

October 2, 2002

MEMORANDUM TO: Michael R. Johnson, Chief
Probabilistic Safety Assessment Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

FROM: See-Meng Wong/**RAI**
Licensing Section
Probabilistic Safety Assessment Branch

SUBJECT: SUMMARY MINUTES OF SEPTEMBER 4, 2002 PUBLIC MEETING TO
DISCUSS THE IMPROVEMENT FOR PHASE 1 AND PHASE 2 FIRE
PROTECTION SIGNIFICANCE DETERMINATION PROCESS (SDP)
METHODOLOGY.

Attached is the summary minutes of the September 4, 2002 public meeting between NRC staff and external stakeholders which summarizes the discussion of a proposed Phase 1 screening process for the fire protection SDP, and discussions of proposed approaches for addressing each issue affecting the Phase 2 fire protection SDP methodology to develop improvements for the methodology. The handout materials distributed to the meeting participants are attached.

Attachments: As stated

CONTACT: See Meng Wong, NRR/DSSA/SPSB
415-1025

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Fire Protection SDP Revision Task

Summary Minutes of Public Meeting
Regency Room, Double Tree Hotel Rockville, Rockville, Maryland
September 4, 2002

1. Meeting Objectives

- (a) To discuss a proposed Phase 1 screening process for the fire protection SDP methodology, and
- (b) To discuss possible approaches for addressing each issue affecting the Phase 2 fire protection SDP methodology to develop improvements for the methodology.

2. Agenda

M. Reinhart started the meeting with introductory remarks on the purpose and objectives of the meeting. The primary goals were to discuss a proposed Phase 1 screening process for the fire protection SDP, and discuss possible approaches for addressing each issue affecting the Phase 2 fire protection SDP tool. He was also the chair and moderator of all discussions in the meeting.

S. Wong and R. Langstaff provided a proposed strawman for the Phase 1 screening process, including a set of screening questions, for discussion between the meeting participants.

F. Emerson, NEI presented the industry proposal for the Phase 1 SDP process.

S. Wong provided a comprehensive summary of the issues affecting the Phase 2 fire protection SDP methodology. He led the discussions on the possible approaches for addressing each issue to develop improvements for the Phase 2 fire protection SDP methodology.

NRC staff and industry representatives participated actively in all discussions on the Phase 1 screening process, and the possible approaches for treating each issue affecting the Phase 2 fire protection SDP tool. The meeting participants also discussed the planning for the national workshop to discuss the possible and alternative approaches for addressing each issue affecting the Phase 2 SDP methodology.

3. Discussion of Phase 1 Screening Process (S. Wong, R. Langstaff)

S. Wong and R. Langstaff provided a proposed strawman for the Phase 1 screening process, including a set of screening questions (See attachment 1 for details of screening questions), for discussion between the meeting participants. S. Wong also presented a proposed approach for processing a finding that filtered through the Phase 1 screening questions but not screened as a Green (low risk-significant) finding yet. The proposed approach is based on considerations of scenario ignition frequency and the number of degraded defense-in-depth (DID) elements.

F. Emerson, NEI presented an industry proposal for the Phase 1 SDP process (See attachment 2 for details). The concept of the industry proposed Phase 1 process includes the evaluation of fire ignition frequency, DID degradations, and credit for safe shutdown capability.

The outcome of the discussions was a proposed set of Phase 1 screening questions from melding the approaches presented to improve the Phase 1 SDP methodology. The proposed set of Phase 1 screening questions were:

- (1) Does the finding only affect achieving/maintaining ability to reach cold shutdown conditions? Y - screen to Green, N - continue.
- (2) Does the finding affect the ability to achieve/maintain hot shutdown functions? Y - go to Phase 2, N - continue.
- (3) Is the fire ignition frequency greater than Low? Y - go to Phase 2, N - continue.
- (4) Is the defense-in-depth degradation High? Y - go to Phase 2, N - screen to Green

The meeting participants proposed a criterion of less than 1E-4/year for "Low" fire ignition frequency to be considered in the Phase 1 screening question #3. The meeting participants also proposed that a working group, comprising of J.S. Hyslop, Jim Trapp, Roy Fuhrmeister, Dan Frumkin, Fred Emerson/NEI and David Conti/NAESCO, evaluate the feasibility of using the proposed fire ignition frequency criterion for the Phase 1 methodology. The meeting participants also proposed that NEI and its Fire Protection Task Force group provide clarification on their criteria for "High" degradation rating of defense-in-depth elements, which are different from the criteria described in the current fire protection SDP.

