March 20, 2003

NOTE TO: File

FROM: Daniel Frumkin, Plant Systems Branch, NRR**/RA/**

SUBJECT: FIRE PROTECTION SDP REVISION HOT SHORTS/SPURIOUS OPERATIONS TASK GROUP CONFERENCE CALLS MARCH 6, 2003, MARCH 10, 2003, AND MARCH 13, 2003

Three conference calls were held, as captioned above. Notes from the conference calls are contained in the following Appendices:

APPENDIX A: March 6, 2003
APPENDIX B: March 10, 2003
APPENDIX C: March 13, 2003

Appendix C, Attachment 1, contains the final version of the strawman for this phase of the SDP requantification. See Appendix C for a description of additional activities planned for this team.

Attachments: As Stated

CONTACT: Daniel Frumkin, NRR/DSSA/SPLB
415-2280

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FROM: Daniel Frumkin, Plant Systems Branch, NRR**/RA/**

SUBJECT: FIRE PROTECTION SDP REVISION HOT SHORTS/SPURIOUS OPERATIONS TASK GROUP CONFERENCE CALLS MARCH 6, 2003, MARCH 10, 2003, AND MARCH 13, 2003

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Appendix C, Attachment 1, contains the final version of the strawman for this phase of the SDP requantification. See Appendix C for a description of additional activities planned for this team.

Attachments: As Stated

CONTACT: Daniel Frumkin, NRR/DSSA/SPLB
415-2280

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OFFICIAL RECORD COPY

SUBJECT: FIRE PROTECTION SDP REVISION TASK GROUP CONFERENCE CALL
MARCH 6, 2003
TEAM G: HOT SHORTS/SPURIOUS ACTUATIONS

TEAM G MEMBERS:
Daniel Frumkin, NRC - Team Lead
Fred Emerson, NEI
Harold Barrett, Duke Energy
Ken Sullivan, BNL
Keith Began, NMC
Steven Nowlen, SNL
Mark Salley, NRC
Jim Higgins, BNL
J. S. Hyslop, NRC (Not in attendance)

On March 3, 2003, a conference call was held to discuss the incorporating hot shorts and spurious actuations into the proposed fire protection significant determination process (SDP). A brief agenda was transmitted via email to the meetings attendees, by the team lead.

Agenda:

Fred will discuss the effort of the NEI 00-01 team.
Ken will provide us information about the notebooks.

The meeting generally followed the agenda. Jim Higgins, explained how the Phase 2 plant specific notebooks could be applied to the fire SDP process. This process (as described in Attachment 1) is consistent with the way that the other Phase 2 SDP's are done. He indicated that some modification of the notebooks would be required, but felt that a procedure could be developed to either have this done in the field or done by staff senior risk analysts (SRA). A discussion of the process that Jim Higgins used to modify the notebooks is included in Attachment 3.

Fred presented his straw man (Attachment 2) including a table of probabilities of spurious operations. This table was discussed briefly and his straw man is moving forward as modified by the discussion of the notebooks. The following points relate to the attached straw man (Attachment 1):

1) Reduced the formula to 4 factors, 3 factors will be used when required circuits are the issue. The last 2 factors were merged into one, and will be taken from the notebooks.
2) Deleted discussion of screening and going to Phase 3. It would be possible to basic screening criteria related to inter-cable shorts of armored cable, etc., which may be something to consider for inclusion, or to provide to SDP writers as a suggestion. A color in Phase 2, does not assume going to Phase 3. The current use of the SDP is that a color in Phase 2 goes to a choice letter. Hopefully the Phase 2 will be 'close enough' that a Phase 3 is not needed (at least that is what we are trying for).
3) If the event sequence leads to equipment loss leading to transient that is not addressed in the notebooks, perhaps conservatively set the P_{CCD} to 1.0. If using a P_{CCD} of 1.0, the finding is not Green then either use judgment to develop a number or default to a Phase 3. We could also set up a table similar to Fred's 1.0, .1, .01, table and have inspectors choose a value based on the description.
4) The table is not final.

