OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes **Without a Flood Watch**
BASIC EVENT/ EVENT TREE:	OP / SO2CW1, SO2CW3 & SO2CW4 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

AND POST-INITIATOR HUMAN ERROR PROBABILITY

CALCULATION WORKSHEET

HRA WORKSHEET 1

ORIGINATED BY:	Zaito S. Kolbar	5-31-96
	(Nuclear Safety Group)	**Date**
REVIEWED BY:	Gary Chuang	5-31-96
	(NSG Reviewer)	**Date**
REVIEWED BY:	Roger Gaeler	5-31-96
	(Nuclear Training-Operations)	**Date**
APPROVED BY:	H.E. Mohamed	6/18/96
	(NSG RM Supervisor)	**Date**

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes Without a Flood Watch.
BASIC EVENT/ EVENT TREE:	OP / SO2CW1, SO2CW3 and SO2CW4 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

I. INTRODUCTION

This human reliability analysis (HRA) is to evaluate the human actions related to the Barrier Control Program PRA for the Safety Equipment Building in the event of a Circulating Water System failure without a floodwatch posted .

II. ACCIDENT SEQUENCES INVOLVED:

The accident sequence involved is the Circulating Water System (CWS) pipe failure resulting in flooding in the turbine building. CWS flooding in one unit will impact both units and could cause a turbine trip.

Based on transient flood calculations[1], in the event of a CWS flood in the turbine building, if the CWS pumps are stopped in about 10 minutes, the transient flood level rises to elevation 8'11", which is above the elevation of the bottom of barriers between the SEB and turbine building (excluding block walls).

However, even if all watertight doors between the SEB and turbine building are open, less than 5000 ft^3 of water enters the SEB. This amount would not cause flooding of any non-flood qualified safety-related equipment.

III. DESCRIPTION OF HUMAN ACTIONS:

The human action involved is for the operator (without the help of the floodwatch) to properly diagnose the event, identify the location of the break and stop the appropriate or all Circulating Water pumps in 10 minutes. Per the Alarm Response Instruction, SO23-15-57.C, the associated response would be to secure the affected pump(s) or isolate the source of leakage to reduce further flooding. It may be necessary to stop all four Circ Water Pumps to terminate the flooding event.

IV. TIME LINE:

Operations has evaluated the expected response of operating crews to a flooding event initiated due to failure of a Circulating Water Pump discharge expansion bellows rupturing in the Unit 2 Turbine Building using the simulator

OPERATOR ACTION SUMMARY DATA SHEET

(no floodwatch was included). The following were the results (reference E-mail from Van Fisher to Walter Marsh dated 9/30/93 attached):

Description of Scenario

Time to first indication (or annunciation) (T_i):

T = 0 minutes	Circulating Water Pump 2MP118 Water Box Outlet expansion bellows ruptures. Operations selected the outlet because it makes identification of affected CWS more difficult in the Control Room and in the field.
T(Ti)=~2 secs	First alarm annunciated in the Control Room, "Turbine Building Flooding" alarm at 57C57.
T = ~3 minutes	Second set of alarms annunciated in the Control Room, Turbine Building Sump Hi/Hi level and BPS Trouble alarm.
T = ~4.5 minutes	480 Volt ground alarms on MCC's BB. BM, BW and BK.
T = ~5 minutes	Supply breakers to MCC's BB, BM, BW and BK open on overcurrent.
T = ~6 minutes	Non-1E Instrument Bus Failure due to submergence of 2Q069. Main Generator AVR A trips due to submergence of Main Generator PT secondary circuits.
T = ~9 minutes	All Instrument Air Compressors Relay will actuate due to submergence of motor intake.
T = ~9.5 minutes	Main Generator Relays (Main Turbine Trip) will actuate from Stator Ground due to submergence of Main Generator PT primary circuits.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes Without a Flood Watch.
BASIC EVENT/ EVENT TREE:	OP / SO2CW1, SO2CW3 and SO2CW4 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

Field Report Script

T = 0 Request for inspection of turbine building to locate reason for flooding alarm.

T = 2 minutes Report that large amount of water at 7' as seen from the 30' elevation of the TB. Water level is rising. Source unknown. (If the inlet bellows had ruptured associated with south end, the field operator could report the specific water box affected. This would have made the scenario too easy).

T = ~3 minutes Operator still on 30' passes center of condenser, vicinity of water box outlets, and reports large amounts of water shooting from water box outlet MOV area - cannot tell which one.

T = ~4 minutes Reports that north end is also not leaking, that the water is coming from the water box outlet area, cannot tell which one.

Conclusions

- the operators checked the Circulating Water Pump instrumentation (water box differential pressure, pump amperage, condenser vacuum) within a few minutes of receipt of the flooding alarm. If an inlet bellows had ruptured, the water box DP would have dropped indicating which CW pump to stop.
- operators requested field inspection within 30 seconds of flooding alarm receipt. It is reasonable to assume if an inlet bellows had ruptured, it would be identified by the field report within 5 minutes.
- Therefore, operators will stop the affected CW pump in less than 10 minutes.

This E-mail discussion references the outlet water box, which renders diagnosis of which Circ Water pump to isolate more difficult. This bounds the diagnosis likelihood of an inlet water box rupture. Flood volumes from an

outlet water box rupture are less severe than volumes from an inlet water box rupture.

Maximum allowable time (T_m) :

~ 10 minutes — Both trains of ECCS and CCW would remain available.

Post-diagnosis action time (T_a) :

<1 minute — To push the stop button of applicable or all Circulating Water pump(s).

Diagnosis Time ($T_d = T_m - T_a - T_i$) :

~9 minutes

V. COMPETING ACTIONS:

Operator will be investigating multiple alarms annunciated in the Control Room such as the first set of alarms "Turbine Building Flooding" , the second set of alarms "Turbine Bldg. sump Hi/Hi level and BPS Trouble" alarm, 480 V MCC ground alarms, low condenser vacuum, and others that may come up. It is expected that the operator will be communicating with field report during the first 4-5 minutes of the event in diagnosing the event. If there are actions necessary such as closing an SEB barrier, it is expected that a separate operator would be sent to help due to the urgency of the event.

VI. PRECEDING RELATED ACTIONS:

None.

VII. CONSEQUENCES OF FAILING TO PERFORM ACTION:

Failing to perform this action in 10 minutes will result in a loss of all three CCW pumps and/or one or both trains of HPSI, LPSI and CS pumps if SEB barriers are breached.

OPERATOR ACTION: Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes Without a Flood Watch.

BASIC EVENT/ EVENT TREE: OP / SO2CW1, SO2CW3 and SO2CW4 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

VIII. CONSEQUENCES OF PERFORMING ACTION:

Operator action to stop the appropriate or all of the CW pump(s) in about 10 minutes will prevent submergence of the CCW pumps and/or HPSI, LPSI and CS pump(s) in the SEB.

IX. CREW TRAINING AND EXPERIENCE:

[Provide ranking of 0 thru 5 (0 being none, 1 being poor or not practiced, 5 being very good)]

	SIMULATOR	CLASSROOM	PLANT EXPER.
IDENTIFY	5*	5*	1
DIAGNOSIS	5*	5*	1
RESPONSE	5*	5*	1

* The Alarm Response Instruction procedure is practiced regularly in the simulator training. Degraded Circulating Water System condition is also being practiced in the simulator training.

X. CLARITY OF APPLICABLE PROCEDURES:

There are procedures written that can be used related to this event: Alarm Response Procedure SO23-15-57.C, Turbine Bldg. Flooding.

XI. AVAILABILITY OF RELEVANT INDICATIONS:

Cues For Operator Action:

First alarm in 2 seconds after the event - Turbine Building flooding alarm.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes Without a Flood Watch.

