PSEG NUCLEAR L.L.C.
SALEM/OPERATIONS

2-EOP-SGTR-1 - Rev. 27

STEAM GENERATOR TUBE RUPTURE

- Biennial Review Performed: Yes ____ No √
- Change Package(s) and Affected Document Number(s) incorporated into this revision:
  DCP No. 80057587 **Rev. No.** 00 **AD No.** P050 **Rev. No.** 0
  DCP No. 80057587 **Rev. No.** 00 **AD No.** P051 **Rev. No.** 0

REVISION SUMMARY

The following changes are included in this revision:

- Deleted previous Steps 44.3 and 44.4 relating to R46 Isolation. This change was incorporated as the existing 2R46 Main Steam Line Monitoring System was replaced with an Adjacent-to-Line Ion-Chamber for each individual steam pipe IAW DCP 80057586, Upgrade of Salem Unit 2 R46 Main Steam Line Radiation Monitors. As a result of this DCP, isolation of the monitors is no longer required. Additionally, deleted the statement indicating "the R 46 radiation monitors are isolated," from the EOP Basis for Step 44. **[80057587-0384]** **[80057587-0386]**

IMPLEMENTATION REQUIREMENTS

Effective Date: 10/28/2006

DCP 80057587, Upgrade of Salem Unit 2 R46 Main Steam Line Radiation Monitors

---

APPROVED: [signature] for
Operations Director - Salem

10-21-06
Date

EMERGENCY OPERATING PROCEDURE
2-EOP-SGTR-1
STEAM GENERATOR TUBE RUPTURE

1.0 Entry Conditions

See Flowchart

2.0 Operator Actions

2.1 Immediate Actions

None

2.2 Subsequent Actions

See Flowchart

3.0 Attachment List

3.1 Continuous Action Summary

3.2 Tables

A - Steam System Valve Alignment To Minimize Secondary Contamination
E - RCS Depressurization Termination Criteria
F - RCS Depressurization Termination Criteria
G - RCS Depressurization Termination Criteria

3.3 Figures

None

3.4 Graphs

None

3.5 Checkoff Sheets

None

3.6 Attachments

1 - Major Action Categories

CONTINUOUS ACTION SUMMARY

CONDITION	ACTION
BEFORE STEP 15 CONTROLLED COOLDOWN: RCS PRESSURE LESS THAN 1350 PSIG AND ECCS FLOW ESTABLISHED	STOP RCPs
IF SI HAS BEEN TERMINATED: RCS SUBCOOLING 0 °F OR PZR LEVEL CAN NOT BE MAINTAINED GREATER THAN 11% (19% ADVERSE)	START ECCS PUMPS AS NECESSARY TO RESTORE SUBCOOLING AND PZR LEVEL AND GO TO EOP-SGTR-3
RCS PRESSURE LESS THAN 1500 PSIG AND BIT FLOW ESTABLISHED	CLOSE CHG PUMP MINIFLOW
RCS PRESSURE GREATER THAN 2000 PSIG	OPEN CHG PUMP MINIFLOW
"AFWST LEVEL LO-LO" ALARM (10.3%)	SHIFT AFW PUMP SUCTION
MS10 FAILS TO RESEAT	CLOSE ASSOCIATED MS9
ANY SG LEVEL RISING IN AN UNCONTROLLED MANNER OR ANY SG ABNORMAL RADIATION	STOP RCS COOLDOWN AND DEPRESSURIZATION AND RETURN TO STEP 1
ANY UNISOLATED SG COMPLETELY DEPRESSURIZED OR DEPRESSURIZING IN AN UNCONTROLLED MANNER AND SG IS NOT NEEDED FOR RCS COOLDOWN	GO TO EOP-LOSC-1
"RWST LEVEL LO" ALARM (15.2 FT)	GO TO EOP-LOCA-3

TABLE A

STEAM SYSTEM VALVE ALIGNMENT TO MINIMIZE SECONDARY CONTAMINATION

LOCATION: TURBINE BUILDING ELEV 120 FT

VALVE NUMBER	REQUIRED POSITION	VALVE DESCRIPTION	INITIALS
21TD17	CLOSED	21E MSR DR V	
22TD17	CLOSED	22E MSR DR V	
23TD17	CLOSED	23E MSR DR V	
21TD117	CLOSED	21W MSR DR V	
22TD117	CLOSED	22W MSR DR V	
23TD117	CLOSED	23W MSR DR V	
21MS62	CLOSED	MS TO MSR E STOP V	
22MS62	CLOSED	MS TO MSR E STOP V	
23MS62	CLOSED	MS TO MSR E STOP V	
21MS66	CLOSED	MS TO MSR W STOP V	
22MS66	CLOSED	MS TO MSR W STOP V	
23MS66	CLOSED	MS TO MSR W STOP V	
21MS70	CLOSED	TURB BYP ORIFICE ISOL	
21MS113	CLOSED	TURB BYP ORIFICE ISOL	
21MS159	CLOSED	TURB BYP ORIFICE ISOL	
21MS114	CLOSED	TURB BYP ORIFICE ISOL	
21MS78	CLOSED	TURB BYP ORIFICE ISOL	
21MS115	CLOSED	TURB BYP ORIFICE ISOL	
21MS161	CLOSED	TURB BYP ORIFICE ISOL	
21MS116	CLOSED	TURB BYP ORIFICE ISOL	
21MS86	CLOSED	TURB BYP ORIFICE ISOL	
21MS117	CLOSED	TURB BYP ORIFICE ISOL	
21MS163	CLOSED	TURB BYP ORIFICE ISOL	
21MS118	CLOSED	TURB BYP ORIFICE ISOL	
22MS70	CLOSED	TURB BYP ORIFICE ISOL	
22MS113	CLOSED	TURB BYP ORIFICE ISOL	
22MS159	CLOSED	TURB BYP ORIFICE ISOL	
22MS114	CLOSED	TURB BYP ORIFICE ISOL	
22MS78	CLOSED	TURB BYP ORIFICE ISOL	
22MS115	CLOSED	TURB BYP ORIFICE ISOL	
22MS161	CLOSED	TURB BYP ORIFICE ISOL	

TABLE A

STEAM SYSTEM VALVE ALIGNMENT TO MINIMIZE SECONDARY CONTAMINATION

LOCATION: TURBINE BUILDING ELEV 120 FT (CONT'D)

VALVE NUMBER	REQUIRED POSITION	VALVE DESCRIPTION	INITIALS
22MS116	CLOSED	TURB BYP ORIFICE ISOL	
22MS86	CLOSED	TURB BYP ORIFICE ISOL	
22MS117	CLOSED	TURB BYP ORIFICE ISOL	
22MS163	CLOSED	TURB BYP ORIFICE ISOL	
22MS118	CLOSED	TURB BYP ORIFICE ISOL	

LOCATION: TURBINE BUILDING ELEV 88 FT

VALVE NUMBER	REQUIRED POSITION	VALVE DESCRIPTION	INITIALS
21MS261	CLOSED	21 MS & TURB BYP DRN ISOL	
22MS261	CLOSED	22 MS & TURB BYP DRN ISOL	

LOCATION: INNER PENETRATION AREA ELEV 100 FT

VALVE NUMBER	REQUIRED POSITION	VALVE DESCRIPTION	INITIALS
21MS121	CLOSED	SG HDR SAMPLE STOP	
23MS121	CLOSED	SG HDR SAMPLE STOP	
21MS19	CLOSED	MS HDR DRN	
23MS19	CLOSED	MS HDR DRN	

LOCATION: OUTER PENETRATION AREA ELEV 100 FT

VALVE NUMBER	REQUIRED POSITION	VALVE DESCRIPTION	INITIALS
22MS121	CLOSED	SG HDR SAMPLE STOP	
24MS121	CLOSED	SG HDR SAMPLE STOP	
22MS19	CLOSED	MS HDR DRN	
24MS19	CLOSED	MS HDR DRN	

TABLE A

STEAM SYSTEM VALVE ALIGNMENT TO MINIMIZE SECONDARY CONTAMINATION

LOCATION: MIXING BOTTLE AREA ELEV 100 FT

VALVE NUMBER	REQUIRED POSITION	VALVE DESCRIPTION	INITIALS
21MS21	CLOSED	MS MIX BOT DR STOP V	
22MS21	CLOSED	MS MIX BOT DR STOP V	

TABLES E,F,G

RCS DEPRESSURIZATION TERMINATION CRITERIA

- **<u>BOTH</u> OF THE FOLLOWING:**

  RCS PRESSURE LESS THAN

  RUPTURED SG PRESSURE

  <u>AND</u>

  PZR LEVEL GREATER THAN 11%

  (19% ADVERSE)

<u>OR</u>

- **PZR LEVEL GREATER THAN 77% (74% ADVERSE)**

<u>OR</u>

- **RCS SUBCOOLING 0°F**

MAJOR ACTION CATEGORIES

- IDENTIFY AND ISOLATE RUPTURED SG(s)
- COOL DOWN TO ESTABLISH RCS SUBCOOLING MARGIN
- DEPRESSURIZE RCS TO RESTORE INVENTORY
- TERMINATE SI TO STOP PRIMARY-TO-SECONDARY LEAKAGE
- PREPARE FOR COOLDOWN TO COLD SHUTDOWN

SALEM GENERATING STATION

2-EOP-SGTR-1
STEAM GENERATOR TUBE RUPTURE

BASIS DOCUMENT

EOP Step No: ENTRY CONDITIONS

ERG Step No: ENTRY CONDITIONS

EOP Step:

EOP-TRIP-1 Steps 27, 27.1, 27.2, 27.3, 36.2
EOP-LOSC-1 Steps 8, 8.1, 8.2, 8.3
EOP-LOSC-2 Steps 11, 11.1, 11.2, 11.3
EOP-LOCA-1 Steps 4, 4.1, 4.2, 4.3
EOP-FRHS-3 Step 10.7

Purpose:

To provide the plant conditions for entry into this procedure.

ERG Basis:

N/A

EOP Basis:

- EOP-TRIP-1 Step 27, EOP-LOSC-1 Step 8, EOP-LOSC-2 Step 11, and EOP-LOCA-1 Step 4, when NR or WR level on any SG is increasing in an uncontrolled manner or when any secondary radiation detector is in warning or alarm (condenser air ejector, blowdown, or main steamline).
- EOP-TRIP-1 Step 36.2 and EOP-FRHS-3 Step 10.7, when sample results on any SG indicate primary-to-secondary leakage.

This procedure is used to perform recovery from a SGTR accident.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: CAS

ERG Step No: FOLDOUT PAGE

EOP Step:

CONTINUOUS ACTION SUMMARY

Purpose:

To remind the operator to monitor certain parameters or conditions and respond as directed if any of these parameters or conditions are exceeded.

ERG Basis:

The CONTINUOUS ACTION SUMMARY provides a mechanism to address potential unexpected plant responses and multiple/subsequent failures that may occur at any time during the performance of a specific Emergency Operating Procedure (EOP) and which potentially require a transition to another procedure. The CONTINUOUS ACTION SUMMARY also provides a vehicle to identify operator actions that should be performed at any time that certain symptoms appear during the performance of a procedure.

EOP Basis:

Same as ERG basis, with the following additional information:

The flowcharts use a Continuous Action Summary (CAS) table in place of a foldout page. The CAS contains the important items that should be continuously monitored during the performance of the EOP. The CAS is located in the upper left corner on each flowchart sheet and is the same for all flowchart sheets in a given procedure.

Supplemental Information:

DW-92-070 RCS cooldown and depressurization should be stopped if another tube rupture is present.

EOP Step No: CAS (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
1500 psig	B.10	RCS pressure for closing charging pump miniflow valves when charging pumps are injecting through the BIT.
2000 psig	B.11	RCS pressure for opening charging pump miniflow valves.
11%	D.04	Value showing PZR level just in range including allowances for normal channel accuracy and reference leg process errors.
19%	D.05	Value showing PZR level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.
10.3%	U.01	AFST low-low level switchover setpoint.
15.2 ft	U.02	RWST level switchover setpoint.
1350 psig	W.05	RCP trip parameter and setpoint including allowances for normal channel accuracy and post-accident transmitter errors.

EOP Step No: CAS (CONTINUED)

ERG Deviations:

DEV.1 Changed ERG RCP Trip Criteria substep a. from "Charging pumps or high-head SI pumps - AT LEAST ONE RUNNING" to "ECCS FLOW ESTABLISHED".

JUST. Per the ERG Executive Volume discussion of Generic Issue RCP TRIP/RESTART, the intent of this RCP trip criterion is "Successful operation of the Safety Injection System". Use of the criterion "ECCS flow established" is more indicative of flow delivery to the RCS than verification of pump operating status. [SD-2]

DEV.2 Added an item requiring opening and closing the centrifugal charging pump miniflow valves based on RCS and SI conditions.

JUST. Centrifugal charging pump miniflow valve guidance is required by FSAR 6.3.2.16 to prevent completely filling the VCT with water during safety injection. [SD-3]

DEV.3 Added actions to monitor RCP Trip Criteria before EOP Step 15.

JUST. The RCP trip criteria in ERG Step 1 were deleted and incorporated as a CAS item instead, due to the continuous action nature of that step. Per ERG Executive Volume discussion of Generic Issue RCP TRIP/RESTART, these criteria do not apply after an operator-controlled cooldown is initiated. This qualification has been added to the CAS item.

DEV.4 Added action to close associated MS9 if MS10 fails to reset.

JUST. Due to the possibility that a ruptured SG could overfill and open the MS10, this action was added to the CAS to ensure timely isolation, if necessary. Refer to ERG Step 3 Knowledge Item #1.

EOP Step No: N/A

ERG Step No: Note 1-1

EOP Step:

N/A

Purpose:

To remind the operator that the foldout page for E-3 should be open.

ERG Basis:

The foldout page provides a list of important items that should be continuously monitored. If any of the parameters exceed their limits, the appropriate operations should be initiated.

EOP Basis:

N/A

Supplemental Information:

ERG Knowledge Item: The operator should know what items comprise each foldout page.

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG note to open the foldout page for this procedure.

JUST. The Continuous Action Summary (CAS) replaces the ERG foldout page. The CAS is located in the upper left corner on each flowchart sheet and is in continuous view to the operator. Thus it does not have to be opened. [SD-6]

EOP Step No: N/A

ERG Step No: Note 1-2

EOP Step:

N/A

Purpose:

To inform the operator that sampling of the secondary side of the SGs may be necessary in this procedure. Personnel should be made available to perform this function if necessary.

ERG Basis:

Personnel qualified for sampling for activity in the SGs may not be immediately available or prepared. Such personnel should be alerted as early as possible to expedite sampling.

EOP Basis:

N/A

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG note regarding personnel available for sampling.

JUST. This ERG note is not needed since Chemistry Department personnel provide 24-hour coverage. Sampling of SGs is a normal duty performed by Chemistry Department personnel, and personnel are available on every shift to perform routine or emergency sampling of SGs.

EOP Step No: N/A

ERG Step No: Step 1

EOP Step:

N/A

Purpose:

To trip RCPs if required conditions are satisfied.

ERG Basis:

RCP trip is required to ensure core cooling for certain small LOCA sizes and conditions. Although RCP trip to ensure core cooling is not necessary for a SGTR, RCP trip is required if the specified criteria are met to insure against possible operator misdiagnosis, operator error, or a multiple failure event scenario.

EOP Basis:

N/A

Supplemental Information:

ERG Knowledge Item: Importance of RCP trip when established criteria are exceeded.

ERG Knowledge Item: This step is a continuous action step.

ERG Knowledge Item: The RCP trip criteria applies until an operator-controlled RCS cooldown is initiated.

ERG Deviations:

DEV.1 Deleted ERG Step 1 (check if RCPs should be stopped).

JUST. Due to the continuous action nature of this step, its actions have been converted into a CAS item. Consequently, the step was then deleted to eliminate redundancy and streamline the procedure.

EOP Step No: Step 1

ERG Step No: Note 1-3

EOP Step:

MAINTAIN SEAL INJECTION FLOW TO ALL RCPs

Purpose:

To ensure that seal cooling flow is maintained even if RCPs are stopped.

ERG Basis:

The effectiveness of the RCP Number 1 seal is not affected by pump rotation. To ensure continued performance of the seal, cool filtered water should be continuously supplied. The operator should not isolate the seal injection lines unless directed to in the procedure.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Seal injection flow response following a safety injection.

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG note about maintaining seal injection.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG Note was converted into a continuous action step. [SD-20]

EOP Step No: Steps 2 and 3

ERG Step No: Step 2

EOP Step:

(Step 2) IS ANY SG NR OR WR LEVEL RISING IN AN UNCONTROLLED MANNER **[RUPTURED SG IDENTIFICATION]**

(Step 3) IS RUPTURED SG IDENTIFIED **[RUPTURED SG IDENTIFICATION]**

Purpose:

To identify which SGs have ruptured tubes.

ERG Basis:

Subsequent recovery actions require the operator to distinguish between intact SGs and those with ruptured tubes in order to minimize primary-to-secondary leakage. Symptoms evident after reactor trip which identify SGs with failed tubes include high or increasing secondary side activity and uncontrollably increasing SG levels in the affected SGs (see ERG Section 2, DESCRIPTION). Although the SG level response should be a clear indication of the affected SGs for large tube failures, it may be necessary to sample for high activity if leakage is relatively small. The operator is instructed to continue with ERG Steps 5 through 12 (EOP Steps 7 through 12) while attempting to identify the ruptured SGs in order to expedite recovery.

EOP Basis:

Same as ERG basis, with the following additional information:

The SG B/D sample isolation valves (SS94) automatically close on either a Phase A Isolation signal OR on any automatic AFW pump start signal. The 23 AFW Pump automatic start signals that close the SS94 valves are loss of 125VDC control power, low-low SG water level, 4KV group bus UV, and AMSAC actuation. The 21 and 22 AFW Pump automatic start signals that close the SS94 valves are low-low water level, SGFP trip, AMSAC, and SEC load sequencing. Refer to Logic Diagrams 231446 thru 231448 for the details on these pump start and SS94 isolation signals.

Normally, the SS94 valves can NOT be re-opened to sample SGs until the Phase A Isolation signal is reset AND the automatic AFW pump start signals are removed.

EOP Step No: Step 2 and 3 (CONTINUED)

EOP Basis: (CONTINUED)

To allow prompt SG sample capability without having to wait for SG water levels to rise above the low-low setpoint, a SG B/D SAMPLE ISOLATION BYPASS keyswitch was installed on control console CC2 by DCP 2EC-3470. This switch has positions of OFF and ON. In the OFF position, the SS94 valves respond normally to Phase A Isolation and AFW pump automatic start signals. In the ON position, the auto close signal to the SS94 valves due to an AFW pump automatic start signal is bypassed, allowing the operator to open the valves using their normal open pushbuttons. A SG B/D SAMPLE ISOLATION BYPASS status light illuminates above the keyswitch to indicate that this bypass is in effect. Note that the Phase A Isolation signal is NOT bypassed by this keyswitch. Thus, Phase A Isolation must still be reset to allow opening these valves using the normal open pushbutton.

