPI.

RHR

The RHR pumps are also the LPCI pumps. Therefore, the importance of this system is affected by system failures and human failure events that appear with failure of LPCI in TQUV type sequences (failure of all injection), and with failure of RHR in the TW (loss of containment heat removal) sequences.

TQUV sequences: The importance of LPCI is affected by consideration of additional systems (e.g., firewater, CRD). Also, on a relative basis, these sequences may be of less significance if a conservative assessment is made of the probability of failure to depressurize the reactor following a loss of high pressure injection. However, this should not impact the MSPI, since it is only those cutsets that involve failures of the LPCI system that are relevant.

TW sequences: The importance of RHR is affected by the HEP for failure to initiate suppression pool cooling, and the credit taken for venting and continued injection, post-venting.

The issues affecting the importance of RHR are:

- credit taken for alternate injection systems (e.g., firewater, SW cross-tie, CRD)
- treatment of venting (HEP, recognizing that for MSPI, this occurs in the same cutset as equipment failure of RHR, not the failure to depressurize)
- Injection post-venting (NPSH issues, environmental survivability of systems in the reactor building (Mk II containments), sources injecting from outside the containment/RX building, e.g., SW, firewater)
- frequency of initiating events involving loss of the power conversion system (PCS)
- credit for recovery of PCS (e.g., restoration of the condenser as a heat sink)

Cooling water systems (SW/ESW/RBCCW)

The cooling water systems are required for cooling diesel generators and for the secondary side of the RHR heat exchangers. While room cooling may be required for some pumps, e.g., HPCI, RCIC, CS, that function is not included in the system function for MSPI. Therefore, the sequences of interest are:

LOOP sequences: while the importance of cooling water systems will be affected by the same things as the emergency ac power system, the effect will be smaller because the failure of SW to the diesels is typically a small contribution to CDF cutsets.

TW sequences: again the importance will be impacted by those things that affect the suppression pool cooling function of RHR, i.e., credit for venting and post-venting injection, and initiation of suppression pool cooling. If significant credit is taken for success of venting then this will decrease tie significance of the cooling water system in the same way as it does for RHR.

In some cases, failures of cooling water systems may be candidates for consideration as support system initiators. Inappropriately excluding their contribution or significantly underestimating the frequency of their loss will result in an underestimate of the importance of the system.

For multi-unit sites some plants have the capability to cross-tie systems between units. Depending on the credit given this can have a significant impact on the significance of a support system.

For the fault tree linking approach to PRA, the method used to cut logic loops (dependence of support systems on support systems) if done incorrectly can result in under or overestimation of the significance of the system.

Inappropriate screening of the need for room cooling will lead to underestimating the significance of the cooling systems.

The issues affecting the importance of the cooling water systems are:

- types of cooling loads on the system
- significance of the LOOP scenarios
- treatment of support system initiators
- credit for venting and post-venting injection (TW sequences)
- credit for cross-tie with a sister unit
- approach to cutting logic loops
- screening of the need for room cooling

PWR MSPI Systems

The MSPI systems for PWRs are:

emergency ac power
high pressure safety injection
auxiliary feedwater system
residual heat removal system
cooling water support (SW/CCW)

Emergency ac power system

As for BWRs, the frequency of the loss of offsite power, the derivation of the various time windows for recovery of offsite power, the probability of recovery, and the failure probabilities and CCF probabilities of the diesels will affect the significance of the emergency ac power system. However, in addition, the treatment of RCP seal LOCAs can have a significant effect on the importance of the diesel generators. The issues affecting the importance of the emergency ac power system are:

- frequency of offsite power as a function of duration
- RCP seal cooling model
- credit taken for recovery of ac power, including:
    - recovery of offsite power
    - cross-tie with sister unit
    - alternate sources, e.g., combustion gas turbine
- time windows for recovery based on factors such as;
    - battery depletion (including credit for load shedding)
    - room heat up
    - credit taken for providing alternate seal cooling
- CCF probabilities of diesel generators
- credit for manual operation of AC-independent AFW/EFW pump following battery depletion

High pressure safety injection

For injection, HPSI is primarily required for small and medium LOCAs, and SGTR. Its importance will be affected by LOCA frequencies, and the modeling of SGTR, in particular the

HEP for failure to isolate the faulted generator. If credit is taken for depressurization to allow low head pumps to inject (core cooling recovery), the significance of the HPSI will decrease.

