APPENDIX G
ATTACHMENT 2

PHASE 2 SIGNIFICANCE DETERMINATION PROCESS TEMPLATE FOR PWR DURING SHUTDOWN

TABLE OF CONTENTS

1.0 ENTRY CONDITIONS AND APPLICABILITY

As directed in the SRM to SECY 97-168, the staff is inspecting and monitoring licensee performance at shutdown to ensure that the licensees are maintaining a mitigation capability (equipment, instrumentation, policies, procedures, and training) consistent with the staff's estimate of industry shutdown risk presented to the Commission in SECY 97-168 (the proposed shutdown rule). In the Reactor Oversight Process (ROP), the significance of such inspection findings is assessed using a Risk Informed process, called the Significance Determination Process (SDP). The shutdown SDP consists of three phases: Phase 1, Definition and Initial Screening of Findings; Phase 2, Initial Risk Significance Approximation and Basis; and Phase 3, Risk Significance Finalization and Justification. Inspection Manual Chapter (IMC) 0609 Appendix G, Shutdown Operations Significance Determination Process is used by inspectors to conduct the phase 1 screening analysis. This template is used by SRAs to perform phase 2 analyses for certain PWR shutdown findings discussed below.

1.1 Entry Conditions

1.1.1 SDP-related Inspection Finding

This SDP provides a simplified risk-informed framework to estimate the increase in core damage frequency during shutdown operations due to performance deficiencies that are identified as requiring quantitative assessment from the Phase 1 Screening Tool.

Concurrent performance deficiencies should be assessed collectively if they resulted from a closely-tied common cause. If causes are independent, each performance deficiency should be assigned a color individually. See IMC 0609, Appendix A for more detailed guidance.

1.1.2 Management Directive 8.3 Entry

Procedures are given in Chapter 4 for using this template to perform quantitative assessment of shutdown events to satisfy Management Directive (MD) 8.3.

1.2 Applicability

The process in this SDP is designed to provide Senior Reactor Analysts a simple scrutable probabilistic risk framework for use in identifying potentially risk-significant shutdown issues within the initiating events, mitigation systems, and barriers cornerstones. The results from this SDP tool are intended to facilitate communication on the basis of risk significance between the NRC and licensees.

2.0 LIMITS AND PRECAUTIONS

2.1 Limits

The template is a simplified tool that generates an order-of-magnitude assessment of the risk significance of inspection findings during shutdown.

2.2 Precautions

2.2.1 The analyst should consider each evaluated Core Damage sequence using the event trees to ensure that the scenario makes sense for the deficiency. The variability of plant configurations at shutdown and timing issues may result in performance deficiencies which do not directly map on the event trees. Contact risk analyst in NRR/SPSB for assistance if needed.

2.2.2 The analyst must understand: (1) the differences between precursor and condition findings, (2) the definitions of the plant operational states, and (3) the definitions of the shutdown initiating events.

2.2.3 The availability of standby RCS injection along with operator error drives shutdown risk. As long as standby injection is available, in most cases, standby injection buys time for other operator recovery actions such as: leak path termination and RHR recovery. If there are factors that could render the standby RCS injection unavailable such as: gas intrusion or support system unavailability, then these factors (assumptions) become risk significant and should be assessed carefully.

2.2.4 Upon RWST depletion and long term failure of RHR, recirculation of RCS inventory from the sump is not credited in this phase 2 model except when the refueling cavity is flooded, since: (1) for many licensees, the low pressure injection pumps that are necessary for recirculation are the same pumps used for RHR, and (2) there is a high likelihood that trash accumulated during the outage could block the sump screens.

2.2.5 Some findings are not covered by these templates and go directly to Headquarters for Phase 3 analysis. Examples of such findings are as follows:

- Potential over-pressurization of low -pressure piping and deficiencies associated with maintaining low temperature over pressure protection.

- Use of Nozzle Dams without an adequate RCS vent path that would prevent the RCS from re-pressurizing above 25 psig following an extended loss of RHR (25 psi represents an approximate differential pressure capability for the nozzle dams).

- Findings that increase the likelihood of having a boron dilution event such as the source range monitors being inoperable or the RWST having boron concentrations lower than Technical Specifications prescribed values.

2.2.6 Findings that involve containment closure are assessed using IMC 0609 Appendix H.

3.0 ABBREVIATIONS AND DEFINITIONS

3.1 Abbreviations

CETs	Core Exit Thermocouples
CD	Core Damage
High Decay Heat	Decay heat of early time window
Low Decay Heat	Decay heat of late time window
CCW	Component Cooling Water
DHR	Decay Heat Removal
ECCS	Emergency Core Cooling System
IEL	Initiating Event Likelihood
INDIC.	Indication
IMC	Inspection Manual Chapter
LOI	Loss of Reactor Inventory Initiating Event
LER	Licensee Event Report
LOOP	Loss of Offsite Power
LORHR	Loss of RHR Initiating Event
OP.	Operator
POS	Plant Operational State
PRA	Probabilistic Risk Assessment
RCS	Reactor Coolant System
RHR	Residual Heat Removal
ROP	Reactor Oversight Process
SDP	Significance Determination Process
SG	Steam Generator
SG PORV	Steam Generator Power Operated Relief Valve
SRW	Service Water
TBB	Time to Boiling
TW	Time Window
TW-E	Early Time Window, before refueling operation
TW-L	Late Time Window, after refueling operation

3.2 Definitions

Phases of a Significance Determination

Phase 1 - Characterization and Initial Screening of Findings: Precise characterization of the finding and an initial screening of very low-significance findings for disposition by the licensee's corrective action program.

Phase 2 - Initial Risk Significance Approximation and Basis: Initial approximation of the risk significance of the finding and development of the basis for this determination for those findings that are not screened out in Phase 1 screening.

Phase 3 - Risk Significance Finalization and Justification: Review and as-needed refinement of the risk significance estimation results from Phase 2, or development of any risk analysis outside of this guidance, by an NRC risk analyst (any departure from the guidance provided in this document or IMC 609 Appendix G for Phase 1 or Phase 2 constitutes a Phase 3 analysis and must be performed by an NRC risk analyst).

Types of Shutdown Performance Deficiencies

Precursor Finding - Inspection Findings that: (1) have the potential to cause a loss of the operating train of RHR, (2) increase the likelihood that the operating RHR train could be lost, or (3) result in a shutdown event - cause a loss/interruption of the operating train of RHR.

Condition findings - Inspection findings that only involve a degradation of the licensee's capability to mitigate an event if an event were to occur. Findings only affecting the standby train of RHR are condition findings.

Shutdown Initiating Events

Loss of RHR (LORHR) - Includes losses of RHR resulting from failures of the RHR system (such as RHR pump failure) or failures of the RHR support systems other than offsite power.

Loss of Offsite Power (LOOP) - Includes losses of offsite power which cause a loss of RHR. LOOP events are not assessed in POS 3.

Loss of Reactor Inventory (LOI) - Includes losses of RCS inventory that lead to a loss of RHR due to loss of RHR pump suction.

Loss of Level Control (LOLC) - This initiating event category includes: (1) the operator overdrains the RCS to reach midloop conditions such that RHR is lost, and (2) the operator fails to maintain level or flow control while in midloop such that the RHR function is lost.

Plant Operational States (POSs)

POS 1 - This POS starts when the RHR system is put into service. The RCS is closed such that a steam generator could be used for decay heat removal, if the secondary side of a steam generator is filled. The RCS may have a bubble in the pressurizer. This POS ends when the RCS is vented such that the steam generators cannot sustain core heat removal. This POS typically includes Mode 4 (hot shutdown) and portions of Mode 5 (cold shutdown).

POS 2 - This POS starts when the RCS is vented such that: (1) the steam generators cannot sustain core heat removal and (2) a sufficient vent path exists for feed and bleed. This POS includes portions of Mode 5 (cold shutdown) and Mode 6 (refueling). Reduced inventory operations and midloop operations with a vented RCS are subsets of this POS.

NOTE: Performance deficiencies occurring during a vacuum refill of the RCS require use of the POS 1 event trees.

POS 3 - This POS represents the shutdown condition when the refueling cavity water level is at or above the minimum level required for movement of irradiated fuel assemblies within containment as defined by Technical Specifications. This POS occurs during Mode 6.

Time Windows

Early Time Window (TW-E) - This time widow represents the time before POS 3 is entered. The decay heat is relatively high. The reactor is either in POS 1 or 2.

Late Time Window (TW-L) - This time window represents the time after POS group 3. The decay heat is relatively low. The reactor is either in POS 1 or POS 2.

Other Key Shutdown Definitions

Available - A piece of equipment is considered available if: (1) it can be put into service within half the time that is needed for the equipment to perform its function, (2) procedures or standing orders exist for using the equipment to meets its intended function, (3) all necessary supporting systems (such as AC power, cooling water, and DC control power) can be put into service within half the time that is needed for the equipment to perform its function, and (4) operators have been trained for using the equipment for the given situation.