BASIC EVENT/ EVENT TREE: OP / SO2CW1, SO2CW3 and SO2CW4 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

Indicators Used:

"57C57 TURBINE BLDG FLOODING" alarm.
Upon receipt of this alarm, the required action per the ARP is to send an operator to the Turbine Building and investigate the source of this alarm. The procedure also mentioned to inspect the Main Condenser in the area of the Circulating Water Inlet and Outlet.

Indicator Availability/Adequacy:

The TB flooding alarm indication will provide the CR operator some verification as to the relative location of the break source. No immediate notification or response can be credited since there is no floodwatch posted in this case.

XII. CONSIDERATIONS FOR "LOCAL" ACTIONS:

- Is required action proceduralized?

  Yes. SO23-15-57.C procedure states, to send an operator to the Turbine Bldg. and investigate the cause of the alarm.

- How accessible is the component from the control room? Considering distance and number of security doors, estimate time to reach component from the control room.

  In ~2 minutes[3] , the operator will be able to report to the CR that large amount of water is present in the 7' elevation as seen from the 30' elevation.

- Is action considered to be relatively simple or complex?

  Relatively simple.

- Are any special tools required (keys, wrenches, etc.)? If so, will they be readily accessible during the accident sequence?

  No.

OPERATOR ACTION SUMMARY DATA SHEET

- Will performance of the action require entering a harsh environment where protection clothing or equipment is necessary?

  No.

- Are there any unique aspects of the action which could affect the likelihood of successful completion (i.e., requires more than one person, must be performed concurrent with other actions, requires communication with the control room, etc.)?

  No.

XIII. COMMUNICATIONS AND OPERATOR AVAILABILITY:

Available.

XIV. OPERATOR OVERSIGHT/CHECKING:

It is expected that the Control Room Supervisor and the Shift Superintendent (SS) will be around and provide oversight and second check to the NCO and/or NACO.

XV. STRESS LEVEL:

A moderately high level of stress can be initially present in the control room due to multiple alarm annunciations.

XVI. SPECIFIC QUESTIONS ABOUT ACTION:

None.

XVII. OTHER INSIGHTS:

None.

XVIII. REFERENCES:

1 Calculation M-120.15, Rev. 6, "Plant Flooding Analysis Review".

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes Without a Flood Watch.

BASIC EVENT/ EVENT TREE: OP / SO2CW1, SO2CW3 and SO2CW4 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

2 SO23-15-57.C, Rev. 1 - Annunciator Panel 57C, Vital Bus Power

3 E-mail from Van Fisher to Walter Marsh dated 9/30/93 - Operator Response to Flooding

POST-INITIATOR HUMAN ERROR PROBABILITY CALCULATION WORKSHEET

BASIC EVENT NAME: *OP - SO2CW1/SO2CW3/SO2CW4 Event Tree*

HUMAN ACTION DESCRIPTION: *Operator to Stop the affected or all Circulating Water Pump(s) in 10 minutes Without A Flood watch*

PROCEDURAL SUPPORT DETERMINATION:

STEPS 1 & 2: Is the post-initiator human action supported by written procedures? Circle yes or no below.

Yes: List Applicable Procedures: *SO23-15-57.C (page 139), "Annunciator Panel 57C, Vital Bus Power"*

No: Assign Total Failure Probability (F_T) = 1.0.

REQUIRED TIME RELATIONSHIP DETERMINATION:

STEP 3: Determine maximum allowable time:

Maximum Allowable Time (T_m) = *10 minutes*

Identify method of determining T_m (Judgement,, RETRAN): *M-120.15, Rev. 6-Plant Flooding Analysis Review.*

STEPS 4 - 8: Determine the diagnostic time:

Post-diagnosis Action Time (T_a) = *1 minute*

Identify method of determining T_a (Judgement, walk-thru, simulator, etc): *Simulator exercise- E-mail Van Fisher to Walter Marsh dated 9/30/93 "Operator Response to Flooding".*

Available Diagnosis Time (T_d) = T_m - T_a = *10 - 1 = 9 minutes*

Assumptions: First Alarm "Turbine Bldg.. Flooding" window 57C57 will be annunciated in 2 seconds in the control room. During the next minutes several alarms such as the Turbine Bldg. sump alarm and ground alarms will be annunciated (MCC BB,BM,BW,&BK) in CR. Alarm Response Instruction procedure SO23-15-57.C "Turbine Bldg.. Flooding" will direct the operator with the required response.

DIAGNOSIS HEP DETERMINATION:

STEP 9:

9a) Select the initial diagnosis HEP from Figure 7-1 or Table 8-2 (NUREG/CR-4772).

$HEP_{initial}$ = *0.15 Using Median Joint HEP Figure 7-1(NUREG/CR-4772). The ARP's are being practiced in simulator requalification exercises.*

9b) Is more than 1 abnormal event involved as defined in Table 8-1, Step 9b? **Yes** **No**
If yes, adjust HEP per Step 9B (Table 8-1) and Table 8-2 & 8-4.

$HEP_{adjusted}$ = *0.15*

9c) Adjust HEP based on Table 8-3 guidelines: (Circle one) Upper Lower Nominal

$HEP_{initial}$ = *0.15*

9d) Is diagnosis HEP driven by symptom oriented EOI? (Circle one) **Yes** **No**
If 'yes,' adjust HEP to lower bound (Figure 7-1).

$HEP_{adjusted}$ = *0.15*

9e) Does HEP involve knowledge of critical RCS/Containment parameters? (Circle one) **Yes** **No**

If no, go to step 9g. If parameters are committed to memory, use lower bound values in Figure 7-1 or Table 8-2. Otherwise use nominal values. Use Table 8-3 to adjust the new values, as appropriate.

$HEP_{adjusted}$ = _____ (Circle one) **Lower** **Nominal**

9f) Not applicable.

9g) Is diagnosis error for HEP credible? (Circle one) **Yes** No

If 'yes,' write last adjusted HEP from Steps 9a - 9e as the final diagnosis HEP below and continue to Step 10. If 'no,' assign 'Final Diagnosis HEP' = 0.0 and discuss below.

Final Diagnosis HEP (median) = *0.15* (EF=10)

Final Diagnosis HEP (mean) = *0.3995274*

Assumptions: _____

POST-DIAGNOSIS HEP DETERMINATION:

STEP 10: As defined in Step 10 of Table 8-1, identify type of post-diagnosis task and stress level:

(Circle one) **Dynamic** Step-by-step

(Circle one) Extremely high **Moderately high**

Based on type of task and stress level, select HEP (s) for post-diagnosis action HEP(s) from Table 8-1. [Note: If time stress is present or if this task is required as a result of an ineffective initial task, assess applicability of doubling rule (Step 10g, Table 8-1). If yes, discuss in assumptions below.]

Post-Diagnosis Action HEP(s) (median) = *0.05(initial error) x 0.5(checker) = 0.025 Table 8-5, Item #4, Table 8-5, Item # 7*

Post-Diagnosis Action HEP(s) (mean) = *0.0665879*

Assumptions: _____

TOTAL FAILURE PROBABILITY (F_T) DETERMINATION:

STEP 11: Perform step 11 of Table 8-1 using mean values:

F_T = Final Diagnosis HEP + Post-Diagnosis Action HEP(s) = *0.3995274 + 0.0665879 = 0.47* *EF = 10*
[Note: If the calculated value of F_T exceeds 1.0, use 1.0.]