4. Discussion of Technical Issues Affecting Phase 2 Fire Protection SDP Methodology (S. Wong)

S. Wong provided a summary of the technical issues concerning the current version of the Phase 2 fire protection SDP. (See attachment 3: "Summary Minutes of Working Group Meeting, August 14, 2002"). The discussions were focused on two general issues and nine specific issues. The general issues were: (a) Phase 2 objectives and goals, and (b) the quantification approach. The specific issues were: (a) fire scenario development, (b) fire scenario frequencies, (c) degradation ratings for fixed fire detection and suppression systems, (d) manual suppression and fire brigade response evaluations, (e) fire barriers, (f) credit for compensatory measures, (g) safe shutdown findings, (h) credit of human actions, and (i) treatment of Appendix R exemptions.

The meeting participants discussed the possible approaches for treating each of the identified issues. In preparation for the November workshop, individuals were assigned, voluntarily or through group vote, as task leads on each specific Phase 2 SDP issue to develop action plans for short-term and long-term fixes to improve the Phase 2 methodology. The assigned task leads for each issue are identified below:

- (A) General issue 1 - Phase 2 objectives and goals: **Peter Koltay**
- (B) General issue 2 - Quantification approach: **J.S. Hyslop**
- (C) Specific issue 1 - Fire scenario development: **Paul Lain**
- (D) Specific issue 2 - Fire scenario frequency: **J.S. Hyslop**
- (E) Specific issue 3 - Degradation ratings for fixed fire detection and suppression systems: **Fred Emerson**
- (F) Specific issue 4 - Manual suppression and fire brigade response evaluations: **Paul Lain**
- (G) Specific issue 5 - Fire barriers: **Dan Frumkin**
- (H) Specific issue 6 - Credit for compensatory measures: **Fred Emerson**
- (I) Specific issue 7 - Safe shutdown findings: **Gareth Parry**
- (J) Specific issue 8 - Credit for human actions: **Gareth Parry**
- (K) Specific issue 9 - Treatment of Appendix R exemptions: **Peter Koltay**

5. Discussion of Licensing Basis Issues Affecting Fire Protection (M. Reinhart)

M. Reinhart opened a short discussion with industry representatives on the issues concerning the fire protection licensing bases that had been previously accepted by NRC in the 1980s. The industry representatives presented the view that the present-day interpretation of the 1980s fire protection licensing bases need further clarification to help resolution of a number of previously resolved issues that are being reopened. The outcome of the discussions was to pursue clarification and necessary resolution of this issue at other forums such as the NEI Licensing Forum to be held in November, 2002.

6. Wrap-Up/ Action Items/Next Meeting (M. Reinhart, S. Wong)

The action items are:

- (a) Preparation of public workshop in early November 2002 for discussing the fixes for the Phase 2 SDP methodology (S. Wong). The individuals assigned as task leads for each Phase 2 SDP issue are identified in Section 4.
- (b) NEI and its Fire Protection Task Force group provide clarification on their criteria for "High" degradation rating of defense-in-depth elements by October 1, 2002 (F. Emerson).

- (c) F. Emerson volunteered to prepare a combined approach for the Phase 1 SDP methodology for discussion at the November public workshop.