Core Damage - Core damage corresponds to a peak clad temperature above 1300 degrees Fahrenheit. Above 1340 degrees Fahrenheit, phenomena such as clad oxidation and ballooning affect core behavior. This definition is consistent with the definition of the onset of core damage used in NUREG/CR 6144 Vol.2, Part 1A, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1, Analysis of Core Damage Frequency from Internal Events During Mid-Loop Operations".

Gravity Feed - Gravity feeding to the RCS may be credited if Gravity Feed is expected to be available AFTER RCS boiling initiates. To credit Gravity Feed, the analyst needs to consider the following factors that can negate the elevation head provided by the RWST or other sources of RCS inventory: (1) pressure drops in the surge line, (2) entrained water accumulating in the pressurizer, (3) RCS vent paths that are restricted (to control loose parts or control off gassing).

Mid Loop - As defined in Generic Letter 88-17, a mid-loop condition exists whenever the RCS water level is below the top of the flow area of the hot legs at the junction with the reactor vessel.

RCS Vented - RCS vented with such that(1) SG heat removal cannot be sustained, and (2) the vent path is large enough to support feed and bleed. Examples of vent paths include: open pressurizer manways, safety relief valve removal, or vessel head removal.

Reduced Inventory Operations - As defined in Generic Letter 88-17, reduced inventory operation exists whenever the reactor vessel water level is lower than 3 feet below the reactor vessel flange.

RWST Depletion - RWST level reaches the level that requires makeup or recirculation to continue injection to RCS.

Shutdown Operations - Shutdown Operation exists during hot shutdown, cold shutdown, and refueling when more than one fuel assembly is in the reactor vessel and the decay heat removal system is in operation.

4.0 PROCEDURE FOR SIGNIFICANCE DETERMINATION

Step 4.1 Transition from SDP Phase 1

Step 4.1.1 Use the Information Gathered in the Phase 1 process to identify the set of equipment that the licensee planned to meet the following safety functions: Standby RCS injection, RCS pressure control, and steam generator cooling if applicable.

Caution: Equipment is considered available if: (1) it can be put into service within half the time that is needed for the equipment to perform its function, (2) procedures or standing orders exist for using the equipment to meets its intended function, (3) all necessary supporting systems (such as AC power, cooling water, and DC control power) can be put into service within half the time that is needed for the equipment to perform its function, and (4) operators have been trained for using the equipment for the given situation.

Caution: The availability of standby RCS injection along with operator error drives shutdown risk. As long as standby injection is available, in most cases, standby injection allows time for other operator recovery actions such as leak path termination and RHR recovery. If there are factors that could render the standby RCS injection unavailable such as gas intrusion or support system unavailability, then these factors (assumptions) become risk significant and should be assessed carefully.

Caution: If the finding required a licensee to enter into a high risk POS (such as reduced inventory conditions) or increased the time the licensee remained in a high risk POS, call the PRA Branch (SPSB) in NRR for assistance in estimating the average CDF of the POS as a basis for evaluating the delta CDF for the finding. An example of such a finding is the following. A licensee exited midloop conditions prematurely due to leaking SG nozzle dams because the incorrect nozzle dam pins were used. As a result, the licensee re-entered midloop conditions. The delta CDF of this finding is represented by the risk of draining the vessel for the second time to reach midloop conditions added to the risk of the additional time spent at midloop beyond what was originally anticipated.

Step 4.2 Determine if the finding is a precursor to an initiating event (a loss of the DHR function) or a condition finding.

NOTE: Precursor findings: (1) have the potential to cause a loss of the operating train of RHR, or (2) increase the likelihood that the operating RHR train could be lost, or (3) result in a shutdown event - cause a loss/interruption of the operating train of RHR. Condition findings only involve a degradation of the licensee's capability to mitigate an event if an event were to occur. Findings only affecting the standby train of RHR are condition findings. The templates treats precursor and condition findings differently.

Go To Step 4.3 for Precursor Findings

OR

Go To Step 4.4 for Condition Findings

NOTE: If this tool is being used to assess a shutdown event under Management Directive 8.3, Go to Step 4.5.

Step 4.3 Procedure for Assessing Precursor Findings

Step 4.3.1 Identify each TW and POS where the finding could have occurred.

Step 4.3.2 Determine the IEL. The IEL is the conditional likelihood of having a loss of the RHR function given the occurrence of the performance deficiency.

- IF a finding increases the likelihood of a loss of level control (LOLC) or actually caused a LOLC, THEN LOLC is the applicable initiating event. Use Table 1 to determine the IEL. Go to Step 4.3.3.

- IF a finding increases the likelihood of a loss of offsite power (LOOP) or actually caused a LOOP, THEN LOOP is the applicable initiating event. Use Table 2 to determine the IEL. Go to Step 4.3.3.

- IF a finding increases the likelihood of a loss of reactor inventory (LOI) or actually caused a LOI, THEN LOI is the applicable initiating event. Use Table 3 to determine the IEL. Go to Step 4.3.3.

- IF a finding increases the likelihood of a loss of the operating train of RHR (LORHR) or actually caused a LORHR (except for LOOP and LOI), THEN LORHR is the applicable initiating event. Use Table 4 to determine the IEL. Go to Step 4.3.3.

- IF a finding involves the RHR support systems (except for LOOP and LOI), THEN LORHR is the applicable initiating event. Use Table 4 to determine the IEL. Go to Step 4.3.3.

Step 4.3.3 Use the SDP Worksheet that contains the POS and initiating event that were determined to be applicable in Step 4.3.2.

EXCEPTIONS:
(1) For LOI Pos 1 if RCS < 200F, use the POS 1 LOLC worksheets and event trees.

(2) If failure of the cavity seal could occur following LOOP or SBO, use the LOOP POS 2 worksheet.

Step 4.3.4 Enter the time to RCS boiling and an approximate time to core uncovery/core damage in the first line of the Worksheet.

Table 8 can be used to approximate a time to core damage from hot leg midplane conditions. Use licensee values if available.

Step 4.3.5 Label the IEL in each row of the lower section of the worksheet.

Step 4.3.6 Determine Credit for each top event function.

A. Verify that the licensee has the instrumentation referenced for the top event function.

NOTE: If the licensee does not have the referenced instrumentation available or the referenced instrumentation is not reflective of RCS conditions, then the default operator credit MUST by decreased by 2.

B. To obtain the Equipment Credit, credit each available system that is (1) capable of maintaining the top event function and (2) is not impacted by the finding. Use the Event Tree associated with the Worksheet to help understand the successes and failures associated with each accident sequence. Use guidance in Tables 6 and 7 to determine equipment credits. Document key assumptions.

C. To obtain the Operator Credit, use the default operator credit unless any of the following four conditions are applicable:

1. If the referenced instrumentation is missing or misleading, then decrease the operator credit by two.
2. The default time is incorrect and significantly reduced. If the diagnoses time is less than 20 minutes OR the time to perform the action is approximately the time required, then decrease the operator credit by one.
3. If the action is complicated by missing equipment, unaccessible equipment, steam or high radiation, or loop seals for venting pumps, then decrease the operator credit by two.
4. If the procedures are incomplete for the shutdown plant configuration, then the operator credit is decreased by one.

NOTE: If the default operator credit is changed and results in a negative operator credit, then the operator credit is zero.

D. Determine the Credit for Function for each Top Event Function needed. Select the lower of Equipment Credit and Operator Credit, and enter the value in this column.

Step 4.3.7 Quantification of Core Damage Scenarios

Quantify each accident scenario by adding the credits for IEL + Mitigation Credit. Enter the sum in the Result column.

NOTE: For phase 2 analyses, the recovery credit is not used.

Step 4.3.8 Identifying the Frequency of Finding Occurrence. Select between Condition A or B.

A. If the performance deficiency occurred during an outage (forced outage, refueling outage, etc.), the color of the finding is determined similar to the process using the guidance in IMC 0609 Appendix A. The resulting ICCDP associated with the performance deficiency is interpreted as the addition to the licensee's total CDF contribution over the previous year (previous 12 months). Therefore, the resulting ICCDP becomes the increase in delta CDF.

B. If the deficiency needs a random event to reveal the deficiency (e.g. at Palisades, the digging of a sign revealed underground protective cabling common to both offsite power sources outside the protected area), then the frequency of the random event (1/32 calender years of operation) is multiplied by:

The Frequency that the licensee enters an outage (1 outage per 18 months) * (12 months/ calender year) *(Number of Days of POS 1 operation/ outage) * (1 calender year/365 days) *(CCDP of POS 1 operation)

Added to:

The Frequency that the licensee enters an outage (1 outage per 18 months) * (12 months/ calender year) *(Number of Days of POS 2 operation/ outage) * (1 calender year/365 days) *(CCDP of POS 2 operation).

Step 4.4 Process for Assessing SDP Condition Findings

NOTE: Only the core damage scenarios impacted by the finding are quantified.