Supplemental Information:

ERG Knowledge Items:

- Effect of primary-to-secondary leakage on SG water level.
- Steam release from a SG may cause a momentary increase in narrow range level.
- An imbalance of feed flow may cause water level in one intact SG to increase more rapidly than the others.
- Steam flow/feed flow mismatch or SG narrow range level response may identify ruptured SGs prior to reactor trip.
- All SGs should be examined for indications of tube failures to detect tube failures in multiple SGs, including SGs with secondary side breaks.

Plant-Specific Information:

- Hand-held radiation monitors may be an effective means of detecting high steamline radiation for plants without main steamline radiation monitors.
- Means for operating SG Blowdown System to monitor for high activity in any SG.
- Immediately following reactor trip, wide range SG level trend may provide an earlier indication of the ruptured SGs than the narrow range. However, the reliability of this instrumentation for use during hot shutdown conditions should be evaluated on a plant-specific basis including consideration of calibration effects, redundant channels indications, sensitivity to changes in SG inventory relative to the narrow range. Refer to document GENERIC INSTRUMENTATION in the Generic Issues section of the Executive Volume for additional discussion on wide range SG level instrumentation.

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 4

ERG Step No: Cautions 3-1 and 3-2, Step 3

EOP Step:

CAUTION AT LEAST ONE SG MUST BE MAINTAINED AVAILABLE FOR RCS COOLDOWN
[**RUPTURED SG ISOLATION**]

Purpose:

- To alert the operator that a steam supply to the 23 AFW Pump must be maintained if no other source of feed flow is available in order to ensure a secondary heat sink for RCS cooldown.
- To alert the operator that feed flow and a steam release path must be maintained from at least one SG in order to cool the RCS.
- To isolate flow from the ruptured SGs to minimize radiological releases.
- To maintain pressure in the ruptured SGs greater than the pressure in at least one intact SG following cooldown of the RCS in subsequent steps.

ERG Basis:

(ERG Caution 3-1) Subsequent operator actions isolate steam flow from the ruptured SGs to the turbine-driven AFW pump. If no intact SGs supply this pump and no other source of feed flow is available, this could lead to a loss of secondary heat sink. Therefore, this isolation must not be performed.

(ERG Caution 3-2) If no intact SG is available, steam release must be maintained from either a ruptured or faulted SG to cool the RCS to RHR System operating conditions. If a ruptured SG is selected, steam release from that SG should not be isolated as directed in the following step.

(ERG Step 3) Isolation of the ruptured SG(s) effectively minimizes release of radioactivity from this generator. In addition, isolation is necessary to establish a pressure differential between the ruptured and non-ruptured SGs in order to cool the RCS and stop primary-to-secondary leakage. This can be demonstrated by considering steady state energy transfer from the RCS to the SGs simply expressed as:

$$Q_{RCS} = UA_I (T_{RCS} - T_{SGI}) + UA_R (T_{RCS} - T_{SGR})$$

where

Q_{RCS} = Heat generation rate in the primary system
UA = Total convective heat transfer coefficient
T_{RCS} = Average RCS temperature

SUB I = refers to intact SG
SUB R = refers to ruptured SG

EOP Step No: Step 4 (CONTINUED)

ERG Basis: (CONTINUED)

Assuming that the SGs are at saturation conditions:

$$Q_{RCS} = UA_I\ [T_{RCS} - T_{SAT}\ (PSG_I)] + UA_R\ [T_{RCS} - T_{SAT}\ (PSG_R)]$$

where $T_{SAT}(P)$ = Saturation temperature at pressure, P
PSG = SG pressure.

The amount of subcooling in the primary system is expressed as

$$T_{sub} = T_{SAT}\ (P_{RCS}) - T_{HOT}$$

In order to stop primary-to-secondary leakage, the primary pressure must be reduced to a value equal to that of the ruptured SG. In that case:

$$P_{RCS} = PSG_R$$
$$T_{sub} = T_{SAT}\ (PSG_R) - (T_{RCS} + \Delta T/2)$$

where ΔT = core temperature rise.

So, with leakage terminated, the energy transferred into the SGs is:

$$Q_{RCS} = UA_I\ [T_{SAT}\ (PSG_R) - T_{SAT}(PSG_I)] - (T_{sub} + \Delta T/2) x\ (UA_I + UA_R).$$

Two important conclusions can be derived from this final expression with respect to stable conditions without primary-to-secondary leakage. First, note that in order to remove heat generated in the primary system, the ruptured SG pressure and RCS pressure must be maintained greater than the non-ruptured SG pressures. Secondly, as this pressure differential is increased, so is the subcooling in the primary system. If sufficient pressure differential cannot be maintained, leakage from the RCS will continue since RCS pressure will remain greater than the ruptured SG pressure in order to remove decay heat. In that case, the operator is directed to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY to minimize this leakage.

EOP Basis:

Same as ERG basis, with the following additional information:

After the 23 AFW pump is tripped, the pump should be stopped (by depressing the "23 STOP" bezel) to close 2MS132. This prevents the turbine from restarting when 2MS52 is reset locally.

EOP Step No: Step 4 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Basis for selecting a ruptured or faulted SG for RCS cooldown if no intact SG is available. Refer to ERG Section 3.2, Key Utility Decision Points.

ERG Knowledge Item: The MS10 on the ruptured SG should remain available to limit SG pressure unless it fails open. This will minimize any challenges to the code safety valve. (See related CAS entry.)

ERG Knowledge Item: Means of closing and isolating plant specific valves between the main steamline isolation valve and turbine stop valve, such as steam dump valves, Moisture Separator Reheater (MSR) valves, sample line valves, etc. These valves provide a backup means of isolating the ruptured SG if the associated main steamline isolation valve should fail. These valves may be closed in parallel with subsequent recovery steps after the ruptured SG(s) is isolated from the intact SG(s) by closing the appropriate main steam isolation and bypass valves.

ERG Plant Specific Information: Actions for isolating the ruptured SG should consider any difference in the time delay between closing individual main steamline isolation valves (slow close) and closing all main steamline valves (fast close). The benefit of steam dump to condenser must be weighed against the possibility of SG overfill due to a delay in stopping primary-to-secondary leakage.

ERG Plant Specific Information: Action should be taken to identify and isolate steam traps upstream of the MSIVs. Unisolated traps could result in a steam release causing the ruptured generator to slowly depressurize. An unisolated steam trap could also result in a small release of activity to the secondary side of the plant.

ERG Plant-Specific Information: The probability of no intact SG available for RCS cooldown may be sufficiently small to warrant removal of this caution (Caution 3-2) and associated contingency actions on a plant-specific basis, particularly for three or four loop plants. The benefit of this additional coverage should be weighed against the increased burden on operator training and complexity of the optimal recovery procedure.

Setpoints and Numerical Values:

Value	Setpoint	Description
1045 psig	O.03	Setpoint for SG steam dump to atmospheric controller which will prevent SG safety valve actuation (typically 25 psi below the lowest safety valve set pressure).

EOP Step No: Step 4 (CONTINUED)

ERG Deviations:

DEV.1 Resequenced ERG Substep 3.c to follow Substep 3.f AER and precede Substep 3.f.3 RNO (isolation of 23 AFW Pump).

JUST. The steam supply to the 23 AFW Pump can only be isolated by closing the manual isolation valves locally at the pump or by closing the 23 AFW Pump trip valve. Closing the local isolation valves would be time consuming and delay isolation of the ruptured SG. Closing the trip valve is not desirable if this pump is the only source of feedwater. If operation of a 21 or 22 AFW Pump can be confirmed, the 23 AFW Pump can be tripped immediately from the control room.

In summary, the other actions required for isolation of the ruptured SG can be performed expeditiously and from the control room. Isolation of steam supply to the 23 AFW Pump is potentially time consuming, especially if the 21 or 23 SG is ruptured and the 23 AFW Pump is the only source of feedwater. Therefore, performing the EOP steps in the prescribed sequence ensures that the ruptured SG is isolated in the most logical and expeditious manner.

DEV.2 Deleted ERG caution regarding maintaining 23 AFW Pump flow if it is the only source of feed flow.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into an action step. [SD-20]

EOP Step No: Step 5

ERG Step No: Caution 4-1

EOP Step:

IF ANY RUPTURED SG IS FAULTED,
THEN MAINTAIN FEED FLOW ISOLATED UNLESS NEEDED FOR RCS COOLDOWN
[RUPTURED SG FEED FLOW STATUS]

Purpose:

To prevent excessive RCS cooldown due to feeding a faulted SG.

ERG Basis:

The following step instructs the operator to feed a ruptured SG which is not faulted (secondary side boundary is intact) to ensure the SG tubes remain covered. However, if the ruptured SG is also faulted, primary-to-secondary leakage will continue even if the tubes remain covered. Feeding such a SG may aggravate an uncontrolled cooldown of the RCS and may increase the possibility of SG overfill. Feeding a ruptured SG as directed in the following step should be avoided if that SG is also faulted, unless it is needed to cool the RCS.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG caution regarding the isolation of feed flow to a faulted SG.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into a continuous action step. [SD-20]

EOP Step No: Step 6

ERG Step No: Step 4

EOP Step:

IS RUPTURED SG NR LEVEL GREATER THAN 9% (15% ADVERSE)
[RUPTURED SG FEED FLOW STATUS]

Purpose:

To reduce feed flow to the ruptured SGs to minimize the potential for SG overfill.

To establish and maintain a water level in the ruptured SGs above the top of the U-tubes in order to promote thermal stratification to prevent ruptured SG depressurization.

ERG Basis:

Following a SGTR, primary-to-secondary leakage into the affected SG will exceed steam flow and lead to an accumulation of water in the SG. Feed flow will increase the rate of accumulation and reduce the time at which SG overfill would occur. Hence, feed flow to the ruptured SG should be minimized.

It is also important to maintain the water level in the ruptured SG above the top of the U-tubes. When the primary system is cooled in subsequent steps, the SG tubes in the ruptured SG will approach the temperature of the reactor coolant, particularly if reactor coolant pumps continue to run. If the steam space in the ruptured SG expands to contact these colder tubes, condensation will occur which would decrease the ruptured SG pressure. As previously demonstrated (see EOP Step 4), this would reduce the reactor coolant subcooling margin and/or increase primary-to-secondary leakage, possibly delaying SI termination or causing SI reinitiation. Consequently, the water level must be maintained above the top of the tubes to insulate the steam space. In addition to insulating the steam space, this ensures a secondary side heat sink in the event that no intact SG is available and also provides protection against misdiagnosis of the ruptured SG due to an imbalance of feed flow.

EOP Step No: Step 6 (CONTINUED)

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: The operator should stop feed flow as early as permitted to minimize the potential for SG overfill.

ERG Knowledge Item: In most cases, the ruptured SG level will continue to increase even after feed flow has been completely terminated. However, for some multiple failure events, such as an unisolable SGTR (i.e., ruptured SG cannot be isolated from any intact SG), level may decrease during RCS cooldown due to steaming. Consequently, level in the ruptured SG should be monitored periodically to ensure that it remains above the tubes unless the ruptured SG is also faulted. In addition to ensuring heat sink if no intact SG is available, this also minimizes radiological releases.

ERG Knowledge Item: The operator should continuously monitor ruptured SG level. If feed flow to the ruptured SG is stopped due to level being in the narrow range and later the level drops below the NR, feed flow to the ruptured SG should be reinitiated to reestablish level in the NR.

Setpoints and Numerical Values:

Value	Setpoint	Description
9%	M.02	Value showing SG level just in the narrow range including allowances for normal channel accuracy and reference leg process errors.
15%	M.03	Value showing SG level just in the narrow range including allowance for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 7

ERG Step No: Caution 5-1, Step 5

EOP Step:

IS POWER AVAILABLE TO BOTH PZR PORV STOP VALVES
[PORV STATUS]

Purpose:

To alert the operator of the potential for a PZR PORV sticking open after a pressure transient.

To ensure that at least one PZR PORV is available for RCS pressure control.

To isolate a failed open PZR PORV if necessary.

ERG Basis:

(ERG Caution 5-1) Normally, the PZR PORV is checked to ensure that it has closed after RCS pressure decreases below its setpoint. Because pressure transients may occur, and the PORV is expected to be available, this caution alerts the operator to check closure.

(ERG Step 5) PZR PORVs are provided to relieve RCS pressure excursions to minimize any challenge to the PZR code safety valves. In addition, these valves are an alternative means of controlling RCS pressure. Consequently, at least one PZR PORV should be available.

Stop valves are also provided to isolate leakage from any failed open PORV. In some cases these valves may be closed during plant operation or may fail closed following a station blackout. This step restores power to the stop valves and ensures the availability of at least one PZR PORV. This step also directs the operator to isolate any PORV which fails to close to minimize the loss of reactor coolant. If leakage through the PORV and stop valve continues, the operator is directed to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, which provides guidance for reducing ECCS flow to minimize leakage through the PORV and primary-to-secondary leakage through the failed SG tubes.

EOP Basis:

Same as ERG basis.

EOP Step No: Step 7 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: This step is a continuous action step as indicated by the caution preceding it.

Setpoints and Numerical Values:

Value	Setpoint	Description
2335 psig	A.02	Pressurizer PORV pressure setpoint.

ERG Deviations:

DEV.1 Deleted ERG caution regarding the PZR PORV opening.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into an action step. [SD-20]

DEV. 2 Directed the operator to open a PZR PORV if the RCS pressure is greater than 2335 psig.

JUST. If the operator observes that the PZR PORVs have opened automatically, then he would take no action. If they failed to open, however, he would manually open them. This backs up an automatic response with manual confirmatory action. [SD-30] This action also addresses the concerns of DW-94-028. Also, see Salem reference PR-95-208266.

EOP Step No: Step 8

ERG Step No: Step 6

EOP Step:

IS ANY SG PRESSURE DROPPING IN AN UNCONTROLLED MANNER
[FAULTED SG EVALUATION]

Purpose:

To identify any faulted SG(s) (failure in secondary pressure boundary) and to ensure proper isolation.

ERG Basis:

An uncontrolled SG pressure decrease or a completely depressurized (i.e., near containment or atmospheric pressure) SG indicates a failure of the secondary pressure boundary. If it cannot be verified that all faulted SG steamlines and feedlines are isolated, the operator is instructed to leave EOP-SGTR-1 and transfer to EOP-LOSC-1, LOSS OF SECONDARY COOLANT, to perform the isolation actions. Therefore, this step alerts the operator to a possible misdiagnosis or subsequent failure. Since decreasing SG pressure can be caused by manual actions during a controlled cooldown of the RCS, the operator must distinguish between a "controlled" and "uncontrolled" depressurization of the suspect SGs. The operator should return to EOP-SGTR-1, STEAM GENERATOR TUBE RUPTURE, to continue recovery when isolation of the secondary fault has been completed (as directed by EOP-LOSC-1).

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: If no intact SG is available, it may be necessary to cool the RCS using a faulted SG by adjusting feed flow. In that case, isolation of the affected SG should not be performed.

ERG Knowledge Item: "Uncontrolled" means not under the control of the operator and incapable of being controlled by the operator using available equipment.

ERG Knowledge Item: If no intact SG is available, then the faulted SGs do not have to be isolated if the RCS cooldown rate is less than 100°F/hr.

ERG Knowledge Item: Automatic steam dump operation or addition of feed flow may cause SG pressure to decrease unexpectedly.

EOP Step No: Step 8 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Restructured ERG step to eliminate negatives.

JUST. Since the EOP Writer's Guide requires that action steps avoid negative wording when possible, this step was written in a positive context. [SD-11]

EOP Step No: Step 9

ERG Step No: Step 7

EOP Step:

MAINTAIN TOTAL FEED FLOW GREATER THAN 22E04 LB/HR
UNTIL AT LEAST ONE SG NR LEVEL IS GREATER THAN 9% (15% ADVERSE)
[SG LEVEL CONTROL]

Purpose:

To control feed flow to the intact SGs to prevent excessive RCS cooldown and SG overfill.

To maintain an adequate secondary side heat sink.

To identify a previously undetected SG tube failure which could potentially result in SG overfill.

ERG Basis:

In most cases, feed flow will exceed steam flow from the intact SGs resulting in an accumulation of water in the SGs. This excess feed flow will also result in a cooldown of the RCS at a rate dependent upon the feed flow rate and heat generation rate in the primary system. Consequently, feed flow must be adjusted to control SG level and reactor coolant temperature. This step also provides for monitoring level in the intact SGs to detect multiple or subsequent tube failures. In that case, the operator is returned to EOP Step 1 to isolate the affected SG and repeat the recovery actions.

If reactor trip occurs from a high power level, the water level may shrink below the narrow range so that temporarily no reliable indication of SG water level is available. During this time, feed flow should be maintained greater than the plant specific minimum safeguards AFW flow requirement for heat removal plus allowances for normal channel accuracy to ensure an adequate secondary side heat sink. This minimum feed flow requirement satisfies the feed flow requirement of the Heat Sink Status Tree until level in at least one SG is restored into the NR. NR level is reestablished in all intact SGs to maintain symmetric cooling of the RCS. Once intact SG level has been re-established in the NR, the operator is directed to establish a control band between the AFW actuation setpoint and 50%. This control range ensures that an adequate inventory will be maintained close to the typical SG level control band and will prevent the actuation of the AFW signal. Actuation of the AFW signal could result in potential releases from the ruptured SG through the opened steam supply valves to the 23 AFW Pump if the ruptured SG contained the steam supply tap.

EOP Basis:

Same as ERG basis.

EOP Step No: Step 9 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: "Level increase in an uncontrolled manner" means that the operator cannot control level using available equipment, i.e., level continues to rise even when all feed flow valves to that SG are fully closed.

ERG Knowledge Item: This step is a continuous action step.

ERG Knowledge Item: "Intact" refers to any SG which has not been diagnosed as having a failed tube or secondary break.

ERG Knowledge Item: At this point in a SGTR event, AFW should be delivering to the intact SG(s). If AFW is not available, the operator should try to establish main feedwater. If main feedwater is not available, then at least one intact SG should be depressurized to establish condensate system flow.

ERG Knowledge Item: Once level is restored into the NR, the secondary heat sink requirement has been satisfied and the operator throttles AFW flow to control SG level and reactor coolant temperature. SG level should be allowed to gradually increase until the level is within the stated control band.

DW-89-056: Reference leg heatup errors should be included in the determination of the level setpoint for normal containment conditions.