Note: *A value of 0.5 was used in the Event Tree.*

Prepared by: Z. S. Roldan

Date: 5-31-96

Checked By: [signature]

Date: 5-31-96

*NOTE: For all figures and tables, refer to NUREG/CR-4772. "STEPS" refer to Table 8-1 of NUREG/CR-4772.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes **With a Flood Watch**
BASIC EVENT/ EVENT TREE:	OP / SO2CW5, SO2CW6 & SO2CW7 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

AND POST-INITIATOR HUMAN ERROR PROBABILITY

CALCULATION WORKSHEET

HRA WORKSHEET 2

ORIGINATED BY:	Zoto S. Polen	5-31-96
	(Nuclear Safety Group)	**Date**
REVIEWED BY:	Gary Chung	5-31-96
	(NSG Reviewer)	**Date**
REVIEWED BY:	Roger Grato	5-31-96
	(Nuclear Training-Operations)	**Date**
APPROVED BY:	Ms Mahamed	6/18/96
	(NSG RM Supervisor)	**Date**

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes With a Flood Watch.
BASIC EVENT/ EVENT TREE:	OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

I. INTRODUCTION

This human reliability analysis (HRA) is to evaluate the human actions related to the Barrier Control Program PRA for the Safety Equipment Building in the event of a Circulating Water System failure with a floodwatch posted .

II. ACCIDENT SEQUENCES INVOLVED:

The accident sequence involved is the Circulating Water System (CWS) pipe failure resulting in flooding in the turbine building. CWS flooding in one unit will impact both units and could cause a turbine trip.

Based on transient flood calculations[1], in the event of a CWS flood in the turbine building, if the CWS pumps are stopped in about 10 minutes, the transient flood level rises to elevation 8'11", which is above the elevation of the bottom of barriers between the SEB and turbine building (excluding block walls).

However, even if all watertight doors between the SEB and turbine building are open, less than 5000 ft^3 of water enters the SEB. This amount would not cause flooding of any non-flood qualified safety-related equipment.

III. DESCRIPTION OF HUMAN ACTIONS:

The human action involved is for the operator, with the help of a floodwatch, to properly diagnose the event, identify the location of the break and stop the appropriate or all Circulating Water pumps in 10 minutes. Per the Alarm Response Procedure, SO23-15-57.C, the associated response would be to secure the affected pump(s) or isolate the source of leakage to reduce further flooding. It may be necessary to stop all four Circ Water Pumps to terminate the flooding event.

IV. TIME LINE:

Operations has evaluated the expected response of operating crews to a flooding event initiated due to failure of a Circulating Water Pump discharge expansion bellows rupturing in the Unit 2 Turbine Building using the simulator

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes With a Flood Watch.
BASIC EVENT/ EVENT TREE: OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree	

OPERATOR ACTION SUMMARY DATA SHEET

(no floodwatch was included). The following were the results (reference E-mail from Van Fisher to Walter Marsh dated 9/30/93:

Description of Scenario

Time to first indication (or annunciation) (T_i):

T = 0 minutes	Circulating Water Pump 2MP118 Water Box Outlet expansion bellows ruptures. (Operations selected the outlet because it makes identification of affected CWS more difficult in the Control Room and in the field). **At this point the floodwatch is expected to immediately notify the control room of the event, describing the flood and the approximate location of the water source.**
T(Ti)=~2 secs	First alarm annunciated in the Control Room, Turbine Building Flooding Alarm.
T = ~3 minutes	Second set of alarms annunciated in the Control Room, Turbine Building Sump Hi/Hi level and Blowdown Processing System (BPS) Trouble alarm.
T = ~4.5 minutes	480 Volt ground alarms on MCC's BB. BM, BW and BK.
T = ~5 minutes	Supply breakers to MCC's BB, BM, BW and BK open on overcurrent.
T = ~6 minutes	Non-1E Instrument Bus Failure due to submergence of 2Q069. Main Generator AVR A trips due to submergence of Main Generator PT secondary circuits.
T = ~9 minutes	All Instrument Air Compressors relay will actuate due to submergence of motor intake.
T = ~9.5 minutes	Main Generator Relays (Main Turbine Trip) will actuate from Stator Ground due to submergence of Main Generator PT primary circuits.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes With a Flood Watch.
BASIC EVENT/ EVENT TREE:	OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

Field Report Script

T = 0 Request for inspection of turbine building to locate reason for flooding alarm. **At this point the floodwatch is expected to immediately notify the control room of the event, describing the flood and the approximate location of the water source.**

T = 2 minutes Report that large amount of water at 7' as can be seen from the 30' elevation of the TB. Water level is rising. Source unknown. (If the inlet bellows had ruptured associated with south end, the field operator could report the specific water box affected. This would have made the scenario too easy).

T = ~3 minutes Operator still on 30' passes center of condenser, vicinity of water box outlets, and reports large amounts of water shooting from water box outlet MOV area - cannot tell which one.

T = ~4 minutes Reports that north end is also not leaking, that the water is coming from the water box outlet area, cannot tell which one.

Conclusions

- the operators checked the Circulating Water Pump instrumentation (water box differential pressure, pump amperage, condenser vacuum) within a few minutes of receipt of the flooding alarm. If an inlet bellows had ruptured, the water box DP would have dropped indicating which CW pump to stop.
- operators requested field inspection within 30 seconds of flooding alarm receipt. It is reasonable to assume if an inlet bellows had ruptured, it would be identified by the field report within 5 minutes. A floodwatch would report the rupture in <1 minute.
- Therefore, operators will stop the affected CW pump in less than 10 minutes.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes With a Flood Watch.

BASIC EVENT/ EVENT TREE: OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

This E-mail discussion references the outlet water box, which renders diagnosis of which Circ Water pump to isolate more difficult. This bounds the diagnosis likelihood of an inlet water box rupture. Flood volumes from an outlet water box rupture are less severe than volumes from an inlet water box rupture.

Maximum allowable time (T_m) :

~ 10 minutes Both trains of ECCS & CCW would remain available.

Post-diagnosis action time (T_a) :

<1 minute To push the stop button of applicable or all Circulating Water pump(s).

Diagnosis Time ($T_d = T_m - T_a - T_i$) :

~9 minutes

V. COMPETING ACTIONS:

Operator will be investigating multiple alarms annunciated in the Control Room such as the first set of alarm "Turbine Building Flooding" , the second set of alarms "Turbine Bldg. sump Hi/Hi level and BPS Trouble" alarm, 480 V MCC ground alarms, low condenser vacuum, and others that may come up.

VI. PRECEDING RELATED ACTIONS:

None.

VII. CONSEQUENCES OF FAILING TO PERFORM ACTION:

Failing to perform this action in about 10 minutes will result in a loss of all three CCW pumps and/or one or both trains of HPSI and LPSI pumps if SEB barriers are breached.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes With a Flood Watch.
BASIC EVENT/ EVENT TREE: OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree	

OPERATOR ACTION SUMMARY DATA SHEET

VIII. CONSEQUENCES OF PERFORMING ACTION:

Operator action to stop the appropriate or all of the CW pump(s) in about 10 minutes will prevent submergence of the CCW pumps and/or HPSI and LPSI pump(s) in the SEB.

IX. CREW TRAINING AND EXPERIENCE:

[Provide ranking of 0 thru 5 (0 being none, 1 being poor or not practiced, 5 being very good)]

	SIMULATOR	CLASSROOM	PLANT EXPER.
IDENTIFY	5*	5*	1
DIAGNOSIS	5*	5*	1
RESPONSE	5*	5*	1

* The Alarm Response Instruction procedure is practiced regularly in the simulator training. Degraded Circulating Water System condition is also being practiced in the simulator training.

X. CLARITY OF APPLICABLE PROCEDURES:

There are procedures written that can be used related to this event: Alarm Response Procedure SO23-15-57.C, Turbine Bldg. Flooding.

XI. AVAILABILITY OF RELEVANT INDICATIONS:

Cues For Operator Action:

First alarm in 2 seconds after the event - Turbine Building flooding alarm.