7. Meeting Attendees

Mark Reinhart, NRC/NRR	See-Meng Wong, NRC/NRR
Mark Caruso, NRC/NRR	Lauren Quinones-Navarro, NRC/NRR
Peter Wilson, NRC/NRR	Peter Koltay, NRC/NRR
Russell Gibbs, NRC/NRR	Paul Lain, NRC/NRR
D. Frumkin, NRC/NRR	Jim Trapp, NRC/Region 1
Roy Fuhrmeister, NRC/Region 1	Walt Rogers, NRC/Region 2
Ron Langstaff, NRC/Region3	Rebecca Nease, NRC/Region 4
Nathan Siu, NRC/RES	J.S. Hyslop, NRC/RES
Fred Emerson, NEI	David Conti, NAESCO
Mark Reidmeyer, AmerenUE	David Wiegand, STP Nuclear Operating Co.
Jack Hicks, TXU Energy/CPSES	Gary Cavanaugh, OPPD/Ft. Calhoun Station

Phase 1 Screening Process Strawman Approach

A. Phase 1 Screening Checklist

4. Is the finding considered more than minor (based on IMC 0612 criteria)?
5. Does the finding has a described performance deficiency?
6. For the described finding, are the licensing basis requirements met? If Yes, do not proceed with the SDP analysis. No, continue.

B. Phase 1 Screening Questions

- (a) Is there any equipment, including cables, important to safety in the area(s) affected by the finding? Yes, continue. No, screen to **Green**
- (b) For a finding affecting safe shutdown, would only reaching cold shutdown be affected? Yes, screen to **Green**. No, continue.
- (c) Are multiple trains of equipment important to safety in the area(s) affected by the finding? Yes, go to Phase 2. No, continue.
- (d) Are multiple rooms affected by the finding? Yes, go to Phase 2. No, continue.
- (e) Other proposed questions:
 - (a) For a finding affecting safe shutdown, would safe shutdown still be achievable without significant delay? Yes, screen to Green. No, continue.
 - (b) For a finding affecting fire brigade effectiveness, would there be a significant delay in extinguishing a fire? Yes, continue. No, screen to Green.
 - (c) For a finding affecting fire detection, would there be a failure or significant delay to detect a fire? Yes, continue. No, screen to Green.

C. Proposed Phase 1 Screening Approach

If the finding filters through the Phase 1 screening questions (and not screened to Green yet), the finding should be subject to the Phase 2 analysis process by a decision based on the scenario ignition frequency and the number of degraded defense-in-depth (DID) elements as shown below:

C.1 Exposure time > 30 days

Scenario Ignition Frequency	1 Degraded DID Element	2 Degraded DID Elements
> 1E-5	Phase 2	Phase 2
1E-6 to 1E-5	Green	Phase 2
< 1E-6	Green	Green

C.2 Exposure time < 30 days

Scenario Ignition Frequency	1 Degraded DID Element	2 Degraded DID Elements
> 1E-4	Phase 2	Phase 2
1E-5 to 1E-4	Green	Phase 2
< 1E-5	Green	Green

Fire Protection SDP Revision Task

Summary Minutes of Working Group Meeting
Conference Room O10B2, One White Flint North, Rockville, Maryland
August 14, 2002

1. Meeting Objectives

- (a) To discuss the issues affecting the Phase 2 fire protection SDP methodology, and
- (b) To discuss possible approaches for addressing each issue to develop improvements for the Phase 2 fire protection SDP methodology.

2. Agenda

S. Wong started the meeting with introductory remarks on the purpose and objectives of the meeting. The primary goals were to discuss the issues, and possible approaches for addressing each issue affecting the Phase 2 fire protection SDP tool. He was also the chair and moderator of all discussions in the meeting.

S. Wong provided a summary of the current Phase 2 fire protection SDP methodology (IMC 0609, Appendix F), and discussed the difficulties that may be experienced by NRC inspectors in following the guidance for implementing each of the steps of the Phase 2 methodology.

S. Nowlen, SNL provided a comprehensive summary of the issues affecting the Phase 2 fire protection SDP methodology. (See attachment 2). He led the discussions on the possible approaches for addressing each issue to develop improvements for the Phase 2 fire protection SDP methodology.

NRC staff and the NEI representative participated actively in all discussions of the issues affecting the Phase 2 fire protection SDP tool. The meeting participants also discussed possible and alternative approaches for addressing each issue affecting the Phase 2 fire protection SDP tool.