EOP Step No: Step 9 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
$22x10^4$ lb/hr	S.02	The minimum safeguards AFW flow requirement for heat removal plus allowances for normal channel accuracy (typically one AFW pump capacity at SG design pressure).
9%	M.02	Value showing SG level just in the narrow range including allowances for normal channel accuracy and reference leg process errors.
15%	M.03	Value showing SG level just in the narrow range including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
33%	M.09	Normal SG narrow range level representing the upper control band limit.
9%	M.10	SG level greater than the AFW actuation setpoint.
15%	M.11	SG level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 10

ERG Step No: Caution 8-1, Steps 8, 9, and 10

EOP Step:

IF BLACKOUT LOADING OCCURS ON ANY VITAL BUS AFTER SI RESET,
THEN PERFORM ACTIONS PER TABLE C
[SAFEGUARDS RESET ACTIONS]

Purpose:

To alert the operator of a possible configuration that would not provide automatic start of safeguards equipment.

To reset the SI signal to remove the associated interlocks.

To reset the containment isolation signals to remove the associated interlocks.

To restore a sustained compressed air supply to allow control of air-operated equipment inside containment (e.g. charging and letdown valves, PZR PORVs, etc.)

ERG Basis:

(ERG Caution 8-1) With the SI signal reset, no further automatic signal will be generated to restart safeguards equipment. Normal sequencing of safeguards loads onto the emergency bus after DG startup will not occur. However, a "blackout" sequencer actuation is possible.

(ERG Step 8) In order to realign or stop safeguards equipment as directed in subsequent steps, the SI signal must be reset.

(ERG Step 9) With containment Phase A or Phase B Isolation signals present, containment penetration isolation valves are maintained closed, which limits the availability of instrument air, normal CVCS operation, and CCW supply. In order to open these valves as directed in subsequent steps, these signals must be cleared.

Although Phase A and Phase B Isolation signals are identified in this step, they are not necessarily expected to have occurred for a tube failure event. However, they are highlighted here to address the possibility that they may have occurred due to multiple failures. No valve will reposition upon actuation of the resets, but subsequent control actions will open the valves. These valves should remain closed, unless necessary process streams are being established, until the cause of the isolation signals is determined or corrected.

EOP Step No: Step 10 (CONTINUED)

ERG Basis: (CONTINUED)

(ERG Step 10) The Instrument (Control) Air System for the reference plant utilizes a large volume receiver to sustain pressure in the system. A separate receiver inside containment allows limited equipment operation; however, the line to the compressors is isolated with Phase A Isolation. While opening the containment valves provides a flow path, a compressor may also have to be started (with attendant electrical considerations) to supply pressure.

EOP Basis:

Same as ERG basis, with the following additional information:

The SECs must be reset as part of safeguards reset to allow operator control of the associated equipment. If the SEC will not reset, the operator will be directed to block the affected SEC and attempt to reset the SEC. The SEC block switch on RP1 functions only to block the safety injection signal to the SEC. In addition, this block switch will only function if an SI signal is present. If efforts to reset the SEC are still unsuccessful, the operators will be directed to de-energize the affected SEC to allow operator control of safeguards equipment.

If a blackout loading sequence occurs after the SI signal is reset, the operator may be required to restart additional safeguards equipment that was running prior to blackout loading sequence initiation. Table C provides the required actions to reset the SEC as well as a list of equipment which is to be loaded on the appropriate vital buses if required. The loading sequencer must be reset and required loads manually started if operation is required. This action is necessary because different equipment is started for blackout loading than for safeguards loading

Supplemental Information:

ERG Knowledge Item: Approximate time/cycles air-operated equipment can be operated without air compressor.

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG caution on blackout loading after SI reset.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into a continuous action step. [SD-20]

EOP Step No: Step 10 (CONTINUED)

ERG Deviations: (CONTINUED)

DEV.2 Added plant specific details for resetting of SI signal (SECs).

JUST. The SECs must be reset along with (but following) SI to allow manual control of safeguards equipment. The necessary steps have been added, along with possible contingency actions. [SD-13]

DEV.3 Revised ERG step (establish instrument air to containment) to accommodate the plant specific design.

JUST. The ERG action for starting an air compressor was deleted since an emergency air compressor is auto started on an SI. It is checked running in a previous step. Since the instrument air receiver is located outside containment, the control air isolation valves must be opened to supply air operated valves inside containment. [SD-15]

DEV.4 Added plant specific details to reset the 230V control centers.

JUST. Some 230V loads are initially locked out in SEC Modes II, III, and IV to reduce initial DG loading. These loads include charging/RHR/CS pump room coolers, RHR sump pumps, BAT heaters, 21 and 22 Charging Pump Auxiliary Lube Pumps, and DG auxiliary loads such as air-start air compressors, jacket water heaters, fuel oil transfer pumps, etc. At 20 minutes after SEC actuation, this lockout is automatically removed, allowing these loads to be automatically energized. This lockout is reset manually as a backup to the automatic reset. [SD-16]

EOP Step No: Step 11

ERG Step No: Caution 12-1

EOP Step:

IF RCS PRESSURE DROPS TO LESS THAN 300 PSIG (420 PSIG ADVERSE) IN AN UNCONTROLLED MANNER, THEN START BOTH RHR PUMPS
[RHR PUMP STOP CRITERIA]

Purpose:

To alert the operator that if RCS pressure should decrease in an uncontrolled manner to less than the shutoff head of the RHR pumps, they must be manually restarted since the SI signal has been reset.

ERG Basis:

Except for relatively large LOCAs, the RCS pressure should remain greater than the shutoff head of the RHR pumps until later in the recovery following a controlled cooldown and depressurization. To avoid damage to the RHR pumps, instructions are provided to stop these pumps early in the recovery if RCS pressure is greater than their shutoff head. An automatic signal to restart these pumps will not be available if RCS pressure subsequently decreases uncontrollably to less than their shutoff head. In that case, manual action is required to restart these pumps.

EOP Basis:

Same as ERG basis, with the following information:

If RCS pressure is greater than the RHR pump shutoff head in Step 11 and the RHR pumps are stopped in Step 12 as a result of flow being less than 300 gpm, and subsequently, RCS pressure drops less than the RHR pump shutoff head *in an uncontrolled manner*, then the RHR pumps should be restarted and left running, even if flow is less than 300 gpm at that point.

Supplemental Information:

None

EOP Step No: Step 11 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
300 psig	B.07	Shutoff head pressure of the RHR pumps plus allowances for normal channel accuracy.
420 psig	B.08	Shutoff head pressure of the RHR pumps plus allowance for normal channel accuracy and post accident transmitter errors.

ERG Deviations:

DEV.1 Deleted ERG caution regarding starting RHR pumps if RCS pressure drops below shutoff pressure.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into a continuous action step. [SD-20]

EOP Step No: Step 12

ERG Step No: Step 12

EOP Step:

IS RHR FLOW AT LEAST 300 GPM ON 21 OR 22 SJ49 (COLD LEG INJECTION METER)
[RHR PUMP STOP CRITERIA]

Purpose:

To stop RHR pumps to avoid pump damage.

ERG Basis:

Operation of the RHR pumps in the SI mode at RCS pressures greater than their shutoff head is not recommended for long periods of time. On low-head systems where the pump recirculates on a small volume circuit, there is concern for pump and motor overheating. When the criteria outlined in this step are met, the RHR pumps are stopped to prevent pump damage due to overheating.

EOP Basis:

Same as ERG basis, with the following additional information:

To determine if RHR Pumps should be stopped, the EOP uses RHR flow of at least 300 gpm as indicated on the 21 or 22 SJ49 cold leg injection flow meters. Confirmation of injection flow ensures that RHR pump discharge pressure is adequate to overcome RCS pressure and the pump is not operating on mini-flow.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
300 gpm	S.03	The minimum Low-Head SI pump flow which indicates injection into the RCS.

EOP Step No: Step 12 (CONTINUED)

ERG Deviations:

DEV.1 Revised ERG step to use RHR flow instead of RCS pressure magnitude/trend to determine the need for RHR Pump shutdown.

JUST. RHR flow is a positive indication of injection whereas RCS pressure less than the RHR pump shutoff head is only an inference of the capability of injection. ERG E-1 Step 13 Plant Specific Information states that this is acceptable on a plant specific basis. [SD-17]

EOP Step No: Step 13

ERG Step No: Caution 13-1

EOP Step:

IS RUPTURED SG IDENTIFIED
[RUPTURED SG IDENTIFICATION]

Purpose:

To alert the operator that the ruptured SGs should be isolated from the intact SGs before steam is released from the intact SGs in subsequent steps to cool the RCS.

ERG Basis:

Isolation of the ruptured SG from the intact SGs should be completed before decreasing the intact SG pressures. Complete isolation of the ruptured SG must be performed, but is not required prior to depressurization of the intact SGs. Isolation of the ruptured SG minimizes radiological releases and ensures RCS subcooling when primary-to-secondary leakage is terminated in subsequent steps (see EOP Step 4).

If no intact SG is available, it may be necessary to release steam from a ruptured SG to cool the RCS. Subsequent steps transfer the operator to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, to better address this condition.

EOP Basis:

Same as ERG basis, with the following additional information:

The strategy of this step ensures that the ruptured SG is identified and isolated from the intact SGs. If isolation of the ruptured SG cannot be verified by a minimum isolation, then isolation of the intact SGs from the ruptured SGs is verified. Minimum isolation of the ruptured SG consists of closing the MS167 (Stop) and MS18 (Bypass) valves, which allows depressurization of the intact SGs for cooldown of the RCS. The flowchart step is structured such that continuation to the next step, which is the RCS cooldown step, is prevented until minimum isolation is completed.

Note that in EOP Step 4, the MS7 valve was either closed or isolated via upstream isolation valves. "MS7 closed" intent in this step is satisfied if the MS7 is failed open, but has been isolated by upstream isolation valves.

EOP Step No: Step 13 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Isolation of steam flow from the ruptured SG through branch lines off the main steamlines should be completed expeditiously, but is not required prior to RCS cooldown. Isolation of the branch lines may be completed in parallel with the RCS cooldown and subsequent recovery steps.

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG caution regarding isolation of the ruptured SG(s).

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into this action step. [SD-20]

EOP Step No: Step 14

ERG Step No: Step 13

EOP Step:

IS RUPTURED SG PRESSURE GREATER THAN 375 PSIG

Purpose:

To identify a secondary side break in the ruptured SG and transfer the operator to the appropriate contingency procedure.

To minimize possible pressurized thermal shock of the reactor vessel due to rapid cooldown below 350°F in subsequent steps.

ERG Basis:

Subsequent steps direct the operator to dump steam from the intact SGs to cool the RCS as rapidly as possible in order to establish adequate subcooling margin. The temperature at which this cooldown is terminated depends on the pressure in the ruptured SGs. If this pressure is less than the saturation pressure corresponding to 350°F plus 20°F and inaccuracies, this cooldown could result in an PURPLE priority on the Thermal Shock Status Tree. To avoid this condition the operator is transferred to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, which limits the cooldown rate to less than 100°F/hr.

A ruptured SG pressure less than the saturation pressure corresponding to a temperature for precluding pressurized thermal shock (PTS) conditions is also a possible indication of a steam break associated with the affected SG. For such an event, the EOP-SGTR-3 procedure is more appropriate since primary-to-secondary leakage cannot be terminated until cold shutdown.

The basis for determining footnote (O.05) starts with determining a temperature that will preclude PTS since the cooldown rate of 100°F can be exceeded in EOP-SGTR-1. Violating the PTS limitation would transition the operator to EOP-FRTS-2 and stop the cooldown, which contradicts the instructions provided in Step 15 of EOP-SGTR-1. To prevent this occurrence, footnote (I.02) should be selected as the starting temperature. To this value, an assumed 40°F temperature rise across the core and the uncertainty of the core exit temperature indication should be added to the value. If this value exceeds 350°F, it should be used as the initial temperature input. If this value does not exceed 350°F, then 350°F should be used as the minimum initial temperature input. A 20°F margin should then be added to this initial temperature value, along with the uncertainty in the RCS subcooling indication. This temperature should then be converted to a saturation pressure, and the uncertainty in SG pressure indication considered.

EOP Step No: Step 14 (CONTINUED)

ERG Basis: (CONTINUED)

A pressure based on 350°F was chosen to prevent unnecessary transitions from EOP-SGTR-1 at higher pressures when it is still desirable to continue with EOP-SGTR-1 and to minimize possible pressurized thermal shock of the reactor vessel. Since there is no check on the reactivity condition, there is no guarantee that return to criticality will not occur during RCS cooldown for plants with BIT removed or boron concentration reduced. A plant specific evaluation may be required to determine the optimized RCS temperature used as the basis for Footnote (O.05) for plants with BIT removed or reduced BIT boron concentration.

Under the unlikely case that recriticality occurs, the RCS cooldown would result in a challenge to the Critical Safety Functions, i.e., a criticality condition on the Shutdown Margin Status Tree. The operator will be directed to FRSM-1, RESPONSE TO NUCLEAR POWER GENERATION, or FRSM-2, RESPONSE TO LOSS OF CORE SHUTDOWN, to initiate emergency boration of the RCS and obtain adequate shutdown margin. After the adequate shutdown margin is assured, the operator will be directed to go back to EOP-SGTR-1 procedure to continue the recovery actions.

EOP Basis:

Same as ERG basis.

Supplemental Information:

DW-93-055: ERG Footnote (O.05) is revised to preclude violating PTS limiting temperatures depending on the PTS category of the plant. This plant is a Category II plant.

Setpoints and Numerical Values:

Value	Setpoint	Description
375 psig	O.05	Steam generator saturation pressure corresponding to temperature T2 plus 20°F, plus allowances for normal channel accuracy and post-accident transmitter errors for pressure instrument.

ERG Deviations:

DEV.1 Added instructions for shifting the Gland Seal supply to an alternate available source.

JUST. At this point in the cooldown and depressurization, the operator is directed to shift gland seal to an alternate source to assist in maintaining condenser vacuum. This will allow continued use of the condenser steam dumps. [SD-56]

EOP Step No: N/A

ERG Step No: Notes 14-1 and 14-2

EOP Step:

N/A

Purpose:

To prevent main steamline isolation valve (MSIV) closure on low compensated steamline pressure during controlled RCS cooldown.

To alert the operator to the potential for inadvertent steamline isolation during the subsequent SG depressurization.

ERG Basis:

(ERG Note 14-1) An automatic protection feature is provided to close the main steamline isolation valves when steam pressure approaches the low steamline pressure SI setpoint. In the following step the operator is instructed to dump steam from the intact SGs which is expected to reduce their pressure below this setpoint. If automatic isolation occurred, steam flow to the condenser would be terminated requiring the operator to continue the cooldown by dumping steam to the atmosphere. In addition to delaying recovery, this would increase the radiological releases and reduce feedwater supply. This note directs the operator to block the low steamline pressure SI signal when PZR pressure decreases below the P-11 permissive.

(ERG Note 14-2) An automatic protection feature is provided to close the main steamline isolation valves when the steam pressure rate signal is exceeded. In the following step, the operator is instructed to dump steam from the intact SGs which may result in exceeding the rate setpoint. Therefore, this note is intended to alert the operator of this possibility.

EOP Basis:

N/A

EOP Step No: N/A (CONTINUED)

Supplemental Information:

ERG Knowledge Item: The steamline pressure at which steamline isolation occurs is rate dependent and may occur at a significantly higher pressure than the setpoint so that the signal should be blocked as soon as PZR pressure decreases to less than (A.05) psig.

ERG Knowledge Item: For small tube failures, PZR pressure may remain above the P-11 permissive. Although pressure will decrease as the RCS is cooled, it may still remain greater than the P-11 permissive. In that case the operator can reduce PZR pressure using PZR spray or a PORV, so that the SI signal can be blocked.

ERG Knowledge Item: The rapid cooldown should be continued using the atmospheric steam dumps if MSIV closure occurs.

ERG Plant-Specific Information: SI actuation logic should be evaluated to determine if an SI signal would be generated on low steamline pressure or equivalent after SI reset. If so, containment Phase A isolation may also occur and the equipment loading on the 4KV vital buses may be rearranged if low steamline pressure SI occurs.

ERG Plant-Specific Information: For some plants, automatic main steamline isolation may occur on some combination of low steamline pressure, low Tavg, or high steam flow rate. The permissive for blocking this signal should be evaluated on a plant-specific basis.

ERG Plant Specific Information: The note may be written to warn the operator not to exceed a certain cooldown rate to prevent MSIV closure.

Setpoints and Numerical Values:

N/A

ERG Deviations:

DEV.1 Deleted both ERG notes; Note 14-1 regarding blocking the SI signal from low steamline pressure and; Note 14-2 regarding main steamline isolation after blocking the low steamline pressure SI signal.

JUST. These notes are not applicable to this plant's Reactor Protection System design. For the reference plant, above P-11, an SI/MSIV isolation occurs on low SG pressure. Below P-11 with manual block, this signal is blocked and an MSIV isolation on high negative pressure rate is enabled. This plant has an SI/MSIV isolation signal generated by high steam flow coincident with either low Tavg or low SG pressure. This SI signal is blockable below the low Tavg setpoint, but the MSIV isolation signal is not blockable. P-11 does not affect or relate to these signals at all. The SI signal is effectively blocked because SI has already occurred and been reset. (Refer to Plant Specific Information items and Logic Drawings 221056 and 221057.)

EOP Step No: N/A

ERG Step No: N/A

EOP Step:

CAUTION IF RCPs ARE NOT RUNNING, THE FOLLOWING STEPS MAY CAUSE A FALSE THERMAL SHOCK STATUS TREE INDICATION FOR THE RUPTURED LOOP. DISREGARD THE RUPTURED LOOP T-COLD INDICATION UNTIL STEP 43 IS REACHED OR A TRANSITION IS MADE TO ANOTHER PROCEDURE .

Purpose:

To alert the operator that during a natural circulation cooldown, a false symptom of a red or purple path condition in Thermal Shock Status Tree is possible due to the redirection of SI flow in the ruptured loop.

ERG Basis:

N/A

EOP Basis:

If the RCS is being cooled down on natural circulation during a steam generator tube rupture event, reverse flow through the ruptured loop during the cooldown or when the pressurizer PORV is opened to depressurize the RCS is possible and could cause the SI flow path in the ruptured loop to change. This change in the SI flow path could result in an indicated cold leg temperature (due to the location of the cold leg RTD) that decreases to the point that the symptoms for FRTS-1 would occur. This false indication would only be seen in the ruptured loop since it is essentially stagnant while the other loops are circulating by natural circulation. When the PORV is closed, the flow paths are expected to change and the indicated cold leg temperature should increase resulting in the symptoms disappearing. When SI is terminated, the indicated cold leg temperature would increase if it did not do so earlier resulting in the symptoms for FRTS-1 no longer being present. This is an expected condition and the operator should only monitor the Thermal Shock Status Tree for information purposes. After the cooldown and depressurization is completed and SI is terminated, the operator should monitor the Thermal Shock Status Tree to determine if a red or purple path still exists and FRTS-1 should be implemented. The decision should be based on the symptoms existing after SI is terminated. If a multiple or subsequent accident occurs, the operator could transfer out of SGTR-1 prior to terminating SI. For that case he should monitor the Thermal Shock Status Tree when he makes the transition out of SGTR-1 to determine if at that time a red or purple path exists and FRTS-1 should be implemented.