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes With a Flood Watch.
BASIC EVENT/ EVENT TREE: OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree	

OPERATOR ACTION SUMMARY DATA SHEET

Indicators Used:

"57C57 TURBINE BLDG FLOODING" alarm.
Upon receipt of this alarm, the required action per the ARP is to send an operator to the 7' Turbine Building and investigate the source of this alarm. It is expected that the CRS will send help to the operators in the field as necessary. The procedure also mentioned to inspect the Main Condenser in the area of the Circulating Water Inlet and Outlet.

Indicator Availability/Adequacy:

The TB flooding alarm indication plus the floodwatch, will provide the CR operator some verification as to the relative location of the break source(i.e. which Unit) and description of the volume of this flood.

XII. CONSIDERATIONS FOR "LOCAL" ACTIONS:

- Is required action proceduralized?

  Yes. SO23-15-57.C procedure states, to send an operator to the 7' Turbine Bldg. and investigate the cause of the alarm.

- How accessible is the component from the control room? Considering distance and number of security doors, estimate time to reach component from the control room.

  The floodwatch will report large amount of water in <1 minute.

- Is action considered to be relatively simple or complex?

  Relatively simple.

- Are any special tools required (keys, wrenches, etc.)? If so, will they be readily accessible during the accident sequence?

  None.

- Will performance of the action require entering a harsh environment

where protection clothing or equipment is necessary?

No.

- Are there any unique aspects of the action which could affect the likelihood of successful completion (i.e., requires more than one person, must be performed concurrent with other actions, requires communication with the control room, etc.)?

  No.

XIII. COMMUNICATIONS AND OPERATOR AVAILABILITY:

Normal means of communications should be available.

XIV. OPERATOR OVERSIGHT/CHECKING:

It is expected that the Control Room Supervisor and the Shift Superintendent (SS) will be around and provide oversight and second check to the NCO and/or NACO.

XV. STRESS LEVEL:

A moderately high stress level is expected.

XVI. SPECIFIC QUESTIONS ABOUT ACTION:

None.

XVII. OTHER INSIGHTS:

None.

XVIII. REFERENCES:

1 Calculation M-120.15, Rev. 6, "Plant Flooding Analysis Review".

2 SO23-15-57.C, Rev. 1 - Annunciator Panel 57C, Vital Bus Power

OPERATOR ACTION:	Operator to Stop the affected or all Circulating Water System Pumps in 10 Minutes <u>With</u> a Flood Watch.

BASIC EVENT/ EVENT TREE: OP / SO2CW5, SO2CW6 and SO2CW7 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

3 E-mail from Van Fisher to Walter Marsh dated 9/30/93 - Operator Response to Flooding

POST-INITIATOR HUMAN ERROR PROBABILITY CALCULATION WORKSHEET

BASIC EVENT NAME: *OP - SO2CW5/SO2CW6/SO2CW7 Event Tree*

HUMAN ACTION DESCRIPTION: *Operator to Stop the affected or all Circulating Water Pump(s) in 10 Minutes With A Flood Watch*

PROCEDURAL SUPPORT DETERMINATION:

STEPS 1 & 2: Is the post-initiator human action supported by written procedures? Circle yes or no below.

Yes: List Applicable Procedures: *SO23-15-57.C (page 139), "Annunciator Panel 57C, Vital Bus Power"*

No: Assign Total Failure Probability (F_T) = 1.0.

REQUIRED TIME RELATIONSHIP DETERMINATION:

STEP 3: Determine maximum allowable time:

Maximum Allowable Time (T_m) = *10 minutes*

Identify method of determining T_m (Judgement,, RETRAN): *M-120.15, Rev. 6-Plant Flooding Analysis Review.*

STEPS 4 - 8: Determine the diagnostic time:

Post-diagnosis Action Time (T_a) = *1 minute*

Identify method of determining T_a (Judgement, walk-thru, simulator, etc): *Simulator exercise- E-mail Van Fisher to Walter Marsh dated 9/30/93 "Operator Response to Flooding".*

Available Diagnosis Time (T_d) = T_m - T_a = *10 - 1 = 9 minutes*

Assumptions: It is expected that at T=0, the floodwatch would notify the CR of the event. First Alarm "Turbine Bldg. Flooding" window 57C57 will be annunciated in 2 seconds in the control room. During the next minutes several alarms such as the Turbine Bldg. sump alarm and ground alarms will be annunciated (MCC BB,BM,BW,&BK) in CR. Alarm Response Instruction procedure SO23-15-57.C "Turbine Bldg. Flooding" will direct the operator to do the required response.

DIAGNOSIS HEP DETERMINATION:

STEP 9:

9a) Select the initial diagnosis HEP from Figure 7-1 or Table 8-2 (NUREG/CR-4772).

$HEP_{initial}$ = *0.15 Using Median Joint HEP Figure 7-1(NUREG/CR-4772). The use of ARP's are being stressed in simulator requalification exercises.*

9b) Is more than 1 abnormal event involved as defined in Table 8-1, Step 9b? **Yes** **No**
If yes, adjust HEP per Step 9B (Table 8-1) and Table 8-2 & 8-4.

$HEP_{adjusted}$ = *0.15 (EF=10)*

9c) Adjust HEP based on Table 8-3 guidelines: (Circle one) Upper Lower Nominal
$HEP_{initial}$ = *0.015 (Because of the floodwatch, the event is reported immediately to the CR.)*

9d) Is diagnosis HEP driven by symptom oriented EOI? (Circle one) **Yes** **No**
If 'yes,' adjust HEP to lower bound (Figure 7-1).

$HEP_{adjusted}$ = *0.015*

9e) Does HEP involve knowledge of critical RCS/Containment parameters? (Circle one) **Yes** **No**

If no, go to step 9g. If parameters are committed to memory, use lower bound values in Figure 7-1 or Table 8-2. Otherwise use nominal values. Use Table 8-3 to adjust the new values, as appropriate.

$HEP_{adjusted}$ = _____ (Circle one) **Lower** **Nominal**

9f) Not applicable.

9g) Is diagnosis error for HEP credible? (Circle one) **Yes** No

If 'yes,' write last adjusted HEP from Steps 9a - 9e as the final diagnosis HEP below and continue to Step 10. If 'no,' assign 'Final Diagnosis HEP' = 0.0 and discuss below.

Final Diagnosis HEP (median) = *0.0 15*

Final Diagnosis HEP (mean) = *0.04 (EF=10)*

Assumptions: *The floodwatch will provide general location of the break source and feedback, such as which Unit is affected.*

POST-DIAGNOSIS HEP DETERMINATION:

STEP 10: As defined in Step 10 of Table 8-1, identify type of post-diagnosis task and stress level:

(Circle one) **Dynamic** Step-by-step

(Circle one) Extremely high **Moderately high**

Based on type of task and stress level, select HEP (s) for post-diagnosis action HEP(s) from Table 8-1. [Note: If time stress is present or if this task is required as a result of an ineffective initial task, assess applicability of doubling rule (Step 10g, Table 8-1). If yes, discuss in assumptions below.]

Post-Diagnosis Action HEP(s) (median) = *0.05(initial error) x 0.05(checker) = 0.0025 Table 8-5, Item #4, Table 8-5, Item # 9*

Post-Diagnosis Action HEP(s) (mean) = *0.00665879*

Assumptions: The flood watch will provide positive identification of the event and feedback.

TOTAL FAILURE PROBABILITY (F_T) DETERMINATION:

STEP 11: Perform step 11 of Table 8-1 using mean values:

F_T = Final Diagnosis HEP + Post-Diagnosis Action HEP(s) = *0.04 + 0.00665879* = *0.047* *EF = 10*
[Note: If the calculated value of F_T exceeds 1.0, use 1.0.]