Step 4.4.1 Select the applicable initiating events (the lost function cause the failure of a top event used to mitigate the initiating event scenario) by identifying the equipment or safety functions affected and determine the initiating event scenarios that must be evaluated (i.e., the affected function plays some role in mitigating the initiating event scenario).

Step 4.4.2 Determine the exposure times for the degraded condition in the mitigating system. A separate exposure time must be determined for each POS for findings that span one or more POS. Using Table 5, determine an IEL for each applicable initiating event in each applicable POS.

Step 4.4.3 Use the SDP Worksheet(s) that contain the POSs and initiating events that were determined to be applicable in Step 4.4.2. Perform the following steps on the Worksheet for each applicable POS and initiating event.

Step 4.4.4 Enter the time to RCS boiling and an approximate time to core uncovery/core damage in the first line of the Worksheet.

Table 8 can be used to estimate time to core damage from hot leg midplane conditions. Use the licensee values if available.

Step 4.4.5 Label the IEL in each row of the lower section of the worksheet.

Step 4.4.6 Determine Revised Credit for each top event function Impacted by the Finding

A. Verify that the licensee has the instrumentation referenced for the top event function.

NOTE: If the licensee does not have the referenced instrumentation available or the referenced instrumentation is not reflective of RCS conditions, then the default operator credit must be decreased by two.

B. To obtain the Equipment Credit, credit each available system that is (1) capable of maintaining the top event function and (2) is not impacted by the finding. Use the Event Tree associated with the Worksheet to help understand the successes and failures associated with each accident sequence. Use guidance in Tables 6 and 7 to determine equipment credits. Document key assumptions.

NOTE: Each top event has a equipment credit and an operator credit, only the equipment credit change or the operator credit change is propagated through the worksheets. See the following example:

Example: If the licensee has a finding that changes the FEED equipment credit from 5 to 3, then the revised credit for the FEED & BLEED FUNCTION becomes 3, regardless of the BLEED credit or the operator credit.

C. To obtain a revised Operator Credit, use the following guidance:

1. If the referenced instrumentation is missing or misleading, then decrease the operator credit by two.

2. The default time is incorrect and significantly reduced. If the diagnoses time is less than 20 minutes OR the time to perform the action is approximately the time required, then decrease the operator credit by one.
3. If the action is complicated by missing equipment, unaccessible equipment, steam or high radiation, or loop seals for venting pumps, then decrease the operator credit by two.
4. If the procedures are not complete for the shutdown plant configuration, then the operator credit is decreased by one.

NOTE: If the default operator credit is changed and results in a negative operator credit, then the operator credit is zero.

Example: If the licensee has a finding that changes the operator credit from a 5 to a 3 due to a loss of instrumentation, then the revised credit for the FEED & BLEED FUNCTION becomes 3, regardless of the equipment FEED & BLEED equipment credit.

D. Determine the Credit for Function for each Top Event Function needed. Select the lower of Equipment Credit and Operator Credit, and enter the value in this column.

Step 4.4.7 Quantification of Core Damage Scenarios

Quantify each accident scenario that is impacted by the finding adding the credits for IEL + Mitigation Credit. Enter the sum in the Result column.

NOTE: For phase 2 analyses, the recovery credit is not used.

Step 4.4.8 Go to the next applicable Worksheet and begin at Step 4.4.1, or if all Worksheets are completed, continue to Step 4.4.9.

Step 4.4.9 Estimating the Risk Significance of the Inspection Finding

The risk significance of an inspection finding is determined in the same manner as for at-power findings. Use IMC 0609, Appendix A, Step 2.4, "Estimating the Risk Significance of Inspection Findings," to determine the risk significance of a finding.

Step 4.5 Process for Assessing Events Under MD 8.3

Step 4.5.1 Identify the TW and POS where the shutdown event occurred.

Step 4.5.2 Identify the appropriate shutdown initiating event.

Use an IEL = 1.0 if the event caused a loss of interruption of the RHR function.

OR

Determine the IEL. Evaluate each question in order. Only one of the following will apply:

- IF a finding increases the likelihood of a loss of level control (LOLC) or actually caused a LOLC, THEN LOLC is the applicable initiating event. Use Table 1 to determine the IEL. Go to Step 4.5.3.

- IF a finding increases the likelihood of a loss of offsite power (LOOP) or actually caused a LOOP, THEN LOOP is the applicable initiating event. Use Table 2 to determine the IEL. Go to Step 4.5.3.

- IF a finding increases the likelihood of a loss of reactor inventory (LOI) or actually caused a LOI, THEN LOI is the applicable initiating event. Use Table 3 to determine the IEL. Go to Step 4.5.3.

- IF a finding increases the likelihood of a loss of the operating train of RHR (LORHR) or actually caused a LORHR (except for LOOP and LOI), THEN LORHR is the applicable initiating event. Use Table 4 to determine the IEL. Go to Step 4.5.3.

- IF a finding involves the RHR support systems (except for LOOP and LOI), THEN LORHR is the applicable initiating event. Use Table 4 to determine the IEL. Go to Step 4.5.3.

Step 4.5.3 Use the SDP Worksheet that contains the POS and initiating event that were determined to be applicable in Step 4.5.1.

EXCEPTIONS:

(1) For LOI POS 1 if RCS < 200F, use the POS 1 LOLC worksheets and event trees.

(2) If failure of the cavity seal could occur following LOOP or SBO, use the LOOP POS 2 worksheet.

Step 4.5.4 Enter the time to RCS boiling and an approximate time to core uncovery/core damage in the first line of the Worksheet.

Table 8 can be used to estimate time to core damage from hot leg midplane conditions. Use the licensee values if available.

Step 4.5.5 Label the IEL in each row of the lower section of the worksheet.

Step 4.5.6 Determine the revised Credit for each top event function impacted by the finding for the as found condition during the event.

A. Verify the licensee has the instrumentation referenced for the top event function.

NOTE: If the licensee does not have the referenced instrumentation available or the referenced instrumentation is not reflective of RCS conditions, then the default operator credit MUST be reduced by two.

B. To obtain the Equipment Credit, credit each available system that is (1) capable of maintaining the top event function and (2) is not impacted by the finding. Use the Event Tree associated with the Worksheet to help understand the successes and failures associated with each accident sequence. Use guidance in Tables 7 and 8 to determine equipment credits. Document key assumptions.

C. To obtain the Operator Credit, use the default operator credit unless any of the following four conditions are applicable:

1. If the referenced instrumentation is missing or misleading, then decrease the operator credit by two.
2. The default time is incorrect and significantly reduced. If the diagnoses time is less than 20 minutes OR the time to perform the action is approximately the time required, then decrease the operator credit by one.
3. If the action is complicated by missing equipment, unaccessible equipment, steam or high radiation, or loop seals for venting pumps, then decrease the operator credit by two.
4. If the procedures are not directed for shutdown configuration that the plant is in, then the operator credit is decreased by one.

NOTE: If the default operator credit is changed and results in a negative operator credit, then the operator credit is zero.

D. Determine the Credit for Function for each Top Event Function needed. Select the lower of Equipment Credit and Operator Credit, and enter the value in this column.

Step 4.5.7 Quantification of Core Damage Scenarios

Quantify each accident scenario by adding the credits for IEL + Mitigation Credit. Enter the sum in the Result column.

NOTE: For phase 2 analyses, the recovery credit is not used.

Step 4.5.8 Go to the next applicable Worksheet and begin at Step 4.5.1, or if all Worksheets are completed, continue to Step 4.5.9.

Step 4.5.9 Estimating the Risk Significance of the Inspection Finding

The risk significance of an inspection finding is determined in the same manner as for at-power findings. Use IMC 0609, Appendix A, Step 2.4 - "Estimating the Risk Significance of Inspection Findings" to determine the risk significance of a finding.