Supplemental Information:

None

EOP Step No: N/A (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added this caution to allow operators to remain in SGTR-1 in the event of a false red or purple path on the Thermal Shock status tree during natural circulation cooldown. The wording is modified from the referenced DW to remind the operators to monitor the ruptured loop t-cold, and reconsider the Thermal Shock Status Tree if transition to other procedure is made prior to Step 43.

JUST. This change is in accordance with DW 94-26 and Order 80054899, Operation 0110.

EOP Step No: Step 15

ERG Step No: Step 14

EOP Step:

DETERMINE REQUIRED RCS TEMP USING TABLE D
[RCS COOLDOWN]

Purpose:

To establish sufficient subcooling in the RCS so that the primary system will remain subcooled after pressure is decreased to stop primary-to-secondary leakage.

ERG Basis:

The principal goal of the EOP-SGTR-1 procedure is to stop primary-to-secondary leakage and to establish and maintain sufficient indications of adequate coolant inventory. These indications include a PZR level indication to trend coolant inventory and RCS subcooling to ensure that the indicated PZR level is reliable. This step is designed to establish sufficient subcooling in the RCS so that the primary system will remain subcooled after RCS pressure is decreased in subsequent steps to stop primary-to-secondary leakage.

Since, in order to stop this leakage, the RCS pressure must be decreased to a value equal to the ruptured SG pressure, the temperature at which this cooldown is terminated is dependent upon the ruptured SG pressure. A table should be constructed for various ruptured SG pressures showing the fluid temperature corresponding to 20°F subcooling at each of these pressures, including allowances for subcooling uncertainties with normal or adverse containment conditions. The cooldown should be based on the CETs since these also provide the input for SI termination and reinitiation. The 20°F subcooling is provided as operating margin to accommodate fluctuations in RCS temperature, perturbations in ruptured SG pressure, interpolation between listed ruptured SG pressures, and overshoot during RCS depressurization.

As previously demonstrated (see EOP Step 4), the pressure of the intact SGs must be maintained less than the pressure of the ruptured SGs in order to maintain RCS subcooling. Since flow from the ruptured SG should be isolated, this pressure differential is established by dumping steam only from the intact SGs. Steam dump to the condenser is preferred to minimize radiological releases and conserve feedwater supply. However, the MS10s on the intact SGs provide an alternative steam release path. If no intact SG is available, RCS temperature should be controlled by adjusting feed flow to a faulted SG or by releasing steam from a ruptured SG. This latter method will result in continued primary-to-secondary leakage and is best handled in EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY.

EOP Step No: Step 15 (CONTINUED)

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: It is not intended for the operator to reevaluate the required core exit temperature or precisely interpolate between values listed in the table.

ERG Knowledge Item: When the required core exit temperature is reached, the intact SG pressure (or feed flow to a faulted SG) should be controlled to maintain that temperature.

ERG Knowledge Item: Cooldown of the RCS should be completed before continuing in the procedure.

ERG Knowledge Item: Natural circulation flow in the ruptured loops may stagnate during this cooldown. The hot leg temperature in that loop may remain significantly greater than the intact loops. In addition, safety injection flow into the cold leg may cause the cold leg fluid temperature to decrease rapidly in that same loop. Steps to depressurize the RCS and terminate SI should be performed as quickly as possible after the cooldown has been completed to minimize possible pressurized-thermal shock of the reactor vessel.

ERG Knowledge Item: RCS cooldown should proceed as quickly as possible and should not be limited by the 100°F/hr Technical Specification limit. Integrity limits should not be exceeded since the final temperature will remain above 350°F.

ERG Knowledge Item: The RCP trip criteria (ERG Step 1; CAS item in EOP) do not apply after a controlled cooldown is initiated.

DW-93-055: ERG Footnote (O.05) is revised to preclude violating PTS limiting temperatures depending on the PTS category of the plant. (This plant is a Category II plant.)

ERG Knowledge Item: If more than one SG is ruptured, the lowest ruptured SG pressure should be used to determine the required core exit temperature. If cooldown to a target core exit temperature is already in progress when a subsequent SGTR is diagnosed the operator should stop the cooldown until the subsequent ruptured SG is isolated since continuing the cooldown would lower the pressure in the newest ruptured SG and result in unnecessary releases prior to its isolation from the intact SGs. The target core exit temperature should be reexamined to determine if the temperature should be reduced based on the subsequent ruptured SG pressure. If a RCS depressurization is in progress, although it does not impact the pressure in the newest ruptured SG, for the sake of simplicity it should be stopped and the plant stabilized by the operator until the newest ruptured SG is isolated. (DW-92-070)

EOP Step No: Step 15 (CONTINUED)

Supplemental Information: (CONTINUED)

ERG Plant Specific Information: If no intact SG is available, the operator must decide between feeding a faulted SG or steaming a ruptured SG for RCS cooldown to RHR conditions. One must weigh the concerns of reactor vessel thermal stresses, increased discharge to containment, and stresses on the SG tubes against increased radiological releases from the ruptured SG and the potential for SG overfill on an event specific basis. Refer to ERG Section 3.2, Key Utility Decision Points.

ERG Plant Specific Information: Alternative means of dumping steam from the intact SGs, such as steam flow to the turbine-driven AFW pumps, should be evaluated on plant specific basis.

Setpoints and Numerical Values:

Value	Setpoint	Description
Table G01	G.01	Temperature corresponding to 20°F subcooling at ruptured SG pressure including allowance for normal channel accuracy.
Table G02	G.02	Temperature corresponding to 20°F subcooling at ruptured SG pressure including allowance for normal channel accuracy and post-accident transmitter errors, not to exceed 100°F.
375 psig	O.05	Steam generator saturation pressure corresponding to temperature T2 plus 20°F, plus allowances for normal channel accuracy and post-accident transmitter errors for pressure instrument.
25%	X.07	Steam dump valve demand for the rapid cooldown of SGTR-1.

<u>EOP Step No:</u> Step 15 (CONTINUED)

<u>ERG Deviations:</u>

DEV.1 Transitioned to EOP-SGTR-3 if no intact SG is available and use of a faulted SG results in an uncontrollable cooldown.

JUST. Per Plant Specific Information Item #1, the plant prefers to steam a ruptured SG rather than feed a faulted SG which results in an uncontrolled cooldown, to avoid reactor vessel PTS concerns.

DEV.2 Added a continuous action step which monitors when RCS "TAVG LOW-LOW" is reached.

JUST. The continuous action step was added to alert the operator that the "BYPASS TAVG" pushbuttons must be depressed after receipt of the Low-Low Tavg signal to allow continued use of the condenser steam dumps.

DEV.3 Did not specify "lowest" SG pressure for use in determining target core exit temperature as required by DW-92-070.

JUST. The qualification to use the "lowest" ruptured SG pressure was originally added by DW-92-070 but was later deleted per validation comment VA-115.

EOP Step No: N/A

ERG Step No: Caution 15-1

EOP Step:

N/A

Purpose:

To alert the operator that the RCS cooldown in ERG Step 14 should be completed before continuing to ERG Step 15.

ERG Basis:

After the RCS is cooled by dumping steam in EOP Step 15, two symptoms are expected to be observed which confirm the success of previous operator actions to identify and isolate the ruptured SGs and demonstrate that primary-to-secondary leakage can be terminated. Specifically, the ruptured SG pressure should remain above that of the intact SGs and RCS subcooling should be greater than instrument uncertainties. Subsequent steps check for these symptoms and direct the operator to the appropriate contingency procedures if either one is not observed.

Reducing RCS pressure in subsequent steps by condensing or relieving steam in the PZR not only stops break flow, but also refills the PZR in preparation for SI termination. Although concurrent RCS cooldown and depressurization may reduce the amount of leakage into the secondary initially, it increases the demands on the operator and may lead to a delay in SI termination (refer to ERG Background Document, Section 5, FREQUENT QUESTIONS). Furthermore, concurrent cooldown and depressurization would also require more precise pressure control to maintain RCS subcooling. While such control may be provided with normal spray, it may require cycling of a PZR PORV if normal spray is unavailable. For these reasons, RCS cooldown should be complete before continuing with subsequent steps.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

EOP Step No: N/A (CONTINUED)

ERG Deviations:

DEV.1 Deleted the ERG Caution regarding completing the cooldown before proceeding with ERG Step 15.

JUST. EOP Step 15 structure ensures that the cooldown is completed before proceeding to the next step. Therefore, the caution is redundant and serves no purpose. Deleted caution to streamline the EOP.

EOP Step No: Step 16

ERG Step No: Steps 15 and 16

EOP Step:

IS RUPTURED SG PRESSURE STABLE OR RISING

Purpose:

To direct the operator to EOP-SGTR-3 if a ruptured SG cannot be isolated because of a steam leak.

To determine if a loss of reactor coolant other than the diagnosed SGTR event is occurring.

ERG Basis:

After the primary system has been cooled by depressurizing the intact SGs, even a small steam leak will depressurize the ruptured SG since no energy will be transferred from the RCS into that SG. As previously demonstrated (see EOP Step 4) a sufficient pressure differential must be maintained between the ruptured and intact SGs used for cooldown in order to ensure RCS subcooling after primary-to-secondary leakage is terminated. Although the magnitude of the required pressure differential changes with RCS temperature, approximately 250 psi is required at no-load temperature, if the RCPs are running, so that primary-to-secondary leakage can be stopped while maintaining RCS subcooling; less is necessary at lower temperatures. The required pressure differential is significantly higher if the RCPs are not running. If the ruptured SG pressure is slowly decreasing, the differential can be maintained by decreasing the intact SGs pressure. If the pressure differential between the ruptured SG and the intact SGs cannot be maintained above 250 psi, then EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY provides the best guidance for minimizing primary-to-secondary leakage. Note that this pressure differential criterion does not ensure RCS subcooling in the subsequent steps if RCPs are not running. If the subcooling is lost, the subsequent steps will direct the operator to EOP-SGTR-3 to stop the primary-to-secondary leakage. *It should be noted that the pressure differential criterion does not apply to an intact SG which is not being used for cooldown.* (emphasis added)

The RCS cooldown completed in EOP Step 15 is designed to establish a 20°F subcooling margin, i.e., 20°F greater than uncertainties, in the primary system at the ruptured SG pressure. For SGTR events, including multiple tube failures, the primary pressure will stabilize at a value greater than the ruptured SG pressure with SI on. Consequently, at this stage of the recovery, the subcooling margin is expected to be greater than 20°F. If not, a LOCA is suspected. In that case, the operator is directed to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, to stop ECCS pumps one at a time after it is demonstrated that the reduced ECCS flow is sufficient to maintain adequate coolant inventory.

EOP Step No: Step 16 (CONTINUED)

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: If the ruptured SG pressure is slowly decreasing, it may be possible to maintain sufficient pressure differential between the intact and ruptured SGs by continuing to depressurize the intact SGs. However, the RCS cooldown rate should be maintained less than 100°F/hr to avoid an PURPLE priority on the Thermal Shock Status Tree.

ERG Knowledge Item: If the ruptured SG pressure decreases after RCS cooldown is stopped, the operator should verify that actions to isolate the SG have been completed, including throttling of feed flow, before transferring to EOP-SGTR-3.

ERG Knowledge Item: It is desirable to complete recovery in EOP-SGTR-1 for a SGTR event since this minimizes primary-to-secondary leakage. Consequently, if the operator is unsure as to whether sufficient pressure differential can be maintained, recovery should be continued in EOP-SGTR-1. In that case, instructions are provided to transfer the operator to EOP-SGTR-3 if SI reinitiation is necessary.

ERG Knowledge Item: For multiple tube failures, RCS pressure may temporarily decrease below the ruptured SG pressure during cooldown. However, pressure and subcooling should quickly increase when the cooldown is complete. The transition to EOP-SGTR-3 is not necessary if subcooling increases sufficiently after the cooldown is complete.

Setpoints and Numerical Values:

Value	Setpoint	Description
250 psi	O.11	Minimum pressure differential between ruptured SG(s) and intact SG(s) for transfer to ECA-3.1, SGTR WITH LOSS OF REACTOR COOLANT - SUBCOOLED RECOVERY DESIRED.
20°F	R.10	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables, plus 20°F.

ERG Deviations:

DEV.1 Changed the conditions in the ERG RNO regarding ruptured SG pressure dropping to less than 250 psi above intact SG pressure to a continuous action step.

JUST. This is implied by ERG Step 15.RNO and further strengthened by discussion in DW-87-006, which deals with this step.

EOP Step No: Step 17

ERG Step No: Step 17

EOP Step:

IS NORMAL PZR SPRAY AVAILABLE
[RCS DEPRESSURIZATION WITH NORMAL SPRAY]

Purpose:

To decrease RCS pressure to stop primary-to-secondary leakage and establish an indicated PZR level.

ERG Basis:

After the cooldown is completed, ECCS flow will pressurize the RCS to an equilibrium condition where break flow equals ECCS flow. This equilibrium pressure will be somewhere between the ruptured SG pressure and the shutoff head of the ECCS pumps and increases with ECCS capacity, as shown in Figure 26. A major objective of the EOP-SGTR-1 procedure is to bring the plant from point A to point B where primary-to-secondary leakage will be stopped. However, the path one takes is important.

The illustrated curve represents equilibrium conditions where ECCS flow and break flow are equal. Hence, for points on the curve, reactor coolant inventory is constant. To the left of this curve RCS pressure is greater than equilibrium so that break flow exceeds ECCS flow. Therefore, in this region coolant inventory is decreasing. Conversely, to the right of the curve, ECCS flow exceeds break flow so that coolant inventory is increasing. The ideal path from point A to point B should increase coolant inventory and restore PZR level. Hence, the ideal path (Figure 27) requires a depressurization of the RCS.

In some cases, PZR level may approach the upper tap (top of the indicating range) before RCS pressure is reduced to the ruptured SG pressure. This may be a symptom of a smaller tube failure, voiding in the upper head during natural circulation conditions, or injection of the SI accumulators. In that case, the preferred path from point A to point B is demonstrated in Figure 28. Depressurization of the RCS is terminated on high PZR level to prevent filling the PZR and loss of PZR pressure control. Following SI termination, PZR level decreases which further reduces RCS pressure to equilibrium with the ruptured SG. In some cases, such as a small tube failure in a high pressure SI plant, the PZR may be sufficiently full such that no depressurization of the RCS is necessary prior to SI termination.

On the other hand, for multiple tube failures or reduced ECCS capacity for a smaller tube failure, it may be necessary to decrease RCS pressure below that of the ruptured SG pressure in order to restore PZR level. This path is shown in Figure 29. In that case reverse flow, i.e., secondary-to-primary leakage, will supplement ECCS flow to restore PZR level. If pressure continued to be reduced to saturation, voiding in the primary system may result in an unreliable PZR level indication and delay SI termination. To avoid this, depressurization of the RCS is terminated if minimum RCS subcooling is reached.

EOP Step No: Step 17 (CONTINUED)

ERG Basis: (CONTINUED)

With PZR spray (normal and auxiliary) stopped, both PZR pressure and level should increase toward equilibrium conditions. If level continues to increase without a corresponding increase in pressure, leakage from the spray valves should be suspected. If this persists until filling of the PZR is imminent, appropriate measures to stop the leakage, such as stopping the RCPs as necessary to terminate spray flow or isolating the auxiliary spray line should be performed. It may be necessary to stop two (or more) RCPs to terminate spray flow, depending on which spray valve is failed open, the existing pressurizer level, and the individual plant design. Spray effectiveness with different combinations of RCPs running will vary with plant design as discussed in the EOP basis section below. Depressurization of the RCS due to leakage from the spray valves will stop once the PZR fills with water. Therefore, this condition should not prevent or delay termination of ECCS flow in subsequent steps when all the necessary criteria are satisfied.

The preferred means of RCS depressurization is normal PZR spray since this does not result in a loss of reactor coolant. If normal spray is not available, an alternative means of depressurizing the RCS, such as a PZR PORV or auxiliary spray must be used. However, the use of a PORV will result in an additional loss of reactor coolant which may rupture the PRT and lead to abnormal containment conditions. On the other hand auxiliary spray may cause excessive thermal stresses in the spray nozzle and may not be sufficient to rapidly decrease RCS pressure. For these reasons, it is used only if normal spray and all PZR PORVs are unavailable.

EOP Basis:

Same as ERG basis with the following additional information.

Expected spray flow with different combinations of RCPs running will vary depending on which spray valve is open, the existing pressurizer level, and individual plant design. Analyses have demonstrated that differential pressure for providing spray flow is available for 2-loop, 3-loop and 4-loop plants when the RCP in the loop with the pressurizer surge line is running. Spray differential pressure may be available if the surge line RCP is idle and the other spray line RCP is running; it is more likely with the non-spray RCP(s) also running. With only non-spray RCP(s) running, spray differential pressure will likely be negative (indicating no spray flow will occur) or insignificant unless PZR level is high. Refer to the supplemental information from DW-2002u below for additional guidance on stopping RCPs to minimize spray flow for different plant designs and conditions.