Note: *A value of 0.05 was used.*

Prepared by: Z. S. Roldan

Date: 5/31/96

Checked By: Gary Olney

Date: 5-31-96

*NOTE: For all figures and tables, refer to NUREG/CR-4772. "STEPS" refer to Table 8-1 of NUREG/CR-4772.

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break.
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

AND POST-INITIATOR HUMAN ERROR PROBABILITY

CALCULATION WORKSHEET

HRA WORKSHEET 3

ORIGINATED BY:	Zaila S. Golden	/	5-31-96
	(Nuclear Safety Group)	/	**Date**
REVIEWED BY:	Gary Chuang	/	5-31-96
	(NSG Reviewer)	/	**Date**
REVIEWED BY:	Peggy Grabe	/	5-31-96
	(Nuclear Training-Operations)	/	**Date**
APPROVED BY:	M K Mohamed	/	6/18/96
	(NSG RM Supervisor)	/	**Date**

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break .
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

I. INTRODUCTION:

This human reliability analysis (HRA) is to evaluate the human actions related to the Barrier Control Program PRA for the Safety Equipment Building.

II. ACCIDENT SEQUENCES INVOLVED:

The accident sequence pertains to an event resulting in a failure of Shutdown Cooling System(SDCS) in the Safety Equipment Building (SEB) and the only source of inventory make-up to prevent core uncovery are the Charging Pumps during Modes 4, 5 and 6(level<23'). Mid-loop condition (which is the most restrictive) is assumed in this case. Time-to-core uncovery is ~2.5 hours[2,5] in the event of a loss of SDC while at mid-loop.

Failure of the SDCS can be caused by flooding or auxiliary steam line break. The flooding event can be due to Circulating Water System(CWS) pipe break, Component Cooling Water (CCW) pipe break, Saltwater Cooling (SWC) pipe break or Fire Suppression pipe break. The steam line break is due to auxiliary steam line break at the corridor of the 8' SEB. If the barriers are impaired during any of these events, the hazard (flood or steam) will travel or propagate into the SEB which can cause failure of CCW pumps or LPSI, HPSI, CS pumps.

III. DESCRIPTION OF HUMAN ACTIONS:

The human action involved is to inject water to the RCS using the Charging Pumps[2] within 2.5 hours. This is accomplished by aligning two manual valves and one of two motor operated valve(MOV) at CR57 to the RCS and starting the Charging Pumps at CR58. The Loss of SDC procedure SO23-13-15 Att. 5, Section 2.4, describes the actions required.

Charging Pumps can be started at CR58:
2(3) HS-9228-1, P190
2(3) HS-9229-1(2), P191
2(3) HS-9230-2, P192

Any one of the MOV's can be opened at CR57:
2(3)HV9420
2(3)HV9434

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break .
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

Manual valves:

S2(3)1208MU065	Unit 2 - Room 106A, Unit 3 - Room 107J in Radwaste Area
S2(3)1204MU154	Room 209, Penetration Area Elev. 30, near Penetration 71
S2(3)1208MU005	Room 209, Penetration Area Elev. 30, near Penetration 49

Note: Per SO23-13-15 Att. 5 Section 2.4.7 or 2.4.8, MU065 will be opened together with either MU154 or MU005 (HPSI Header 1 or 2, respectively).

IV. TIME LINE:

Time to first indication (or annunciation) (T_i):

Approximately 5 minutes after a pipe break (e.g. CCW, Circ Water pipe break), an alarm will be annunciated in the CR57, "SEB Train A or B Flooding" at 57C46 or 57C56.

If the SDCS fails (such as the LPSI pumps and/or the associated CCW pumps) due to a steam line break, several alarms will be annunciated in CR57C and CR64A.

The alarms and indications listed below will help the operator diagnose the loss of SDC:

- Reactor Core exit temperature is indicated on QSPDS Page 633 for CETs and Page 721 for HJTCs.
- RWLP thermocouple reference temperature is a measure of RX Core temperature just above the Upper Fuel Alignment Plate.
- CR57 2(3)TI-0303-1, 2(3)TI-0303-2, 2(3)TR-0351A - SDCS Temperature
- 57C39 "SDCS FLOW LO"
- LPSI/CS Motor Amperage Fluctuating

For SEB flooding, the following alarms will annunciate in the CR:

- 57C46 "SAFETY EQPT BLDG TRAIN A FLOODING"
- 57C56 "SAFETY EQPT BLDG TRAIN B FLOODING"

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break .
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

If CCW fails, the following alarms will annunciate in the CR57:

- 64A37 "SHUTDOWN HX TRAIN A CCW FLOW LO"
- 64A38 "SHUTDOWN HX TRAIN B CCW FLOW LO"
- 64A39 "CCW PUMP MOTOR BRG TEMP HI"

Maximum allowable time (T_m) :

2.5 hours

Post-diagnosis action time (T_a) :

25 minutes (includes field alignment of Charging pumps, if necessary)

Diagnosis Time ($T_d = T_m - T_a - T_i$) :

$T_d = T_m - T_a - T_i$ = 2.5 hrs - 25 min - 5 min = 2 hrs

V. COMPETING ACTIONS:

Isolation of the initiating event, such as; CCW line break, CWS pipe break, or steam line break.

VI. PRECEDING RELATED ACTIONS:

None.

VII. CONSEQUENCES OF FAILING TO PERFORM ACTION:

Failing to perform this action within 2.5 hours will eventually lead to core uncovery.

VIII. CONSEQUENCES OF PERFORMING ACTION:

Operator action to inject water to RCS within 2.5 hours will prevent core uncovery.

IX. CREW TRAINING AND EXPERIENCE:

[Provide ranking of 0 thru 5 (0 being none, 1 being poor or not practiced, 5 being very good)]

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break .
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

	SIMULATOR	CLASSROOM	PLANT EXPER.
IDENTIFY	5*	5*	1
DIAGNOSIS	5*	5*	1
RESPONSE	5*	5*	1

* The Alarm Response Instruction procedure is practiced regularly in the simulator training.

X. CLARITY OF APPLICABLE PROCEDURES:

SO23-13-15 Loss of Shutdown Cooling System is reasonably clear procedure.

XI. AVAILABILITY OF RELEVANT INDICATIONS

All relevant indications are available such as SDC pump flow, LPSI pump amperage, etc..

XII. CONSIDERATIONS FOR "LOCAL" ACTIONS:

- Is required action proceduralized?

  Yes. SO23-15-57.C procedure states, to dispatch an operator to the affected area and investigate. The Loss of SDC procedure (SO23-13-15) specifies actions necessary in aligning the Charging Pumps for injection including the manual valves.

- How accessible is the component from the control room? Considering distance and number of security doors, estimate time to reach component from the control room.

  In ~25 minutes the operator would be able to align the charging pumps per SO23-13-15. This includes travel time to reach the valve location and manipulate the valves(2" line).

- Is action considered to be relatively simple or complex?

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break .
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

Relatively simple.

- Are any special tools required (keys, wrenches, etc.)? If so, will they be readily accessible during the accident sequence?

  None.

- Will performance of the action require entering a harsh environment where protection clothing or equipment is necessary?

  No.

- Are there any unique aspects of the action which could affect the likelihood of successful completion (i.e., requires more than one person, must be performed concurrent with other actions, requires communication with the control room, etc.)?

  No.

XIII. COMMUNICATIONS AND OPERATOR AVAILABILITY:

All normal means of communications are expected to be available.

XIV. OPERATOR OVERSIGHT/CHECKING:

It is expected that the Control Room Supervisor and the Shift Superintendent (SS) will be around and provide oversight and second check to the NCO and/or NACO.

XV. STRESS LEVEL:

Moderately high stress level is expected.

XVI. SPECIFIC QUESTIONS ABOUT ACTION:

None.