5.0 FIGURES, TABLES, WORKSHEETS AND EVENT TREES

5.1 Figures

5.2 Tables

5.3 Worksheets

Figure 1 - Determination of Applicable POSs and Time Windows - PWRs

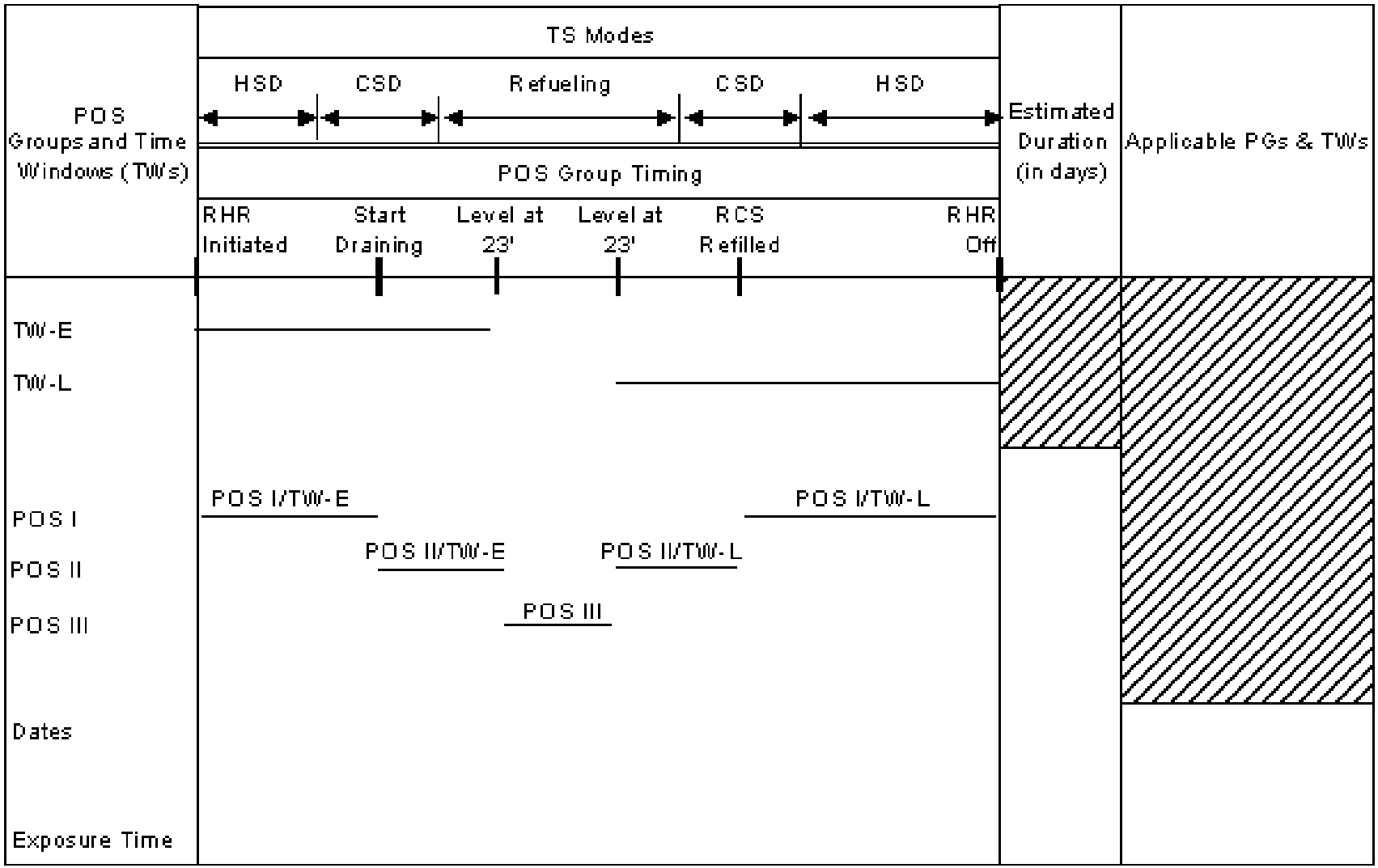


Table 1 - Initiating Event Likelihood (IELs) for LOLC Precursors

Time to RHR loss due to loss of RHR function due to loss of NPSH or vortexing assuming no successful operator action	Was RCS level indication reasonable reflection of RCS level ? AND Is DHR flow indication and DHR motor current available	Can action to recover RHR be identified within ½ time to RHR loss? Eg. Decrease RHR pump flow rate or increase RCS level	Can action to recover RHR be performed within ½ time to RHR loss?	Estimated IEL
LOLC occurred OR X<20 min.	N/A	N/A	N/A	0
20<x< 40 min.	YES	YES	YES	1
20<x< 40min.	NO	N/A	N/A	0
20<X <40min.	YES	NO	N/A	0
20<x< 40 min.	YES	YES	NO	0
40<x< 60 min.	YES	YES	YES	2
40<x< 60min.	NO	N/A	N/A	0
40<X <60min.	YES	NO	N/A	0
40<X<60 min.	YES	YES	NO	0
1HR<X<2HR	YES	YES	YES	3
1HR<X<2HR	NO	Yes	Yes	1
1HR<X<2HR	YES	NO	N/A	0
1HR<X<2HR	YES	Yes	NO	0
X>2HR	YES	YES	YES	4
X>2HR	NO	Yes	Yes	1
X> 2HR	YES	NO	N/A	0
X> 2 HR	YES	Yes	NO	0

Table 2 - Initiating Event Likelihoods (IELs) for LOOP Precursors

Type of LOOP precursor	Estimated Initiator Rating
Actual LOOP occurred	0
Work Activities have the potential to affect existing power supplies (example: crane operating close to a Reserve Auxiliary Transformer supplying power to RHR without adequate controls on its movement)	1

Table 3 - Initiating Event Likelihood (IELs) for LOI Precursors

Time to RHR loss due to loss of RHR pump suction Given no successful operator action (X = time to loss of RHR pump suction)	Was RCS Level indication a reasonable reflection of RCS level ? AND Is DHR flow indication and DHR motor current available (LOLC events only)	Can leak path be readily identified within ½ time to loss of RHR	Can drain path be isolated by at least one functional valve such that a train of RHR can be re-started (e.g. not RHR suction valves)	Estimated IEL
LOI occurred X<20 min.	N/A	N/A	N/A	0
20<x< 40 min.	YES	YES	YES	1
20<x< 40min.	NO	N/A	N/A	0
20<X <40min.	YES	NO	N/A	0
20<x< 40 min.	YES	YES	NO	0
40<x< 60 min.	YES	YES	YES	2
40<x< 60min.	NO	N/A	N/A	0
40<X <60min.	YES	NO	N/A	0
40<X<60 min.	YES	YES	NO	0
1HR<X<2HR	YES	YES	YES	3
1HR<X<2HR	NO	YES	YES	1
1HR<X<2HR	YES	NO	N/A	0
1HR<X<2HR	YES	YES	NO	0
X>2HR	YES	YES	YES	4
X>2HR	NO	YES	YES	1
X> 2HR	YES	NO	N/A	0
X> 2 HR	YES	YES	NO	0

Table 4 - Initiating Event Likelihoods (IELs) for LORHR Precursors

Time to RHR loss given no successful operator action	Trouble alarms present for finding AND Core Exit Thermocouples (CETs) Ex. DHR high temp. DHR low flow Support System Trouble Alarms Ex. CCW low flow	Can action to recover RHR be identified within ½ time to RHR loss? (e.g., RHR recovery procedures, support system recovery procedures)	Can action to recover RHR be performed within ½ time to RHR loss?	Estimated IEL
LORHR occurred OR< 20 minutes	N/A	N/A	N/A	0
20<X<40 min.	Yes	Yes	Yes	1
20<X< 40 min.	No	N/A	N/A	0
20 <X< 40min.	Yes	No	N/A	0
20<X< 40 min.	Yes	Yes	NO	0
40<X< 60min.	Yes	Yes	Yes	2
40<X< 60min.	No	N/A	N/A	0
40<X< 60min.	Yes	No	N/A	0
40>X < 60min.	Yes	Yes	NO	0
1hr< X<2 hr.	Yes	Yes	Yes	3
1hr <X< 2 hr.	No	Yes	Yes	1
1 hr <X<2 hr.	Yes	No	N/A	0
1hr <X < 2 hr.	Yes	Yes	No	0
X > 2 hr	Yes	Yes	Yes	4
X > 2 hr	No	Yes	Yes	1
X> 2 hr	Yes	No	N/A	0
X> 2 hr	Yes	Yes	NO	0

Table 5 - Initiating Event Likelihoods (IELs) for Condition Findings - PWRs

Row	Approximate Conditional Frequency	Example Event Type	IEL		
I	> 1 per 1-10 yr	Loss of offsite power (LOOP), Loss of RHR (LORHR)	**1**	**2**	**3**
II	1 per 10-10 ^{2} yr	Loss of Inventory (LOI)	**2**	**3**	**4**
III	1 per 10-10^{2} yr	Loss of Level Control (LOLC)[1]	**2**	**2**	**2**
			> 30 days	**3-30 days**	**< 3 days**
			Exposure Time for Degraded Condition		

LOLC is only applicable to POS group II.
LORHR and LOI are not applicable to POS group III.