For those plants for which feed and bleed is an option, the importance of HPSI will be affected by the unavailability of the AFW system, and any credit taken for recovery of main feedwater. The issues affecting the importance of the HPSI are:

- small and medium LOCA frequencies (including stuck open PORVs)
- credit for core cooling recovery (rapid depressurization)
- SGTR frequency and HEP for failure to isolate the faulted generator
- modeling of AFW system
- recovery of main feedwater
- transient frequencies
- credit for cooldown to shutdown cooling instead of high pressure ECCS recirculation following smaller LOCAs

<u>Auxiliary feedwater system</u>

AFW importance can be affected by the credit taken for recovery of main feedwater, and, for those plants for which it is an option, probably more so by the credit taken for feed and bleed, which is a function of the HEP and the assumptions on the success criteria (1 PORV vs 2). In all cases, sequences involving loss of the AFW will need to address containment heat removal. This is typically achieved by establishing RHR following cooldown and depressurization, or by sump recirculation.

A loss of DC bus has the potential to initiate a transient / loss of offsite power (e.g. circuit breakers don't operate), cause loss of normal heat removal (no main feedwater), defeat an entire division of emergency safeguards (HPSI, AFW, pressurizer PORV), often resulting in only one motor-driven AFW pump available to mitigate the transient absent recovery of DC power. The CDF from this initiator is highly dependent on the frequency and modeling of recovery of DC power.

The issues affecting the importance of the AFW system are:

- credit taken for Feed and Bleed (F&B) (if applicable)
  - the HEP for failure to initiate feed and bleed
  - the success criterion, (1 vs. 2 PORVs)
- credit for recovery of main feedwater
- credit for other forms of SG cooling (e.g., fire water, stand-by FW pumps)
- probabilities of failure to establish containment heat removal, particularly the HEPs for either establishing RHR (including cooldown and depressurization), or establishing sump recirculation
- transient frequencies
- treatment of loss of DC power initiator
- CCF probabilities of AFW/EFW pumps

<u>Residual heat removal system</u>

All sequences that include failure of AFW and PCS will contribute to the importance of the RHR system. For those plants that require the low pressure pumps for high head recirculation

(piggy-back mode), the sequences that end in sump recirculation will contribute to the importance of the RHR system. For plants where the RHR pumps are also the low pressure injection pumps, the importance of the system is affected by the assumptions made for the large and medium LOCAs. For some plants (Beaver Valley, Surry and North Anna) the RHR function is performed by the inside and outside containment spray recirculation system. While, in a relative sense, the importance of the RHR system will be less than that for the other plants, the same issues will affect its significance on an absolute basis. The issues that can affect the significance of the RHR system are:

- LOCA frequencies (all categories) (for all plants there are LOCA sequences that include failure of residual heat removal, either from failure of RHR or failure of sump recirculation)
- Credit for recovery of main feedwater

Cooling water systems

These are typically required for diesel generator cooling, for RCP seal cooling (CCW and SW), for pump cooling and RHR in the recirculation mode, and other decay heat removal functions, such as room cooling. They may or may not be needed for pump cooling for injection from the RWST following a LOCA, but since ultimately all F&B and LOCA sequences transfer to the requirement for decay heat removal they all require cooling water. Failures of cooling systems may be identified as support system initiators. Inappropriately excluding their contribution or significantly underestimating the frequency of their loss will result in an underestimate of the importance of the system.

Some cooling systems, e.g., service water, may be more prone to problems arising from the environment, e.g., raw water as opposed to chemically controlled water. This could have an impact on valve reliability to change state.

The issues that can influence the importance of the cooling water systems are:

- treatment of support system initiators
- the assessment of LOOP and recovery of ac power
- LOCA treatment
- credit for inter-unit cross-ties
- Internal (to system) environmental conditions
- provision of alternate charging pump cooling (e.g., using the firewater system)
- CCF probabilities of cooling water pumps (failure to run) and common cause contributors to loss of intake capability

3 Identification of Capability Category for SRs Required for MSPI

This section presents the task group's assessment of what capability category is needed for the supporting level requirements (SRs) of the ASME PRA Standard [Ref. 3] that are necessary to ensure that the PRA is of sufficient technical adequacy to support the MSPI function. The calculation of the MSPI is based upon importance measures (Fussell-Vesely, and/or Birnbaum), and the importance measure of any one event in the PRA model is affected to some extent by everything else in the PRA model. Therefore it is important that the overall PRA model is such that it is reasonably complete in addressing significant contributors, and correctly captures the

various functional and inter-system dependencies to the extent required to support the accuracy necessary for the MSPI. This indicates that the majority of the SRs in the ASME Standard should be met. The question is whether they should be met at capability category I or II.