OPERATOR ACTION:	Operator to Align Charging Pumps to the RCS in 2.5 hours given loss of SDC caused by flooding or steam line break .
BASIC EVENT/EVENT TREE:	OP/SO2CC7,SDRCC5; OP1/SO2CW3,SO2CW6; OP2/SO2CC5 ALI/SO2SL3; D/SO2FR2; E/SO2SL5; G/SO2CC9 Barrier Event Tree

XVII. OTHER INSIGHTS:

None.

XVIII. REFERENCES:

1 SO23-15-57.C, Rev. 1 - Annunciator Panel 57C, Vital Bus Power

2 SO23-13-15, Rev. 3 - Loss of Shutdown Cooling, AOI

3 SO23-15-61.A, Rev. 1 - Annunciator Panel 61A, Firewater/Rad Monitors

4 P&ID 40112C

5 Calculation N-0220-029, Rev. 0, dated May 1993 RCS Heatup Following Loss of SDC.

POST-INITIATOR HUMAN ERROR PROBABILITY CALCULATION WORKSHEET

BASIC EVENT NAME:	HUMAN ACTION DESCRIPTION:
OP-SO2CC7/SDRCC5; OP1-SO2CW3/SO2CW6 *OP2-SO2CC5 ; ALI-SOSL3; D-SO2FR2* *E-SOSL5; G-SO2CC9*	Operator to Align Charging Pumps to the RCS in 2.5 hours Given Loss of SDC caused by Flooding or Steam Line Break

PROCEDURAL SUPPORT DETERMINATION:

STEPS 1 & 2: Is the post-initiator human action supported by written procedures? Circle yes or no below.

Yes: List Applicable Procedures: *SO23-15-57.C , "Annunciator Panel 57C, Vital Bus Power"* ; SO2-13-15-Loss of SDC.

No: Assign Total Failure Probability (F_T) = 1.0.

REQUIRED TIME RELATIONSHIP DETERMINATION:

STEP 3: Determine maximum allowable time:

Maximum Allowable Time (T_m) = *2.5 hours*

Identify method of determining T_m (Judgement,, RETRAN): *SO23-13-15 Loss of SDC; Calculation # M-120-15*

STEPS 4 - 8: Determine the diagnostic time:

Post-diagnosis Action Time (T_a) = *30 minutes*

Identify method of determining T_a (Judgement, walk-thru, simulator, etc): *Judgement, simulator and per procedures SO23-13-15, SO23-15-57.C & SO23-15-64.A.*

Available Diagnosis Time (T_d) = T_m - T_a = *2.5 hrs - 30 mins = 2 hours*

Assumptions:

DIAGNOSIS HEP DETERMINATION: (start here)

STEP 9:

9a) Select the initial diagnosis HEP from Figure 7-1 or Table 8-2 (NUREG/CR-4772)..

$HEP_{initial}$ = ***6E-5*** *Using Median Joint HEP Figure 7-1(NUREG/CR-4772). The use of ARP's & AOI's are being stressed in simulator requalification exercises.*

9b) Is more than 1 abnormal event involved as defined in Table 8-1, Step 9b? **Yes** **No**
If yes, adjust HEP per Step 9B (Table 8-1) and Table 8-2 & 8-4.

$HEP_{adjusted}$ = *6E-5*

9c) Adjust HEP based on Table 8-3 guidelines: (Circle one) Upper Lower Nominal

$HEP_{initial}$ = *6E-5*

9d) Is diagnosis HEP driven by symptom oriented EOI? (Circle one) **Yes** **No**
If 'yes,' adjust HEP to lower bound (Figure 7-1).

$HEP_{adjusted}$ = *6E-5*

9e) Does HEP involve knowledge of critical RCS/Containment parameters? (Circle one) **Yes** **No**

If no, go to step 9g. If parameters are committed to memory, use lower bound values in Figure 7-1 or Table 8-2. Otherwise use nominal values. Use Table 8-3 to adjust the new values, as appropriate.

$HEP_{adjusted}$ = _____ (Circle one) **Lower** **Nominal**

9f) Not applicable.

9g) Is diagnosis error for HEP credible? (Circle one) Yes **NO**

If 'yes,' write last adjusted HEP from Steps 9a - 9e as the final diagnosis HEP below and continue to Step 10. If 'no,' assign 'Final Diagnosis HEP' = 0.0 and discuss below.

Final Diagnosis HEP (median) = *0.0*

Final Diagnosis HEP (mean) = *0.0*

Assumptions: *Diagnosis error is considered not credible because of numerous indications such flooding alarm in the SEB, SDC pump low flow, SDC pump amperage fluctuating. These indications will direct the operator to utilize SO23-13-15, LOSS OF SDC.*

POST-DIAGNOSIS HEP DETERMINATION:

STEP 10: As defined in Step 10 of Table 8-1, identify type of post-diagnosis task and stress level:

(Circle one) Dynamic **Step-by-step**

(Circle one) Extremely high **Moderately high**

Based on type of task and stress level, select HEP (s) for post-diagnosis action HEP(s) from Table 8-1. [Note: If time stress is present or if this task is required as a result of an ineffective initial task, assess applicability of doubling rule (Step 10g, Table 8-1). If yes, discuss in assumptions below.]

Post-Diagnosis Action HEP(s) (median) = *1E-3(initial error) x 0.2(checker) = 2E-4 Table 8-5, Items #10 &6*

Post-Diagnosis Action HEP(s) (mean) = *5E-4*

Assumptions: Post-Diagnosis action of 0.2 is allowed because of time available (2hrs).

TOTAL FAILURE PROBABILITY (F_T) DETERMINATION:

STEP 11: Perform step 11 of Table 8-1 using mean values:

F_T = Final Diagnosis HEP + Post-Diagnosis Action HEP(s) = *0.0 + 5E-4 = 5E-4 EF = 10*

[Note: If the calculated value of F_T exceeds 1.0, use 1.0.]

Note: *A value of 1E-3 was chosen and was used in the applicable Event Trees.*

Prepared by: Z. S. Roldan

Date: 5-9-96

Checked By: Gary Chung

Date: 5-31-96

*NOTE: For all figures and tables, refer to NUREG/CR-4772. "STEPS" refer to Table 8-1 of NUREG/CR-4772.

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC. .
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

AND POST-INITIATOR HUMAN ERROR PROBABILITY

CALCULATION WORKSHEET

HRA WORKSHEET 4

ORIGINATED BY: Zoila S. Polo / 5-31-96
(Nuclear Safety Group) / Date

REVIEWED BY: Gary Elmer / 6-18-96
(NSG Reviewer) / Date

REVIEWED BY: Roger Grabo approved per telecon / 5-31-96
(Nuclear Training-Operations) / Date

APPROVED BY: M Mahan / 6/18/96
(NSG RM Supervisor) / Date

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

I. INTRODUCTION:

This human reliability analysis (HRA) is to evaluate the human actions related to the Barrier Control Program PRA for the Safety Equipment Building while the affected Unit (2 or 3) is in Mode 6 and the RCS water level is >23'.

II. ACCIDENT SEQUENCES INVOLVED:

The accident sequence pertains to an event resulting in failure of Shutdown Cooling System (SDC), High Pressure Safety Injection (HPSI), Containment Spray (CS) and Component Cooling Water (CCW) pumps in the Safety Equipment Building (SEB) while the affected Unit is in Mode 6 with the RCS water level >23'.

Failure of the SDCS can be caused by flooding or auxiliary steam line break in the SEB corridor. The flooding event can be due to Circulating Water System(CWS) breaks, Component Cooling Water (CCW) pipe break or Fire Suppression pipe break in the SEB.