[1]Loss of level control failure is dominated by likelihood of overdraining to reach midloop conditions (this is a demand failure)

Table 6 - Mitigation Capability Credits for Installed Equipment

Type of Remaining Capability	Remaining Capability Rating
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 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)

Table 7 - Credit for Temporary Equipment

Mitigation Capability	Credits
Equipment available during power operation and available during shutdown operation	Use credit similar to at-power SDP; manual alignment and actuation may be needed limiting the credit to the credit for operator action
Temporary Equipment (e.g., skid mounted diesel) that is available during shutdown; equipment and tools needed are staged for quick hookup	Use credit of 1

Table 8 - Definitions and Characterizations of Time Windows from the Surry Shutdown PRA (NUREG/CR-6144 Table 5.4-20) assuming a vented RCS (RCS temperature initially 140F)

Time Post Shutdown	**< 75 hrs**	**75 hrs < X <240 hrs**	**240 hrs <X < 32 days**	**32 days < X**
Decay Heat	**13MW (2 days)**	**10 MW (5 days)**	**7 MW (12 days)**	**5 MW (32 days)**
TBB (from midloop)	**15 min.**	**20 min.**	**27 min.**	**37 min.**
Time to Core Uncovery	**120 min.**	**157 min.**	**209 min.**	**273 min.**
Time to Core Damage	**219 min.**	**297 min.**	**411 min.**	**557min.**

Worksheet 1. SDP for a PWR Plant - Loss Level Control in POS 1 (RCS Closed)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____
(NOTE: losses of inventory shorten time to core uncovery and core damage)

Top Event Function:	Success Criteria and Important Instrumentation:	Equip. Credit	Operator Credit	Credit for Function
SG Cooling (SG)	Operator maintains SG cooling by: (1) maintaining adequate level for 24 hours and (2) venting steam from SGs, and (3) keeping RCS closed. Operator needs SG level and pressure indication and CETs		Credit = 3 if supported by procedures and analyses	
RCS Injection And Bleed Before Core Damage **(FEED& BLEED)**	Operator initiates RCS injection before CD requires: 1standby ECCS train or injection train capable of keeping core covered. Operator needs RCS level indication and CETs. AND Operator opens a RCS vent path (ex PORV) for RCS pressure control.,		Credit = 2, CD assumed >3 hrs w/o injection	
DHR Recovery Before RWST Depletion and CD (RHR-R)	Operator vents RHR pumps and restarts RHR before RWST depletion or Initiates an alternate DHR path other than FEED&BLEED. Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm		Credit = 3 time until RWST depletion assumed > 10 hrs	
Borated Water Makeup before CD (RWSTMU)	Operator initiates RWST makeup before RWST depletion and core damage. Operator needs RWST level indic. w/low level alarm **NOTE: If the licensee has sufficient RWST inventory to last 24 hours, then this event is considered to be always successful.**		Credit = 2, time to RWST depletion and CD > 13 hours	

Circle Affected Functions	IEL	Mitigation Credit	Recovery	Result
LOLC - SG - RHR-R - RWSTMU (4)				
LOLC - SG - FEED&BLEED (5)				

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 ready for use.

Notes: Failure to recover RHR before RWST depletion is assumed to fail recirculation from the sump since the RHR pumps are also used to perform the recirculation function. Recovery of RHR does not guarantee available recirculation since the sump may be unavailable due to trash.

Worksheet 2. SDP for a PWR Plant - Loss Level Control in POS 2 (RCS Vented)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____
(NOTE: losses of inventory shorten time to core uncovery and core damage)

Top Event Function:	Success Criteria and Important Instrumentation:	Equip. Credit	Operator Credit	Credit for Function
RCS injection before Core Damage (FEED)	Operator initiates RCS injection before CD requires: 1standby ECCS train or injection train capable of keeping core covered Operator needs RCS level indication and CETs		Credit = 4 CD assumed >3 hrs w/o injection	
DHR Recovery Before RWST depletion and CD (RHR-R)	Operator vents RHR pumps, and restarts RHR before RWST depletion. Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm		Credit = 3 time to RWST depletion >10hrs	
Borated Water Makeup before CD (RWSTMU)	Operator initiates RWST makeup before RWST depletion and core damage. Operator needs RWST level indic w/ low level alarm **NOTE: If the licensee has sufficient RWST inventory to last 24 hours, then this event is considered to be always successful.**		Credit = 2 time to RWST depletion and CD > 13 hours	

Circle Affected Functions	IEL	Mitigation Credit	Recovery	Result
LOI - RHR-R-RWSTMU (3)				
LOI -FEED (4)				

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 ready for use.

Notes: Failure to recover RHR before RWST depletion is assumed to fail recirculation from the sump since the RHR pumps are also used to perform the recirculation function. Recovery of RHR does not guarantee available recirculation since the sump may be unavailable due to trash.

Worksheet 3. SDP for a PWR Plant - Loss of Offsite Power in POS 1 (RCS Closed)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____
(NOTE: losses of inventory shorten time to core uncovery and core damage)

Top Event Function:	Success Criteria and Important Instrumentation:	Equip. Credit	Operator Credit	Credit for Function
Emergency AC starts and loads (EAC)	One EDG or alternate onsite AC source [1]			
SG Cooling (SGSBO)	Operator maintains SG cooling by: (1) maintaining adequate level for 24 hours and (2) venting steam from SGs, and (3) keeping RCS closed. Operator needs SG level and SG pressure indication and CETs		Credit = 3 if supported by procedures and analyses	
Operator recovers offsite power before CD (RLOOP3)	Recovery of offsite power before core damage given SGSBO failed	Credit = 1 (assumes CD = 3 hours)	N/A	

Circle Affected Functions	IEL	Mitigation Credit	Recovery	Results
LOOP-EAC-SGSBO-RLOOP3 (3)				

[1]Alternate onsite AC source can be credited if it can be tied in to the 4KV buses at least 1 hour before RHR pump shutoff head is reached. Onsite AC sources also include the Keowee Hydro Units and the Lee Combustion Gas Turbines at Oconee.

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 ready for use.

Worksheet 4. SDP for a PWR Plant - Loss of Offsite Power in POS 2 (RCS Vented)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____				
Top Event Function:	**Success Criteria and Important Instrumentation:**	**Equip. Credit**	**Operator Credit**	**Credit for Function**
Emergency AC starts and loads (EAC)	**One EDG or alternate onsite AC source [1]**			
Gravity Feed (GRAVITY) before CD	**Operator initiates Gravity Feed assuming SBO before core damage. Requires an available flow path, procedures, supporting analyses, and CETs.** **Gravity feeding to the RCS may be credited if Gravity Feed is expected to be available AFTER RCS boiling initiates. To credit Gravity Feed, the analyst needs to consider the following factors that can negate the elevation head provided by the RWST or other sources of RCS inventory: (1) pressure drops in the surge line (2) entrained water accumulating in the pressurizer (3) RCS vent paths that are restricted (to control loose parts or control off gassing) .**		**Credit = 3**	
Operator recovers offsite power before CD (RLOOP4)	**Recovery of offsite power before core damage given unsuccessful gravity feed (CD assumed at 4 hours)**	**Credit = 1**	**N/A**	

[1]Alternate onsite AC source can be credited if it can be tied in to the 4KV buses at minimum 1 hour before core damage. Onsite AC sources also include the Keowee Hydro Units and the Lee Combustion Gas Turbines at Oconee.

Operator recovers offsite power before CD (RLOOP18)	**Recovery of offsite power before core damage given successful gravity feed (CD assumed at 18 hours)**	**Credit = 2**	**N/A**	

Circle Affected Functions	**IEL**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Recovery**	**Result**
LOOP-EAC-RLOOP18 (3)				
LOOP-EAC-GRAVITY-RLOOP4 (5)				

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 ready for use.

Worksheet 5. SDP for a PWR Plant - Loss of Inventory in POS I (RCS Closed)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____
(NOTE: losses of inventory shorten time to core uncovery and core damage)

Top Event Function:	Success Criteria and Important Instrumentation:	Equip. Credit	Operator Credit	Credit for Function
RCS injection (FEED)	Operator initiates RCS injection before CD requires: 1standby ECCS train or injection train capable of keeping core covered Operator needs RCS level indic and CETs,		Credit = 4, CD assumed >3 hrs w/o injection	
Leak Path Terminated before RWST depletion (LEAK-STOP)	Operator isolates leak before RWST depletion, requires: one available valve such that RHR can be restarted (not RHR isolation valves) Operator needs RCS level indic.	Credit = 3 for one valve Credit = 4 for two valves	Credit = 3 (assumed >10 hrs to RWST depletion)	
Leak Path Terminated before core uncovery given no FEED (LEAK-STOP2)	Operator isolates leak before core uncovery, requires: one available valve such that RHR can be restarted (not RHR isolation valves), Operator needs RCS level indic.	Credit = 3 for one valve Credit = 4 for two valves	Credit = 2	
SG Cooling (SG)	Operator maintains SG cooling by: (1) maintaining adequate level for 24 hours, (2) venting steam from SGS, and (3) keeping the RCS closed. Operator needs SG level and SG pressure indic. and CETs		Credit = 3, if supported by procedures and analyses	
RCS Vent path for Feed and Bleed (BLEED)	Operator opens a PORV or vent path large enough to remove decay heat		Credit = 4	

DHR recovery before RWST depletion and CD (RHR-R)	**Operator vents RHR pumps and restarts RHR before RWST depletion.** **Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm**		**Credit = 3 (assumed time until RWST depletion > 10 hrs)**	
Borated Water Makeup before CD(RWSTMU)	**Operator initiates RWST makeup before RWST depletion and core damage.** **Operator needs RWST level indication with low level alarm** **NOTE: If the licensee has sufficient RWST inventory to last 24 hours, then this event is considered to be always successful.**		**Credit = 2 time to RWST depletion and CD > 13 hours**	

Circle Affected Functions	**IEL**	**Mitigation Credit**	**Recovery**	**Result**
LOI - SG - RHR-R - RWSTMU (4)				
LOI-SG-BLEED (5)				
LOI- LEAKSTOP-RWSTMU (7)				
LOI - FEED - SG - (9)				
LOI - FEED - LEAKSTOP2 (10)				

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 ready for use.