In Table 3-1, for those SRs for which there is a distinction between capability categories, the suggested category is identified, accompanied by a brief explanation. The table specifically includes remarks pertaining to the issues identified in Section 2 that directly impact the MSPI. The task group paid particular attention to those SRs that relate to the issues identified in Section 2, since they are particularly important for the MSPI applications. The suggestions were informed by the task group's experience with performing and reviewing PRAs, and by Reference 5.

4 Demonstration of Technical Adequacy

Table 3-1 indicates the task group's recommendations on which capability categories are needed to support the MSPI application. The majority of the SRs in the Standard make no distinction between capability categories. For many of the remaining SRs, a capability category I is judged to be sufficient.

All but one of the licensee PRAs were peer reviewed using the NEI-00-02 peer review process [Ref. 6] (the one exception was SONGS, for which the ASME Standard with Addenda A was used as the basis for the review). This peer review process was developed, and for many plants applied, before the ASME standard was completed. To address differences between the criteria used to review the PRA using the NEI-00-02 process, and those implied by the SRs in the standard, NEI has developed a self-assessment process [Ref. 7], with which a licensee can close the gap, and provide an assessment of whether the PRA meets the ASME standard. The staff position on the self-assessment process is documented in Appendix B of RG 1.200. The self-assessment guidance does have a limitation in that it has only been developed for a Capability Category II PRA. While it may be desirable for other applications to have a PRA with CC II for all SRs, it is not practical in the short term, nor is it necessary for the MSPI application. Therefore, a more pragmatic approach is necessary.

In developing the recommended approach, the following factors were considered:

From the technical perspective:

- the results of the PRA that are to be used for the MSPI are not required to be exact, but rather it is only required to be accurate within a factor of 2 or 3, and, as demonstrated in the pilot plant verification report [Ref.5], the effectiveness of the indicator is not particularly sensitive to variability in the PRA treatment of many of the PRA elements.
- experience has shown that the identification and grouping of initiating events (with the exception of support system initiating events) and the development of event trees and fault trees are generally performed in a consistent manner across the industry.

From the process perspective:

- the MSPI is complemented by the performance of the SDP on single failures.
- the MSPI is supplemented by a backstop, based on the expected number of failures of the components, which imposes a color change for systems for which the MSPI is an

insensitive indicator based on an observed number of failures lower than that which would change the color using the MSPI.

- the staff will perform focused reviews or audits; MSPI results that differ significantly from the norm are likely to be triggers for review.

Taking these factors into consideration, the task group considers that, for the majority of SRs, there is reason to believe that, if those facts and observation (F&Os) generated by the peer review that can significantly affect the logic structure or the results of the PRA are addressed, those SRs will have been met to the degree needed for the MSPI. However, it is necessary to demonstrate that those specific issues identified in Section 2 have been addressed appropriately. This can be done by performing a self-assessment in accordance with Appendix B of RG 1.200 against the SRs as identified in Table 4-1.

5 Variability between Licensee PRAs

The way in which requirements that address the issues identified in Section 2 are addressed is in all likelihood different for different PRAs. For example, concerning the credit taken for alternate injection systems (BWR), there is no SR that dictates to what extent this should be done; it is a decision for the individual licensee to make. Therefore, two licensees can produce different MSPI values for equivalent systems at similar plants, that, even though they are both derived using PRAs of an appropriate quality, will require different numbers of failures to trip a color.

As another example, the HEPs for failure to depressurize taken from the licensees' PRAs can vary significantly. It is quite conceivable that the analyses might be done in a manner that is equivalent to a CC II, but it is the differences in the assessments from the HRA method that drive this variability. Therefore, in this case also, the licensees would have different thresholds for color change for HPCI.

These two cases are somewhat different however. In the first case, the difference is caused by a choice as to the level of detail in the model. Therefore, as long as the credit for alternate systems is addressed properly, there is no reason to question the use of the PRA for the derivation of the MSPI. This should be addressed by appropriate attention to the corresponding requirements. The second case is a type of model uncertainty (related to the choice of HRA model), and the choice and acceptability of specific models is to some extent subjective.

Absent an increased level of prescription on the use of a PRA for the MSPI, variability will occur. The staff's major concern here is that a particular choice of model or level of detail may lead to desensitizing the MSPI inappropriately. Therefore, when the Birnbaum importance measure of a particular system at any given plant is significantly different from those of the same system at similar plants, a licensee should be prepared to justify the values used. This places some requirements on the documentation as discussed in Section 6. However, there is also a precaution in the MSPI process against PRA results that result in an insensitive index in the form of the backstop correction.

6 Recommendations on Documentation of Assurance of Technical Adequacy for MSPI

The recommendation of the task group is that, to demonstrate that the PRA is technically adequate to support the MSPI application, the licensees should document the following:

in the archival documentation, that would be available for audit and review:

- a description of the resolution of the significant, i.e., the A and B category, F&Os identified by the peer review team.
- a description of the methods and data used to address the issues identified in Section 2.