The most limiting case is when the fuel is in the core prior to core offload. The only alternate method of core cooling during this configuration is to align Spent Fuel Pool Cooling[5,6] to the RCS. Time to boiling in the refueling cavity during this configuration (about 10 days after shutdown) is about 12 hours[9] in the event of a loss of core cooling.

The total time available to the operator to diagnose and take action to align SFP pump suction to the RCS was conservatively assumed to be the time to bulk boiling in the refueling pool (i.e., 12 hours). However, since the end state is core damage (core uncovery), the actual time available to the operator is greater than 12 hours. Once this alignment is performed, the RCS and the SFP inventories circulate, the time to boiling increases to about 28 hours even if CCW is not available.

III. DESCRIPTION OF HUMAN ACTIONS:

The CR operator will refer to AOI SO23-13-15(Loss of SDC) during the Loss of

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

SDC event and will be directed to do OI SO23-3-2.6.1(CS/SDC/SFP Cooling Crosstie Operation) in aligning SFP Cooling to Recirculate the RCS. The following human actions are necessary to provide an alternate cooling to the RCS:

a) Align Spent Fuel Pool Cooling to recirculate the RCS per OI SO23-3-2.6.1 Attachments 15 & 16. Based on interviews with the operations personnel, the estimated time for this action was 3 to 4 hours. This time was conservatively doubled to 8 hours to include a checker. Time is also available for a second independent checker if the initial action failed.

b) Align the SFP heat exchangers from the opposite Unit CCW. This action would be required if CCW failed, and can be accomplished by using SO23-13-23 Attachment 2 or 3. This action follows item a) above, and as stated in Section II, it may be completed within 28 hours. Operator failure probability to complete this action was judged to be negligible because four critical valve alignments are required to cross tie CCW to the opposite unit and 28 hours is available to perform these alignments.

To place the SFP pumps in the RCS recirculate mode, four critical valve alignments are required:
1) open 1201MU033 located in Penetration 9' elevation Rm 111
2) open 1219MU013 located in Radwaste Bldg 37' elevation Rm 305E
3) close 1219MU012 located in Fuel Handling Bldg elevation 63' Rm 411
4) open 1201MU994 located in Penetration 9' elevation Rm 111

If CCW also failed, to cross tie to the other unit's CCW system, four more critical valve alignments (within 28 hours) would be required:
5) open HV-6217 located in Radwaste Bldg elevation 50' Room 404A
6) open HV-6465 located in Radwaste Bldg elevation 50' Room 404A
7) open 1203MU100 located in Radwaste Bldg elevation 50' Room 406A
8) open 1203MU002 located in Radwaste Bldg elevation 50' Room 406A

IV. TIME LINE:

Time to first indication (or annunciation) (T_i):

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

Approximately 5 minutes (0.08 hrs) after a pipe break (e.g. CCW, Circ Water pipe break), an alarm will be annunciated in the CR57, "SEB Train A or B Flooding" at 57C46 or 57C56.

If the SDCS fails (such as the LPSI pumps and/or the associated CCW pumps) due to a steam line break, several alarms will be annunciated in CR57C and CR64A.

The alarms and indications listed below will help the operator diagnose the loss of SDC:

- Reactor Core exit temperature is indicated on QSPDS Page 633 for CETs and Page 721 for HJTCs.
- RWLP thermocouple reference temperature is a measure of RX Core temperature just above the Upper Fuel Alignment Plate.
- CR57 2(3)TI-0303-1, 2(3)TI-0303-2, 2(3)TR-0351A - SDCS Temperature
- 57C39 "SDCS FLOW LO"
- LPSI/CS Motor Amperage Fluctuating

For SEB flooding, the following alarms will annunciate in the CR:

- 57C46 "SAFETY EQPT BLDG TRAIN A FLOODING"
- 57C56 "SAFETY EQPT BLDG TRAIN B FLOODING"

If CCW fails, the following alarms will annunciate in the CR57:

- 64A37 "SHUTDOWN HX TRAIN A CCW FLOW LO"
- 64A38 "SHUTDOWN HX TRAIN B CCW FLOW LO"
- 64A39 "CCW PUMP MOTOR BRG TEMP HI"

Maximum allowable time (T_m) :

12 hours [9]

Post-diagnosis action time (T_a) :

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

In about 8 hours the operator will be able to accomplish the following alignment task: a) Align the Spent Fuel Pool Cooling to recirculate the RCS (per OI SO23-3-2.6.1 Attachments 15 & 16). Once the above task (a) is complete, the operator would complete the following task if CCW were failed: b) Align cooling to the SFP heat exchangers from the opposite Unit CCW per SO23-13-23 Attachment 2 or 3.

Diagnosis Time ($T_d = T_m - T_a - T_i$) :

$$T_d = 12 - 8 - .08 = 3.92 \text{ or } 3.9 \text{ Hours}$$

V. COMPETING ACTIONS:

Isolation of the initiating event, i.e. CCW line break, CWS pipe break, Aux. Steam Line break.

VI. PRECEDING RELATED ACTIONS:

None.

VII. CONSEQUENCES OF FAILING TO PERFORM ACTION:

Failing to perform this action within 12 hours will lead to bulk boiling in the refueling pool and is conservatively assumed to lead to core damage with no other recovery measure considered.

VIII. CONSEQUENCES OF PERFORMING ACTION:

Operator action to align SFP cooling to the RCS within 12 hours will provide an alternate method of cooling the core.

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

IX. CREW TRAINING AND EXPERIENCE:

[Provide ranking of 0 thru 5 (0 being none, 1 being poor or not practiced, 5 being very good)]

	SIMULATOR	CLASSROOM	PLANT EXPER.
IDENTIFY	5*	5*	1
DIAGNOSIS	5*	5*	1
RESPONSE	5*	5*	1

* The Alarm Response Instruction procedure is practiced regularly in the simulator training. Operators are familiar with this alignment (Ref: Based on an interview with an operator).

X. CLARITY OF APPLICABLE PROCEDURES:

All applicable procedures are clear procedures.

XI. AVAILABILITY OF RELEVANT INDICATIONS

All relevant indications are expected to be available.

XII. CONSIDERATIONS FOR "LOCAL" ACTIONS:

- Is required action proceduralized?

  Yes. SO23-15-57.C procedure instructs that an operator be dispatched to the affected area and investigate, then isolate source of leakage (if possible). In the event of loss of SDC, SO23-13-15(Loss of SDC) and SO23-3-2.6.1 provides a step-by-step procedure in aligning the SFP cooling system to the RCS.

- How accessible is the component from the control room? Considering distance and number of security doors, estimate time to reach component from the control room.

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

All of the equipment is within <30 minute reach, however it is assumed that it will take about 8 hours to complete the alignment necessary as mentioned in Section III. It is expected that due to the emergency situation that there will be several crews assisting in accomplishing this task. Also, once the event occurs, it is expected that Health Physics would be notified and provide the necessary support without delay.

If steam hazard reached the penetration area, it is expected that it will dissipate within one hour from the time of the accident. Similarly if the CWS flooding were to reach the penetration area, it is expected to recede below 9' 8" within one hour. The valves MU033 and MU994 are located in elevation 9' Penetration Building (about 2' above floor level, i.e., elevation 11') and will be accessible after one hour from the time of the event.

- Is action considered to be relatively simple or complex?

  Complex. However it is expected that several experienced and senior personnel would be involved, not only in the control room but also in carrying out the task. Since the affected unit is in Mode 6 with the refueling cavity level >23', restoring shutdown cooling is expected to be the highest priority.

- Are any special tools required (keys, wrenches, etc.)? If so, will they be readily accessible during the accident sequence?

  Keys will be required to unlock valves that are chained locked. These keys are all readily accessible in the CR area.

- Will performance of the action require entering a harsh environment where protection clothing or equipment is necessary?