Figure 26. EQUILIBRIUM RCS PRESSURE VERSUS SI FLOW RATE

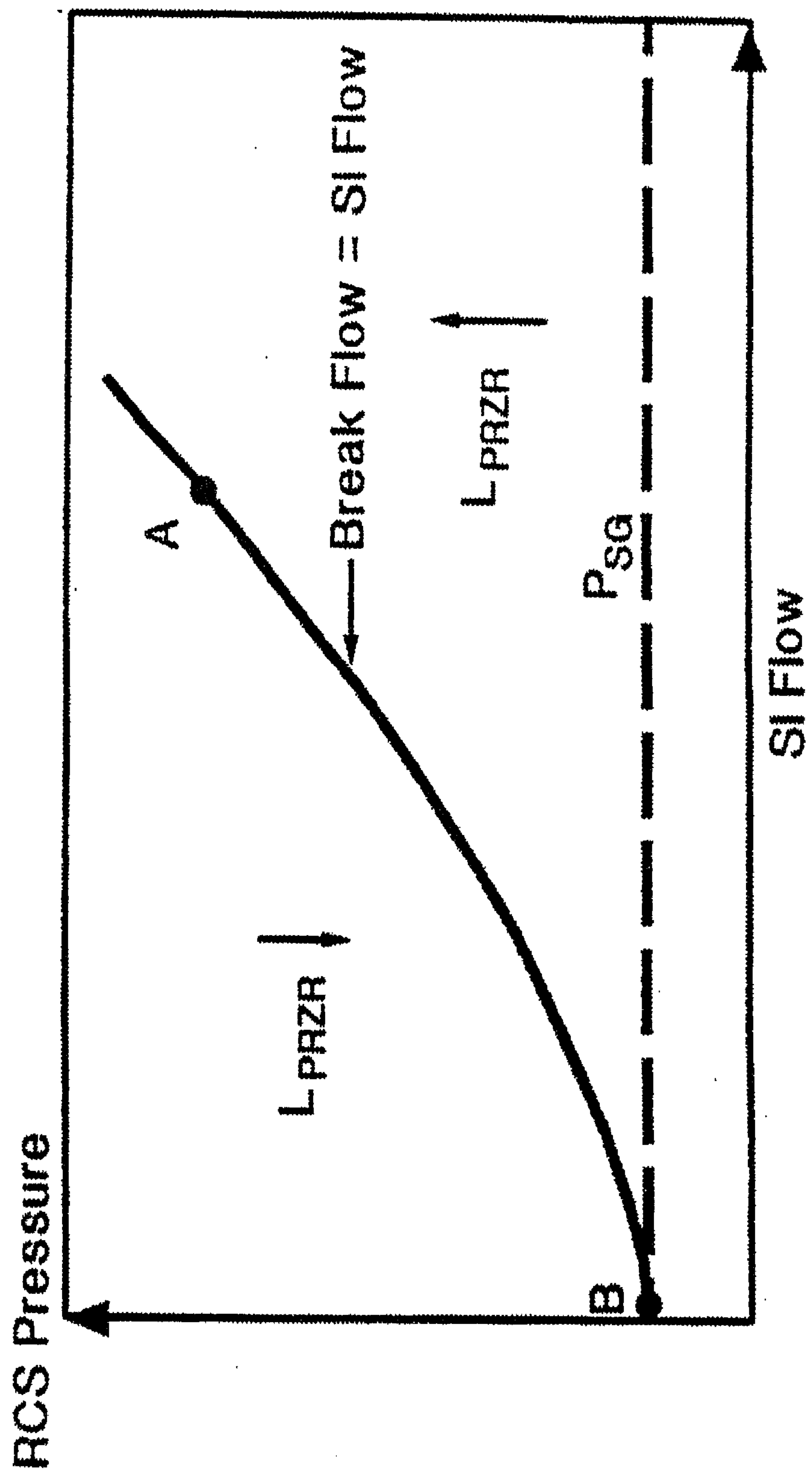


Figure 27. RCS PRESSURE VERSUS SI FLOW RATE SHOWING EXPECTED RECOVERY PATH FOLLOWING SGTR

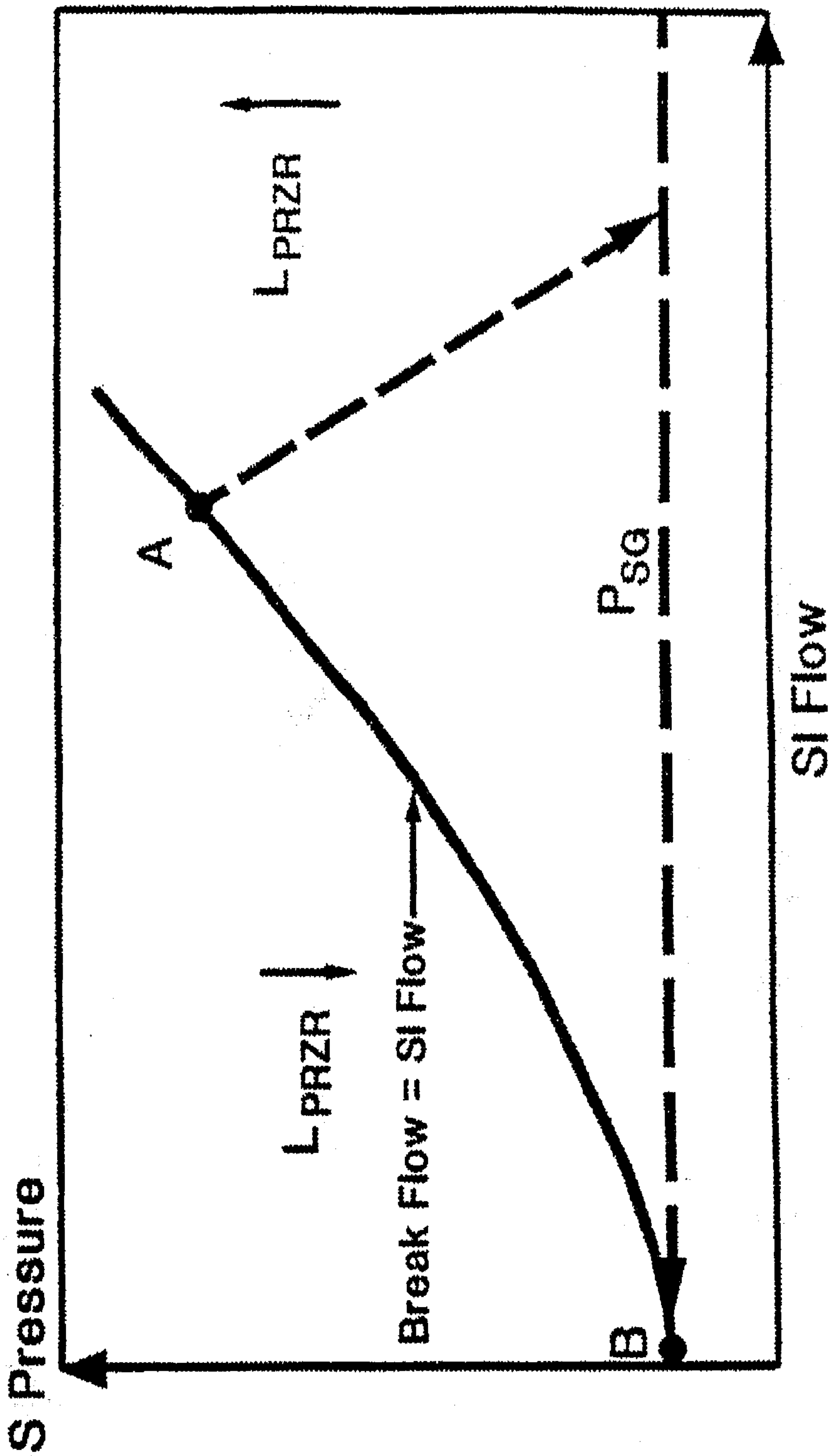


Figure 28. RCS PRESSURE VERSUS SI FLOW RATE SHOWING POSSIBLE RECOVERY PATH FOR SMALL TUBE FAILURES

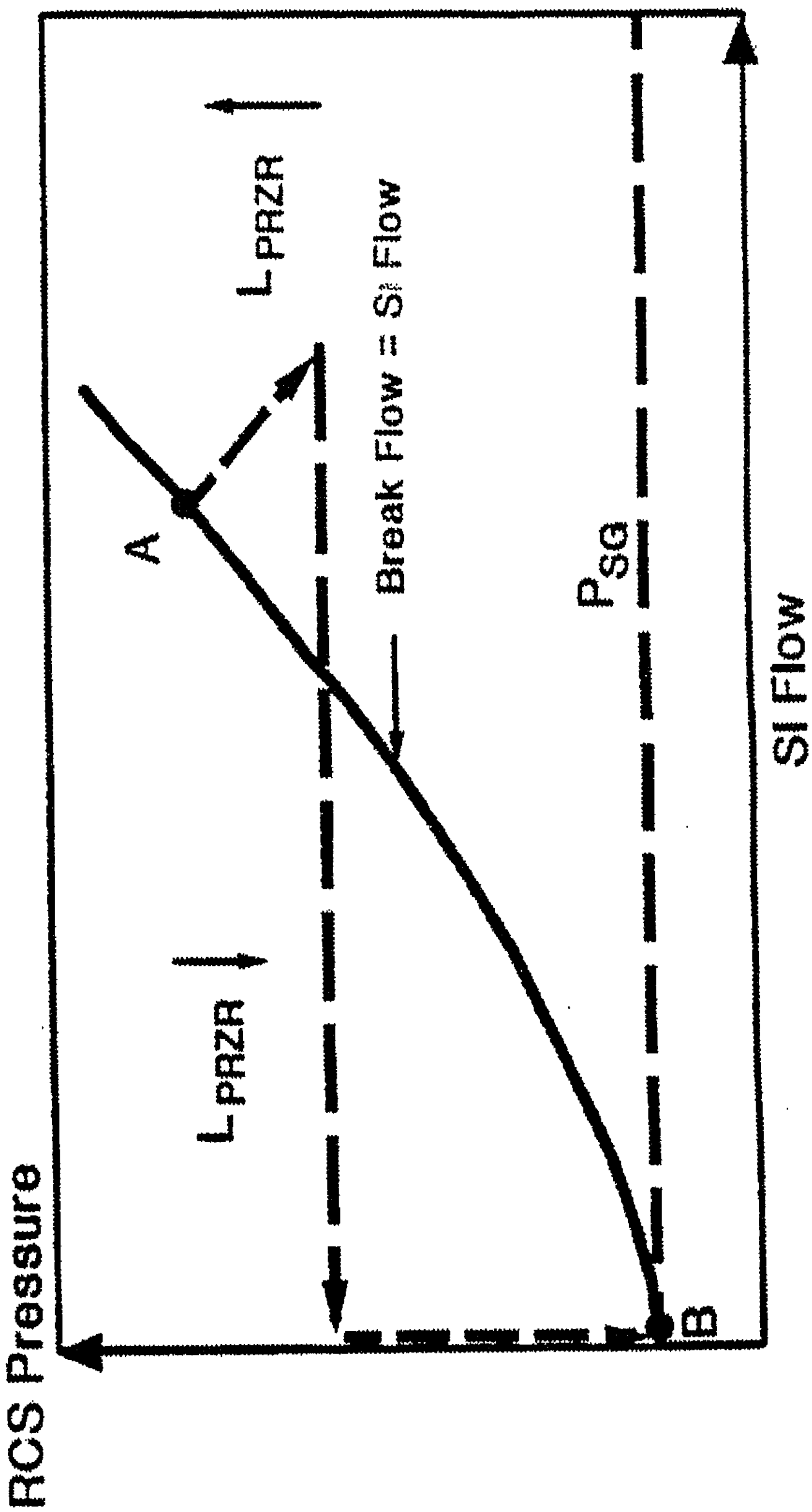
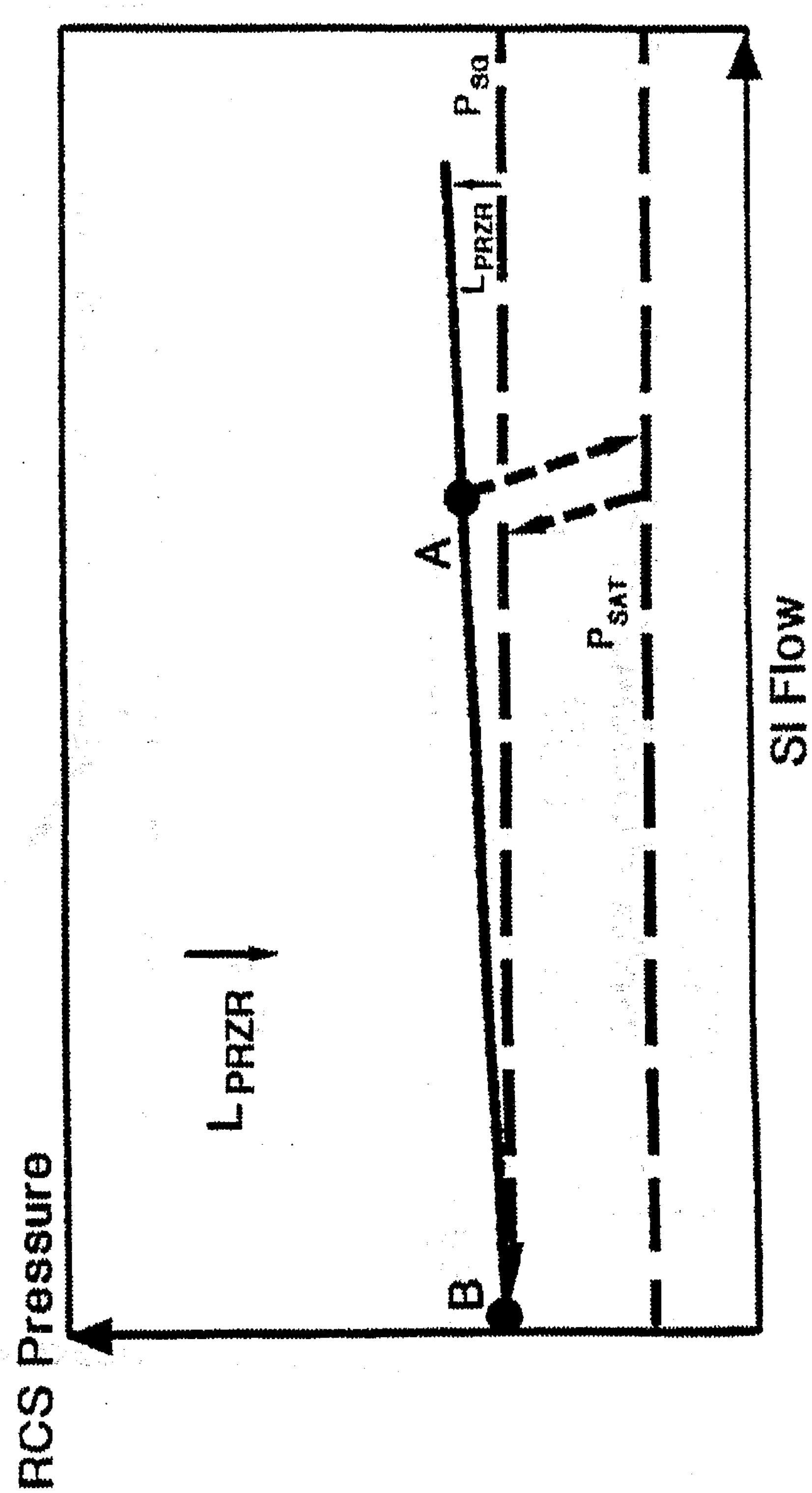


Figure 29. RCS PRESSURE VERSUS SI FLOW RATE SHOWING POSSIBLE RECOVERY PATH FOR MULTIPLE TUBE FAILURES



EOP Step No: Step 17 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Maximum spray flow should be established to decrease primary system pressure as rapidly as possible. The operator should be familiar with how rapidly pressure will decrease with full spray to avoid overshooting the termination criteria. *In addition, if pressure does not decrease or decreases only slowly, the operator should proceed to the next step to select an alternative means of depressurizing the RCS to expedite recovery.* (emphasis added)

ERG Knowledge Item: Voiding in the upper head region is not expected to occur if the reactor coolant pumps are running even with full spray flow. However, if the RCS is depressurized concurrently with the cooldown, some voiding may occur. In that case, PZR level will increase rapidly as water is displaced from the upper head into the PZR.

ERG Knowledge Item: If a subsequent SGTR is diagnosed by the operator while the RCS depressurization is in progress, although it does not impact the pressure in the newest ruptured SG, for the sake of simplicity it should be stopped and the plant stabilized by the operator until the newest ruptured SG is isolated. (DW-92-070)

DW-2002u: High PZR water level with any combination of RCPs operating will increase spray effectiveness.

DW-2002u: The Generic Issue "RCP Trip/Restart" in the ERG Executive Volume will be revised to contain the following:

An analysis was performed to determine available pressurizer spray differential pressure for various combinations of RCPs operating using input data representative of standard Westinghouse 2-loop, 3-loop and 4-loop plants. For this analysis, the spray driving head (or Δp) with various combinations of RCPs operating was compared with the pressurizer elevation head loss (or Δp) to determine whether or not spray would be produced. The results of this analysis are similar to information developed previously for these plant types, where the spray predictions compared favorably with the plant test results.

EOP Step No: Step 17 (CONTINUED)

Supplemental Information: (CONTINUED)

Spray performance is affected by the differences in coolant velocity head (V2/2g) and static pressure associated with the pressurizer surge line connection. The differential pressure available for pressurizer spray is determined by the difference between spray driving Δp (psi) and pressurizer elevation Δp (psi). The spray driving Δp is the differential pressure between the scoop inlet in the cold leg and the surge line inlet in the hot leg. The spray driving Δp is dictated by RCS loop and vessel hydraulic losses and velocity changes. Its value depends on the number of RCPs operating and in which loops they are operating relative to the open spray line. Pressure losses due to reverse flow at either spray scoop are assumed to be minimal. The pressurizer elevation Δp is determined from the difference in elevation head between the spray line (that is, from cold leg scoop to top of the spray line) and the pressurizer/surge line (that is, the Δp due to the steam space, pressurizer liquid volume, and surge line). The pressurizer elevation Δp must be overcome to attain spray flow. Its value depends primarily on the pressurizer liquid level and the density difference between the various fluid states.

The analysis assumed operation at zero percent power with Tavg at no-load temperature and one spray valve failed open. The differential pressure available for spray was determined with both normal (25%) and high (90%) pressurizer levels. Note that these results are general; individual plant characteristics (e.g., piping configuration, core height, pressurizer size) may alter the results. The results of this analysis are summarized in the following table "Differential Pressure (psi) Available for Pressurizer Spray".

Differential Pressure (psi) Available for Pressurizer Spray

A positive differential pressure (Δp) indicates that spray would be produced. A negative Δp (in bold) indicates that the elevation loss is higher than the spray Δp, and spray water could not be raised to the top of the spray line above the pressurizer to initiate spray. A Δp close to zero indicates that spray flow may or may not be produced (due to analysis uncertainties).

[See Table on next page]

EOP Step No: Step 17 (CONTINUED)

Supplemental Information: (CONTINUED)

Note: The table below has been edited to display only results applicable to Salem. Loop "A" has the surge line and a spray line, and loop "B" has a spray line. Equivalent Salem component designations are included in parentheses. Values for differential pressure are in psid.