In the MSPI basis document:

- the results of, and resolution of any findings from, the self-assessment performed for the SRs identified in Table 4-1, taking into consideration Appendix B of RG 1.200, with particular attention to the notes in Table 4-1.
- for those significant F&Os not resolved, a justification why not resolving them has no impact on the efficacy of the MSPI

In addition, the licensee should have the base PRA documentation is available for audit or review by the NRC staff.

7 Recommendations for Staff Review

The intent of RG 1.200 is to reduce the need for staff review of the base PRA. The recommendation of the task group is consistent with this intent. However, the staff may choose to audit the licensee's PRA on a sampling basis. Because of their importance to the MSPI application, the focus of a review should be on those issues identified in Section 2, and summarized in terms of the ASME PRA standard supporting requirements in Table 4-1. The task group considered approaches to determining the need for a staff review. The first approach considered the feasibility of developing guidance on an acceptable range for the parameters associated with each of the issues raised in Section 2, and using this information to identify potential outliers. A concern with this approach is that this would be a very resource intensive activity that was beyond the resources associated with the task group . Furthermore, there is a large number of parameters, and any one parameter being an outlier may not have a significant impact on the MSPI. Therefore, a more practical approach was discussed, based on a cross-comparison of the Birnbaum importance measures between plants of a similar design.

A review should be carried out if the Birnbaum importance measures used for MSPI are significantly different from the typical range found for similar plants so that the index is relatively insensitive, requiring that a larger number of failures is needed to change color than at other similar plants. For similar plants, modeled to the same level of detail and using the same assumptions, it should be expected that the Birnbaum importance measures of the monitored components should be fairly similar. The SPAR models can provide information on the range of variability expected due to differences in details of the design, since the SPAR models are standardized in terms of modeling assumptions. Before full implementation, it is the task group's understanding that there will be a workshop at which the licensees will provide their

Birnbaum importance measures. The differences between these plants are expected to be larger, because of differences in assumptions, modeling philosophy, etc.. A cross comparison of the Birnbaum importance measures between plants of a similar design will enable the importance measures to be ranked numerically, facilitating the identification of potential outliers. It is premature at this stage for the task group to recommend the range of values that would be used to identify an outlier. This will become more clear when the results of the SPAR model and licensee PRA evaluations become available. It is clear, however, that the screening would need to be performed in two stages. First, it has to be ascertained whether the difference is appropriate, resulting from a difference in modeling philosophy such as taking appropriate credit for additional injection systems. It is those plants for which the importance measures appear to have no clear reason for having significantly smaller values to which the review and audit should be directed.

8 References

1. USNRC, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis”, Regulatory Guide 1.174, Revision 1, November 2002.

2. USNRC, “An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities”, Regulatory Guide 1.200 for trial use, February 2004.

3. American Society of Mechanical Engineers (ASME), “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications”, ASME RA-S-2002, April 5, 2002, and “Addenda to ASME RA-S-2002", ASME RA Sa-2003, December 5, 2003.

4. USNRC, “Plan for the Implementation of the Commission’s Phase Approach to Probabilistic Risk Assessment Quality”, SECY-04-0118, July 13, 2004.

5. USNRC, draft “Report on the Independent Verification of the Mitigating Systems Performance Index (MSPI) Results for the Pilot Plants”, NUREG-xxxx, 2004.

6. Nuclear Energy Institute (NEI), “Probabilistic Risk Assessment Peer Review Process Guidance”, NEI-00-02, Revision A3, March 20, 2000.

7. Letter from NEI, Anthony Pietrangelo, Director of Risk and Performance Based Regulation Nuclear Generation, to the USNRC, Ashok Thadani, Director of the Office of Nuclear Regulatory Research, December 18, 2001.

8. Donald Dube, USNRC, vu-graph showing impact of truncation values MSPI Pilot Working Group Public Meeting, March 19, 2003 , ADAMS accession # ML030850500.