3. Discussion of Technical Issues Affecting Phase 2 Fire Protection SDP Methodology (S. Nowlen, S. Wong, et al)

S. Nowlen provided a summary of the technical issues concerning the current version of the Phase 2 fire protection SDP. (See attachment 2 for details of summary). The discussions were focused on two general issues and nine specific issues. The general issues were: (a) Phase 2 objectives and goals, and (b) the quantification approach. The specific issues were: (a) fire scenario development, (b) fire scenario frequencies, (c) degradation ratings for fixed fire detection and suppression systems, (d) manual

suppression and fire brigade response evaluations, (e) fire barriers, (f) credit for compensatory measures, (g) safe shutdown findings, (h) credit of human actions, and (i) treatment of Appendix R exemptions.

The meeting participants discussed the possible approaches for proceeding with the resolution of each of the identified issues. The possible approaches for each issue are summarized below:

(A) General issue 1 - Phase 2 objectives and goals

The core expectations for the Phase 2 methodology are simplicity, transparency, repeatability, and reasonableness to avoid “extra conservatism” in the analysis assumptions. The working group agreed that a possible approach to meet these expectations is to develop objective criteria for clear documentation of the Phase 2 analysis steps, i.e., the description of the analysis steps could be abbreviated and extended discussions in each step can be deferred to an appendix. In addition, it was recommended that a statement of objectives (as proposed in attachment 2) should be included in the fire protection SDP guidance document.

(B) General issue 2 - Quantification approach

The current fire protection SDP utilizes a fire risk equation which is a summation of positive and negative terms with each term accounting for one aspect of the risk calculation. It was noted that this simplified equation appears to be obscuring the results and does not always capture the dependencies between the different aspects of the fire risk equation. The working group proposed returning to a quantification format that more closely parallels the traditional fire PRA approach. An event tree approach that explicitly treats the dependencies, was proposed to the working group for consideration.

(C) Specific issue 1 - Fire scenario development

Although it appears that this issue has no significant technical challenges, the guidance for fire scenario development could be improved to help the NRC inspectors during field assessments. A possible solution is to provide a mechanistic approach for developing fire scenario(s) in the context of several events or phases: initial ignition, fire growth and spread, fully developed fire, propagation to adjacent equipment or rooms, and fire suppression. Another possible approach involving the concept of a fire time-line, is to develop fire scenario(s) in the context of critical events laid out on a linear time-line.

(D) Specific issue 2 - Fire scenario frequency

This issue is centered on the use of an appropriate database of fire events for deriving reasonable estimate(s) of fire ignition frequency data. A possible solution is to use the EPRI database which includes fire events from the fire insurers’ databases. Although a RES database is available, it was considered to be somewhat limited because the database contains fire events for a specific recent time period. The working group agreed that a table of fire ignition frequencies with referenced information sources should be included in the revised SDP document.

(E) Specific issue 3 - Degradation ratings for fixed fire detection and suppression systems

Better guidance for the bases and revised values of the degradation ratings for fixed fire detection and suppression systems are needed to reduce the subjective judgment used

in characterizing the effectiveness of fixed fire protection systems. A possible solution is to clarify the criteria for the degradation ratings and develop appropriate probability values using an expert panel elicitation process. NRR/SPLB would be responsible for providing the results of the expert panel elicitation on the degradation ratings for fixed fire detection and suppression systems.

(F) Specific issue 4 - Manual suppression and fire brigade response evaluations

Better guidance for the bases and probability values of effective manual suppression and fire brigade response are needed to reduce the subjective judgment used in characterizing the effectiveness of manual suppression and fire brigade performance in a developed fire scenario. A possible solution is to clarify the criteria for evaluating the fire brigade response and develop appropriate probability values using an expert panel elicitation process. NRR/SPLB would be responsible for providing the results of the expert panel elicitation on the criteria for evaluating fire brigade performance. In addition, it was proposed that explicit treatment of time factor in the fire scenario development is to be considered in the analysis of fire brigade performance.