Notes: Failure to recover RHR before RWST depletion is assumed to fail recirculation from the sump since the RHR pumps are also used to perform the recirculation function. Recovery of RHR does not guarantee available recirculation since the sump may be unavailable due to trash.

Worksheet 6. SDP for a PWR Plant - Loss of Inventory in POS 2 (RCS Vented)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____
(NOTE: losses of inventory shorten time to core uncovery and core damage)

Top Event Function:	Success Criteria and Important Instrumentation:	Equip. Credit	Operator Credit	Credit for Function
RCS injection before CD (FEED)	Operator initiates RCS injection before CD requires: 1standby ECCS train or injection train capable of keeping core covered Operator needs RCS level indication and CETs.		Credit = 4, CD assumed >3 hrs w/o injection	
Leak Path Terminated before RWST depletion (LEAK-STOP)[2]	Operator isolates leak before RWST depletion, requires: one available valve such that RHR can be restarted (not RHR isolation valves) Operator needs RCS level indication.	Credit = 3 for one valve Credit = 4 for two valves	Credit = 3 (assumed >10 hrs to depletion)	
DHR recovery before RWST depletion and CD (RHR-R)	Operator vents RHR pumps and restarts RHR before RWST depletion. Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm		Credit = 3 time to RWST depletion >10hrs	

[2]If leak path is back to the RWST , then use operator credit = 5 to account that RWST will not deplete but will heat up without cooling.

Borated Water Makeup before CD(RWSTMU)	**Operator initiates RWST makeup before RWST depletion and core damage.** **Operator needs RWST level indication with low level alarm** **NOTE: If the licensee has sufficient RWST inventory to last 24 hours, then this event is considered to be always successful.**		**Credit = 2 time to RWST depletion and CD > 13 hours**	

Circle Affected Functions	**IEL**	**Mitigation Credit**	**Recovery**	**Result**
LOI - RHR-R-RWSTMU (3)				
LOI- LEAK-ST-RWSTMU (5)				
LOI -FEED (6)				

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 ready for use.

Notes: Failure to recover RHR before RWST depletion is assumed to fail recirculation from the sump since the RHR pumps are also used to perform the recirculation function. Recovery of RHR does not guarantee available recirculation since the sump may be unavailable due to trash..

Worksheet 7. SDP for a PWR Plant - Loss of Inventory in POS 3 (Cavity Flooded)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____
(NOTE: losses of inventory shorten time to core uncovery and core damage)

Top Event Function	Success Criteria and Important Instrumentation:	Equip. Credit	Operator Credit	Credit for Function
RCS injection before CD (FEED)	Operator initiates recirculation RCS injection before CD requires: 1 train of recirculation capable of keeping core covered. Verify that sump screens are not blocked by covers or outage debris. Operator needs RCS level indic.		Credit = 4, CD assumed >3 hrs w/o injection	
Leak terminated before RCS injection cannot be sustained and CD occurs (LEAK-STOP)	Operator isolates drain path using at least one functional valve such that RHR can be restarted.	Credit = 3 for one valve Credit = 4 for two valves	Credit = 3 time to CD assumed > 4 hours	
DHR recovery before RCS injection cannot be sustained and CD results (RHR-R)	Operator vents RHR pumps and restarts RHR system. Operator needs RHR inlet/outlet temp and RHR flow indic. w/low alarm.		Credit = 3 time to CD assumed > 4 hours	

Circle Affected Functions	IEL	Mitigation Credit	Recovery	Sequence Color
LOI - RHR-R- (2)				
LOI - LEAK-STOP (3)				
LOI -FEED (4)				

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 ready for use.

Worksheet 8. SDP for a Westinghouse 4-Loop Plant - Loss of RHR in POS I (RCS Closed)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____ (NOTE: losses of inventory shorten time to core uncovery and core damage)				
Top Event Function:	**Success Criteria and Important Instrumentation:**	**Equip. Credit[1]**	**Operator Credit[2]**	**Credit for Function**
DHR recovery before RCS boiling (RHR-S)	**Operator a train of RHR before RCS boiling.** **Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm** **AND IF APPLICABLE[3]** **Operator recovers failed RHR support systems before RCS boiling (SEE FOOT NOTE 3)**		**Credit = 0 if TBB <20 minutes** **IF RHR recovery action can be identified within ½ TBB AND RHR recovery action can be performed within ½ TBB AND Trouble alarms are available.** **THEN** **CREDIT = 1 if 20 min. < TBB < 40 min.** **CREDIT = 2 if 40 min. <TBB < 1 hour** **CREDIT = 3 if TBB > 1 hour**	

[1]If performance deficiency is being transferred from LOOP tree, analyst must consider if the front line systems and necessary support systems are supported from successful EAC.

[2]For the safety function RHR-S, when being transferred from LOOP tree, if TBB < 10 minutes and re-start of RHR requires operator action outside the control room, then operator credit = 0. Otherwise, operator credit = 1.

[3]If this worksheet is being used to assess a RHR support system deficiency that could cause a loss of the operating train of RHR, then the equipment credit and operator credit is determined by the operator's ability to recover the support system before RCS boiling.

SG Cooling (SG)	**Operator maintains SG cooling by: (1) maintaining adequate level for 24 hours, (2) venting steam from SGS, and (3) keeping the RCS closed. Operator needs SG level and pressure indic. and CETs**		**Credit = 3, if supported by procedures and analyses**	
RCS Injection AND Bleed Before Core Damage (FEED&BLEED)	**Operator initiates RCS injection before CD requires: 1standby ECCS train or injection train capable of keeping core covered** **Operator needs RCS level indic. and CETs,** **AND** **Operator also opens a RCS vent path (ex PORV) to control RCS pressure**		**Credit = 2, CD assumed >3 hrs w/o injection**	
DHR recovery before RWST depletion and CD (RHR-R)	**Operator vents RHR pumps and restarts RHR before RWST depletion.** **Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm**	**Consider Equip. Failures in RHR-S that could impact this equip. credit**	**Credit = 2 time until RWST depletion > 10 hrs.**	

Borated Water Makeup before CD(RWSTMU)	**Operator initiates RWST makeup before RWST depletion and core damage.** **Operator needs RWST level indication with low level alarm** **NOTE: If the licensee has sufficient RWST inventory to last 24 hours, then this event is considered to be always successful.**		**Credit = 2 time to RWST depletion and CD > 16 hours**	

Circle Affected Functions	IEL	Mitigation Credit	Recovery	Result
LORHR - RHR-S - SG - RHR-R-RWSTMU (5)				
LORHR - RHR-S - SG - FEED&BLEED (6)				

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 ready for use.

Notes: Failure to recover RHR before RWST depletion is assumed to fail recirculation from the sump since the RHR pumps are also used to perform the recirculation function. Recovery of RHR does not guarantee available recirculation since the sump may be unavailable due to trash..

Worksheet 9. SDP for a Westinghouse 4-Loop Plant - Loss of RHR in POS 2 (RCS Vented)

FILL IN: TIME TO BOILING _____ TIME TO CORE UNCOVERY _____ TIME TO CORE DAMAGE _____ (NOTE: losses of inventory shorten time to core uncovery and core damage)				
Top Event Function:	**Success Criteria and Important Instrumentation:**	**Equip. Credit [1]**	**Operator Credit[2]**	**Credit for Function**
DHR recovery before RCS boiling (RHR-S) **OR** **DHR recovery before RCS boils to Flange Level if Vessel Head is Removed.**	**Operator a train of RHR.** **Operator needs RHR inlet/outlet temp indic. and RHR flow indic. w/low alarm** **AND IF APPLICABLE[3]** **Operator recovers failed RHR support systems before RCS boiling (SEE FOOT NOTE 3)**		**Credit = 0 if TBB <20 minutes** **IF RHR recovery action can be identified within ½ TBB AND RHR recovery action can be performed within ½ TBB AND Trouble alarms are available. THEN** **CREDIT = 1 if 20 min. < TBB < 40 min.** **CREDIT = 2 if 40 min. <TBB < 1 hour** **CREDIT = 3 if TBB> 1 hour**	

[1]If performance deficiency is being transferred from LOOP tree, analyst must consider if the front line systems and necessary support systems are supported from successful EAC.

[2]For the safety function, RHR-S, when being transferred from LOOP tree, if TBB < 10 minute and re-start of RHR requires operator action outside the control room, then operator credit = 0. Otherwise, operator credit = 1.

[3]If this worksheet is being used to assess a RHR support system deficiency that could cause a loss of the operating train of RHR, then the equipment credit and operator credit is determined by the operator's ability to recover the support system before RCS boiling.