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
IE-A1	Category I = Category II = Category III
IE-A2	Category I = Category II = Category III
IE-A3	Category I = Category II = Category III
IE-A4	Category II Attention to plant specific initiators and special initiators, especially loss of DC bus, Loss of AC bus, or Loss of room cooling type initiators
IE-A5	Category I = Category II = Category III
IE-A6	Category I The principal concerns for MSPI are support system initiators and LOSP. It is unlikely these will have been overlooked if IE-4 is met.
IE-A7	Category I in general. However, precursors to losses of cooling water systems in particular, e.g., from fouling of intake structures, may indicate potential failure mechanisms to be taken into account in the system analysis (IE-C6, 7, 8, 9)
IE-A8	Category I. However, system alignments should be taken into account when modeling support system initiators (IE-C6, 7, 8, 9).
IE-A9	Category II for plants that choose FTs to model support systems. Watch for IE frequencies that are substantially (e.g., more than 3 times) below generic values.
IE-A10	Category I = Category II = Category III
IE-B1	Category I = Category II = Category III
IE-B2	Category I = Category II = Category III
IE-B3	Category I = Category II
IE-B4	Category I = Category II = Category III
IE-C1	Category I = Category II = Category III Attention to LOOP frequency as a function of duration
IE-C2	Category II especially for LOOP and medium and small LOCA frequencies including stuck open PORVs
IE-C3	Category I = Category II = Category III
IE-C4	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
IE-C5	no requirement (Category I/II)
IE-C6	Category I = Category II = Category III For plants that choose FTs for support systems, attention to loss of cooling systems initiators.
IE-C7	Category I = Category II = Category III
IE-C8	Category I = Category II = Category III (this appears to relate to IE-A8)
IE-C9	Category II for plants that choose FTs for support systems. Watch for IE frequencies that are substantially (i.e., more than 3 times) below generic values
IE-C10	Category I = Category II = Category III
IE-C11	Category I = Category II
IE-C12	Category I = Category II
IE-D1	Category I = Category II = Category III
IE-D2	Category I = Category II = Category III
IE-D3	Category I = Category II = Category III
AS-A1	Category I = Category II = Category III
AS-A2	Category I = Category II = Category III
AS-A3	Category I = Category II = Category III Attention to credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A4	Category I = Category II = Category III Attention to credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A5	Category I = Category II = Category III Attention to credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A6	Category I = Category II = Category III
AS-A7	Category I = Category II
AS-A8	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
AS-A9	Category II for MSPI systems and components and for systems such as CRD, fire water, SW cross-tie, recovery of FW
AS-A10	Category II in particular for alternate systems where the operator actions may be significantly different, e.g., more complex, more time limited.
AS-A11	Category I = Category II = Category III
AS-B1	Category I = Category II = Category III
AS-B2	Category I = Category II = Category III
AS-B3	Category I = Category II = Category III Attention to credit for injection post-venting (NPSH issues, environmental survivability, etc.)
AS-B4	Category I = Category II = Category III
AS-B5	Category I = Category II = Category III
AS-B6	Category I = Category II = Category III Attention to (a) time phasing in LOOP/SBO sequences, including battery depletion, and (c) adequacy of CRD as an adequate injection source.
AS-C1	Category I = Category II = Category III
AS-C2	Category I = Category II = Category III
AS-C3	Category I = Category II = Category III
AS-C4	Category I = Category II = Category III
SC-A1	Category I = Category II = Category III
SC-A2	Category I = Category II = Category III
SC-A3	Category I = Category II = Category III
SC-A4	Category I = Category II = Category III Attention to modeling of shared systems and cross-ties in multi-unit sites
SC-A5	Category I = Category II = Category III
SC-A6	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
SC-B1	Category II Attention to proper application of the computer codes for T/H calculations, especially for LOCA, IORV, SORV, and F&B scenarios.
SC-B2	Category I
SC-B3	Category I = Category II = Category III
SC-B4	Category I = Category II = Category III
SC-B5	Category I = Category II = Category III
