APPENDIX A

Determining the Significance of Reactor Inspection Findings for At-Power Situations

I APPLICABILITY

The Significance Determination Process (SDP) described in this Appendix is designed to provide NRC inspectors and management with a simplified probabilistic framework for use in identifying potentially risk-significant issues within the Initiating Events, Mitigation Systems, and Barrier cornerstones.

II ENTRY CONDITIONS

Findings that have been screened in the Phase 1 - Initial Screening and Characterization of Findings process described in Inspection Manual Chapter (IMC) 0609, Attachment 4, and that have an adverse effect on the Initiating Events, Mitigation Systems, and Barrier Integrity cornerstones during at-power conditions are assessed using this Appendix.

III SDP PHASE 2 AND PHASE 3 OVERVIEW

Phase 2 - Risk Significance Estimation and Justification Using the Site Specific Pre-Solved Table or the Risk-Informed Inspection Notebook:

Phase 2 is used to develop a plant specific estimate of the risk significance of an inspection finding and to develop the basis for that determination.

Use of the Phase 2 pre-solved table is intended to be accomplished by the inspection staff, with the assistance of an SRA, if needed. SRAs may review all completed Phase 2 assessments to ensure the results are consistent with the Phase 2 guidance. Use of the Phase 2 risk-informed notebook, if required, is intended to be accomplished by the SRA.

The Phase 2 pre-solved tables/worksheets are plant-specific in order to account for variations in available mitigation equipment and other plant-specific attributes. When conducting a Phase 2 analysis, the actual data contained in the pre-solved table should be used if the finding affects one of the targets listed in the table or if a listed target can directly serve as a surrogate for the finding. If the pre-solved table does not contain a target suitable for evaluating the finding of interest, then use of the risk-informed notebook will be necessary. The examples of Phase 2 Worksheets used in this Appendix are identified as Table 3.XX. When conducting a Phase 2 analysis, the actual data contained in the various parts of Table 3.XX in the site specific risk-informed inspection notebook must be used. The pre-solved tables and risk-informed inspection notebooks can be found on the NRC internal web-page by accessing “Risk Informed Regulatory Activities” on the NRR Home Page, then accessing the “SDP Insp Notebooks” at the top of the DRA Licensing and

Operational/Maintenance Support page. The notebooks and pre-solved tables are sensitive, unclassified information and are not publicly available.

The result of the Phase 2 analysis that is White, Yellow, or Red may be used as both the preliminary and/or final significance determination. Using the Phase 2 result as a preliminary significance determination is desirable especially when it is apparent that an extensive analysis would be necessary to reduce high levels of uncertainty (e.g., increases in initiating event frequencies). The intent of the SDP may be better served by acceptance of the Phase 2 result applying applicable SDP Phase 2 usage rules.

The SRA may make changes to the Phase 2 result when there are known refinements such as exposure time, recovery credit, component failure probabilities, etc., that provide a more realistic risk estimate. Although modifying the established Phase 2 result is considered a Phase 3 SDP, the Phase 3 assessment need not involve any greater detail than the modified Phase 2 inputs, especially when it is recognized that the modified inputs are most influential in the outcome of the finding's significance. In these instances, the simplified Phase 3 assessment should be the preliminary color of the finding and be presented to the SDP and Enforcement Review Panel (SERP).

When evaluating the Phase 2 outcome, there may be situations where the result predicts a lower risk estimate (by SDP color) than the licensee's PRA. In some instances the licensee's PRA results may be overly conservative and the SDP notebook may reflect a more realistic risk estimate. In these cases, the SRA should try to determine whether the Phase 2 result or the licensee's PRA result provides the more realistic risk estimate.

Phase 3 - Risk Significance Estimation Using Any Risk Basis That Departs from the Phase 1 or 2 Process:

Phase 3 is used to address those situations that depart from the guidance provided for Phase 1 or Phase 2. A Phase 3 analysis need be no more detailed than an adjustment to the Phase 2.

If the Phase 2 SDP pre-solved tables/worksheets do not clearly address the inspection finding of concern (e.g., internal flooding, external event initiators, etc.), then a Phase 3 analysis should be performed to characterize the significance of the finding. In these instances, the Phase 3 should focus on the influential affects of the performance deficiency. Since there are a limited number of licensees who have external event PRA models, the Phase 3 analysis should not attempt to place more quantitative emphasis on the SDP result than is reasonable. Rather, the SRA or risk analyst should use qualitative insights using the licensee's IPEEE for the preliminary significance determination. In these cases, the overall SDP is best served by having the licensee provide clarifying information for NRC consideration.

Phase 3 is intended to be performed using appropriate PRA techniques and rely on the expertise of an SRA or risk analyst using the best available information that is accessible or can be determined within the SDP timeliness goal established for a particular finding. For the purposes of the SDP, it is not necessary to develop new risk analysis tools or perform extensive analyses or reviews when SDP timeliness would be jeopardized. When it is apparent that the best available information may not be sufficient to provide a meaningful result, the SRA should transition more of the assessment responsibility to the licensee. In these cases, the role of the SRA or other risk analyst would be to review the licensee's assessment versus becoming unnecessarily overburdened in the assessment process.

When a Phase 2 SDP or simplified Phase 3 SDP is used as the basis for a preliminary/final decision, the SRA should confirm the results by engaging with the licensee as early in the process as possible to determine if the licensee's results are similar. When the results are similar (i.e., same significance color), the Phase 2 SDP or simplified Phase 3 result should be used as a basis for the applicable decision and therefore it would be unnecessary to perform a more detailed Phase 3 analysis.

In the event the initial Phase 2 or Phase 3 SDP result is significantly different than the licensee's result (i.e., more than one order of magnitude), the SRA should attempt to determine the reason(s) for the difference within SDP timeliness constraints. Reasonable effort to determine the difference may include further evaluation and comparison with the licensee's PRA model and the use of the Standardized Plant Analysis Risk (SPAR) model for the plant. The SRA should not however make extensive SPAR modeling changes to accommodate the Phase 3 analysis when those changes would cause the SDP timeliness goal to be challenged. SPAR modeling issues, however, should be forwarded to the Division of Risk Assessment, NRR for their review in consultation with the Office of Research.

IV TREATMENT OF CONCURRENT MULTIPLE EQUIPMENT OR FUNCTIONAL DEGRADATIONS

Concurrent multiple equipment or functional degradations are evaluated based on their cause. If the concurrent multiple equipment or functional degradations resulted from a common cause (e.g., a single inadequate maintenance procedure that directly resulted in deficient maintenance being performed on multiple components), then a single inspection finding is written. The significance characterization is determined using a reactor safety Phase 3 SDP, is based on the time periods during which the degradations existed, and reflects the total increase in core damage frequency (CDF).

If multiple cornerstones were affected, the single finding will be assigned to the cornerstone which best reflects the dominant risk influences. The justification for the existence of a common cause must be a stronger causal relationship than poor management or cross-cutting programs (e.g., an inadequate problem identification and resolution program is an inadequate basis to justify a common cause finding).

If independent causes are determined to have resulted in multiple equipment or functional degradations, then separate inspection findings are written. The findings are individually characterized for significance, assuming none of the other independent findings existed. This is necessary to account for the probabilistic independence of the findings.

In all cases, the risk of concurrent multiple equipment or functional degradations and the staff's basis for treating these effects as either having a common cause or being independent should be documented in an inspection report or other appropriate public correspondence.

V RELATIONSHIP OF THE SDP TO THE RISK-INFORMED PERFORMANCE INDICATORS

The NRC Reactor Oversight Process (as defined in IMC 2515) evaluates licensee performance using a combination of Performance Indicators (PIs) and inspections. Thresholds have been established for the PIs, which, if exceeded, may prompt additional NRC actions to focus both licensee and Agency's attention on areas where there is a potential decline in licensee performance.

The white-yellow and yellow-red thresholds for the initiating events and mitigating systems performance indicators were risk-informed using the same "scale" as the SDP described in Appendix A. The green-white thresholds were set low enough to identify performance outliers. As a result, licensee performance is assessed by comparing and "adding" the contributions of both performance indicators and inspection findings in the Action Matrix.

END

Attachment 1 - User Guidance for Significance Determination of Reactor Inspection Findings for At-Power Situations

Attachment 2 - Site Specific Risk-Informed Inspection Notebook Usage Rules

Attachment 3 - User Guidance for Screening of External Events Risk Contributions

APPENDIX A

ATTACHMENT 1

User Guidance
for Phase 2 and Phase 3 Reactor Inspection Findings
for At-Power Situations

Phase 1 - Initial Screening and Characterization of Findings

Step 1: Characterize the inspection finding and describe the assumed impact using IMC0609.04, Exhibit 1.

> CAUTION: The SDP is used to estimate the increase in CDF due only to deficient licensee performance. Therefore, the SDP evaluation should not include equipment unavailability due to planned maintenance and testing. The impact of this equipment not being available for mitigation purposes is included in the baseline CDF for each plant.

(1) If the finding screens other than Green, perform a Phase 2 analysis.

Phase 2.1: Risk Significance Estimation and Justification Using the Site Specific Risk-Informed Inspection Notebook and Pre-Solved Table

> CAUTION: Each pre-solved table is consolidated image of its associated SDP notebook. As noted in IMC 0308, the SDP and risk tools are designed to have users engaged in the process and avoid a "blackbox" approach in determining the risk significance of deficient licensee performance.
>
> The SDP notebooks contain the context for each modeled scenario including fundamental event tree logic, success criteria for each hypothetical initiating event, critical operator actions, and other observations and risk insights that the SDP notebook developers have captured through extensive benchmarking against licensee PRA models. The context for both the SDP notebooks and pre-solved worksheets are captured in the "Read Me First" document posted on the NRC SDP notebook internal website.