RCS loops	RCP hp	Spray valve A open **(PS3)**			Spray valve B open **(PS1)**			Spray valve B open **(PS1)**			Spray valve A open **(PS3)**		
		RCP(s) ON	25% PZR	90% PZR	RCP(s) ON	25% PZR	90% PZR	RCP(s) ON	25% PZR	90% PZR	RCP(s) ON	25% PZR	90% PZR
4	6000	A **(23)**	+16.0	+22.3	B **(21)**	**-1.2**	+5.0	A **(23)**	+6.5	+12.7	B **(21)** C* **(22)** D* **(24)**	**-10.8**	**-4.6**
		A,C **(23,22)** A,D **(23,24)**	+21.0	+27.2	B,C **(21,22)** B,D **(21,24)**	+4.4	+10.6	A,C **(23,22)** A,D **(23,24)**	+11.8	+18.0	B,C **(21,22)** B,D **(21,24)** C, D * **(22,24)**	**-4.8**	+1.4
		A,C,D **(23, 22,24)**	+29.9	+36.1	B,C,D **(21, 22,24)**	+14.5	+20.7	A,C,D **(23, 22,24)**	+21.4	+27.6	B,C,D **(21, 22,24)**	+6.0	+12.2

* - also applies if spray valve B is open instead of spray valve A

As the above results indicate, spray will be produced in all cases when the RCP is operating in the loop with the surge line connection. Spray may be produced if the surge line RCP is idle and the other spray line RCP is running; it is more likely with the non-spray RCP(s) also running. Spray flow with any combination of RCPs operating will be more effective with a high pressurizer water level. These results should be generally applicable to 2-loop, 3-loop and 4-loop plants, although differences in system hydraulics, spray scoop effectiveness, or pressurizer elevation could change a few of the cases listed above. The results also indicate that there will be sufficient operating flexibility to obtain spray flow for the normal shutdown and cooldown operations with one or two pumps stopped. The previous studies for 2-loop, 3-loop and 4-loop plants provided similar results, with 4-loop plants tending to have less operating flexibility than the others. In some 3-loop and 4-loop plants, the spray line in the loop without the surge line may not generate adequate spray unless the pressurizer water level is high.

EOP Step No: Step 17 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
11%	D.04	Value showing PZR level just in range including allowances for normal channel accuracy and reference leg process errors.
19%	D.05	Value showing PZR level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
77%	D.08	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, minus 20% for operating margin.
74%	D.09	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, minus 20% for operating margin, but not less than 50%.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.

ERG Deviations:

DEV.1 Deleted substeps for closing the auxiliary spray valves.

JUST. It is possible to enter ERG Step 17.b from ERG Step 18.a.RNO, so ERG Step 17.b includes closure of the auxiliary spray valves. However, DW-94-013 modified ERG Step 18.a.RNO, greatly increasing the complexity of that step, especially when plant specific details are added. Therefore, auxiliary spray actions have been moved into a separate step to simplify flowchart structure while maintaining the ERG priorities of normal spray, PZR PORV, and auxiliary spray.

DEV.2 If normal PZR spray is having no effect, the EOP provides a transition to the next step for using PZR PORVs for depressurization.

JUST. Incorporates intent of Knowledge Item #1.

DEV.3 Revised step and basis to incorporate guidance for tripping additional RCPs as necessary for the case of a stuck open spray valve.

JUST. This is consistent with the intent of DW 2002u. [CR 70022203]

EOP Step No: Step 18

ERG Step No: Step 18.a.AER

EOP Step:

IS A PZR PORV AVAILABLE
[RCS DEPRESSURIZATION WITH PORV]

Purpose:

To decrease RCS pressure using a pressurizer PORV to stop primary-to-secondary leakage and establish an indicated pressurizer level.

ERG Basis:

In order to both minimize primary-to-secondary leakage and establish an indicated PZR level, the primary system pressure must be reduced before ECCS flow is terminated, as discussed in EOP Step 17. If normal PZR spray is either unavailable or ineffective, an alternative means must be used. These include a PZR PORV and auxiliary PZR spray. Although auxiliary spray would conserve reactor coolant inventory, it may also lead to failure of the spray nozzle since the spray would not be heated by letdown at this time. In order to successfully initiate auxiliary spray flow, the flow through the BIT lines must first be isolated, since sufficient differential pressure will not be available across the auxiliary spray line with the SI lines open to deliver adequate auxiliary spray flow. If the charging flow control valve is not fully open, auxiliary spray flow may not be effective. In addition, auxiliary spray flow may not be effective due to the elevation differences of the spray nozzles unless charging flow to the loops is isolated and the normal PZR spray valves are closed. Therefore, the plant specific steps necessary for establishing auxiliary spray flow should be incorporated into this step. The intent of this action is to establish an auxiliary spray flow path (e.g., open charging flow control valve, ensure the charging line isolation valves are open, isolate the charging header from the loops and close the normal spray valves).

Consequently, a PZR PORV is the recommended alternative to normal PZR spray. Auxiliary spray provides additional redundancy in the event that no PZR pressure control is available. To further ensure recovery in the event that no PZR pressure control is available, the operator is directed to EOP-SGTR-5, SGTR WITHOUT PRESSURIZER PRESSURE CONTROL, which provides for restarting RCPs to restore normal spray, SI reduction to establish auxiliary spray, and SI termination without PZR level to stop primary-to-secondary leakage.

The use of a PZR PORV to depressurize the RCS results in an additional loss reactor coolant. This could lead to cycling of ECCS pumps if the PORV failed to close. Consequently, if a PZR PORV is used to depressurize the RCS, additional guidance is provided to ensure that the PORV has been properly closed or isolated if necessary. Additional guidance is also provided to address upper head voiding and PORV operation, as described in the preceding cautions.

EOP Step No: Step 18 (CONTINUED)

EOP Basis:

Same as the ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

N/A

ERG Deviations:

DEV.1 Moved ERG Step 18.a.AER to before the preceding cautions and note.

JUST. Due to flowchart design, step was moved to streamline EOP flow. The cautions and note only apply to PORV operations. Therefore, by asking this question first, if a PZR PORV is not available, then the reader can avoid reading the cautions and notes aloud and can skip subsequent steps related to PORV operations and go directly to auxiliary spray contingency actions per ERG Step 18.a.RNO. This expedites movement through the EOP by minimizing reading delays and skipping non-applicable steps.

EOP Step No: Step 19

ERG Step No: Caution 18-1

EOP Step:

CAUTION THE PRT MAY RUPTURE CAUSING ADVERSE CONTAINMENT CONDITIONS **[RCS DEPRESSURIZATION WITH PORV]**

Purpose:

To alert the operator that abnormal containment indications i.e., radiation and humidity, may develop as a result of PRT rupture. These indications may not be indicative of a LOCA.

ERG Basis:

If a PZR PORV is opened to decrease RCS pressure, steam will be discharged into the PRT. Depending on RCS pressure, this discharge may be sufficient to break the PRT rupture disk before primary pressure is reduced to the ruptured SG pressure. If that occurs, leakage of contaminated coolant into containment may result in abnormal containment radiation and humidity. Since these symptoms are also characteristic of a loss of coolant accident, this caution is provided to alert the operator that the more likely source in this case is the PRT. The operator should continue recovery in this procedure to stop primary-to-secondary leakage unless otherwise directed by subsequent steps.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 20

ERG Step No: Caution 18-2

EOP Step:

CAUTION CYCLING OF PZR PORV SHOULD BE MINIMIZED
[RCS DEPRESSURIZATION WITH PORV]

Purpose:

To alert the operator that cycling of the PZR PORV should be avoided.

ERG Basis:

Cycling of the PORV should be avoided to minimize the potential of valve failure. This also reduces the discharge to the PRT.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 21

ERG Step No: Note 18-1

EOP Step:

NOTE IF RCPs ARE NOT RUNNING, THEN THE REACTOR VESSEL HEAD MAY VOID DURING RCS DEPRESSURIZATION. THIS WILL CAUSE A RAPID RISE IN PZR LEVEL
[RCS DEPRESSURIZATION WITH PORV]

Purpose:

To inform the operator that PZR level may increase rapidly because of voiding in the upper head region if no RCP is running.

ERG Basis:

Without RCPs running there is very little flow into the upper head region. Fluid in that region remains relatively hot even though the fluid temperature in the active regions of the primary system has been significantly reduced. As the RCS is depressurized, this hotter fluid may flash to steam, forming an upper head void. Similar behavior may occur in the SG tube region of the ruptured loop, although the fluid temperature in the tubes is expected to follow the temperature in the active regions more closely. PZR level will increase rapidly as water displaced from these hotter regions replaces steam vented through the PORV. The PZR may fill within a few minutes resulting in water relief through the PORV unless the PORV is closed. This note informs the operator of this condition so that the PORV can be closed quickly, as directed in the following step.

Although voiding may occur in the inactive regions of the RCS, it is not expected to occur when the primary pressure is initially reduced to equilibrium with the ruptured SG even if no RCPs are running. It would be expected if the ruptured SG pressure is significantly below no-load or significant overshoot occurs during RCS depressurization.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: RCS depressurization should continue until one of the conditions in EOP Step 22 is met, even with a void in the inactive regions, such as the upper head.

EOP Step No: Step 21 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 22

ERG Step No: Step 18

EOP Step:

REVIEW DEPRESSURIZATION TERMINATION CRITERIA IN TABLE F
[RCS DEPRESSURIZATION WITH PORV]

Purpose:

To decrease RCS pressure using a PZR PORV to stop primary-to-secondary leakage and establish an indicated PZR level.

ERG Basis:

In order to both minimize primary-to-secondary leakage and establish an indicated PZR level, the primary system pressure must be reduced before ECCS flow is terminated, as discussed in EOP Step 17. If normal PZR spray is either unavailable or ineffective, an alternative means must be used. These include a PZR PORV and auxiliary PZR spray. Although auxiliary spray would conserve reactor coolant inventory, it may also lead to failure of the spray nozzle since the spray would not be heated by letdown at this time. In order to successfully initiate auxiliary spray flow, the flow through the BIT lines must first be isolated, since sufficient differential pressure will not be available across the auxiliary spray line with the SI lines open to deliver adequate auxiliary spray flow. If the charging flow control valve is not fully open, auxiliary spray flow may not be effective. In addition, auxiliary spray flow may not be effective due to the elevation differences of the spray nozzles unless charging flow to the loops is isolated and the normal PZR spray valves are closed. Therefore, the plant specific steps necessary for establishing auxiliary spray flow should be incorporated into this step. The intent of this action is to establish an auxiliary spray flow path (e.g., open charging flow control valve, ensure the charging line isolation valves are open, isolate the charging header from the loops and close the normal spray valves).

Consequently, a PZR PORV is the recommended alternative to normal PZR spray. Auxiliary spray provides additional redundancy in the event that no PZR pressure control is available. To further ensure recovery in the event that no PZR pressure control is available, the operator is directed to EOP-SGTR-5, SGTR WITHOUT PRESSURIZER PRESSURE CONTROL, which provides for restarting RCPs to restore normal spray, SI reduction to establish auxiliary spray, and SI termination without PZR level to stop primary-to-secondary leakage.

The use of a PZR PORV to depressurize the RCS results in an additional loss reactor coolant. This could lead to cycling of ECCS pumps if the PORV failed to close. Consequently, if a PZR PORV is used to depressurize the RCS, additional guidance is provided to ensure that the PORV has been properly closed or isolated if necessary. Additional guidance is also provided to address upper head voiding and PORV operation, as described in the preceding cautions.

EOP Basis:

Same as ERG basis.

EOP Step No: Step 22 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: The operator should be familiar with how rapidly pressure will decrease with one PZR PORV opened. For the reference plant, RCS pressure decreases at a rate that decreases from 350 psi/minute to 120 psi/minute as RCS pressure approaches the ruptured SG pressure.

ERG Knowledge Item: Voiding may occur in the inactive regions of the RCS as pressure is decreased to a value equal to the ruptured SG pressure. Although the likelihood and extent of voiding are greater for plants where the upper head region is at T_{HOT} during normal operation, voiding may also occur in T_{COLD} upper head plants if the ruptured SG is less than no-load pressure or if significant overshoot occurs during RCS depressurization. In that case, water level in the PZR will increase rapidly as water displaced from the inactive regions replaces steam vented from the PZR. PZR level should be monitored closely to prevent a water solid PZR and potential water relief through the PORV.

ERG Knowledge Item: If a subsequent SGTR is diagnosed by the operator while the RCS depressurization is in progress, although it does not impact the pressure in the newest ruptured SG, for the sake of simplicity it should be stopped and the plant stabilized by the operator until the newest ruptured SG is isolated. (DW-92-070)

Setpoints and Numerical Values:

Value	Setpoint	Description
11%	D.04	Value showing PZR level just in range including allowances for normal channel accuracy and reference leg process errors.
19%	D.05	Value showing PZR level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
77%	D.08	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, minus 20% for operating margin.
74%	D.09	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, minus 20% for operating margin, but not less than 50%.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.

EOP Step No: Step 22 (CONTINUED)

ERG Deviations:

DEV.1 Deleted substep for establishing auxiliary spray.

JUST. It is possible to enter ERG Step 17.b from ERG Step 18.a.RNO, so ERG Step 17.b includes closure of the auxiliary spray valves. However, DW-94-013 modified ERG Step 18.a.RNO, greatly increasing the complexity of that step, especially when plant specific details are added. Therefore, auxiliary spray actions have been moved into a separate step to simplify flowchart structure while maintaining the ERG priorities of normal spray, PZR PORV, and auxiliary spray.

EOP Step No: Step 23

ERG Step No: Step 19

EOP Step:

ARE BOTH PZR PORVs CLOSED
[RCS PRESSURE CHECK]

Purpose:

To detect excessive leakage from the PZR PORV and ensure isolation by closing its block valve.

ERG Basis:

The use of a PZR PORV results in a loss of reactor coolant. Since all ECCS pumps will be stopped in subsequent steps, the PORV must close properly to ensure that adequate coolant inventory can be maintained with only normal charging capacity. Although SI reinitiation criteria are provided to ensure that adequate core cooling will be maintained, stopping all ECCS pumps with a loss of coolant through the PORV in excess of normal makeup capacity may result in unnecessary cycling of the ECCS pumps.

The mass flow rate through a leaking PORV will be approximately within the capacity of the normal Reactor Coolant Makeup System if RCS pressure increases when the PORV is closed. Consequently, the operator is instructed to check that RCS pressure is increasing as additional verification that the ECCS pumps will not be needed to maintain coolant inventory. If pressure does not increase after the PORV and block valve are closed, excessive leakage from the PORV is suspected. In that case the operator is transferred to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, to stop ECCS pumps one at a time after it is demonstrated that the reduced ECCS capacity is sufficient to maintain adequate coolant inventory.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Means of detecting leakage from PZR PORV.

ERG Plant Specific Information: This step is a redundant check on RCS pressure response to ensure minimal leakage from the PZR PORV since increasing RCS pressure is also a necessary condition for SI termination in EOP-SGTR-1. The available instrumentation for detecting leakage from a PZR PORV should be listed. It is expected that the operator would check these indications any time a PZR PORV is used for RCS pressure control. Consequently, removal of this step may be justified on a plant specific basis if the importance and means of detecting leakage from the PORV are adequately addressed in training.

EOP Step No: Step 23 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG RNO Step 19.1 that directs monitoring conditions for indications of PZR PORV leakage.

JUST. This item is covered by training. Deleted as allowed by Plant Specific Information Item.

EOP Step No: Step 24

ERG Step No: Step 18

EOP Step:

IF AUX SPRAY IS NOT AVAILABLE, THEN GO TO EOP-SGTR-5, STEP 1
[RCS DEPRESSURIZATION WITH AUX SPRAY]

Purpose:

To decrease RCS pressure using auxiliary spray to stop primary-to-secondary leakage and establish an indicated PZR level.

ERG Basis:

In order to both minimize primary-to-secondary leakage and establish an indicated PZR level, the primary system pressure must be reduced before ECCS flow is terminated, as discussed in EOP Step 17. If normal PZR spray is either unavailable or ineffective, an alternative means must be used. These include a PZR PORV and auxiliary PZR spray. Although auxiliary spray would conserve reactor coolant inventory, it may also lead to failure of the spray nozzle since the spray would not be heated by letdown at this time. In order to successfully initiate auxiliary spray flow, the flow through the BIT lines must first be isolated, since sufficient differential pressure will not be available across the auxiliary spray line with the SI lines open to deliver adequate auxiliary spray flow. If the charging flow control valve is not fully open, auxiliary spray flow may not be effective. In addition, auxiliary spray flow may not be effective due to the elevation differences of the spray nozzles unless charging flow to the loops is isolated and the normal PZR spray valves are closed. Therefore, the plant specific steps necessary for establishing auxiliary spray flow should be incorporated into this step. The intent of this action is to establish an auxiliary spray flow path (e.g., open charging flow control valve, ensure the charging line isolation valves are open, isolate the charging header from the loops and close the normal spray valves).

Consequently, a PZR PORV is the recommended alternative to normal PZR spray. Auxiliary spray provides additional redundancy in the event that no PZR pressure control is available. To further ensure recovery in the event that no PZR pressure control is available, the operator is directed to EOP-SGTR-5, SGTR WITHOUT PRESSURIZER PRESSURE CONTROL, which provides for restarting RCPs to restore normal spray, SI reduction to establish auxiliary spray, and SI termination without PZR level to stop primary-to-secondary leakage.

EOP Step No: Step 24 (CONTINUED)

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Voiding may occur in the inactive regions of the RCS as pressure is decreased to a value equal to the ruptured SG pressure. Although the likelihood and extent of voiding are greater for plants where the upper head region is at T_{HOT} during normal operation, voiding may also occur in T_{COLD} upper head plants if the ruptured SG is less than no-load pressure or if significant overshoot occurs during RCS depressurization. In that case, water level in the PZR will increase rapidly as water displaced from the inactive regions replaces steam vented from the PZR. PZR level should be monitored closely to prevent a water solid PZR and potential water relief through the PORV.

ERG Knowledge Item: If a subsequent SGTR is diagnosed by the operator while the RCS depressurization is in progress, although it does not impact the pressure in the newest ruptured SG, for the sake of simplicity it should be stopped and the plant stabilized by the operator until the newest ruptured SG is isolated. (DW-92-070)

DW-94-013: With the BIT in service, the driving head through the auxiliary spray header will be insufficient. Therefore, the BIT must be isolated to allow use of auxiliary spray. Prior to isolating BIT injection, at least one SI pump must be verified running to ensure ECCS flow capability to the core is maintained.

EOP Step No: Step 24 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
11%	D.04	Value showing PZR level just in range including allowances for normal channel accuracy and reference leg process errors.
19%	D.05	Value showing PZR level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
77%	D.08	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, minus 20% for operating margin.
74%	D.09	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, minus 20% for operating margin, but not less than 50%.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.
320°F	X.04	Maximum PZR to auxiliary spray delta-T for placing aux spray in service.

ERG Deviations:

DEV.1 Split ERG Step 18.a.RNO into a separate step.

JUST. DW-94-013 modified ERG Step 18.a.RNO, greatly increasing the complexity of that step, especially when plant specific details are added. Therefore, auxiliary spray actions have been moved into a separate step to simplify flowchart structure while maintaining the ERG priorities of normal spray, PZR PORV, and auxiliary spray.

DEV.2 Added a note regarding the 320°F pzr to aux spray delta-T limit.

JUST. This Tech Spec limit is applicable whenever the ERGs prohibit use of aux spray if letdown is isolated. In some instances the ERGs direct use of aux spray even if letdown is isolated because the need to depressurize the RCS overrides the Tech Spec considerations. This note provides assurance to the operator that the EOP has priority over the Tech Spec limit in these instances.