Steve Nowlen stressed the point that this SDP would not be easily applicable to plant wide circuit failure issues; rather this SDP will mainly be applicable to application to a single fire area.

Two meetings are planned as a follow up to this phone call.
Monday, March 10, at 1:30 - conference call relating to determining proper values for spurious operations table. NRC Room O-16-B-6.
Thursday, March 13, at 1:30 - conference call to discuss the entire process with the whole team. NRC Room O-11-B-2.

Information on how to participate:

Telephone number to connect to conference: 1 800 638 8081
Pass code is: 1079#   (this is the same pass code number for both phone calls)

Note that you must listen to entire recording and the beep after dialing into bridge line before entering pass code.

Appendix A - Attachment 1

Strawman for Circuit Failure SDP Phase 2
Second Draft
March 6, 2003

This method is intended to determine the risk significance of circuit failure inspection findings when the inspections resume in October 2003. The concept for this method is based on a simpler version of the risk equation in NEI 00-01, and is to be applied to inspection findings related to single circuit failures or combinations of two circuit failures. This revised equation is

Screening value = F_f * $P_{D/S}$ * P_{SACD} * P_{CCD}

F_f = fire initiation frequency

$P_{D/S}$ = probability that detection and suppression fail to control the fire

P_{SACD} = probability of spurious actuations given cable damage

P_{CCD} = conditional probability of core damage given spurious actuation(s)

> NOTE: The above four factor formula only applies where spurious operations are the issue. Where required circuits are involved (failures other than spurious actuation), such power cables that will cause failure of pump, the P_{SACD} factor drops from the formula. The term drops out (goes to 1.0), since failure is assumed to occur.

The value for P_{SACD} is intended to be a plug-in value based the table provided for the inspector. The value for P_{CCD} is intended to be pulled from the plant specific Phase II notebooks. A series of steps will be developed, for the inspectors to follow, to determine how to assess the risk associated with the loss or spurious operation of plant equipment identified in the notebooks. Also, a method may be developed for determining the risk associated with plant equipment not addressed in the notebooks.

Fire Frequency

This value is taken from the values being developed by another SDP task force.

Failure of Detection/Suppression to Control the Fire

This value is taken from the values being developed by another SDP task force.

Probability of Spurious Actuations

This value will be taken from the following table, based on the information in NEI 00-01 Table 4-4.

Plant Condition	P_{SACD} Value	Comments
No available information about cable type or current limiting devices	0.6	Worst-case value from NEI 00-01 Table 4-4
Thermoset cable (Tset), no other information available (NOI)	0.6	
Thermoplastic cable (Tplas), NOI	0.6	
Armored cable, NOI	0.15	
Tset, inter-cable interactions only	0.02	
Tplas, inter-cable interactions only	0.20	
Armored, with fuses	.002	
Armored, inter-cable interactions only	.002	Assumed, actual value probably lower
Tset, in conduit, NOI	.15	
Tset, in conduit, inter-cable only	.05	
Any of the above, with existence of current limiting device known in circuit	½ of value indicated above	

Conditional Core Damage Probability - P_{CCD}

According to J. Higgins of BNL the P_{CCD} could be derived from the plant specific Phase 2 notebooks. The notebooks would have to be modified slightly, which could be done by a staff Senior Risk Analyst (SRA) or during the notebook's development. An outline of the steps to use the notebooks is as follows:

1) Use site IPEEE to gather information including, initiating event sequences.
2) Determine what kind of transient may be caused by fire.
3) Modify notebook to assume that fire caused transient based on event sequences.

Note: If transient is due to spurious operations use probability of spurious operation multiplier P_{SACD} discussed above.