Step 2.1.1: Check for the most current version of SDP Notebook and Pre-solved Worksheet

The most current version of the SDP notebook and associated pre-solved table can be found on the NRC internal web site. The user should review the posted "Read

Me First" document that provides a brief discussion on SDP notebooks and pre-solved tables.

Step 2.1.2: Determine the appropriate exposure time

Determine the exposure time associated with the finding (i.e., > 30 days, between 3 and 30 days, or < 3 days). If the inception of the condition is unknown, go to Usage Rule 1.1 of Attachment 2, "Site Specific Risk-Informed Inspection Notebook Usage Rules," of this Appendix to determine the appropriate exposure time. The maximum exposure time used in SDP is limited to one year.

Step 2.1.3: Find the appropriate target for the inspection finding in the pre-solved table

The targets (front line, support and electrical systems) provided across the top row of the pre-solved table, contain a listing of various components and operator actions that have been solved for their risk significance. The pre-solved table is used if the target matches the equipment or operator action associated with the finding or if a listed target can directly serve as a substitute for the finding. If the pre-solved table does not contain a target (structures systems and components, SSCs) suitable for evaluating the finding of interest, then bring to the SRAs attention that the use of the risk-informed notebook will be necessary. If the Phase 2 risk-informed notebook is required, that review is intended to be accomplished by the SRA (see Phase 2.2 below).

Step 2.1.4: Determine the risk significance of the inspection finding and the potential risk contribution due to Large Early Release Frequency (LERF)

(1) Determine if the finding is CDF or LERF dominant for an exposure time of one year.

(a) With the appropriate target identified, follow the column down to the bottom of the pre-solved table to the row entitled "FINAL RESULT (Largest of SDP CDF and LERF)." This value represents the risk significance for the target with a one-year exposure period. The row below entitled "Driver of Final Result (CDF or LERF or both)" identifies the dominant risk contributor. If the dominate risk contributor is CDF, no additional review is required for LERF consideration. If LERF is identified as the dominate risk contributor, the "FINAL RESULT (Largest of SDP CDF and LERF)" row has already incorporated the LERF risk contribution.

(b) If exposure period is less than one year continue to step (2), otherwise, continue to step 2.1.5.

(2) Determine the finding's risk-significance based on exposure period of less than one year.

(a) If CDF is the dominant contributor, move up the column to the applicable row marked "<3 Days" or "3 - 30 Days." Starting from the bottom of that series of six rows, look for the first row that contains a value greater than zero. The color of that row is the CDF risk significance for that finding. If all the rows for the target in the specified exposure period contain zeros, the CDF for that finding is Green.

(b) If LERF is the dominate risk contributor for the affected target, the final LERF result or color will be one order less than that described in the "FINAL RESULT (Largest of SDP CDF and LERF)" row for the 3 to 30 day exposure period and two orders less than that described in the "FINAL RESULT (Largest of SDP CDF and LERF)" row for the < 3 day exposure period.

Step 2.1.5: Screen for the potential risk contribution due to external events if results from Step 2.1.4 are Green and is greater than or equal to 1E-7.

If the color determined in step 2.1.4 is other than "Green," then the SRA will conduct additional review for external event contribution using Phase 3 guidance or information from the licensee if the licensee has an available external event PRA model.

(1) There are seven SDP notebooks and associated pre-solved tables which incorporate information allowing the user to screen contribution form external events. (Diablo Canyon, Limerick, Salem, Summer, Crystal River, Nine Mile Point 2, and Indian Point 3). For evaluating external event SDP cases for these seven facilities perform the following:

(a) In the pre-solved table, check the row labeled "External Event CDF." If the color is greater than that of the internal events "PHASE 2 RESULTS" for CDF or LERF, then the color of the finding is dominated by external events and that color should be the final color. Otherwise, the internal events CDF or LERF will be the final color as determined in step 2.1.4.
Note: Due to the slight conservatism in the Phase 2 tools, the external event contribution should not be added to the internal event contribution to determine the final color.

(b) If the exposure period is less than one year decrease the risk significnace by one order of magnitude for exposure periods of 3 to 30 days, and two orders of magnitude for exposure periods <3 days.

(2) For plants where the SDP Phase 2 pre-solved tables/worksheets do not include screening capability for external events or other initiating events that are considered by the licensee's IPEEE analysis, and the external event contribution for internal events from step 2.1.4 is "Green" with a risk-significance greater than or equal to 1E-7, the inspector should complete Attachment 3 of this appendix. This is to evaluate additional information on external event contribution. Inspectors are expected to work with the SRA and provide the necessary plant-specific information to complete this step.

Phase 2.2: **Risk Significance Estimation and Justification Using the Site Specific Risk-Informed Inspection Notebook**

Use of the Phase 2 risk-informed notebook, if required, is intended to be accomplished by the SRA. This process uses the following tables found in the Site Specific Risk-informed Inspection Notebooks. The plant specific notebooks can be found on the NRC internal web-page by accessing "Risk Informed Regulatory Activities" on the NRR Home Page. The tables presented in this Appendix are generic for the purpose of illustration.

Table 1"Categories of Initiating Events for XXX Plant"
Table 2"Initiators and System Dependency for XXX Plant"
Table 3 "SDP Worksheets for XXX Plant"
Table 4"Remaining Mitigation Capability Credit"
Table 5"Counting Rule Worksheet"

Step 2.2.1: Select the initiating event scenarios

On Table 2, "Initiators and System Dependency for XXX Plant," in the plant specific notebook, locate the equipment or safety function that was assumed to be affected by the inspection finding. Identify the initiating event scenarios that must be evaluated using the plant specific worksheets. (See Table 2 in this attachment for an example.)

Step 2.2.2: Estimate the Initiating Event Likelihood

(1) On Table 1, "Categories of Initiating Events for XXX Plant," locate the exposure time associated with the finding (i.e., > 30 days, between 3 and 30 days, or < 3 days). If the inception of the condition is unknown, go to Usage Rule 1.1 of Attachment 2, "Site Specific Risk-Informed Inspection Notebook Usage Rules," of this Appendix to determine the appropriate exposure time.

(2) Determine the Initiating Event Likelihood (i.e., 1 through 8) for each of the initiating events identified in Step 2.2.1.

(3) Go to Attachment 2 and review the information contained in Phase 1 Worksheet to determine if the finding increases the likelihood of each initiating event identified in Step 2.2.1.

(4) If the finding increases the likelihood of an initiating event, increase the Initiating Event Likelihood (IEL) value in accordance with the SDP usage rules in Attachment 2.

(5) Enter the IEL value in the IEL column on the applicable notebook worksheet. (See Table 3.XX "SDP Worksheet for Generic BWR," contained in this Appendix.)

Step 2.2.3: Estimate the Remaining Mitigation Capability in accordance with the SDP usage rules in Attachment 2

(1) For each of the inspection scenarios identified in Step 2.2.1, determine which safety functions are affected by the finding.

(2) Circle the affected safety functions on each worksheet identified in Step 2.2.1.

(3) If the inspection finding increases the likelihood of an initiating event, circle the initiating event for each of the sequences on the worksheet for that particular initiating event.

(4) Evaluate the unaffected equipment for each safety function affected by the finding. Using Table 4, "Remaining Mitigation Capability Credit," determine the remaining mitigation capability credit for each of these functions. The remaining mitigation capability credit assigned may or may not be reduced as a result of the inspection finding. Unaffected safety functions will retain their assigned full mitigation capability credit.

(5) Determine if an operator could recover the unavailable equipment or function in time to mitigate the assumed initiating event. Credit for recovery should be given only if the following criteria are satisfied:

(a) sufficient time is available;
(b) environmental conditions allow access, where needed;
(c) procedures describing the appropriate operator actions exist;
(d) training is conducted on the existing procedures under similar conditions;
(e) any equipment needed to perform these actions is available and ready for use.

If recovery credit is appropriate, enter a value of 1 in the Recovery of Failed Train column of the applicable inspection notebook worksheets.

Step 2.2.4: Estimate the risk significance of the inspection finding

(1) Determine the Sequence Risk Significance for each of the sequences circled in Step 2.2.3 (2) as applicable, using the following formula:

Sequence Risk Significance = (Initiating Event Likelihood + Remaining Mitigation Capability Credit + Recovery Credit)

(2) Complete Table 5, "Counting Rule Worksheet." The result is the Risk Significance (i.e., Green, White, Yellow, or Red) of the inspection finding based on the internal initiating events that lead to core damage.

Step 2.2.5: Screen for the potential risk contribution due to external initiating events

The plant-specific SDP Phase 2 Worksheets do not currently include initiating events related to fire, flooding, severe weather, seismic, or other initiating events that are considered by the licensee's IPEEE analysis. Therefore, the increase in risk of the inspection finding due to these external initiators is not accounted for in the reactor safety Phase 2 SDP result. Because the increase in risk due to external initiators may increase the risk significance characterization of the inspection finding, the impact of external initiators should be evaluated by a SRA or other NRC risk analyst. Experience with using the Site Specific Risk-Informed Inspection Notebooks has indicated that accounting for external initiators could result in increasing the risk significance attributed to an inspection finding by as much as one order of magnitude. Therefore, if the Phase 2 SDP result for an inspection finding represents an increase in risk of greater than or equal to 1E-7 per year (Risk Significance Estimation of 7 or less), then an SRA or other NRC risk analyst should perform a Phase 3 analysis to estimate the increase in risk due to external initiators. This evaluation may be qualitative or quantitative in nature. Qualitative evaluations of external events should, as a minimum, provide the logic and basis for the conclusion and should reference all of the documents reviewed.