RCS injection before CD	**Operator initiates RCS injection before CD requires: 1standby ECCS train or injection train capable of keeping core covered, RCS level indic., CETs,**		**Credit = 4, CD assumed >3 hrs w/o injection**	
DHR recovery before RWST depletion (RHR-R)	**Operator fills RCS, vents RHR pumps, and restarts RHR before RWST depletion, requires: CET w/hi alarm, RHR inlet/outlet temp indic., RHR flow indic. w/low alarm**	**Consider Equip. Failures in RHR-S that could impact this equip. credit**	**Credit = 2 time to RWST depletion >10hrs**	
Borated Water Makeup before CD(RWSTMU)	**Operator initiates RWST makeup before RWST depletion with boric acid transfer pumps and primary grade water,** **Operator needs RWST level indic and low level alarm** **NOTE: If the licensee has sufficient RWST inventory to last 24 hours, then this event is considered to be always successful.**		**Credit = 2 time to RWST and CD assumed > 13 hours**	

Circle Affected Functions	IEL	Mitigation Credit	Recovery	Result
LORHR - RHR-S - RHR-R - RWSTMU (4)				
LORHR - RHR-S - FEED (5)				

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 ready for use.

Notes: Failure to recover RHR before RWST depletion is assumed to fail recirculation from the sump since the RHR pumps are also used to perform the recirculation function. Recovery of RHR does not guarantee available recirculation since the sump may be unavailable due to trash.

Figure 2 - Event Tree for Loss of Inventory - PWR POS-1

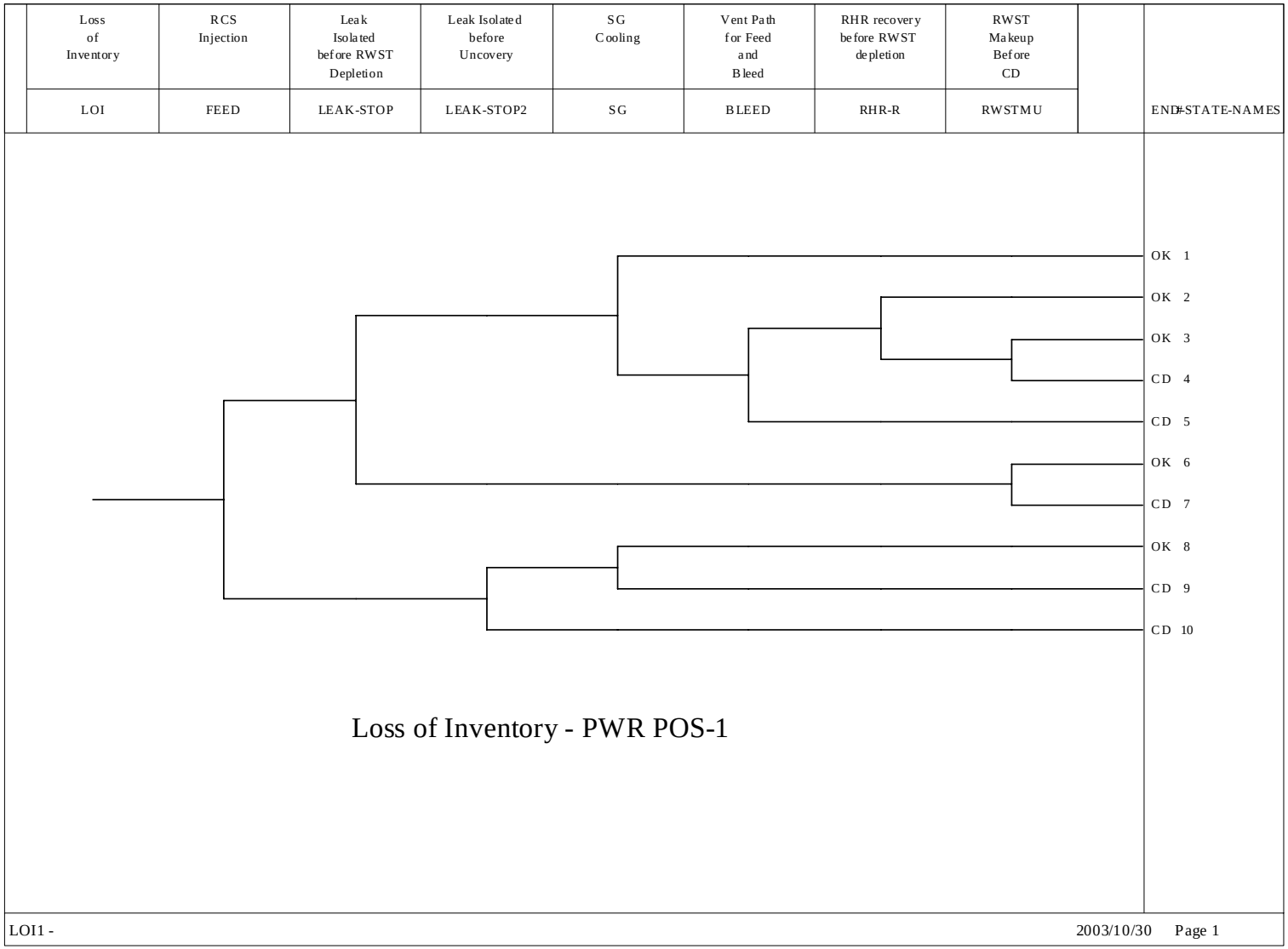
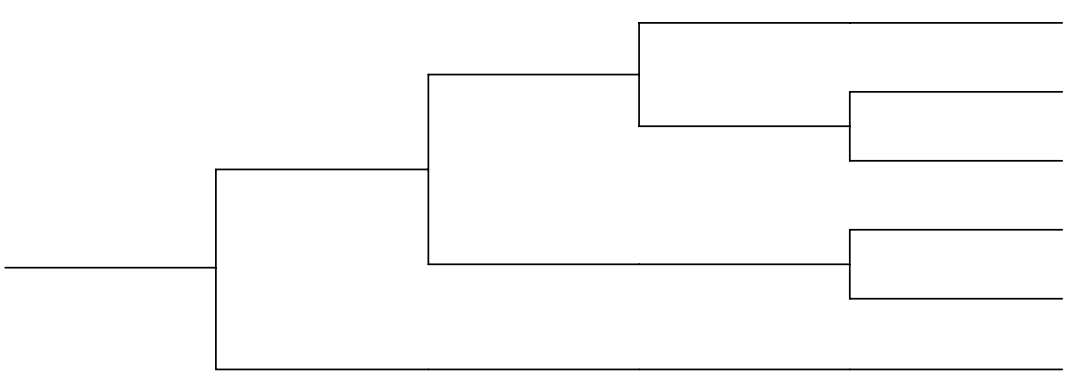


Figure 3 - Event Tree for Loss of Inventory - PWR POS-2

Loss of Inventory	RCS Injection before CD	Terminated before RWST Depletion	RHR Recovery before RWST Depletion	RWST Makeup Before CD		
LOI	FEED	LEAK-STOP	RHR-R	RWSTMU	#	END-STATE-NAMES
					1	OK
					2	OK
					3	CD
					4	OK
					5	CD
					6	CD

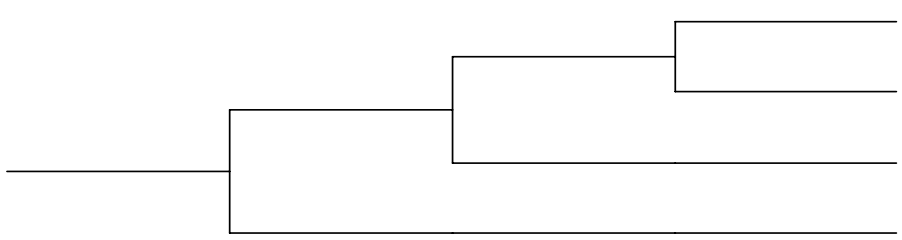


Loss of Inventory - PWR POS-2

LOI2 - 2003/10/30 Page 2

Figure 4 - Event Tree for Loss of Inventory PWR POS-3

Loss of Inventory	RCS Injection Before CD	Terminated before RCS and makeup Depletion	RHR recovery before water inventory depleted		
LOI	FEED	LEAK-STOP	RHR-R	#	END-STATE-NAMES