SC-C1	Category II
SC-C2	Category I = Category II = Category III
SC-C3	Category I = Category II = Category III
SC-C4	Category I = Category II = Category III
SY-A1	Category I = Category II = Category III
SY-A2	Category I = Category II = Category III
SY-A3	Category I = Category II = Category III
SY-A4	Category II for MSPI systems and components
SY-A5	Category I = Category II = Category III
SY-A6	Category I = Category II = Category III
SY-A7	Category I = Category II = Category III
SY-A8	Category I = Category II = Category III
SY-A9	Category I = Category II = Category III
SY-A10	Category I = Category II = Category III
SY-A11	Category I = Category II = Category III Attention to (d) modeling of shared systems
SY-A12	Category I = Category II = Category III
SY-A13	Category I = Category II = Category III
SY-A14	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
SY-A15	Category I = Category II
SY-A16	Category I = Category II = Category III
SY-A17	Category I = Category II = Category III
SY-A18	Category I = Category II = Category III
SY-A19	Category I = Category II
SY-A20	Category I = Category II = Category III Attention to credit for alternate injection systems, alternate seal cooling
SY-A21	Category I = Category II = Category III
SY-A22	Category I = Category II = Category III
SY-B1	Category I Should include EDG, AFW, HPI, RHR CCFs
SY-B2	no requirements
SY-B3	Category I = Category II = Category III
SY-B4	Category I = Category II = Category III
SY-B5	Category I = Category II = Category III Attention to dependencies of support systems (especially cooling water systems) to the initiating events
SY-B6	Category I = Category II = Category III Attention to room cooling requirements, especially in LOOP events
SY-B7	Category I A conservative approach tends to make the MSPI for cooling water systems more important.
SY-B8	Category I = Category II = Category III
SY-B9	Category I = Category II = Category III Attention to credit for injection post-venting (NPSH issues, environmental survivability, etc.)
SY-B10	Category I = Category II = Category III
SY-B11	Category I
SY-B12	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
SY-B13	Category I = Category II = Category III
SY-B14	Category I = Category II = Category III
SY-B15	Category I = Category II = Category III Attention to credit for injection post-venting (NPSH issues, environmental survivability, etc.)
SY-B16	Category I = Category II = Category III
SY-C1	Category I = Category II = Category III
SY-C2	Category I = Category II = Category III
SY-C3	Category I = Category II = Category III
HR-A1	Category I = Category II = Category III
HR-A2	Category I = Category II = Category III
HR-A3	Category I = Category II = Category III
HR-B1	Category I For the level of accuracy required for MSPI, contributions from failures to restore following maintenance or test are unlikely to make a significant difference.
HR-B2	Category I = Category II = Category III
HR-C1	Category I = Category II = Category III
HR-C2	Category I For the level of accuracy required for MSPI, contributions from failures to restore following maintenance or test are unlikely to make a significant difference.
HR-C3	Category I = Category II = Category III
HR-D1	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
HR-D2	Category I For the level of accuracy required for MSPI, the use of screening values for pre-initiator HEPs unlikely to make a significant difference.
HR-D3	Category I As above (HR-D2).
HR-D4	Category I = Category II = Category III
HR-D5	Category I = Category II = Category III
HR-D6	Category I = Category II = Category III
HR-D7	Category I = Category II = Category III
HR-E1	Category I = Category II = Category III Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-E2	Category I = Category II = Category III Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-E3	Category I The HFEs that directly impact the MSPI are well-recognized as important contributors in PRAs. If they are defined in a unique manner that leads to a significantly different HEP from what it typically seen in PRAs, this would most likely have been addressed during the peer review, and, if considered incorrect, resolved through the F&O resolution.
HR-E4	Category I As above (HR-E3).
HR-F1	Category I = Category II = Category III
HR-F2	Category I The intent is that HEPs that are significantly different from the norm (to be defined) will be subject to a sensitivity study to determine the sensitivity of the MSPI to the value.
HR-G1	Category II , though Category I for the critical HEPs would produce a more sensitive MSPI (i.e., fewer failures to change a color)