Step 2.2.6: Screen for the potential risk contribution due to Large Early Release Frequency (LERF)

If the total ΔCDF from the Phase 2 Worksheets (i.e., sum of all sequences) is less than 1E-7 per year, then the finding is not significant from a LERF perspective and no further evaluation is necessary. However, if the total ΔCDF is greater than or equal to 1E-7 then the finding must be screened for its potential risk contribution to LERF using IMC 0609, Appendix H.

Phase 3 - Risk Significance Estimation Using Any Risk Basis That Departs from the Phase 1 or 2 Process:

If necessary, Phase 3 will refine or modify, with sufficient justification, the earlier screening results from Phases 1 and 2. In addition, Phase 3 will address findings that cannot be evaluated using the Phase 2 process. Phase 3 analysis will utilize appropriate PRA techniques and rely on the expertise of NRC SRAs and risk analysts using the best available information that is accessible or can be determined within the established SDP timeliness goal. Phase 3 risk assessments should be conducted using the Risk Assessment Standardization Project (RASP) handbooks. The RASP handbooks provide technical guidance for modeling of internal or external event initiators.

While, for the purposes of the SDP, the level of analysis should be commensurate with the anticipated significance of the findings, it should not be necessary to develop new risk analysis tools or perform extensive analyses, and the evaluation effort should take into account the importance of SDP timeliness.

Documentation

Each finding evaluated through the SDP must be given a color characterizing its significance. In addition, each inspection finding must be justified with sufficient detail to allow a knowledgeable reader to reconstruct the decision logic used to arrive at the final color. Further guidance on inspection report documentation is provided in IMC 0612.

Table 1 - Generic Example - Categories for Initiating Events					
Row	Initiating Event (IE) Frequency	Initiating Event Type	Initiating Event Likelihood **X** = - $\log_{10}$(IE Frequency)		
I	>1 per 1-10 yr	• Reactor Trip (TRANS) • Loss of Power Conversion System (TPCS)	**1**	**2**	**3**
II	1 per $10-10^{2}$ yr	• Loss of Offsite Power (LOOP) • Inadvertent or Stuck Open SRV (IORV) - (BWR)	**2**	**3**	**4**
III	1 per $10^{2}-10^{3}$ yr	• Steam Generator Tube Rupture (SGTR) • Loss of Component Cooling Water (LCCW) • Stuck open PORV/SRV (SORV) - (PWR) • Small LOCA including RCP seal failures - (PWR) • MSLB/MFLB	**3**	**4**	**5**
IV	1 per $10^{3}-10^{4}$ yr	• Small LOCA (RCS rupture) - (BWR) • Med LOCA • loss of offsite power with loss of one AC bus (LEAC)	**4**	**5**	**6**
V	1 per $10^{4}-10^{5}$ yr	• Large LOCA • ATWS - (BWR)	**5**	**6**	**7**
VI	<1 per 10^{5} yr	• ATWS - (PWR) • ISLOCA	**6**	**7**	**8**
			>30 days	30-3 days	<3 days
			Exposure Time for Degraded Condition		

Table 2 - Generic BWR Example - Initiators and System Dependency

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	Name			
ADS	Reactor Vessel Pressure Control and Automatic Depressurization System	5 relief Valves (ADS) & 8 safety valves	IA/nitrogen, 125 V-DC	All except LLOCA
PCS	Power Conversion System	3 reactor feed pumps, 4 condensate pumps,4 condensate booster pumps	4160 V-AC, 125 V-DC, TBCCW, IA	TRAN, IORV, SLOCA, ATWS
RHR	Residual Heat Removal	2 Loops, each with 2 RHR pumps & 1 RHR HX, MOVs	4160 V-AC, 125 V-DC, 480V AC, RHRSW, Pump Room HVAC	All
AC	AC Power (non-EDG)	4160V AC, 480V AC	125V DC	All
DC	DC Power	125V DC (2 batteries & 4 battery charger), 250V DC (2 batteries & 3 battery charger) (shared between two units)	480V AC	All

Affected System		Major Components	Support Systems	Initiating Event Scenarios
EDG	Emergency Diesel Generators	1 dedicated EDG, 1 shared EDG, & 1 SBO DG	125 V-DC, DGCW, EDG HVAC	LOOP
RHRSW	RHR Service Water	2 Loops, 2 pump-motor set per loop	HVAC, 4160 V-AC, 480 V-AC, 125 V-DC	All
SW	Service water	5 pumps in Unit 1/2 Crib house; shared system supplying a common header	4160 V-AC, 125 V-DC, IA	LOSW
TBCCW	Turbine Building Closed Cooling Water System	2 pumps, 2 HXs, an expansion tank	SW, IA, 4160 V-AC	TRAN, TPCS, SLOCA, IORV, LOOP, ATWS
HPCI	High Pressure Coolant Injection	1 TDP, MOV	125 V-DC, 250 V-DC, Room HVAC	All except LLOCA, LOSW
LPCS	Low Pressure Core Spray	2 Trains or Loops; 1 LPCS pump per train	4160 V-AC, 480 V-AC, 125 V-DC, SW, Pump Room HVAC	All except LOSW
RCIC	Reactor Core Isolation Cooling	1 TDP, MOV	125 V-DC, Room HVAC	All except LLOCA, MLOCA
FPS	Fire Protection System	2 diesel fire pumps, MOV	120V AC, SW, 24V Nickel-cadmium batteries	LOSW, LOIA
CRD	Control Rod Drive Hydraulic System	2 MDP, MOV	Non-emergency ESF AC Buses, TBCCW	TRAN, TPCS, SLOCA, IORV, LOOP, ATWS

Affected System		Major Components	Support Systems	Initiating Event Scenarios
IA	Instrument Air	2 compressors for each unit plus a shared compressor supplying both units	SW, 480V AC	LOIA
SLC	Standby Liquid Control	2 MDP, 2 explosive valves	480 V-AC, 125 V-DC	ATWS
APCV	Augmented Primary Containment Vent	Valves, Dampers	Essential Service Bus, IA backed up by accumulators for each valve operator	All

Table 3.XX - SDP Worksheet for Generic BWR — Transients (Reactor Trip) (TRAN)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Power Conversion System (PCS)	1/3 Feedpumps and 1/4 condensate/condensate booster pumps (operator action = 3)
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves (RVs) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in ½ trains in LPCI Mode (1 multi-train system) or ½ LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in ½ trains with heat exchangers and 1/4 RHRSW pumps in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory Makeup (LI)	2/2 CRD pumps (operator action = 2)

Circle Affected Functions		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery of Failed Train	Results	LERF Factor
1 TRAN - PCS - CHR - CV (5, 9) 1 + 3 + 3 + 2	9					0
2 TRAN - PCS -CHR - LI (4, 8) 1 + 3 + 3 + 2	9					0
3 TRAN - PCS - HPI - DEP (11) 1 + 3 + 2 + 2	8					0
4 TRAN - PCS - HPI - LPI (10) 1 + 3 + 2 + 6	12					0

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:

If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Table 4 - Remaining Mitigation Capability Credit

Type of Remaining Mitigation Capability	Remaining Mitigation Capability Credit $X = -\log_{10}$(failure prob)
Recovery of Failed Train Operator action to recover failed equipment that is capable of being recovered after an initiating event occurs. Action may take place either in the control room or outside the control room and is assumed to have a failure probability of approximately 0.1 when credited as "Remaining Mitigation Capability." Credit should be given only if the following criteria are satisfied: (1) sufficient time is available; (2) environmental conditions allow access, where needed; (3) procedures describing the appropriate operator actions exist; (4) training is conducted on the existing procedures under similar conditions; and (5) any equipment needed to perform these actions is available and ready for use.	1
1 Automatic Steam-Driven (ASD) Train A collection of associated equipment that includes a single turbine-driven component to provide 100% of a specified safety function. The probability of such a train being unavailable due to failure, test, or maintenance is assumed to be approximately 0.1 when credited as "Remaining Mitigation Capability."	1
1 Train A collection of associated equipment (e.g., pumps, valves, breakers, etc.) that together can provide 100% of a specified safety function. The probability of this equipment being unavailable due to failure, test, or maintenance is approximately 1E-2 when credited as "Remaining Mitigation Capability."	2
1 Multi-Train System A system comprised of two or more trains (as defined above) that are considered susceptible to common cause failure modes. The probability of this equipment being unavailable due to failure, test, or maintenance is approximately 1E-3 when credited as "Remaining Mitigation Capability," regardless of how many trains comprise the system.	3
2 Diverse Trains A system comprised of two trains (as defined above) that are not considered to be susceptible to common cause failure modes. The probability of this equipment being unavailable due to failure, test, or maintenance is approximately 1E-4 when credited as "Remaining Mitigation Capability."	4 (=2+2)
Operator Action Credit Major actions performed by operators during accident scenarios (e.g., primary heat removal using bleed and feed, etc.). These actions are credited using three categories of human error probabilities (HEPs). These categories are Operator Action = 1 which represents a failure probability between 5E-2 and 0.5, Operator Action = 2 which represents a failure probability between 5E-3 and 5E-2, and Operator Action = 3 which represents a failure probability between 5E-4 and 5E-3.	1, 2, or 3

Table 5 - Counting Rule Worksheet

Step	Instructions	
(1)	Enter the number of sequences with a risk significance equal to 9.	(1) _______
(2)	Divide the result of Step (1) by 3 and round down.	(2) _______
(3)	Enter the number of sequences with a risk significance equal to 8.	(3) _______
(4)	Add the result of Step (3) to the result of Step (2).	(4) _______
(5)	Divide the result of Step (4) by 3 and round down.	(5) _______
(6)	Enter the number of sequences with a risk significance equal to 7.	(6) _______
(7)	Add the result of Step (6) to the result of Step (5).	(7) _______
(8)	Divide the result of Step (7) by 3 and round down.	(8) _______
(9)	Enter the number of sequences with a risk significance equal to 6.	(9) _______
(10)	Add the result of Step (9) to the result of Step (8).	(10) _______
(11)	Divide the result of Step (10) by 3 and round down.	(11) _______
(12)	Enter the number of sequences with a risk significance equal to 5.	(12) _______
(13)	Add the result of Step (12) to the result of Step (11).	(13) _______
(14)	Divide the result of Step (13) by 3 and round down.	(14) _______
(15)	Enter the number of sequences with a risk significance equal to 4.	(15) _______
(16)	Add the result of Step (15) to the result of Step (14).	(16) _______

- If the result of Step 16 is greater than zero, then the risk significance of the inspection finding is of high safety significance (RED).
- If the result of Step 13 is greater than zero, then the risk significance of the inspection finding is at least of substantial safety significance (YELLOW).
- If the result of Step 10 is greater than zero, then the risk significance of the inspection finding is at least of low to moderate safety significance (WHITE).
- If the result of Steps 10, 13, and 16 are zero, then the risk significance of the inspection finding is of very low safety significance (GREEN).