  Yes, some valve locations are in high radiation areas and protective clothing is required. However, it is expected that once the event occurs, Health Physics would be notified and provide the necessary support without delay.

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

- Are there any unique aspects of the action which could affect the likelihood of successful completion (i.e., requires more than one person, must be performed concurrent with other actions, requires communication with the control room, etc.)?

  The operator action (as shown in SO23-3-2.6.1 Att. 15 & 16) requires more than one person. It is expected that procedural actions are being performed concurrent with other actions and requires communication with the control room. It is expected that several teams or crews will be sent out to perform the alignment. For example, two person team is performing electrical alignment and verification, while the other team is performing valve alignment and verification.

XIII. COMMUNICATIONS AND OPERATOR AVAILABILITY:

All normal means of communications are expected to be available.

XIV. OPERATOR OVERSIGHT/CHECKING:

It is expected that a two man team will provide action and checking of a task.

XV. STRESS LEVEL:

Moderately high stress level is expected initially.

XVI. SPECIFIC QUESTIONS ABOUT ACTION:

None.

XVII. OTHER INSIGHTS:

None.

XVIII. REFERENCES:

1 Calculation M-120.15, Rev. 6, "Plant Flooding Analysis Review"

OPERATOR ACTION:	Operator to Align SFP Cooling to the RCS within 12 hours given loss of SDC.
BASIC EVENT/EVENT TREE:	OP/SO2SL4,SO2SL6,SO2CC6,SO2C10,SO2FR3; OP1/SO2CW7,SO2CW4; OP2/SO2CC4; C/SO2FR6 Barrier Event Tree

OPERATOR ACTION SUMMARY DATA SHEET

2 Calculation N-0220-029, Rev. 0, dated May 1993 RCS Heatup Following Loss of SDC.

3 SO23-15-57.C, Rev. 1 - Annunciator Panel 57C, Vital Bus Power

4 SO23-13-15, Rev. 3 - Loss of Shutdown Cooling, AOI

5 SO23-3-2.6.1, Rev. 0 - CS/SDC/SFP Cooling Crosstie Operation

6 SO23-13-23, Rev. 1 - Loss of Spent Fuel Pool Cooling

7 SO23-3-2.11, Rev. 6 - Spent Fuel Pool Operations

8 SO23-15-61.A, Rev. 1 - Annunciator Panel 61A, Firewater/Rad Monitors

9 E-mail from R. C. Scott to M. E. Motamed dated 5/30/96, Time-to-boil after Loss of SDC 10 days after shutdown from full power.

POST-INITIATOR HUMAN ERROR PROBABILITY CALCULATION WORKSHEET

BASIC EVENT NAME:

OP-SO2SL4/SO2CC6/SO2C10;
OP1-SO2CW7/SO2CW4
OP2-SO2CC4; C-SO2FR6 Event Tree

HUMAN ACTION DESCRIPTION:
Operator to Aligns SFP Cooling to Recirculate the RCS within 12 hours

PROCEDURAL SUPPORT DETERMINATION:

STEPS 1 & 2: Is the post-initiator human action supported by written procedures? Circle yes or no below.

Yes: List Applicable Procedures: *SO2-13-15, Loss of SDC; SO23-15-57.C , "Annunciator Panel 57C, Vital Bus Power" ; SO23-3-2.6.1; SO23-13-23.*

No: Assign Total Failure Probability (F_T) = 1.0.

REQUIRED TIME RELATIONSHIP DETERMINATION:

STEP 3: Determine maximum allowable time:

Maximum Allowable Time (T_m) = *12 hours*

Identify method of determining T_m (Judgement,, RETRAN): *SO23-13-15,Loss of SDC ; E-mail from R.C.Scott to M.E.Motamed, Time-to-boil after Loss of SDC 10 days after shutdown from full power.*

STEPS 4 - 8: Determine the diagnostic time:

Post-diagnosis Action Time (T_a) = *8 hours*

Identify method of determining T_a (Judgement, walk-thru, simulator, etc): *Walkthru; interview with an operator; Procedures SO23-13-15, SO23-3-2.6.1, & SO23-13-23; Alarm Response Procedure SO23-15-57.C*

Available Diagnosis Time (T_d) = T_m - T_a = *12 - 8 = 4 hours*

Assumptions:

DIAGNOSIS HEP DETERMINATION: (start here)

STEP 9:

9a) Select the initial diagnosis HEP from Figure 7-1 or Table 8-2 (NUREG/CR-4772)..

$HEP_{initial}$ = ***4E-5*** *Using Median Joint HEP Figure 7-1(NUREG/CR-4772).*

9b) Is more than 1 abnormal event involved as defined in Table 8-1, Step 9b? **Yes** **No**
If yes, adjust HEP per Step 9B (Table 8-1) and Table 8-2 & 8-4.

$HEP_{adjusted}$ = *4E-5 (EF=30)*

9c) Adjust HEP based on Table 8-3 guidelines: (Circle one) Upper Lower Nominal

$HEP_{initial}$ = *4E-5*

9d) Is diagnosis HEP driven by symptom oriented EOI? (Circle one) **Yes** **No**
If 'yes,' adjust HEP to lower bound (Figure 7-1).

$HEP_{adjusted}$ = *4E-5*

9e) Does HEP involve knowledge of critical RCS/Containment parameters? (Circle one) **Yes** **No**

If no, go to step 9g. If parameters are committed to memory, use lower bound values in Figure 7-1 or Table 8-2. Otherwise use nominal values. Use Table 8-3 to adjust the new values, as appropriate.

$HEP_{adjusted}$ = _____ (Circle one) **Lower** **Nominal**

9f) Not applicable.

9g) Is diagnosis error for HEP credible? (Circle one) Yes **NO**

If 'yes,' write last adjusted HEP from Steps 9a - 9e as the final diagnosis HEP below and continue to Step 10. If 'no,' assign 'Final Diagnosis HEP' = 0.0 and discuss below.

Final Diagnosis HEP (median) = *0.0*

Final Diagnosis HEP (mean) = *0.0*

Assumptions: *Diagnosis error was judged not credible due to ample time available(4 hrs) in determining the cause of the event plus the numerous indications available.*

POST-DIAGNOSIS HEP DETERMINATION:

STEP 10: As defined in Step 10 of Table 8-1, identify type of post-diagnosis task and stress level:

(Circle one) Dynamic **Step-by-step**

(Circle one) Extremely high **Moderately high**

Based on type of task and stress level, select HEP (s) for post-diagnosis action HEP(s) from Table 8-1. [Note: If time stress is present or if this task is required as a result of an ineffective initial task, assess applicability of doubling rule (Step 10g, Table 8-1). If yes, discuss in assumptions below.]

Post-Diagnosis Action HEP(s) (median) = *2E-2(initial error) x 0.2(checker) x 0.2(2nd checker)= 8E-4 (EF=5)*

Table 8-5 Items 3 and 6, and judgement

Post-Diagnosis Action HEP(s) (mean) = *1.29 E-3*

Assumptions: It is assumed that there will be ample time to check and verify alignment given that Tmax= 12 hrs.

TOTAL FAILURE PROBABILITY (F_T) DETERMINATION:

STEP 11: Perform step 11 of Table 8-1 using mean values:

F_T = Final Diagnosis HEP + Post-Diagnosis Action HEP(s) = *0.0 + 1.29E-3* = ***1.29E-3***
[Note: If the calculated value of F_T exceeds 1.0, use 1.0]

*Note: A HEP of **1.5E-3 was used in the Event Tree.***

Prepared by: Z. S. Roldan

Date: 5-31-96

Checked By: Gary Cleary

Date: 6-18-96

*NOTE: For all figures and tables, refer to NUREG/CR-4772. "STEPS" refer to Table 8-1 of NUREG/CR-4772.