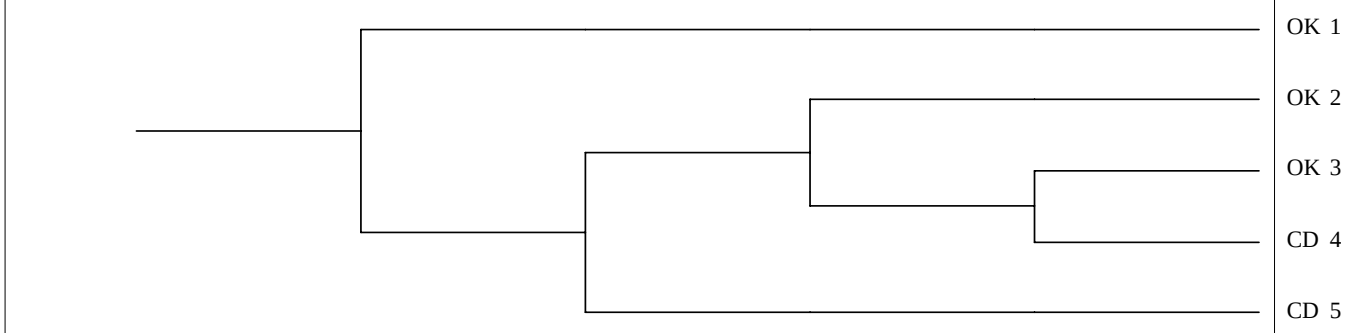
1	OK
2	CD
3	CD
4	CD

Loss of Inventory - PWR POS-3

LOI3 - 2003/10/30 Page 3

Figure 5 - Event Tree for Loss of Level Control - PWR POS-1

Loss of Level Control	Steam Generator Cooling	RCS Injection And Bleed	Recover RHR before RWST Depletion	Make-up to RWST before CD		
LOLC	SG	FEED&BLEED	RHR-R	RWSTMU		#

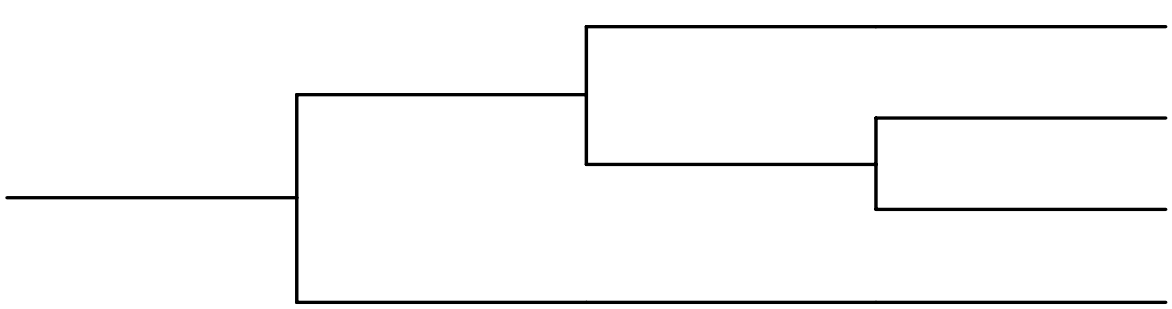


Loss of Level Control - PWR POS-1

LOLC1 - 2003/10/30 Page 4

Figure 6 - Event Tree for Loss of level Control - POS-2

Loss of Level Control	RCS Injection before CD	Recover RHR before RWST Depletion	Make-up to RWST before CD		
LOLC	FEED	RHR-R	RWSTMU	#	
				1	OK
				2	OK
				3	CD
				4	CD

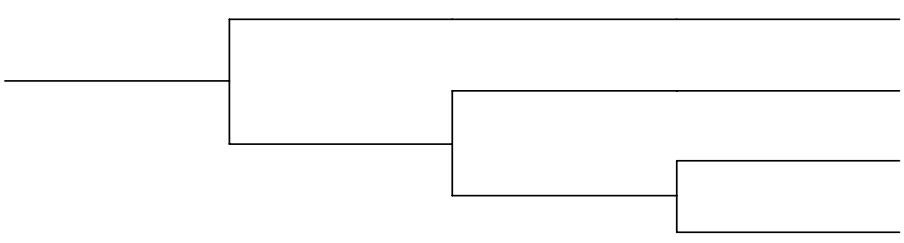


Loss of Level Control - PWR POS-2

LOLC2 - 2003/10/30 Page 5

Figure 7 - Event Tree for Loss of Offsite Power - PWR POS-1

Loss of Offsite Power	AC Power	SG Cooling Maintained	Recovery of Power within 3 hours (before CD)		
LOOP	EAC	SGSBO	RLOOP3	#	END-STATE-NAMES



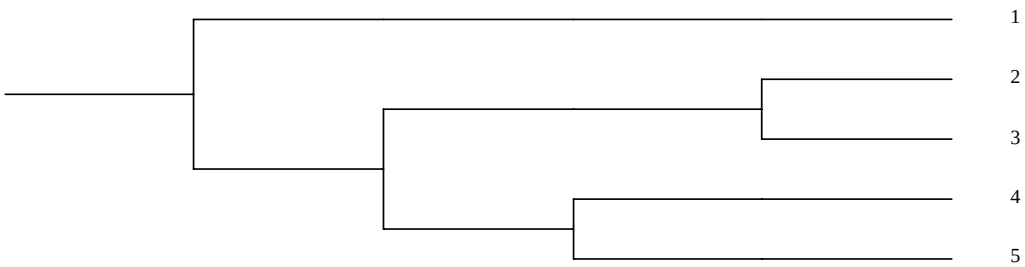
1	LORHR
2	OK
3	OK
4	CD

Loss of Offsite Power - PWR POS-1

LOOP - 2003/10/30 Page 6

Figure 8 - Event Tree for Loss of Offsite Power - PWR POS-2

Loss of Offsite Power	AC Power	Gravity Feed before CD	Recovery of Power (EDG or Offsite) 4 hours	Recovery of Power (EDG or Offsite) 18 hours		
LOOP	EAC	GRAVITY	RLOOP4	RLOOP18	#	END-STATE-NAMES
					1	LORHR
					2	OK
					3	CD
					4	OK
					5	CD

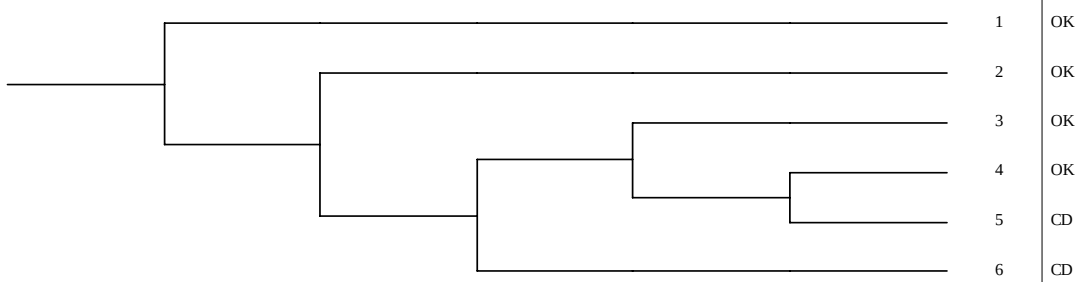


Loss of Offsite Power - PWR POS-2

LOOP2 - 2003/10/30 Page 7

Figure 9 - Event Tree for Loss of RHR - PWR POS-1

Loss of RHR in POS-1	Recover RHR before Boiling	Steam Generator Cooling	RCS Injection And Bleed	Recover RHR before RWST Depletion	Make-up to RWST before CD		
LORHR1	RHR-S	SG	FEED&BLEED	RHR-R	RWSTMU	#	END-STATE-NAMES



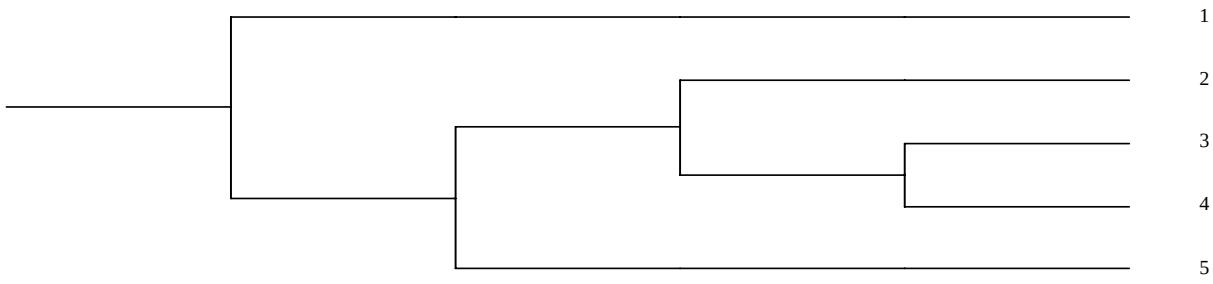
#	END-STATE-NAMES
1	OK
2	OK
3	OK
4	OK
5	CD
6	CD

Loss of RHR - PWR POS-1

LORHR1 - 2003/10/30 Page 9

Figure 10 - Event Tree for Loss of RHR - PWR POS-2

Loss of RHR in POS-2	Recover RHR before Boiling	RCS Injection	Recover RHR before RWST Depletion	Make-up to RWST before CD		
LORHR2	RHR-S	FEED	RHR-R	RWSTMU	#	END-STATE-NAMES
					1	OK
					2	OK
					3	OK
					4	CD
					5	CD



Loss of RHR - PWR POS-2

LORHR2 - 2003/10/30 Page 10