Phase 2 Result: ☐ **GREEN** ☐ **WHITE** ☐ **YELLOW** ☐ **RED**

APPENDIX A

ATTACHMENT 2

Site Specific Risk-Informed Inspection Notebook Usage Rules

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1.0 DETERMINING THE INITIATING EVENT LIKELIHOOD

1.1 Exposure Time

Rule: The exposure time used in determining the Initiating Event Likelihood (IEL) should correspond to the time period that the condition being assessed is reasonably known to have existed. If the inception of the condition is unknown, then an exposure time of one-half of the time period since the last successful demonstration of the component or function (*t/2*) should be used. The maximum exposure time used in SDP is limited to one year.

Basis: A *t/2* exposure time is used when the inception of the condition being assessed is unknown because it represents the mean exposure time for a statistically valid large sample.

Example: Consider an inspection finding that corresponds to the loss of a safety function which was identified as a result of a failed monthly surveillance. Also consider that the loss of safety function was not the result of a misalignment or human error that took place in the last maintenance or routine testing. Therefore, the inception of the condition is unknown. If the monthly surveillance was last successfully performed 32 days prior to the surveillance failure, an exposure time of 16 days (greater than 3 but less than 30 days) would be used for determining the IEL in Table 1 of the SDP notebook in assessing the inspection finding.

1.2 Inspection Finding (Not Involving a Support System) that Increases the Likelihood of an Initiating Event

Rule: An inspection finding in a system can increase the likelihood of an initiating event in SDP process when the failure of the system can cause an initiator. If the increase in the frequency of the initiating event due to the inspection finding is not known, increase the Initiating Event Likelihood (IEL) for the applicable initiating event by one order of magnitude. If specific information exists that indicates the IEL should be increased by more than one order of magnitude, consult with the regional Senior Reactor Analyst (SRA) to determine the appropriate IEL.

Basis: This simplified rule was needed to facilitate Phase 2 screening. Scaling up the frequency of an initiating event strongly depends on the type and the severity of the inspection finding. Judgement and experience with the use of the Phase 2 notebooks were utilized in the establishment of this rule. If an increase by more than one order of magnitude is believed to be appropriate, the SRA should be consulted.

Example: Consider an inspection finding that involves improper adjustment of MSIV pressure setpoints. As a result of this condition, the MSIVs could go shut prematurely and cause a plant trip. Furthermore, the plant is equipped with turbine-driven feedwater pumps which would result in a loss of PCS whenever the MSIVs go shut. The exposure time associated with the inspection finding is 27 days. The inspection finding is assessed to increase the likelihood of a transient with the associated loss of the power conversion system (TPCS) about one order of magnitude during the exposure time; however, the inspection finding would not affect the safety function of MSIVs during SGTR or MSLB scenarios. Using Table 1,“Categories of Initiating Events,” an IEL of 2 would normally be used; but because the inspection finding increases the likelihood of TPCS, an IEL of 1 would be applicable and should be used. Each of the sequences on the TPCS worksheet would then have to be solved because the TPCS initiating event frequency is a component in each of the sequences.

Consider an inspection finding that involves an error in a relay calibration procedure that results in the undervoltage setpoint on the supply breakers from each of the offsite power lines being set incorrectly high. As a result, normal voltage perturbations on the offsite power distribution system could result in a loss of offsite power (LOOP) event. The exposure time associated with this inspection finding is 10 days. Using Table 1, “Categories of Initiating Events,” an IEL of 3 would normally be used; but, because the inspection finding increases the likelihood of a LOOP event, an IEL of 2 would be applicable and should be used. Each of the sequences on the LOOP worksheet would then have to be solved because the LOOP initiating event frequency is a component in each of these sequences. For those plants that have a special initiator for LOOP with loss of one AC bus (LEAC), this worksheet would be solved in a similar manner.

1.3 Inspection Finding of a Support System that Increases the Likelihood of an Initiating Event and/or Reduces the Support Redundancy for Mitigation Capabilities

Rule: For inspection findings that involve the unavailability of a component in a support system that increases the likelihood of an initiating event, increase the Initiating Event Likelihood (IEL) by one order of magnitude for the associated special initiator and evaluate the impact on mitigation capabilities provided in usage rule 2.2, “Inspection Finding Involving Reduced Redundancy of a Support System for the Mitigation Capabilities Supported.” There is an exception to the rule for non-electrical support system cases where the remaining number of redundant components of the support system is just sufficient to meet the success criteria. In these cases, the likelihood of the initiating event should be raised by two orders of magnitude. For inspection findings on electrical support, e.g., electrical buses (DC or AC), always increase the initiating event likelihood by one order of magnitude.

Basis: Simple reliability models and generic data have been used to determine that an order of magnitude increase is appropriate for different configurations of cross-tied support systems. For example, based on generic data the initiating event frequency for a cross-tied support system with one running train and two standby trains is on the order of 1E-4 per year. The initiating event frequency for a cross-tied support system with one running train and one standby train is on the order of 1E-3 per year. Therefore, if an inspection finding causes the former system configuration to be changed to the latter, the risk significance should be evaluated by increasing the initiating frequency by one order of magnitude.

Simple reliability models and generic data have also been used to evaluate the impact of losing a running or standby train in a two-train system. A generic failure frequency for one normally running train is approximately 1E-1 per year [(1E-5 per hour) x (8760hours/year)

≈1E-1/year]. The failure probability of a standby train is about 1 E-2. The failure frequency of a support system with one running train and one standby train is about 1E-3. Upon experiencing a failure, the support system will be configured in one running train with a failure frequency of 1E-1 per year. Therefore, it is appropriate to increase the IEL by two orders of magnitude for cases when the remaining support capabilities is one train credit.

Example: Consider an inspection finding that involves the unavailability of a standby pump in the component cooling water (CCW) system. The CCW system is a two train support system cross-tied into a common header with one pump normally running to provide cooling to the RCPs and a second pump in a standby mode. There is also a swing pump available that can be aligned to either of the trains, if necessary, to support the cooling of essential loads for mitigation capability. However, the swing pump cannot be credited as part of the initial mitigation credit to prevent sudden loss of the CCW system as an initiator. The operation of one CCW pump is sufficient to meet the cooling needs of the RCPs and all essential loads. The unavailability of the standby pump will present a condition where the CCW system is operating with only one running pump to provide cooling to the RCPs. The exposure time associated with this inspection finding is 21 days. The loss of CCW is a special initiator is located in Row III of Table 1, "Categories of Initiating Events," for the affected plant. As a result, an IEL of 4 would normally be assigned when solving loss of CCW accident sequences. But because of the inspection finding, the remaining configuration of the CCW system is a single running pump just sufficient to meet the demands, the likelihood of the initiating event should be raised by two orders of magnitude. An IEL of 2 would be applicable and should be used. Each of the sequences on the loss of CCW worksheet would then have to be solved because the loss of CCW initiating event frequency is a component in each of these sequences. The impact on the mitigating capability would then be assessed through usage rule 2.2, "Inspection Finding Involving Reduced Redundancy of a Support System for the Mitigation Capabilities Supported," which in this case implies an evaluation of the affected sequences with CCW having no more than single train credit. NOTE: If the system configuration had been such that the swing pump could be aligned and started in a timely manner to warrant inclusion in the CCW mitigation success criteria, the CCW system would have twice the mitigtion capacity required to meet the success criteria. Under this condition, mitigation capabilities for the affected scenarios would be evaluated nominally for those scenarios.

Consider an inspection finding that involves the unavailability of a standby pump in a service water system. The service water system is a support system to CCW and Chilled water. It has six pumps. Operation of two pumps would be sufficient to carry worst case post trip loads. The exposure time associated with this inspection finding is 21 days. The loss of service water is located in Row III of Table 1, "Categories of Initiating Events," for the affect plant. As a result, an IEL of 4 would normally be assigned when solving loss of service water accident sequences. But because of the inspection finding, the likelihood of the initiating event increases by one order of magnitude and an IEL of 3 would be applicable and should be used. The impact on mitigating capability would then be assessed through usage rule 2.2, "Inspection Finding Involving Reduced Redundancy of a Support System for the Mitigation Capabilities Supported," which in this case requires no further assessment since the success of the system requires operation of two pumps out of five pumps remaining in the post trip conditions.