Example of Application

The following example illustrates the application of this method:

At a BWR, simultaneous spurious actuations affecting redundant LPCS injection valves are identified as a concern in a specific fire area during an inspection. The licensee is able to quickly identify cable locations for the two valves in question, but not for possible alternative shutdown equipment. The fire frequency is .01 for this area. The probability of non-suppression is 0.5. The cables are known to be thermoset cables; current limiting devices are present (divide by 2); and it is known that cable-to-cable interactions are required to cause the cable failures value (.02) for a final value of .01. Based on the notebooks if this set of valves were to fail the probability of non-recovery would be 0.01.

Appendix A - March 6, 2003, Phone Call

The screening equation is:

$$\text{Screening value} = F_f * P_{D/S} * P_{SACD} * P_{CCD}$$

$$= 0.01 * 0.5 * 0.01 * 0.01$$

$$= 5E\text{-}6$$

This would be the Phase 2 result.

Appendix A - Attachment 2

Strawman for Circuit Failure SDP Phase 2
First Draft
March 4, 2003
F. A. Emerson

This method is intended to determine the risk significance of circuit failure inspection findings when the inspections resume in October 2003. The concept for this method is based on a simpler version of the risk equation in NEI 00-01, and is to be applied to inspection findings related to single circuit failures or combinations of two circuit failures. This revised equation is

Screening value = $F_f * P_{D/S} * P_{SACD} * P_{CCD} * F_{IMP}$

F_f = fire initiation frequency

$P_{D/S}$ = probability that detection and suppression fail to control the fire

P_{SACD} = probability of spurious actuations given cable damage

P_{CCD} = conditional probability of core damage given spurious actuation(s)

F_{IMP} = system PSA importance factor

These terms are independent. While it may appear that P_{CCD} and F_{IMP} are dependent, P_{CCD} represents only the licensee knowledge of cable locations and ability to show the impact of a single fire.

The overall criterion for screening out the combination in question is 1E-6 for the plant as a whole. Rather than count the number of fire areas where the failures in question may occur, which may be difficult where cable routes are not easily identified, the inspector considers only one fire area but drops the screening threshold to 1 E-7. Therefore, if the screening value is less than 1 E-7 for the fire area in question, the circuit failure/combination screens out. If not, a Phase 3 analysis is needed to determine the significance of the failure/combination. This concept is consistent with NEI 00-01.

The values for each of these terms are intended to be plug-in values based in a simple set of guidelines for the inspector, and are determined from the following sources.

<u>Fire Frequency</u>

This value will be taken from the fire frequency values being developed by another SDP task force.

<u>Failure of Detection/Suppression to Control the Fire</u>

This value is taken from the values being developed by another SDP task force.

<u>Probability of Spurious Actuations</u>

This value will be taken from the following table, based on the information in NEI 00-01 Table

Plant Condition	P_{SACD} Value	Comments
No available information about cable type or current limiting devices	0.6	Worst-case value from NEI 00-01 Table 4-4
Thermoset cable (Tset), no other information available (NOI)	0.6	
Thermoplastic cable (Tplas), NOI	0.6	
Armored cable, NOI	0.15	
Tset, inter-cable interactions only	0.02	
Tplas, inter-cable interactions only	0.20	
Armored, with fuses	.002	
Armored, inter-cable interactions only	.002	Assumed, actual value probably lower
Tset, in conduit, NOI	.15	
Tset, in conduit, inter-cable only	.05	
Any of the above, with existence of current limiting device known in circuit	½ of value indicated above	

4-4.