(G) Specific issue 5 - Fire barriers

The treatment of fire barriers in the current Phase 2 fire protection SDP, both in the context of the “double room term” and in its treatment of raceway barriers, needs better guidance for NRC inspectors to properly characterize the effectiveness of fire barriers in any given fire scenario. A possible solution is to clarify the criteria for the degradation ratings and develop appropriate probability values using an expert panel elicitation process. NRR/SPLB would be responsible for providing the results of the expert panel elicitation on the degradation ratings for fire barriers.

(H) Specific issue 6 - Credit for compensatory measures

The assessment of risk credit for compensatory measures has not been rigorously addressed in fire PRA practice. The challenge posed in resolution of this issue is to obtain a quantitative assessment of the net impact of the compensatory measure. A possible solution is to develop appropriate probability values for initial degradation of the fire protection defense-in-depth element and the offsetting compensatory measure using an expert panel elicitation process. In addition, the RES study on compensatory measures would be reviewed to provide insights on crediting compensatory measures in the Phase 2 fire protection SDP.

(I) Specific issue 7 - Safe shutdown findings

The current Phase 2 fire protection SDP does not evaluate licensee performance deficiencies related to post-fire safe shutdown findings. A possible solution is to provide better guidance to evaluate the significance of safe shutdown findings after a finding(s) has filtered through the Phase 1 screening process. Better guidance on plant response modeling, including the consideration of spurious actuations, are needed to enhance the fire protection SDP.

(J) Specific issue 8 - Credit for human actions

Better guidance for the treatment and bases of probability values of human actions in executing alternate shutdown and remote shutdown procedures are needed for enhancing the Phase 2 fire protection SDP. A possible solution is the development of common rules for crediting human actions based on accessibility, time factors, and fire and smoke conditions in a fire scenario. Since human reliability analysis is a complex

process, the working group will explore reasonable methods for crediting human actions.

(K) Specific issue 9 - Treatment of Appendix R exemptions

The current Phase 2 fire protection SDP does not evaluate the treatment of Appendix R exemptions. A possible solution is to evaluate the risk changes due a deficiency in the approved exemption and weighing against the baseline risk of the exemption. The working group will continue to consider all possible approaches to explicitly treat exemptions in the Phase 2 SDP process.

4. Wrap-Up/ Action Items/Next Meeting (S. Wong)

The action items are:

1. Preparation of strawman for assignment of degradation ratings for fixed fire detection and suppression systems (Specific issue 3), fire brigade response (Specific issue 4), and fire barriers (Specific issue 5). Responsibility for developing the strawman and obtaining SPLB concurrence was assigned to P. Lain/SPLB.
2. Preparation of issues for discussion in September 4, 2002 public meeting. (S. Wong)

7. Meeting Attendees

See-Meng Wong, NRC/NRR
Jim Trapp, NRC/Region 1
Roy Fuhrmeister, NRC/Region 1
Paul Lain, NRC/NRR
J.S. Hyslop, NRC/RES
Kendra Hill, NRC/RES
Deann Raleigh, Scientech

Gareth Parry, NRC/NRR
Walt Rogers, NRC/Region 2
Ron Langstaff, NRC/Region3
D. Frumkin, NRC/NRR
Steve Nowlen, SNL
Fred Emerson, NEI

AGENDA TOPICS

Fire Protection SDP Improvement Initiative Public Meeting
Double Tree Hotel Rockville
Wednesday, September 4, 2002
Regency Room

9:00 a.m.	Welcome and Introduction	M. Reinhart
9:05 a.m.	Meeting Purpose and Objectives	M. Reinhart
9:15 a.m.	Proposed Strawman for Phase 1 Screening Process	S. Wong R. Langstaff
10:00 a.m.	NEI Proposed Phase 1 Methodology	F. Emerson, NEI
10:45 a.m.	Break	
11:00 a.m.	Continue Discussion on Phase 1 Screening Methodology	NRC staff, NEI and others
12:00 p.m.	Lunch	
1:00 p.m.	Issues Affecting Phase 2 Methodology, and S. Wong Possible Approaches for Treating Each Issue	
2:30 p.m.	Break	
2:45 p.m.	Discussion of Proposed Improvements to Resolve Issues	All
4:00 p.m.	Planning for National Workshop	M. Reinhart
4:30 p.m.	Adjourn	