Consider an inspection finding that involves the unavailability of a standby compressor in an instrument air system. The instrument air system consists of four compressors and successful operation of one of the compressors is needed. Loss of instrument air is modeled as an initiator. The exposure time associated with the inspection finding is 90 days. The loss of instrument air is located in Row II of Table 1, "Categories of Initiating Events," for the affect plant. As a result, an IEL of 2 would normally be assigned when solving loss of instrument air sequences. Because of the inspection finding, the likelihood of the initiating event increases by one order of magnitude and an IEL of 1 would be applicable and should be used. The impact on mitigating capability would then be assessed through usage rule 2.2, "Inspection Finding Involving Reduced Redundancy of a Support System for the Mitigation Capabilities Supported," which in this case requires no further assessment since the success of the system requires operation of one compressor out of three remaining compressors.

1.4 Inspection Findings Involving Emergency Diesel Generators

Rule: For inspection findings that involve the unavailability of emergency diesel generators (EDGs), determine the impact on mitigation capability of the supported systems and evaluate the loss of offsite power (LOOP) worksheet accounting for the unavailability of the EDG and the affected supported systems. In addition, if the LOOP with loss of one AC bus (LEAC) special initiator is modeled, then increase the Initiating Event Likelihood (IEL) by two orders of magnitude and evaluate the worksheet with the changed likelihood for LEAC.

Basis: The unavailability of an EDG does not increase the likelihood of a LOOP event; therefore, the LOOP IEL is not adjusted when performing the LOOP worksheet. The frequency of LEAC is estimated by multiplying the frequency of a LOOP event with the unavailability of an EDG (approximately 1E-2). If the inspection finding is related to the unavailability of an EDG, then the frequency of LEAC should be the same as the frequency of a LOOP event. In addition, because most plants have two trains of emergency AC power and many of the mitigating systems have more than two trains, the loading of the emergency AC buses is asymmetrical. Therefore, the LEAC worksheet reflects the loss of the emergency AC bus with the greatest risk impact.

Example: Consider an inspection finding that involves the unavailability of one of two EDGs at a PWR. The supported mitigating systems that are impacted by the unavailability of one train of emergency AC power includes one train of each of the auxiliary feedwater (AFW), high pressure safety injection (HPSI), and residual heat removal (RHR) systems. The exposure time associated with this inspection finding is 270 days. In accordance with Table 2, "Initiators and System Dependency," for the affected plant, the LOOP and LEAC worksheets need to be evaluated. The LOOP initiator is located in Row II of Table 1, "Categories of Initiating Events," for the affected plant. As a result, an IEL of 2 is assigned when solving LOOP accident sequences. The LEAC initiator is located in Row IV of Table 1, "Categories of Initiating Events." As a result, an IEL of 4 would normally be assigned when solving LEAC accident sequences; but, because the inspection finding increases the likelihood of a LEAC event, an IEL of 2 would be applicable and should be used. When solving the LOOP worksheet, the EDG and the equipment that it supports needs to be considered unavailable and the remaining mitigation capability modified accordingly. In this example, one train of each of the AFW, HPSI, and RHR systems is assumed unavailable in determining the remaining mitigation capability. In those sequences where AC power has been recovered (annotated as AC Recovered on the worksheets), full credit is given for the supported mitigating equipment because offsite power is available and the equipment does not need the unavailable EDG to perform its function. The LEAC worksheet already takes into account the equipment lost by the unavailability of the EDG; however, each sequence needs to be solved because the LEAC initiating event frequency is a component in each of these sequences.

1.5 Inspection Findings Involving Loss of an Emergency AC Bus

For inspection findings that involve the unavailability of an emergency AC Bus that increases the likelihood of an initiating event, increase the Initiating Event Likelihood (IEL) by one order of magnitude for the associated special initiator. Evaluate loss of offsite power (LOOP) worksheet accounting for both the unavailability of the EDG and the affected mitigation capabilities (even if the normal AC is recovered). In addition, if the LOOP with loss of one AC bus (LEAC) special initiator is modeled, then increase the Initiating Event Likelihood (IEL) by two orders of magnitude and evaluate the worksheet with the changed likelihood for LEAC. Determine the impact of the loss of the emergency bus on mitigation capabilities and evaluate all other worksheets assuming the loss of the affected mitigation capabilities.

<u>Basis:</u> The unavailability of an emergency bus could result in a reactor trip and it may be considered as a special initiator. It therefore behaves like a risk significant event rather than a condition. A stylized evaluation of the loss of an emergency AC bus is utilized in the SDP notebook. This stylized evaluation reflects the logic models that are typically implemented in PRAs to the extent possible. As such, the impact on all mitigation capabilities are evaluated similar to a comprehensive PRA approach, and the frequency of the special initiator of loss of an emergency AC bus is increased by one order of magnitude to avoid direct event evaluation which is not within the SDP scope. The frequency of LEAC is estimated by multiplying the frequency of a LOOP event with the unavailability of an emergency bus. If the inspection finding is related to the unavailability of an emergency bus, then the frequency of LEAC should be raised by two orders of magnitudes to become the same as the frequency of a LOOP event.

<u>Example:</u> Consider an inspection finding that involves the unavailability of one of two emergency AC bus at a PWR. The supported mitigating systems that are impacted by the unavailability of one train emergency AC power includes one train of each of the auxiliary feedwater (AFW), high pressure safety injection (HPSI), residual heat removal (RHR) systems, and the associated support systems to these systems trains (e.g. for component cooling). The exposure time associated with this inspection finding is 3 hr. The Loss of an Emergency AC Bus is set to Row III of Table 1,“Categories of Initiating Events,” for the affected plant. As a result, an IEL of 5 would normally be assigned; but, because of the inspection finding increases the likelihood of a loss of that AC bus initiator, an IEL of 4 would be applicable and should be used when solving the accident sequences associated with the loss of that AC bus initiator. The LOOP initiator is located in Row II of Table 1, “Categories of Initiating Events,” for the affected plant. As a result, an IEL of 4 is assigned when solving LOOP accident sequences. The LEAC initiator is located in Row IV of

Table 1, “Categories of Initiating Events.” As a result, an IEL of 6 would normally be assigned when solving LEAC accident sequences; but, because the inspection finding increases the likelihood of a LEAC event, an IEL of 4 would be applicable and should be used. When solving the LOOP worksheet, the EDG and the equipment that it supports needs to be considered unavailable and the remaining mitigation capability modified accordingly. In this example, one train of each of the AFW, HPSI, and RHR systems is assumed unavailable in determining the remaining mitigation capability even in those sequences where AC power has been recovered (annotated as AC Recovered on the worksheets).

1.6 Inspection Findings Involving Loss of an Emergency DC Bus

For inspection findings that involve the unavailability of an emergency DC Bus that increases the likelihood of an initiating event, increase the Initiating Event Likelihood (IEL) by one order of magnitude for the associated special initiator. Evaluate loss of offsite power (LOOP) worksheet accounting for both the unavailability of the EDG and the affected mitigation capabilities (even if offsite power is recovered). In addition, if the LOOP with loss of one AC bus (LEAC) special initiator is modeled, then increase the Initiating Event Likelihood (IEL) by two orders of magnitude and evaluate the worksheet with the changed likelihood for LEAC. Determine the impact of the loss of the emergency bus on mitigation capabilities and evaluate all other worksheets assuming the loss of the affected mitigation capabilities.

<u>Basis:</u> The unavailability of an emergency DC bus could for some plants result in a reactor trip therefore considered as a special initiator. For these plants loss of DC bus behaves like a risk significant event rather than a condition. A stylized evaluation of the loss of an emergency DC bus is utilized in the SDP notebook. This stylized evaluation reflects the logic models that are typically implemented in PRAs to the extent possible. As such, the impact on all mitigation capabilities are evaluated similar to a comprehensive PRA approach, and the frequency of the special initiator of loss of an emergency DC bus is increased by one order of magnitude to avoid direct event evaluation which is not within the SDP scope. The frequency of LEAC is estimated by multiplying the frequency of a LOOP event with the unavailability of an emergency bus (or the associated EDG). If the inspection finding is related to the unavailability of an emergency DC bus and there is an EDG that relies on that Bus for field flashing, then the frequency of LEAC should be raised by two order to become the same as the frequency of a LOOP event. If the EDG is not supported by the affected DC bus, then the sequences associated with LEAC worksheet will be evaluated by reflecting the impact of the DC bus on the mitigation capabilities.

<u>Example:</u> Consider an inspection finding that involves the unavailability of one of two emergency DC bus at a PWR. The supported mitigating systems that are impacted by the unavailability of one train emergency DC power includes one train of each of the auxiliary feedwater (AFW), high pressure safety injection (HPSI), residual heat removal (RHR) systems, and their associated support systems (e.g. required component cooling). The exposure time associated with this inspection finding is 3 hr. The Loss of an emergency DC bus is set to Row III of Table 1,“Categories of Initiating Events,” for the affected plant. As a result, an IEL of 5 would normally be assigned; but, because of the inspection finding

increases the likelihood of a loss of that DC bus initiator, an IEL of 4 would be applicable and should be used when solving the accident sequences associated with the loss of that DC bus initiator. The LOOP initiator is located in Row II of Table 1, “Categories of Initiating Events,” for the affected plant. As a result, an IEL of 4 is assigned when solving LOOP accident sequences. The LEAC initiator is located in Row IV of Table 1, “Categories of Initiating Events.” As a result, an IEL of 6 would normally be assigned when solving LEAC accident sequences; but, because the inspection finding increases the likelihood of a LEAC event, an IEL of 4 would be applicable and should be used. When solving the LOOP worksheet, the EDG and the equipment that it supports needs to be considered unavailable and the remaining mitigation capability modified accordingly. In this example, one train of each of the AFW, HPSI, and RHR systems is assumed unavailable in determining the remaining mitigation capability, even in those sequences where AC power has been recovered (annotated as AC Recovered on the worksheets).