<u>Conditional Core Damage Probability</u>

The values for this term are based on three factors:

- Knowledge of cable locations for equipment affected by the indicated circuit failures
- Knowledge of cable locations for possible alternative shutdown equipment
- Affect of a single fire on the affected equipment and alternative shutdown equipment

Plant Condition	P_{CCD} Value	Comments
Locations of cables for identified circuit failures not known	1.0	Licensee unable to provide cable locations quickly to support the inspection.
Locations of cables for affected equipment are known and affected by single fire. Locations for possible alternative shutdown equipment not known.	.1	Detailed cable locations for affected equipment provided easily by licensee, but cable locations for possible alternate shutdown equipment cannot be quickly provided
Locations of cables for affected equipment are known, and redundant equipment not affected by single fire. Locations for possible alternative shutdown equipment not known.	.01	Detailed cable locations for affected equipment provided easily by licensee, but cable locations for possible alternate shutdown equipment cannot be quickly provided
Locations for cables of equipment affected by circuit failures, and any alternate shutdown pathway equipment credited by the licensee, are known; at least one safe shutdown pathway not affected by fire.	.001	Detailed cable locations for affected and alternative shutdown equipment provided easily by licensee.

PSA Importance Factor

The last term in the equation is the PSA importance factor, based on the internal events PSA model, for the affected system. This factor, normalized to one, should be easily obtainable from the plant PSA engineering staff. Systems of higher importance will therefore have a greater impact on the screening value than systems of lower importance.

Example of Application

The following example illustrates the application of this method:

At a BWR, simultaneous spurious actuations affecting redundant LPCS injection valves are identified as a concern in a specific fire area during an inspection. The licensee is able to quickly identify cable locations for the two valves in question, but not for possible alternative shutdown equipment. The fire frequency is .01 for this area. The probability of non-suppression is 0.5. The cables are known to be thermoset cables; current limiting devices are present; and it is known that cable-to-cable interactions are required to cause the cable failures. The licensee is able to quickly show that a single fire does not affect cables to both valves. The system importance is 0.1.

The screening equation is:

Screening value = F_f * $_{PD/S}$ * P_{SACD} * P_{CCD} * F_{IMP}

= 0.01 * 0.5 * 0.01 * 0.01 * 0.1

= 5E-8

This example would therefore screen out.

If the licensee was not able to show that cable-to-cable interactions were required to cause the circuit failures (spurious actuations), P_{SACD} would be 0.3, and the screening value would be 1.5 E-6. This revised example would therefore not screen out, and a Phase 3 analysis would be required.

Appendix A - Attachment 3

Evaluation of Fire Area Inspection Findings
Using Risk-Informed Inspection Notebooks
Trial Application
by Jim Higgins, BNL
Rough Draft
March 5, 2003

In order to test the effectiveness of the SDP notebooks in evaluating fire area inspection findings, we used the draft Prairie Island (PI) notebook. Please remember that there are a few changes still to be made in the draft notebook. In this report, we first provide a copy of the base case notebook Tables for the TPCS, SORV, LOOP, and LEAC worksheets.

These were then adapted for a fire in FA #20 based on information from the PI IPEEE, Table B.2.11.1 (see Attachment 1 here for a summary of this information). This was done by first determining which worksheet(s) was the appropriate one(s) to use for the FA evaluation. For FA #20, all MFW is lost, causing a reactor trip due to LOFW. Thus, we initially selected TPCS (Transient without the power conversion system) as the most appropriate to use. For this WS we then fail all equipment that is defined to be lost on the fire in the IPEEE Table. We also modify the SORV worksheet in order to allow the evaluation of an SORV that may occur during the fire. These adapted worksheets are also presented here.

Subsequent discussions with PI indicated that there is some uncertianty as to whether there would also be a loss of offsite power (LOOP) resulting from a fire in FA 20. This is not included in Table B.2.11.1, but apparently was assumed in the IPEEE analysis. Therefore, we have also included herein the LOOP and LEAC Tables. LEAC is the worksheet, generally included in PWR notebooks, that addresses a LOOP with failure of one EDG and also includes the possibility of a stuck open PORV.

Another point worthy of some discussion and consideration relates to credit for fire detection and suppression (FS) activities. For FA 20, the IPEEE did not credit these. I have included here a mark-up of the TPCS worksheet showing how FS credit could be incorporated. If we do the MCR fire at PI, we will need to include that since the IPEEE does provide such FS credit for that fire area.