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
HR-G2	Category I = Category II = Category III Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-G3	Category I See note on HR-G1. Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-G4	Category I See note on HR-G1.
HR-G5	Category II See note on HR-G1.
HR-G6	Category I = Category II = Category III
HR-G7	Category I = Category II = Category III
HR-G8	Category I = Category II = Category III
HR-G9	Category I = Category II = Category III
HR-H1	Category I = Category II
HR-H2	Category I = Category II = Category III Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B, responses to SGTR
HR-H3	Category I = Category II = Category III
HR-I1	Category I = Category II = Category III
DA-A1	Category I = Category II = Category III
DA-A2	Category I = Category II = Category III
DA-A3	Category I = Category II = Category III
DA-B1	Category I The MSPI pilot program did not find that parameter values were a significant source of concern for MSPI sensitivity. However, attention to service condition (clean vs untreated water) for SW systems

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
DA-B2	Category I = Category II
DA-C1	Category I = Category II = Category III Attention to LOOP recovery
DA-C2	Category I = Category II = Category III
DA-C3	Category I = Category II = Category III
DA-C4	Category I = Category II = Category III
DA-C5	Category I = Category II = Category III
DA-C6	Category I = Category II = Category III
DA-C7	Category I The MSPI pilot program did not find that parameter values were a significant source of concern for MSPI sensitivity.
DA-C8	Category I The MSPI pilot program did not find that parameter values were a significant source of concern for MSPI sensitivity.
DA-C9	Category I = Category II
DA-C10	Category I The MSPI pilot program did not find that parameter values were a significant source of concern for MSPI sensitivity.
DA-C11	Category I = Category II = Category III
DA-C12	Category I The MSPI pilot program did not find that parameter values were a significant source of concern for MSPI sensitivity.
DA-C13	Category I = Category II = Category III
DA-C14	Category I = Category II = Category III
DA-C15	Category I = Category II = Category III Attention to recovery from LOSP and loss of SW events
DA-D1	Category I For BWRs with isolation condenser, attention to the likelihood of a stuck open SRV
DA-D2	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
DA-D3	Category I The uncertainty characterization does not play a role in the MSPI.
DA-D4	Category II/III. If a Bayesian approach is used its validity should be examined. (This requirement will probably be significantly changes in Addendum B of the ASME Standard)
DA-D5	Category I Given that there is a fall back position on the incorporation of CCF in the MSPI, it does not seem reasonable to require a higher category.
DA-D6	Category I Given that there is a fall back position on the incorporation of CCF in the MSPI, it does not seem reasonable to require a higher category.
DA-D7	Category I The MSPI pilot program did not find that parameter values were a significant source of concern for MSPI sensitivity.
DA-E1	Category I = Category II = Category III
QU-A1	Category I = Category II = Category III
QU-A2	Category I It is judged that performing a point estimate calculation, rather than using a formal propagation of uncertainty, will not have much of an impact on the accident sequences and cutsets involving the MSPI systems.
QU-A3	Category I = Category II = Category III
QU-A4	Category I = Category II = Category III
QU-B1	Category I = Category II = Category III
QU-B2	Category I = Category II = Category III Truncation limits should be chosen to be appropriate for F-V calculations. Based on sensitivity cases performed by the Office of Research [Ref. 8] the task group recommends that truncation limits be 5 to 6 orders of magnitude smaller than the base CDF.

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
QU-B3	Category I = Category II = Category III This is an MSPI implementation concern and should be addressed in the guidance document. Truncation limits should be chosen to be appropriate for F-V calculations. Based on sensitivity cases performed by the Office of Research [Ref. 8] the task group recommends that truncation limits be 5 to 6 orders of magnitude smaller than the base CDF.
QU-B4	Category I = Category II = Category III
QU-B5	Category I = Category II = Category III Attention to cutting logic loops for ESW systems
QU-B6	Category I = Category II = Category III
QU-B7	Category I = Category II = Category III
QU-B8	Category I = Category II = Category III
QU-B9	Category I = Category II = Category III
QU-C1	Category I = Category II = Category III
QU-C2	Category I = Category II = Category III
QU-C3	Category I = Category II = Category III
QU-D1	Category I = Category II = Category III
QU-D2	Category I = Category II = Category III
QU-D3	Category II Understanding the differences between plant models, particularly as they affect the MSPI, is important for the proposed approach to the identification of outliers recommended by the task group.
QU-D4	Category I = Category II = Category III
QU-D5	Category II for those who have used fault tree models to address support system initiators.
QU-E1	Category I = Category II = Category III
QU-E2	Category I = Category II = Category III

Table 3-1 Capability Categories for MSPI

Supporting Requirement	Comments
QU-E3	Category I Uncertainty characterization does not play a role in MSPI.
QU-E4	Category II for the issues that directly affect the MSPI
QU-F1	Category I = Category II = Category III
QU-F2	Category I Category II/III is not necessary for MSPI.
QU-F3	Category I = Category II = Category III
QU-F4	Category I = Category II = Category III
QU-F5	Category I = Category II = Category III
QU-F6	Category I = Category II = Category III

Table 4-1 SRs for self-assessment

Supporting Requirement	Comments
IE-A4	Focus on plant specific initiators and special initiators, especially loss of DC bus, Loss of AC bus, or Loss of room cooling type initiators
IE-A7	Category I in general. However, precursors to losses of cooling water systems in particular, e.g., from fouling of intake structures, may indicate potential failure mechanisms to be taken into account in the system analysis (IE-C6, 7, 8, 9)
IE-A9	Category II for plants that choose FTs to model support systems. Watch for IE frequencies that are substantially (e.g., more than 3 times) below generic values.
IE-C1	Focus on LOOP frequency as a function of duration
IE-C2	Focus on LOOP and medium and small LOCA frequencies including stuck open PORVs
IE-C6	For plants that choose FTs for support systems, attention to loss of cooling systems initiators.
IE-C9	Category II for plants that choose FTs for support systems. Watch for IE frequencies that are substantially (i.e., more than 3 times) below generic values
AS-A3	Focus on credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A4	Focus on credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A5	Focus on credit for alternate sources, e.g., gas turbines, CRD, fire water, SW cross-tie, recovery of FW
AS-A9	Category II for MSPI systems and components and for systems such as CRD, fire water, SW cross-tie, recovery of FW
AS-A10	Category II in particular for alternate systems where the operator actions may be significantly different, e.g., more complex, more time limited.
AS-B3	Focus on credit for injection post-venting (NPSH issues, environmental survivability, etc.)
AS-B6	Focus on (a) time phasing in LOOP/SBO sequences, including battery depletion, and (c) adequacy of CRD as an adequate injection source.
SC-A4	Focus on modeling of shared systems and cross-ties in multi-unit sites
SC-B1	Focus on proper application of the computer codes for T/H calculations, especially for LOCA, IORV, SORV, and F&B scenarios.