1.7 Inspection Findings Involving Safety-Related Battery Chargers

Rule: Inspection findings that involve the unavailability of a battery charger for a safety-related DC bus when there is no spare battery charger available and no recovery action can be taken should be treated by (1) increasing the initiating event frequency for loss of DC bus by one order of magnitude if the loss of DC bus is a special initiator, and (2) solving all other worksheets that contain equipment powered by the affected DC bus, assuming the loss of the DC bus.

Inspection findings that involve the unavailability of a battery charger for a safety-related DC bus when a spare charger is available and/or recovery action can be taken should be treated by: (1) increasing the initiating event frequency for loss of the DC bus by one order of magnitude if the loss of DC bus is a special initiator, and (2) nominally solving the base case for all other worksheets that contain equipment powered by the affected DC bus.

Inspection findings that involve the unavailability of a battery charger for a safety-related DC bus, when a dedicated spare charger is available for the safety-related bus and is automatically aligned when the primary charger fails, should be treated as a “Green” finding, unless the loss of the associated DC bus is a special initiator. If the loss of DC bus is a special initiator, the inspection finding should be evaluated by increasing the initiating event frequency for the loss of DC bus by one order of magnitude, and solving the worksheet.

Basis: Loading of a DC bus without an operable charger would result in eventual battery depletion and therefore the loss of the associated DC bus. Also, prolonged loss of a battery charger without any recovery action or alignment of an alternate charger could render the DC bus inoperable.

Example: Consider an inspection finding that involves the unavailability of the battery charger for one of two safety-related DC buses and the facility does not have an installed spare. The exposure time associated with this inspection finding is 1 day. The loss of DC bus special initiator is located in Row IV of Table 1, “Categories of Initiating Events,” for the affected plant. As a result, an Initiating Event Likelihood (IEL) of 6 would normally be assigned when solving loss of DC bus accident sequences; but, because the inspection finding increases the likelihood of a loss of DC bus event, an IEL of 5 would be applicable and should be used. Each of the sequences on the loss of DC bus worksheet would then have to be solved because the loss of DC bus initiating event frequency is a component in each of these sequences. In addition, each of the worksheets specified by Table 2, "Initiators and System Dependency," for the equipment powered by the affected DC train need to be solved considering this equipment unavailable.

Consider an inspection finding that involves the unavailability of the battery charger for one of two safety-related DC buses and the facility does have a spare charger available. The exposure time associated with this inspection finding is 1 day. The loss of DC bus special initiator is located in Row IV of Table 1, "Categories of Initiating Events," for the affected plant. As a result, an Initiating Event Likelihood of 6 would normally be assigned when solving loss of DC bus accident sequences; but, because the inspection finding increases the likelihood of a loss of DC bus event, an Initiating Event Likelihood of 5 would be applicable and should be used. Each of the sequences on the loss of DC bus worksheet would then have to be solved because the loss of DC bus initiating event frequency is a component in each of these sequences. In addition, each of the worksheets specified by Table 2, "Initiators and System Dependency," for the equipment powered by the affected DC train need to be solved nominally.

Consider an inspection finding that involves the unavailability of the battery charger for one of two safety-related DC buses and the facility does have an installed spare which can be shared between the DC buses and needs to be manually aligned. The exposure time associated with this inspection finding is 1 day. The loss of DC bus special initiator is located in Row IV of Table 1, "Categories of Initiating Events," for the affected plant. As a result, an Initiating Event Likelihood (IEL) of 6 would normally be assigned when solving loss of DC bus accident sequences; but, because the inspection finding increases the likelihood of a loss of DC bus event, an IEL of 5 would be applicable and should be used. Each of the sequences on the loss of DC bus worksheet would then have to be solved nominally because they are fed by the affected DC bus.

Finally consider an inspection finding that involves the unavailability of a battery charger for one of the two DC safety buses and the facility does have an installed, dedicated and automatically aligned spare charger for each DC bus. The exposure time associated with this inspection finding is 1 day. The loss of DC bus special initiator is located in Row IV of Table 1, "Categories of Initiating Events," for the affected plant. As a result, an Initiating Event Likelihood (IEL) of 6 would normally be assigned when solving loss of DC bus accident sequences; but, because the inspection finding increases the likelihood of a loss of DC bus event, an IEL of 5 would be applicable and should be used. No further evaluation is needed due to sufficient levels of built-in redundancy are designed for the battery chargers. If loss of the DC bus is not a special initiator, the inspection finding should be considered as Green.

1.8 Inspection Findings Involving Safety-Related Battery

Rule: Inspection findings that involve the unavailability of an emergency battery bank should be treated differently depending on the capacity of the associated battery charger in carrying the safety injection (SI) loads. If the battery chargers cannot carry the SI loads, the inspection finding that involves the unavailability of an emergency battery should be treated as the loss of the associated DC bus for all initiators specified in Table 2. If the battery chargers can carry the SI loads as footnoted in Table 2, the inspection finding that involves the unavailability of an emergency battery should be treated as the loss of the associated DC bus only in LOOP and LEAC worksheets. In addition, the loss of Battery bank would also necessitate increasing the Loss of DC frequency (if it is a special initiator) by one order of magnitude.

Basis: In some plants the battery charger cannot carry the SI loads. Loss of the associated battery will therefore render the DC bus unavailable for all initiators when SI is actuated. Alternatively, when the charger is capable of carrying the SI loads, the DC bus will only be unavailable under Station Blackout (SBO) scenarios where there would be no AC power to the chargers.

Example: Consider an inspection finding that involves the unavailability of the battery for one of two safety-related DC buses and the facility does not have battery chargers capable of carrying the SI loads. The exposure time associated with this inspection finding is 1 day. The loss of DC bus special initiator is located in Row IV of Table 1, “Categories of Initiating Events,” for the affected plant. As a result, an Initiating Event Likelihood (IEL) of 6 would normally be assigned when solving loss of DC bus accident sequences; but, because the inspection finding increases the likelihood of a loss of DC bus event, an IEL of 5 would be applicable and should be used. Each of the sequences on the loss of DC bus worksheet would then be solved because the loss of DC bus initiating event frequency is a component in each of these sequences. In addition, each of the worksheets specified by Table 2, “Initiators and System Dependency,” for the equipment powered by the affected DC train needs to be solved considering the associated DC bus is unavailable.

Now consider the case where the facility has battery chargers of sufficient capacity to carry the SI loads. The exposure time associated with this inspection finding is 1 day. The LOOP and LEAC initiators are in Rows II and IV respectively. For 1 day exposure time, the LOOP and LEAC will have an initiating event likelihood of 4 and 6 respectively. Since one of the emergency diesel generators (EDGs) cannot be started without the associated battery, the LEAC IEL should be raised by two orders of magnitude to an IEL of 4. The LOOP worksheet therefore will be solved assuming an IEL of 4 and failure of one DC bus and the associated EDG. The LEAC worksheet will be solved nominally with an IEL of 4. Similarly, the loss of DC bus special initiator is located in Row IV of Table 1, “Categories of Initiating Events,” for the affected plant. As a result, an Initiating Event Likelihood (IEL) of 6 would normally be assigned when solving loss of DC bus accident sequences; but, because the inspection finding increases the likelihood of a loss of DC bus event, an IEL of 5 would be applicable and should be used.

2.0 DETERMINING REMAINING MITIGATION CAPABILITY

2.1 Inspection Finding Involving a Loss of Redundancy of the Mitigation Capabilities

Rule: For an inspection finding that reduces the remaining mitigation capability such that the total available equipment is less than two times the equipment that is required to fulfill the safety function, the remaining mitigation capability credit should not exceed one train. For an inspection finding that reduces the remaining mitigation capability such that two or more times the equipment that is required to fulfill the safety function remains, solve all of the worksheet sequences that contain the safety function giving full mitigation credit.

Basis: The SDP worksheets typically assume that if the mitigation capability is such that a single failure can be tolerated without loss of a function, then multi-train credit is assigned. However, if an inspection finding indicates that a performance issue contributed to the failure of at least one train of a system, there is a higher potential for a common cause failure mechanism. In such cases single train credit is more appropriate when the remaining mitigation capability does not provide full redundancy (twice the number of trains required).

Example: Consider a finding that involves the unavailability of one train of a low pressure injection system. The system is normally a four train system that requires two trains to satisfy the success criteria (e.g., 2/4 trains [multi-train system]). Each of the worksheets specified by Table 2, "Initiators and System Dependency," for this system needs to be solved considering one train unavailable. When solving each of the worksheets that credit this system, only one train of remaining mitigation capability credit would be given because of the loss of redundancy (e.g., 2/3 trains [1 train]) in this system.

2.2 Inspection Finding Involving Reduced Redundancy of a Support System for the Mitigation Capabilities Supported

Rule: For inspection findings that involve the unavailability of a component in a support system, determine the reduced redundancy for the support system to the mitigation capabilities, and evaluate each of the worksheets directed by Table 2, "Initiators and System Dependency," for the unavailability of the affected supported systems. The reduced redundancy of an affected support system is defined as the remaining number of redundant paths including the backup systems and any diversified equipment that could be aligned to support the function of the associated mitigation capability. The backup systems and the manually aligned diversified equipment that can be credited should be limited to those identified in the SDP worksheet associated with the support system initiator, if applicable, or those systems that are noted in Table 2. If the inspection finding reduces the support system redundancy such that the total remaining support system redundancy is more than two times the equipment that is required to directly support the associated mitigation function, no further evaluation of the affected scenarios are required. If the inspection finding reduces the support system redundancy such that the total remaining support system redundancy is equal to two times the equipment that is required to directly support the associated mitigation function, the affected scenarios that include the mitigation function are solved nominally. If the inspection finding reduces the support system redundancy such that the total remaining support system redundancy is less than two times the equipment that is required to directly support the associated mitigation function, the remaining credit should not exceed one train credit for the affected scenarios that include the mitigation function.