Finally, we evaluated four postulated inspection findings using the modified worksheets.

The evaluation seems to work fairly well in this first test case. We should polish this evaluation one up a bit and then try a few other FAs, such as the main control room.

SUBJECT: FIRE PROTECTION SDP REVISION TASK GROUP CONFERENCE CALL
MARCH 10, 2003
TEAM G: HOT SHORTS/SPURIOUS ACTUATIONS

TEAM G MEMBERS:
Daniel Frumkin, NRC - Team Lead
Fred Emerson, NEI
Harold Barrett, Duke Energy
Ken Sullivan, BNL (Not in attendance)
Keith Began, NMC (Not in attendance)
Steven Nowlen, SNL
Mark Salley, NRC
J. S. Hyslop, NRC

On March 10, 2003, a conference call was held to discuss the probability of spurious operations assuming that cable failure were to occur. There was agreement regarding the probability of spurious actuations on all lines except conduit. Fred suggested that according to the expert panel report that spurious actuations in conduits were less likely than in cable trays, whereas Mark and Steve indicated that there was no basis for a lesser likelihood.

Steve Nowlen and Fred Emerson have agreed to determine if there is more information to bolster their positions, and will have this information for a conference call planned for March 13th.

A revised table will be issued following the March 13th phone call.

SUBJECT: FIRE PROTECTION SDP REVISION TASK GROUP CONFERENCE CALL
MARCH 13, 2003
TEAM G: HOT SHORTS/SPURIOUS ACTUATIONS

TEAM G MEMBERS:
Daniel Frumkin, NRC - Team Lead
Fred Emerson, NEI
Harold Barrett, Duke Energy (Not in attendance)
Ken Sullivan, BNL
Keith Began, NMC
Steven Nowlen, SNL
Mark Salley, NRC (Not in attendance)
J. S. Hyslop, NRC
Jim Higgins, BNL

On March 13, 2003, the team lead initiated a conference call with the team to discuss the deliverable to SPSB for this phase of the SDP development.

Fred had proposed a strawman on March 6, which the team lead modified and sent out for comment. Some comments were sent in which were incorporated. Two sections of the strawman were discussed during the meeting.

First, the team did not agree on the probability of spurious operations for damaged cables inside conduit vs. damaged cables in cable trays. Two key players (Dan Funk of EPRI) and Mark Salley were unavailable for the call, therefore this issue remained unresolved. As an interim measure, probability “ranges” have been added to the probability of spurious operations table. Fred will revise the table to include conditions where credit can be taken for the use of current limiting devices. Also, Fred revised the strawman to include detail regarding the application of the table.

Second, the team members wanted to understand clearly the method by which the SDP worksheets would be revised to apply the worksheet to the fire protection SDP. Fred provided this specific comment over email. More detail is provided in the March 6, 2003, minutes, but these minutes were not yet available to the team. Ken Sullivan committed to develop a step-by-step procedure for applying the SDP worksheet to fire protection issues.

Attachment 1 to this memo is the final input for this stage of the process. The team will continue to work through examples, bases, application of the worksheets and will work to resolve the issues with determining the probability of spurious operations. Fred provided a comment on the example, the example was modified to take into account his comment.

Appendix C - Attachment 1

Strawman for Circuit Failure SDP Phase 2
Third Draft
March 13, 2003

This method is intended to determine the risk significance of circuit failure inspection findings when the inspections resume in October 2003. The concept for this method is based on a simpler version of the risk equation in NEI 00-01, and is to be applied to inspection findings related to single circuit failures or combinations of two circuit failures. This revised equation is

Screening value = $F_f * P_{D/S} * P_{SACD} * P_{CCD}$

F_f = fire initiation frequency

$P_{D/S}$ = probability that detection and suppression fail to control the fire

P_{SACD} = probability of spurious actuations given cable damage

P_{CCD} = conditional probability of core damage given spurious actuation(s)

> NOTE: The above four factor formula only applies where spurious operations are the issue. Where required circuits or components are involved (failures other than spurious actuation), such power cables that will cause loss of power to a pump, the P_{SACD} factor drops from the formula. The term drops out (goes to 1.0), since failure is assumed to occur.