EOP Step No: Step 25

ERG Step No: Caution 20-1

EOP Step:

CAUTION DELAYING SI TERMINATION MAY CAUSE RUPTURED SG OVERFILL
[SI TERMINATION CRITERIA]

Purpose:

To alert the operator that primary-to-secondary leakage will continue until ECCS flow is terminated.

ERG Basis:

As previously demonstrated (see EOP Step 17), SI termination is necessary to control reactor coolant inventory and stop primary-to-secondary leakage. If ECCS flow is not terminated, leakage into the secondary will eventually fill the SG with water and lift the atmospheric relief valves. This could damage the relief valve and main steamline which would complicate subsequent recovery and aggravate the radiological consequences. Hence, SI must be terminated when the criteria in subsequent steps are satisfied to prevent SG overfill.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Voiding in the upper head region should not preclude SI termination. Such a void is expected to be confined to the upper head region and will not expand below the top of the hot legs if RCS subcooling is maintained at the core exit. Although an upper head void may hinder PZR pressure and level control, it is not a sufficient safety concern to prevent SI termination if the specified criteria are met.

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 26

ERG Step No: Step 20

EOP Step:

IS RCS SUBCOOLING GREATER THAN 0°F
[SI TERMINATION CRITERIA]

Purpose:

To determine if conditions have been established which indicate that SI flow is no longer required.

ERG Basis:

Previous operator actions are designed to ensure adequate coolant inventory exists and that SI flow is not likely to be needed. This step performs a final check on system conditions to verify the success of previous actions. Refer to the document SI TERMINATION/REINITIATION in the Generic Issues section of the ERG Executive Volume for the basis of the SI termination criteria.

In the EOP-SGTR-1 procedure, all ECCS pumps are stopped at the same time to terminate leakage into the ruptured SG. In the contingency procedure, EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, the ECCS pumps are stopped one at a time when it is demonstrated that the reduced ECCS capacity will be sufficient to maintain adequate coolant inventory. If the criteria in EOP-SGTR-1 for complete SI termination are not satisfied, the operator is directed to EOP-SGTR-3 to reduce ECCS flow, if possible, in order to minimize leakage from the primary. If all criteria are satisfied except for PZR level, the operator is to return to EOP Step 14 to repeat actions which restore PZR level. This transition is provided since depressurization of the RCS may have been terminated on minimum RCS subcooling for multiple tube failure events.

Note that one of the criteria for SI termination requires that a minimum feed flow is available. This is different than the more general termination criteria which requires that a minimum feed flow is actually delivered to the intact SGs. If no intact SG is available, it may be necessary to use a faulted SG to cool the RCS following a SG tube failure. In that case, feed flow to the faulted SG necessary to control RCS temperature may be significantly less than the criteria for SI termination, which was conservatively calculated to ensure secondary heat sink. Therefore, if sufficient flow is available but not necessarily delivered, the conditions for SI termination are satisfied.

EOP Basis:

Same as ERG basis.

EOP Step No: Step 26 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Meaning of minimum feed flow available.

Setpoints and Numerical Values:

Value	Setpoint	Description
11%	D.04	Value showing PZR level just in range including allowances for normal channel accuracy and reference leg process errors.
19%	D.05	Value showing PZR level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
9%	M.02	Value showing SG level just in the narrow range including allowances for normal channel accuracy and reference leg process errors.
15%	M.03	Value showing SG level just in the narrow range including allowance for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.
$22x10^4$lb/hr	S.02	The minimum safeguards AFW flow requirement for heat removal plus allowances for normal channel accuracy (typically one AFW pump capacity at SG design pressure).

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 27

ERG Step No: Step 21

EOP Step:

STOP BOTH SI PUMPS
[SI TERMINATION]

Purpose:

To terminate the injection of water into the RCS from all but one centrifugal charging pump

ERG Basis:

When the conditions for terminating ECCS flow are satisfied, ECCS flow must be terminated to stop primary-to-secondary leakage. This is done by stopping all ECCS pumps not needed for normal reactor coolant makeup. These pumps are placed in standby to ensure their availability in the event that ECCS flow must be reinitiated.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Primary-to-secondary leakage will continue with one centrifugal charging pump running until normal charging and letdown are established. Consequently, this and subsequent steps should be completed as quickly as possible to prevent SG overfill.

ERG Knowledge Item: RCS temperatures will tend to increase when ECCS flow is stopped. Steam dump from the intact SGs should be increased to stabilize core exit temperatures.

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Did not specify placing the ECCS pumps in standby after stopping them.

JUST. When a pump is stopped, its pushbutton control switch is electronically aligned by design to automatically start when required. No additional manual action is required to place the pump in "standby". [SD-18]

EOP Step No: Step 28

ERG Step No: Steps 22, 23, and 24

EOP Step:

IS CHARGING PUMP SUCTION ALIGNED TO THE RWST
[NORMAL CHARGING ALIGNMENT]

Purpose:

To stop injection flow to the RCS through the BIT.

To properly establish a charging path and charging flow.

To maintain PZR level by adjusting normal charging flow.

ERG Basis:

(ERG Step 22) Normal charging and the BIT injection lines are parallel flow paths from the discharge of the centrifugal charging pumps. Isolating the BIT directs the flow only through the charging lines which provides more precise flow control. The inlet valves should be closed first to minimize any pressure surge in the BIT. Prior to isolating the BIT, the operator checks that the charging pump miniflow valves are open in order to ensure that the charging pump minimum flow is available.

Prior to opening the charging pump miniflow isolation valves, the operator checks to determine if the charging pumps are aligned to the RWST in the injection mode or to the discharge of the RHR pumps in the recirculation mode. If the charging pumps are aligned to the RWST, the miniflow isolation valves should be opened. If the charging pumps are aligned to the discharge of the RHR pumps in the recirculation mode, the miniflow valves should not be opened since this will, for certain conditions, establish a flow path from the containment sump through the RHR pumps via the CVCS relief valves to the CVCS holdup tanks. For the recirculation mode, the operator opens the charging flow control valve to establish a minimum charging flow prior to isolating the BIT.

(ERG Step 23) Proper alignment of the charging path allows flow to be controlled in the normal manner. This provides more precise reactor coolant inventory control which minimizes primary-to-secondary leakage while maintaining a boration path. The specified flow ensures minimum flow through the charging pump(s) for cooling and is well on scale on the normal charging flow meter. The amount of charging flow established is limited to avoid potential runout of the centrifugal charging pumps due to simultaneous injection through the BIT and normal charging lines. For the reference plant normal miniflow does not isolate on an SI signal and should be available. However, if it is not available, adequate flow is provided to the centrifugal charging pumps with the establishment of 60 gpm charging flow. It should be noted that miniflow should be verified prior to reducing charging flow below 60 gpm in subsequent steps.

EOP Step No: Step 28 (CONTINUED)

ERG Basis: (CONTINUED)

(ERG Step 24) PZR level will tend to decrease when ECCS flow is terminated as primary pressure and ruptured SG pressure will equalize. In some cases, PZR level may decrease below the top of the heaters before equilibrium is reached. In addition, if the RCS temperature is decreasing, shrinkage of the primary coolant could reduce PZR level, possibly requiring manual operation of ECCS pumps. The operator is instructed to control charging flow as necessary to maintain PZR level on span in order to compensate for these effects.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Centrifugal charging pump runout is only a concern at low RCS pressures. Consequently, charging flows slightly greater than recommended are acceptable for conditions typical of a SGTR event. However, excessive charging flow may result in increased primary-to-secondary leakage and should be avoided.

ERG Knowledge Item: Excessive charging flow that causes RCS pressure to increase will also result in primary-to-secondary leakage. Charging flow should be controlled only as necessary to maintain PZR level.

ERG Knowledge Item: If the PZR is solid, charging flow will also control RCS pressure. In that case, flow should be controlled as necessary to maintain RCS subcooling greater than instrument uncertainties.

ERG Knowledge Item: More detailed guidance on how to control charging flow is provided in EOP Steps 40 and 41. This step is intended as an interim measure to maintain PZR level while alignment of the CVCS is completed. EOP steps 40 and 41 supersede this step.

EOP Step No: Step 28 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
60 gpm	S.01	Charging flow rate comparable to normal charging pump miniflow when in recirculation mode.
25%	D.06	Value showing pressurizer level just covering the heaters, including allowances for normal channel accuracy and reference leg process errors.
33%	D.07	Value showing pressurizer level just covering the heaters including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.

ERG Deviations:

DEV.1 Added an action to adjust RCP seal injection as necessary after charging flow is established.

JUST. Meets the intent of the ERG Basis section, which requires that the minimum seal injection flow be maintained. [SD-28]

EOP Step No: Step 29

ERG Step No: N/A

EOP Step:

NOTIFY CHEMISTRY THAT A SGTR IS IN PROGRESS AND DIRECT THEM TO SAMPLE THE RCS FOR BORON, ACTIVITY, AND IODINE
[RCS SAMPLE]

Purpose:

To inform the Chemistry Department that a SGTR is in progress and to obtain a RCS sample.

ERG Basis:

N/A

EOP Basis:

At this point the SGTR primary-to-secondary leakage has been minimized. Subsequent recovery actions will require that RCS radiological and reactivity conditions are determined by a RCS sample.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added step regarding the notification to Chemistry to take a RCS sample.

JUST. Subsequent SGTR recovery actions will involve RCS and SG samples and RCS shutdown calculations. This step was added as an anticipatory action to reduce response time of applicable subsequent sample actions.

EOP Step No: Step 30

ERG Step No: Step 25

EOP Step:

IS RCS SUBCOOLING GREATER THAN 0°F
[SI REINITIATION CRITERIA]

Purpose:

To verify that the normal makeup capacity is sufficient to maintain adequate coolant inventory and to instruct the operator to initiate ECCS flow when necessary to maintain adequate coolant inventory.

ERG Basis:

Reliable indications of RCS subcooling and PZR level are necessary to monitor coolant inventory trends and ensure sufficient core cooling. If either of these indications cannot be maintained with normal charging, reactor coolant makeup flow must be supplemented with ECCS flow to restore such indications. If RCS subcooling is lost, an undetected loss of reactor coolant is suspected. In that case, the operator is transferred to EOP-SGTR-3, SGTR WITH LOCA - SUBCOOLED RECOVERY, to stop ECCS pumps one at a time after it is demonstrated that the reduced SI capacity is sufficient to maintain adequate coolant inventory.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Reinitiating ECCS flow by generating an SI signal should be avoided unless necessary to establish ECCS flow since this will also cause a containment isolation signal and rearrange loads on the 4KV vital buses if offsite power is unavailable. This may also cause excessive ECCS flow.

ERG Knowledge Item: Starting ECCS pumps will increase primary-to-secondary leakage and, consequently, should be avoided unless necessary to maintain RCS subcooling or PZR level.

ERG Knowledge Item: No preference is given in the generic guidelines about which pumps to start to establish ECCS flow although an individual plant may have preference. The operator has the option of using either a SI pump or centrifugal charging pump. If the operator selects to use a centrifugal charging pump, then he must align the suction and discharge of the pump to the ECCS mode and isolate the normal charging suction and discharge flow paths. (DW-93-032)

ERG Knowledge Item: This step is a continuous action step.

EOP Step No: Step 30 (CONTINUED)

Supplemental Information: (CONTINUED)

ERG Knowledge Item: If conditions deteriorate and the operator is required to manually start ECCS pumps to restore RCS subcooling or pressurizer level, the operator should leave the ECCS pumps on until the SI reduction criteria is met in the appropriate step.

Setpoints and Numerical Values:

Value	Setpoint	Description
11%	D.04	Value showing PZR level just in range including allowances for normal channel accuracy and reference leg process errors.
19%	D.05	Value showing PZR level just in range, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 31

ERG Step No: Step 26

EOP Step:

IS ANY CS PUMP RUNNING
[CS PUMP STOP CRITERIA]

Purpose:

To stop CS pumps if running and no longer needed.

ERG Basis:

Spray pumps are automatically actuated on High-High containment pressure. In EOP-TRIP-1, REACTOR TRIP OR SAFETY INJECTION, step 11, the operator verifies that the Containment Spray System is operating if it is required. During a LOCA, the need for continued operation of the Spray System is monitored in EOP-LOCA-1, step 10. After containment pressure is reduced, the pumps can be stopped to prevent RWST depletion. If at any time the containment pressure increases above the High-High containment pressure setpoint, the PURPLE path of the Containment Environment Status Tree sends the operator to EOP-FRCE-1, RESPONSE TO EXCESSIVE CONTAINMENT PRESSURE. EOP-FRCE-1, step 3, checks the need for CS and verifies that the spray system is operational if it is required.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: This step is a continuous action step.

ERG Knowledge Item: As part of the action to terminate containment spray, the operator should close the motor operated valve on the CS pump. The action will ensure containment isolation. (DW-94-005)

Setpoints and Numerical Values:

Value	Setpoint	Description
13 psig	T.04	Pressure for resetting spray signal minus allowances for normal channel accuracy.

EOP Step No: Step 31 (CONTINUED)

ERG Deviations:

DEV.1 Did not specify placing the CS pumps in standby after stopping them.

JUST. When a pump is stopped, its pushbutton control switch is electronically aligned by design to automatically start when required. No additional manual action is required to place the pump in "standby". [SD-18]

EOP Step No: Steps 32 and 33

ERG Step No: Step 11

EOP Step:

(Step 32) ARE ALL 4 KV GROUP BUSES ENERGIZED
[4 KV GROUP BUS RESTORATION]

(Step 33) IS 2E GROUP BUS ENERGIZED AND BKR 2E6D CLOSED
[PZR HEATER POWER AVAILIBILITY]

Purpose:

To ensure electrical power supply is available to all essential equipment used in this procedure.

ERG Basis:

If offsite power is lost to any AC electrical bus, manual action may be required to establish an electrical power supply to equipment used during recovery, such as instrument air compressor, PZR and SG PORVs with associated isolation valves, steam dump valves, condenser vacuum pumps, PZR heaters, etc. If offsite power cannot be restored, essential equipment used in subsequent steps, such as emergency air compressor and PZR PORVs and MS10s, must be loaded on the AC vital buses.

EOP Basis:

Same as ERG basis, with the following additional information:

If offsite power cannot be restored to the group buses, the only load that needs to be powered from a vital bus is the pressurizer heaters. Pressurizer heaters can be supplied from Group Buses 2E or 2G or from Vital Buses 2A or 2C. It is preferred to power them from a group bus to minimize unnecessary DG loading on the vital buses. The 2E6D and 2G6D breakers supply not only the pressurizer heaters but also the rod drive MG sets. The rod drive MG set input breakers do NOT have undervoltage trips. To cover the case where the 2E6D and 2G6D breakers might have been opened due to an ATWT (to cause control rods to drop into the core), their input breakers are checked open prior to closing the 2E6D and 2G6D breakers to prevent an inadvertent and undesirable restart of the rod drive MG sets. Refer to Drawings 203062 and 2030633 for the electrical power supply arrangement.

EOP Step No: Steps 32 and 33 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: This step is intended to ensure that power is available to equipment needed for cooldown and depressurization of the RCS to expedite recovery. One should continue RCS cooldown and depressurization should be continued as soon as possible while continuing to restore power to other equipment that may be useful during recovery.

ERG Knowledge Item: This step is a continuous action step. Since power to the AC buses could be lost at any time, this step applies throughout the procedure.

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Directed verification of 4KV group buses instead of all AC Buses per the ERG.

JUST. The EOP checks power to all 4KV group buses, which supplies power to all other buses. The S2.OP-AB.LOOP-0001(Q) procedure will restore power to 4KV vital buses if needed.

DEV.2 Delayed manual loading of loads onto 4KV vital buses until this point in the EOP.

JUST. Step was moved to later in the EOP per validation comment VA-113. Due to FSAR requirements to terminate SI and primary-to-secondary leakage within a certain time frame, these ERG actions were postponed until now to allow SI termination to be completed sooner.

EOP Step No: Step 34

ERG Step No: Step 28

EOP Step:

IS PZR LEVEL GREATER THAN 25% (33% ADVERSE)
[ESTABLISHING LETDOWN]

Purpose:

To establish a controlled bleed path from the RCS.

ERG Basis:

The letdown system provides a bleed path to offset charging flow so that RCS pressure can be stabilized and primary-to-secondary leakage does not occur. This also provides a means of cleaning and degasifying the primary coolant in preparation for cooldown to cold shutdown. The letdown flow also heats incoming charging flow which supplies auxiliary spray. This minimizes thermal stresses in the spray nozzle caused by auxiliary spray. Since letdown is automatically isolated on low PZR level, the operator is directed to continue with subsequent steps which restore PZR level, if necessary, and then establish letdown when PZR level is restored.

If normal letdown cannot be established, excess letdown is established to balance seal injection flow. Charging may have to be reduced after excess letdown is established due to the limited capacity of excess letdown.

EOP Basis:

Same as ERG basis.

EOP Step No: Step 34 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Excess letdown may not provide sufficient flow to offset seal injection particularly at low RCS pressures. Consequently, attempts to establish normal letdown should continue. If necessary, seal injection should be reduced to the minimum necessary for RCP seal cooling to prevent leakage into the ruptured SG.

ERG Knowledge Item: If excessive activity levels in the RCS are suspected, then an evaluation of the consequences of establishing letdown should be made prior to taking that action.

Setpoints and Numerical Values:

Value	Setpoint	Description
25%	D.06	Value showing PZR level just covering the heaters, including allowances for normal channel accuracy and reference leg process errors.
33%	D.07	Value showing PZR level just covering the heaters including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
87 gpm	S.09	Minimum indicated charging flow for cooling of letdown in the regenerative heat exchanger. Also, minimum charging flow rate when borating the RCS by using normal charging aligned to RWST.
195°F	X.05	Maximum excess letdown heat exchanger outlet temperature.
300 psig	X.12	Setpoint for low pressure letdown flow automatic pressure control.

ERG Deviations:

DEV.1 Made the action step to monitor PZR level into a continuous action step.

JUST. First Knowledge Item implies that this step is a continuous action.

EOP Step No: Step 35

ERG Step No: Step 27

EOP Step:

ALIGN CVC MAKEUP SYSTEM FOR "AUTO" AND SET FOR GREATER THAN RCS BORON CONCENTRATION
[CHARGING PUMP SUCTION ALIGNMENT TO VCT]

Purpose:

To ensure that the VCT Makeup System is set for greater than the RCS boron concentration to avoid boron dilution.

To ensure VCT level control.