Basis: Evaluation of this type of inspection finding, if not caused by a common cause failure mechanism, involves a direct application of the SDP rules derived from generic reliability models and generic reliability data for evaluation of simultaneous unavailability of multiple systems.

Example: Consider an inspection finding that involves the unavailability of one of three pump of an emergency service water (ESW) system. The ESW system is a standby, support system with two headers which support two motor-driven auxiliary feedwater pump trains , two high pressure safety injection system trains , two residual heat removal system trains, and two emergency diesel generators. The third pump (i.e., swing pump) can be aligned and started from the MCR. As a result of this condition, ESW will be configured with one pump train dedicated to each header supporting one train of the mitigation capability (i.e., equal to twice the mitigation capability needed). As identified in Table 2, "Initiators and System Dependency," the applicable worksheets would be evaluated nominally for each of the mitigation systems associated with the support system finding.

2.3 Inspection Findings Involving Equipment that Impact Operator Action Credit

Rule: When evaluating inspection findings that impact safety functions involving mitigating equipment and operator action, the remaining mitigation credit should correspond to the equipment or operator action credit, whichever is most limiting.

Basis: The failure of safety functions that are composed of both equipment and operator action can occur by the failure of either the equipment or the operator action. Because the associated failure probabilities are relatively small, the failure probability of the safety function can be determined by adding the individual failure probabilities together. Consequently, the failure probability of the safety function can be approximated by the order of magnitude of the most limiting component. For example, a safety function is comprised of a multi-train system which has a failure probability of 1E-3 coupled with an operator action which has a failure probability of 1E-2. Therefore, the failure probability of the safety function is 1.1E-2, or approximately 1E-2.

Example: Consider an inspection finding involving the failure of one of the high pressure safety injection (HPSI) pumps. One of the safety functions impacted by this finding is high pressure recirculation (HPR). The success criteria for the HPR function is one of two HPSI pumps, one of two residual heat removal (RHR) pumps and one of two RHR heat exchangers with operator action for switchover (operator action credit = 3). With one HPSI pump unavailable, the remaining mitigation capability becomes equipment limited and a credit of 2 (1 train) should be assigned to the HPR function.

3.0 CHARACTERIZING THE RISK SIGNIFICANCE OF INSPECTION FINDINGS

3.1 Treatment of Shared Systems Between Units

Rule: When evaluating inspection findings that involve systems that impact multiple units, the inspection finding should be evaluated for each unit separately.

Basis: The risk significance of an inspection finding is attributed to the unit on which it is applicable. If the inspection finding affects more than one unit and it affects the units differently, then the SDP should be conducted once for each unit as it applies to that unit.

Example: Consider an inspection finding that involves the unavailability of an emergency diesel generator (EDG). The particular EDG is credited as mitigating equipment on the dedicated unit and a second unit via an operator action to cross-tie the EDG. Therefore, the inspection finding needs to be evaluated separately for each unit. For the dedicated unit, the finding would be evaluated as a finding involving a normally standby, split train support system that increases the likelihood of an initiating event and the impact on mitigating system capability can explicitly be determined. For the other unit, the inspection finding would be evaluated as a finding that impacts the remaining mitigation capability, the ability to cross-tie the EDG, which is credited in certain accident sequences. Specifically, only LOOP and LEAC accident sequences that contain the emergency AC power function need to be solved. As a result, the inspection finding will result in separate risk characterizations for each unit which may or may not be the same.

3.2 Counting Rule

Rule: Every three affected accident sequences that have the same order of magnitude of risk, as determined by the addition of the initiating event likelihood and the remaining mitigation capability, constitute one equivalent sequence which is more risk significant by one order of magnitude. This rule is applied in a cascading fashion.

Basis: The Counting Rule is necessary because the risk significance of an inspection finding is determined by the increase in core damage frequency due to the associated performance deficiency. This risk increase represents the summation of the changes in risk associated with each of the affected accident sequences. A simplified rule was needed to relate accident sequences that represent different orders of magnitude of risk significance. Judgement and experience with the use of the Phase 2 Notebooks were used in the establishment of this rule.

Examples: Consider an inspection finding that affects three accident sequences in the Phase 2 Notebook that each have a risk significance of 7, which is Green. Using the Counting Rule, these three accident sequences would constitute an equivalent accident sequence that is one order of magnitude more risk significant, which is 6 or White.

Now, consider an inspection finding that affects a total of eight accident sequences in the Phase 2 Notebook. One sequence has a risk significance of 7, Green, and seven sequences have a risk significance of 8. Using the Counting Rule, the seven sequences of 8 would constitute two equivalent sequences one order of magnitude more risk significant, 7. In turn, these two sequences, when added with the sequence that had a risk significance of 7, would constitute an equivalent accident sequence that is one order of magnitude more risk significant, 6 or White.

END

APPENDIX A

ATTACHMENT 3

User Guidance for Screening of External Events Risk Contributions

When the Phase 2 SDP analysis results for an inspection finding show an increase in risk estimate of greater than 1E-7 (Risk Significance Estimation of 7), the SRA or risk analyst can perform a Phase 3 analysis of external events risk contributions, **or** proceed to Step 1.0, "Screening of Fire Risk Contributions." Step 1.0 is the first step in screening of risk contributions from external events that may add to the significance of an inspection finding.

All three steps of this process to screen risk contributions from external events (Steps 1.0-3.0) should be performed to further assess the significance of an inspection finding that has a preliminary risk significance estimation of greater than 1E-7 for internal events risk contributions. If any one area of the external events screening process requires a Phase 3 evaluation, the other remaining areas should also be screened or evaluated. Flow charts for Steps 1.0 and 2.0 of the process are provided to show the decision points for screening of external event risk contributions.

1.0 Screening of Fire Risk Contributions

Step 1.1 Determine whether the affected SSC is in the protected train of a post-fire safe shutdown path. If yes, proceed to Step 1.2. If no, proceed to Step 2.0, "Screening of Seismic Risk Contributions."

Step 1.2 If the affected SSC is part of a safe shutdown path, identify the risk significant fire areas for which the affected SSC is credited as part of the safe shutdown path. Estimate the fire frequency for the identified fire area(s) using Table 1.4.2 of IMC 0609 Appendix F, "Fire Protection SDP," or consult with Operational Support and Maintenance Branch (APOB). Proceed to Step 1.3.

Step 1.3 For each fire area of concern, multiply its fire frequency estimate with the duration factor of the inspection finding. Then, add the product values to generate the screening value of change in CDF due to fire risk contributions.

Step 1.4 If the total sum of the products of the duration factor and fire area fire frequency estimates is less than 1E-6, proceed to Step 2.0. If no, proceed to Step 1.5.

Step 1.5 The fire risk contributions may be substantial enough to alter the preliminary Phase 2 significance determination of the inspection finding. Using guidance in the RASP External Events Handbook, evaluate the fire risk contributions that may add to the significance of an inspection finding. After this evaluation is completed, proceed to Step 2.0 for screening of seismic risk contributions.

2.0 Screening of Seismic Risk Contributions

Step 2.1 Determine whether the affected SSC is on the seismic safe shutdown list (i.e., addressed in Seismic Margins approach) or credited in a seismic PRA. If yes, proceed to Step 2.2. If no, the seismic risk should be considered as insignificant to the finding, proceed to Step 3.0, "Screening of Flood Risk Contributions."

Step 2.2 Determine whether the affected SSC is used to mitigate the consequences of a loss of offsite AC power supply. If the affected SSC is required to perform its intended functions to mitigate the consequences of loss of offsite AC power during a seismic event, proceed to Step 2.3. If no, proceed to Step 3.0, "Screening of Flood Risk Contributions."

Step 2.3 Determine whether the exposure time of the finding is less than 3 days. If the exposure time of the finding is less than 3 days, proceed to Step 3.0, "Screening of Flood Risk Contributions." If no, proceed to Step 2.4.

Step 2.4 The seismic risk contributions may be substantial enough to alter the preliminary Phase 2 significance determination of the inspection finding. Using guidance in the RASP External Events Handbook, evaluate the seismic risk contributions that may add to the significance of an inspection finding. After this evaluation is completed, proceed to Step 3.0 for screening of flood risk contributions.

3.0 Screening of Flood Risk Contributions

Step 3.1 Determine whether the affected SSC is identified as critical to avoiding core damage for any flood scenario of significance. A list of significant flood scenarios identified at specific U.S. nuclear power plants is shown in Table 3.1 of this Attachment. The flood initiator frequency estimate for each significant flood scenario is also provided in Table 3.1. If the affected SSC is identified on the list in Table 3.1, proceed to Step 3.2. If no, flood risk contributions are screened out from further external events risk analysis in Step 4.0.

Step 3.2 If the affected SSC is identified on Table 3.1 for a specific plant with a reported flood scenario(s) of significance, the SRA or risk analyst should determine the conditional core damage probability (CCDP) estimate of the flood scenario(s) as identified in the plant-specific IPE internal flood analysis.

Step 3.3 For an identified flood scenario(s), multiply the flood initiator frequency estimate and the CCDP estimate of the flood scenario(s) that credits the affected SSC. If the product of the flood frequency estimate and the CCDP estimate is less than 1E-8, the risk contribution from the flood scenario(s) are screened out from further external events risk analysis. If no, proceed to Step

3.4. (Note: LERF multiplier used for internal event risk estimates is not be applied for multiplying with external event significance.)