Table 4-1 SRs for self-assessment

Supporting Requirement	Comments
SC-C1	Category II
SY-A4	Category II for MSPI systems and components
SY-A11	Focus on (d) modeling of shared systems
SY-A20	Focus on credit for alternate injection systems, alternate seal cooling
SY-B1	Should include EDG, AFW, HPI, RHR CCFs
SY-B5	Focus on dependencies of support systems (especially cooling water systems) to the initiating events
SY-B9	Focus on credit for injection post-venting (NPSH issues, environmental survivability, etc.)
SY-B15	Focus on credit for injection post-venting (NPSH issues, environmental survivability, etc.)
HR-E1	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B
HR-E2	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B
HR-G1	Category II , though Category I for the critical HEPs would produce a more sensitive MSPI (i.e., fewer failures to change a color)
HR-G2	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B
HR-G3	Category I See note on HR-G1. Attention to credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B
HR-G5	Category II See note on HR-G1.
HR-H2	Focus on credit for cross ties, depressurization, use of alternate sources, venting, core cooling recovery, initiation of F&B
HR-H3	The use of some systems may be treated as a recovery action in a PRA, even though the system may be addressed in the same procedure as a human action modeled in the accident sequence model (e.g., recovery of feedwater may be addressed in the same procedure as feed and bleed). Neglecting the cognitive dependency can significantly decrease the significance of the sequence.
DA-B1	Focus on service condition (clean vs untreated water) for SW systems

Table 4-1 SRs for self-assessment

Supporting Requirement	Comments
DA-C1	Focus on LOOP recovery
DA-C15	Focus on recovery from LOSP and loss of SW events
DA-D1	For BWRs with isolation condenser, focus on the likelihood of a stuck open SRV
QU-B2	Truncation limits should be chosen to be appropriate for F-V calculations. Based on sensitivity cases performed by the Office of Research [Ref. 8] the task group recommends that truncation limits be 5 to 6 orders of magnitude smaller than the base CDF.
QU-B3	This is an MSPI implementation concern and should be addressed in the guidance document. Truncation limits should be chosen to be appropriate for F-V calculations. Based on sensitivity cases performed by the Office of Research [Ref. 8] the task group recommends that truncation limits be 5 to 6 orders of magnitude smaller than the base CDF.
QU-D3	Understanding the differences between plant models, particularly as they affect the MSPI, is important for the proposed approach to the identification of outliers recommended by the task group.
QU-D5	Category II for those who have used fault tree models to address support system initiators.
QU-E4	Category II for the issues that directly affect the MSPI

Appendix A

Mitigating Systems Performance Index (MSPI) PRA Quality Task Group Charter

As a result of NRC and stakeholder recommendations, the MSPI PRA Quality Task Group has been convened to resolve issues related to the quality required of a PRA for implementation of the MSPI.

In RG 1.174 and in RG 1.200, the PRA quality required for an application is defined in terms of the scope of the PRA, its level of detail, and its technical adequacy. Consistent with the scope of the MSPI, the scope of PRA required for the MSPI application is a level 1 PRA at full power. Since a Standard to support the scope of PRA required has been endorsed in RG 1.200, the MSPI application can be classified as a Phase 2 type application in the Commission's Phased Approach to PRA quality.

The objectives of the Task Group are to:

- Provide guidance on the level of detail and the characteristics of the base PRA needed to support the MSPI implementation, using, as a basis, the supporting level requirements and capability categories of the ASME PRA Standard.

- Provide guidance on licensee and staff activities needed to demonstrate that the base PRA is technically adequate to support its use to support the MSPI application, addressing the use of RG 1.200, the roles of peer review and self-assessment, and guidance for determining the need for, and scope of, staff audit of the base PRA model.

- Provide recommendations on an approach to dealing with those PRA uncertainties, assumptions, and methodological issues that are known to affect MSPI significance levels.

- Review and revise recommendations based on experience with initial implementation.

- Provide resolution of those emergent PRA methodological issues that are discovered during the lead plant implementation of the MSPI.

The Task Group recommendations will be provided in a letter report.