> Fred's Comment - Should we assume the failure probability is 1 for component failure? Licensee should have same flexibility as for spurious actuations to show that the probability can be lower.

The value for P_{SACD} is intended to be a plug-in value based the table provided for the inspector. The value for P_{CCD} is intended to be pulled from the plant specific Phase II notebooks. A series of steps will be developed, for the inspectors to follow, to determine how to assess the risk associated with the loss or spurious operation of plant equipment identified in the notebooks. Also, a method may be developed for determining the risk associated with plant equipment not addressed in the notebooks.

Fire Frequency

This value is taken from the values being developed by another SDP task force.

Failure of Detection/Suppression to Control the Fire

This value is taken from the values being developed by another SDP task force.

Probability of Spurious Actuations

This value will be taken from the following table, based on the information in NEI 00-01 Table 4-4. The highest value of 0.6 will initially be used; if the resulting calculation does not screen out, then other values may be used. In order to credit values less than 0.6, the licensee must provide the necessary information (described in the table) within a short time during the inspection.

Plant Condition	**P_{SACD} Value**	**Comments**
No available information about cable type or current limiting devices	0.6	Worst-case value from NEI 00-01 Table 4-4
Thermoset cable (Tset), no other information available (NOI)	0.6	
Thermoplastic cable (Tplas), NOI	0.6	
Armored cable, NOI	0.15	
Tset, inter-cable interactions only	0.02	
Tplas, inter-cable interactions only	0.20	
Armored, inter-cable interactions only	.002	Assumed, actual value probably lower
Tset, in conduit, NOI	.15 - .6	Value under discussion
Tset, in conduit, inter-cable only	.05 - .6	Value under discussion
Any of the above, with existence of current limiting device known in circuit and if current limiting device is 150% or less of nominal circuit current	½ of value indicated above	Still under discussion

Conditional Core Damage Probability - P_{CCD}

According to J. Higgins of BNL the P_{CCD} could be derived from the plant specific Phase 2 notebooks. The notebooks would have to be modified slightly, which could be done by a staff Senior Risk Analyst (SRA) or during the notebook's development. An outline of the steps to use the notebooks is as follows:

1) Use site IPEEE to gather information including, initiating event sequences.
2) Determine what kind of transient may be caused by fire.
3) Modify notebook to assume that fire caused transient based on event sequences.

Note: If transient is due to spurious operations use probability of spurious operation multiplier P_{SACD} discussed above.

Example of Application

The following example illustrates the application of this method:

At a BWR, simultaneous spurious actuations affecting redundant LPCS injection valves are identified as a concern in a specific fire area during an inspection. The licensee is able to quickly identify cable locations for the two valves in question, and the cables are located in close proximity, i.e., will be affected by same fire scenario. The fire frequency is .01 for this area. The probability of non-suppression is 0.5. The cables are known to be thermoset cables; current limiting devices rated at less than 150% of nominal power are present (divide by factor 2); and it is known that cable-to-cable interactions are required to cause the cable failures value (.02) for a final value of .01. Based on the notebooks if this set of valves were to fail the probability of non-recovery would be 0.01.

The screening equation is:

Screening value = $F_f * P_{D/S} * P_{SACD} * P_{CCD}$

= 0.01 * 0.5 * 0.01 * 0.01

= 5E-7

This would be the Phase 2 result

If the cables are required cables for required components such as pump power cables, then the P_{SCAD} factor drops from the formula. Therefore, screening equation is:

Screening value = $F_f * P_{D/S}$ [* P_{SACD} =1 drops out] * P_{CCD}

= 0.01 * 0.5 * 0.01

= 5E-5

This would be the Phase 2 result