Step 3.4 Multiply the above product(s) of flood frequency estimate(s) and the CCDP estimate(s) for the flood scenario(s) and the duration factor. If this value(s) is less than 1E-8, the risk contributions from the flood scenario(s) are screened out from further external events risk analysis. If no, proceed to Step 3.5.

Step 3.5 The flood risk contributions may be substantial enough to alter the preliminary Phase 2 significance determination of the inspection finding. Using guidance in the RASP External Events Handbook, evaluate the flood risk contributions that may add to the significance of an inspection finding. After this evaluation is completed, proceed to step 4.0 for the determination of the estimate of total risk contributions from external events.

4.0 Estimation of External Event Risk Contributions

Step 4.1 Determine the estimate of total risk contributions from external events based on the results of evaluations performed in Steps 1.5, 2.4, and 3.5. This estimate must be added to the preliminary risk significance estimation for internal events risk contributions. [Caution: the LERF multiplier for the internal events risk estimate may not be applicable for multiplication with the external event risk estimate.]

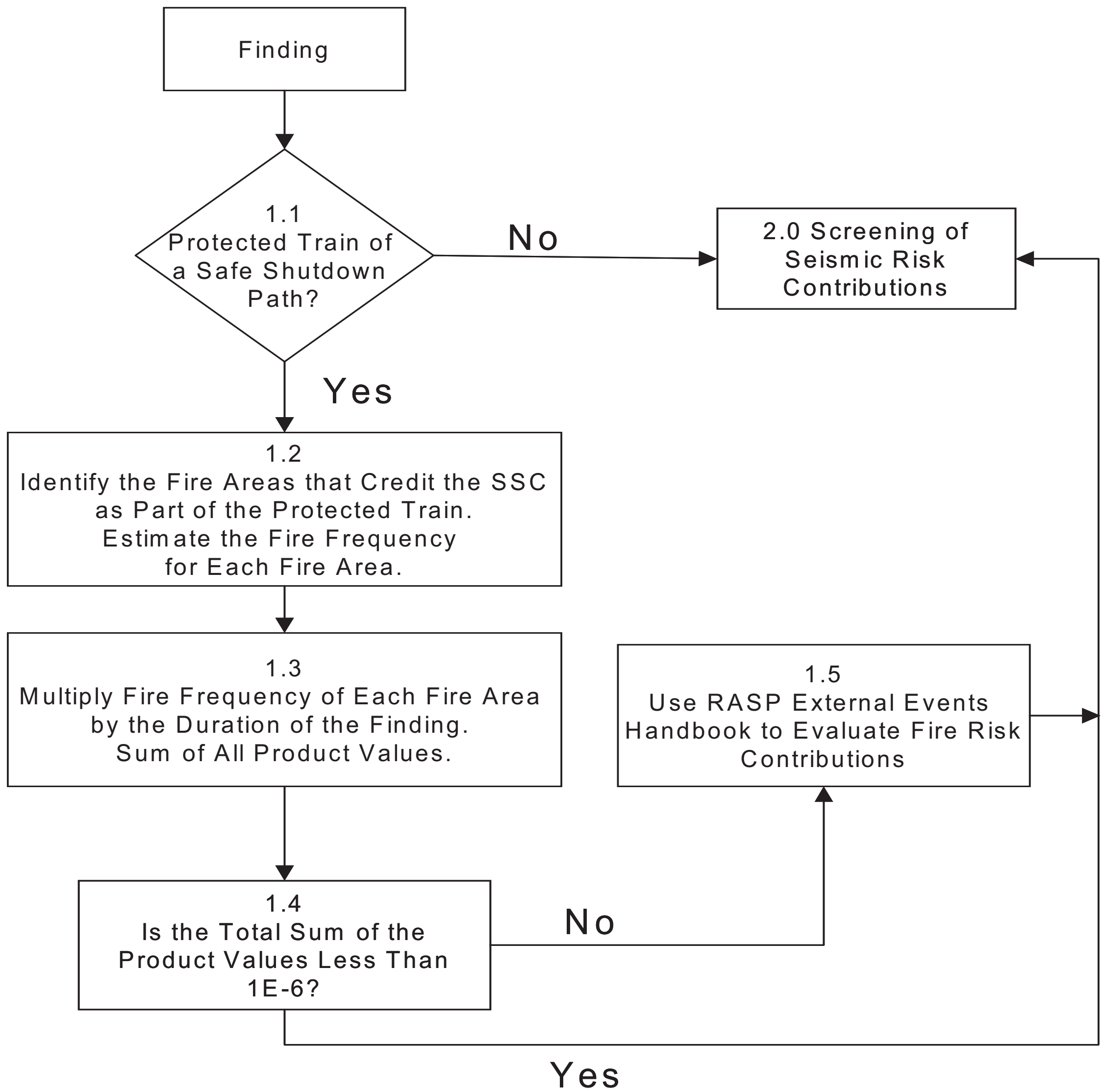
Step 4.2 Document the results.

Table 3.1 Plant Specific Flood Scenarios and Initiator Frequencies.

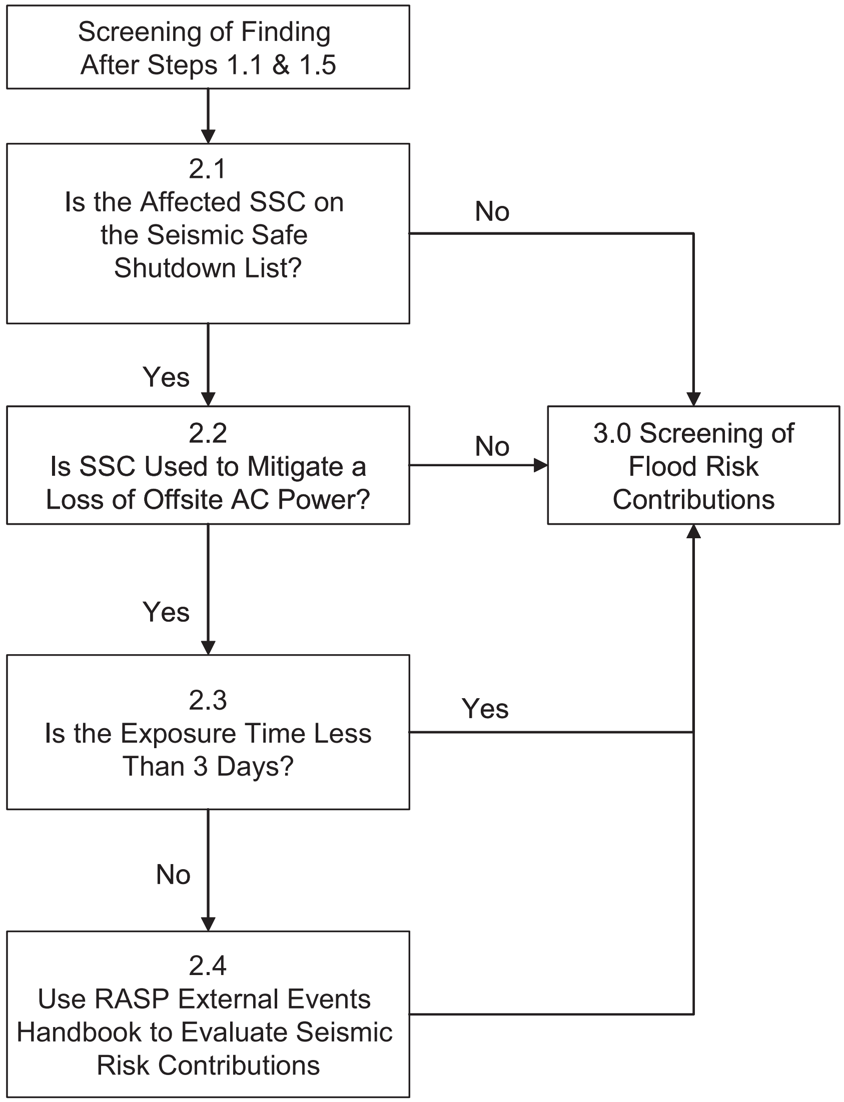
The subject Table may contain proprietary plant specific information. Therefore, the Table content is located in the RASP Hand Book and on the ROP Digital City Internal Website under the drop-down menu titled Forms, Templates, Sample Report & More.

END

Flowchart 1.0 Screening of Fire Risk Contributions



Flowchart 2.0 Screening of Seismic Risk Contributions



ATTACHMENT 4

Revision History For
IMC 0609 Appendix A

Commit-ment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	09/10/2004	Multiple editorial changes to enhance user friendliness of the document. For example, re-format action steps, provided additional examples, added the reference to Appendix J for steam generator issues.	N/A	N/A	N/A
N/A	12/01/2004	Corrected two errors on page 4 of the worksheet, under MS cornerstone for screening issues and under BI cornerstone guidance for question 3 for screening to Green.	N/A	N/A	N/A
N/A	11/22/05	Enhanced guidance to help meet timeliness requirements for finalizing the SDP for inspection findings.	N/A	N/A	N/A

N/A	03/23/07 CN 07-011	Incorporate references to the site-specific inspection notebooks and associated Pre-Solved Tables; In Attachment 2, update the site specific risk-informed inspection notebooks usage rules; Attachment 3, provide user guidance for screening of external events risk contributions.	1.Training has been provided to the SRAs at last two SRA counterpart meetings, and the SRAs have provided training to the region based and resident inspectors. 2. Formalized training will be introduced through the P-111 course.	1. 10/2006 2. FY 2008	ML070720624
N/A	01/10/08 CN 08-002	Removed the Phase 1 Initial Screening and Characterization of Findings process to create the new IMC 0609, Attachment 4. Added clarification statement to Step 2.1.2 and Usage Rule 1.1 that the maximum exposure time used in SDP is limited to one year.	N/A	N/A	ML073460588