ERG Basis:

The automatic VCT Makeup System is designed to supplement letdown flow to maintain VCT level during a cooldown of the RCS. This additional inventory compensates for shrinkage of the reactor coolant. The boron concentration of the makeup water should be set for greater than the RCS concentration to avoid boron dilution during RCS cooldown.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 36

ERG Step No: Step 29

EOP Step:

HAS COLD LEG RECIRC BEEN ESTABLISHED
[CHARGING PUMP SUCTION ALIGNMENT TO VCT]

Purpose:

To transfer pump suction to the VCT and thus (1) to stop RWST depletion if in the injection mode, or (2) to stop delivery of sump water to the RCS if in the recirculation mode.

ERG Basis:

Charging pump suction transfers to the RWST on an SI signal. To reestablish normal charging conditions, suction must be transferred back to the VCT. If charging requirements exceed VCT makeup capabilities, suction will automatically transfer back to RWST on VCT low level.

For this type of transient, the RWST inventory may be depleted (e.g. due to operation of the Containment Spray System) and switchover to recirculation may occur. From an optimal recovery standpoint, it is desirable to preclude the need to switchover the ECCS System to the recirculation mode. Consequently, the recovery strategy includes actions to reduce ECCS flow and establish charging flow in combination with the initiation of RCS cooldown, RCS depressurization and RHR System operation. For the situation in which the RCS is intact, the actions to reduce ECCS flow (i.e., stop RHR pumps, stop SI pumps and realign centrifugal charging pumps for normal charging) should be completed prior to the depletion of the RWST inventory and switchover to recirculation.

Although unlikely, it is possible that the RWST inventory could be depleted and switchover to recirculation could occur before the ECCS flow reduction steps are performed. Consequently, if the plant is in the recirculation mode prior to ECCS flow reductions, the operator will have to realign the centrifugal charging pumps suction to the VCT from the RHR pump discharge instead of from the RWST. Prior to realigning the centrifugal charging pumps suction from the discharge of the RHR pumps to the VCT, the operator should confirm that the VCT makeup capabilities are sufficient to satisfy the charging flow. Since the centrifugal charging pumps suction will automatically transfer to the RWST if charging requirements exceed VCT makeup capability following the realignment, the operator should also confirm that sufficient RWST inventory exists to support operation of the centrifugal charging pumps with suction aligned to the RWST. This will provide pump protection should automatic realignment of the centrifugal charging pump suction to the RWST occur and provide time for operator action to stop the centrifugal charging pumps or realign them to the discharge of the RHR pumps.

EOP Step No: Step 36 (CONTINUED)

ERG Basis: (CONTINUED)

To complete realignment of the centrifugal charging pump suction to the VCT, the cross connect valve(s) from the RHR pump discharge will need to be closed. These cross connect valve(s) also supply suction flow to the SI pumps in the recirculation mode. Consequently, the operator should check that the SI pumps are stopped (as instructed in EOP Step 27) before closing a cross connect valve(s) that is supplying a SI pump with suction flow. (DW-91-029)

EOP Basis:

Same as ERG basis, with the following additional information:

Prior to aligning the centrifugal charging pump suction valves to the VCT, a verification is made to ensure VCT level is greater than 4%. This ensures level is adequate to allow opening the VCT suction valves and subsequently closing the RWST suction valves. To complete this operation, the suction valves are realigned in the appropriate sequence to ensure that a suction supply is always maintained.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
4%	U.06	VCT level for auto switchover from the VCT to the RWST.

EOP Step No: Step 36 (CONTINUED)

ERG Deviations:

DEV.1 Added plant-specific details for shifting centrifugal charging pump suction to the VCT.

JUST. VCT level must be greater than 4% to clear the VCT-to-RWST automatic switchover signal to allow normal alignment. Plant-specific details aid operators in performing these actions in a consistent manner. [SD-12]

DEV.2 Did not fully incorporate DW-91-029.

JUST. The EOP implemented the injection mode portion of DW-91-029, but not the recirculation portion. As described in the response to DW-91-029, precautions must be taken prior to transferring pump suction back to the VCT if switchover from the RWST to the containment sump has taken place. The EOP is written to allow the realignment of the pump suction to the VCT only if there is an adequate supply of water in the RWST. If an adequate supply of water in the RWST does not exist, then the operator is instructed to continue with the next step without transferring the suction source to the VCT. Incorporation of the recirculation mode portion of DW-91-029 would burden the operator with monitoring certain parameters and taking corrective actions to prevent centrifugal charging pump damage in certain circumstances. Due to this potential for centrifugal charging pump damage, the risk outweighs the benefit. This portion of the DW item will be handled as a long term recovery action with TSC consultation. [SD-57]

EOP Step No: Step 37

ERG Step No: Caution 30-1

EOP Step:

CAUTION RCS AND RUPTURED SG PRESSURE MUST BE MAINTAINED LESS THAN 1045 PSIG TO PREVENT OPENING RUPTURED SG MS10 OR SAFETY VALVES **[MINIMIZE RCS TO SECONDARY LEAKAGE]**

Purpose:

To alert the operator that both the ruptured SG pressure and RCS pressure must be maintained less than the SG MS10 setpoint to prevent lifting of the MS10 and code safety valve.

ERG Basis:

Since flow can occur between the RCS and the secondary side of the ruptured SG via the failed tube, the pressure in the primary system will affect the pressure in the ruptured SG and vice versa. If RCS pressure is greater than the SG MS10 setpoint, primary-to-secondary leakage will compress the steam bubble in the ruptured SG and increase pressure until the MS10 eventually lifts. Therefore, the RCS and ruptured SG pressures should be maintained less than the SG MS10 setpoint.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
1045 psig	O.03	Setpoint for SG steam dump to atmospheric controller which will prevent SG safety valve actuation (typically 25 psi below the lowest safety valve set pressure).

ERG Deviations:

DEV.1 Added a plant specific MS10 pressure setpoint.

JUST. For operator reference, the ruptured SG MS10 setpoint from EOP Step 4 was repeated here.

EOP Step No: Step 38

ERG Step No: N/A

EOP Step:

NOTE TABLE H APPLIES UNTIL EOP-SGTR-2 IS IMPLEMENTED
[MINIMIZE RCS TO SECONDARY LEAKAGE]

Purpose:

To alert the operator that the actions in the table apply for the duration of this procedure.

ERG Basis:

N/A

EOP Basis:

To inform the operator that once this EOP is exited, then other guidance will be given. Therefore, this table's applicability ends when this EOP ends.

Supplemental Information:

None

EOP Step No: Step 38 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
25%	D.06	Value showing PZR level just covering the heaters, including allowances for normal channel accuracy and reference leg process errors.
33%	D.07	Value showing PZR level just covering the heaters including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
77%	D.08	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, minus 20% for operating margin.
74%	D.09	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, minus 20% for operating margin, but not less than 50%.
50%	D.12	PZR level corresponding to the middle of the level span.
320°F	X.04	Maximum pressurizer to auxiliary spray delta-T for placing aux spray in service.

ERG Deviations:

DEV.1 Added a note stating the applicability period for this table's actions.

JUST. Incorporates intent of Knowledge Item in ERG Step 30 (EOP Step 41).

EOP Step No: Step 39

ERG Step No: N/A

EOP Step:

NOTE DEPRESSURIZATION METHODS IN ORDER OF PREFERENCE ARE:
- NORMAL SPRAY
- AUX SPRAY-LETDOWN IN SERVICE
- PORV
- AUX SPRAY-LETDOWN ISOLATED

[MINIMIZE RCS TO SECONDARY LEAKAGE]

Purpose:

To alert the operator of the order of preference for the depressurization methods.

ERG Basis:

N/A

EOP Basis:

The methods used to depressurize the RCS are selected based on reliability and effectiveness. If an RCP(s) is running, then normal spray is preferred. The next choice is auxiliary spray with water heated by letdown since it conserves RCS inventory (unlike the use of a PZR PORV). A PZR PORV is the next choice. Auxiliary spray without letdown in service is the last choice because it will result in thermal stresses to the PZR spray nozzle, which could cause nozzle damage and failure.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added a note regarding the preference for depressurization methods.

JUST. This note incorporates the intent of ERG Step 30 basis, regarding depressurization method priorities.

EOP Step No: Steps 40 and 41

ERG Step No: Step 30

EOP Step:

(Step 40) NOTE THE 320°F PZR TO AUX SPRAY DELTA-T LIMIT MAY BE EXCEEDED
[MINIMIZE RCS TO SECONDARY LEAKAGE]

(Step 41) PERFORM ACTIONS IN TABLE H WHILE CONTINUING WITH THIS PROCEDURE
[MINIMIZE RCS TO SECONDARY LEAKAGE]

Purpose:

To control RCS pressure and reactor coolant makeup flow to maintain an indicated PZR level while minimizing primary-to-secondary leakage.

ERG Basis:

In order to explain the basis for the guidance provided in this step, consider again equilibrium conditions between leakage through the failed SG tube and RCS charging flow, as shown in ERG Figure 30. For primary system pressures greater than the ruptured SG pressure (P_{SG}), primary-to-secondary leakage will occur so that excess charging flow, i.e., greater than letdown and coolant shrinkage, is necessary to maintain PZR inventory. Conversely, for letdown flows greater than charging flow, the equilibrium RCS pressure is less than the ruptured SG pressure and secondary-to-primary leakage will occur. The ideal conditions, shown by Point B, occur when charging flow exactly compensates for letdown and coolant shrinkage so that RCS pressure and the ruptured steam generator pressure equalize. For these conditions both the pressurizer and ruptured steam generator inventories will remain constant. Obviously fluctuations about these ideal conditions will occur due to variations in ruptured steam generator pressure, cooldown rates, and letdown flows. Consequently, the operator must continuously adjust RCS pressure and charging flow to control PZR and ruptured SG inventories. This step provides guidance for performing these actions in the form of a table.

ERG Figure 30 can be divided into four different regions which are characterized by PZR and ruptured SG level behavior. For primary pressures greater than the ruptured SG pressure, leakage into the SG will increase SG water level (L_{SG}). Alternatively, water level will decrease for RCS pressures less than the ruptured SG pressure. Similarly, PZR level (L_{PZR}) will increase for RCS pressures less than equilibrium. This leads to the four regions illustrated in ERG Figure 30. The steps one performs to stabilize the plant at the ideal, equilibrium conditions depend on the PZR inventory and ruptured SG water level behavior. For example, if PZR level is low, region II or region III must be entered to increase PZR level. This requires one to increase charging flow or decrease RCS pressure, as shown in ERG Figure 30. The further into these regions, the more rapidly PZR level will increase. Of course, if PZR level is high the opposite response would be necessary. However, the ruptured SG water level must also be considered.

EOP Step No: Steps 40 and 41 (CONTINUED)

ERG Basis: (CONTINUED)

If the SG water level is increasing, RCS pressure must be reduced to stop primary-to-secondary leakage. If the SG water level is decreasing, primary pressure should be increased by energizing PZR heaters to minimize leakage into the RCS.

Note that in some cases, actions which address PZR level conflict with those which address SG level. For example, if SG level is increasing one must decrease RCS pressure. Since this will also increase PZR level, the PZR could fill with water if level is initially high. However, by reducing charging flow, PZR level will decrease. Since this will also decrease RCS pressure if heaters are not energized, SG level will also stabilize. Hence, for this situation the preferred action is to reduce charging flow. In other situations, controlling either RCS pressure or charging flow or a combination of both will work equally well.

In general, SG level provides a more direct and more accurate indication of leakage between the primary and secondary than RCS and SG pressure indications. However, if level is offscale so that no trend can be observed, one must rely on RCS and ruptured SG pressures as indirect indications of leakage. While instrument inaccuracies may lead to some primary-to-secondary leakage, such leakage will be contained provided RCS and ruptured SG pressures are maintained below the MS10 set pressure.

Normal PZR spray is the preferred means of controlling RCS pressure. If it is not available, auxiliary spray should be used if letdown is in service. A PZR PORV should be used instead of auxiliary spray if letdown is not in service to minimize thermal stresses on the spray nozzle.

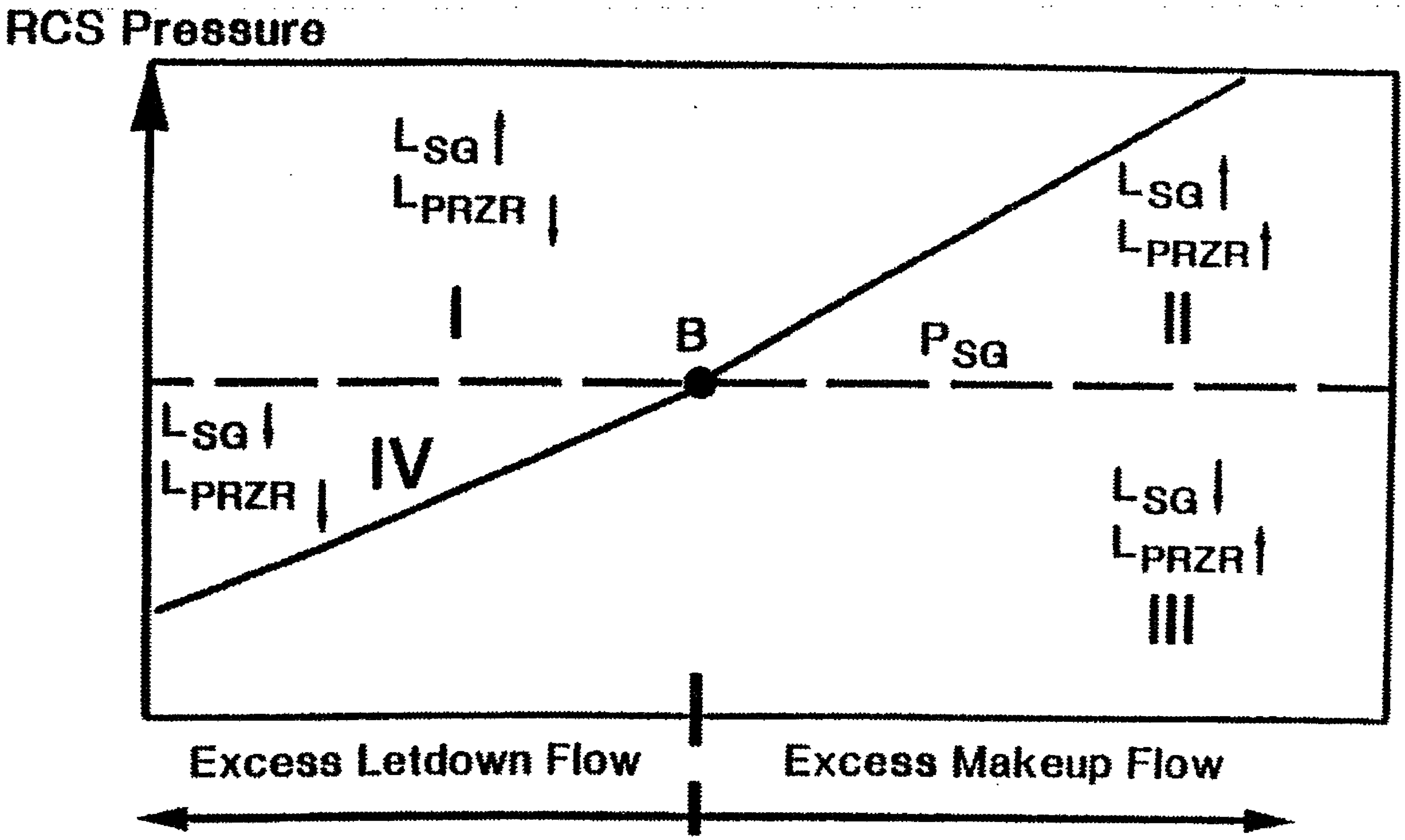
EOP Basis:

Same as ERG basis with the following additional information:

This Technical Specification limit prevents thermal shock to the PZR spray nozzle, the failure of which would degrade PZR pressure control capability using spray. This limit is likely to be exceeded whenever auxiliary spray is used with letdown isolated. Although it is desirable to remain within this Technical Specification limit at all times, the overall objective of the EOPs is to protect the health and safety of the public and there are times when this is the overriding priority.

This 320°F limit is observed whenever the ERGs prohibit use of auxiliary spray if letdown is isolated. This limit is not applicable (may be exceeded) whenever the ERGs direct use of auxiliary spray even if letdown is isolated because the need to depressurize the RCS (to protect the public) overrides this limit and its associated concerns. This note explicitly identifies instances in the EOPs where this limit may be exceeded to assure the operator of this fact.

Figure 30. ILLUSTRATION OF RCS AND RUPTURED SG PRESSURE EQUILIBRIUM



EOP Step No: Steps 40 and 41 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Use of table provided in this step.

ERG Knowledge Item: "Charging" flow refers to total flow into the RCS from the charging pumps. If the PZR is solid, charging flow will also control RCS pressure. In that case, flow must be controlled to maintain RCS subcooling greater than instrument uncertainties and control ruptured SG inventory. (DW-93-053)

ERG Knowledge Item: The operator is expected to continue with subsequent steps while performing actions prescribed in this step. Reference to this table should be made throughout the remainder of this procedure as necessary to control RCS and ruptured SG inventories until an alternate cooldown procedure is implemented.

ERG Knowledge Item: SG level increasing or decreasing refers to conditions which may lead to overfill or to uncovering the U-tubes before corrective actions can be taken. For tube failures in multiple SGs, actions should be based on the SG most likely to overfill.

Setpoints and Numerical Values:

Value	Setpoint	Description
25%	D.06	Value showing PZR level just covering the heaters, including allowances for normal channel accuracy and reference leg process errors.
33%	D.07	Value showing PZR level just covering the heaters including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, not to exceed 50%.
77%	D.08	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, minus 20% for operating margin.
74%	D.09	Value showing PZR level at the upper tap, including allowances for normal channel accuracy, post-accident transmitter errors, and reference leg process errors, minus 20% for operating margin, but not less than 50%.
50%	D.12	PZR level corresponding to the middle of the level span.
320°F	X.04	Maximum pressurizer to auxiliary spray delta-T for placing aux spray in service.

ERG Deviations:

DEV.1 Added a note regarding the applicability of the 320°F pzr to aux spray delta-T limit.

JUST. Refer to EOP basis. [SD-60]

EOP Step No: Step 42

ERG Step No: Step 33

EOP Step:

OPERATE PZR HEATERS AS NECESSARY TO SATURATE PZR WATER AT RUPTURED SG PRESSURE
[MINIMIZE RCS TO SECONDARY LEAKAGE]

Purpose:

To saturate the water in the PZR to minimize any RCS pressure transients due to restarting an RCP, initiating PZR spray, or opening a PZR PORV.

ERG Basis:

Following a SGTR, hot water is drained from the PZR. Subsequent recovery actions fill the PZR with highly subcooled water. Spraying into the steam space or opening a PORV under these criteria could rapidly decrease RCS pressure and subcooling. In addition, criteria for RCP restart which address collapse of an upper head void were calculated based on saturated PZR conditions. Consequently, to minimize any RCS pressure transient, the PZR water should be saturated. However, since excessive operation of PZR heaters will tend to increase RCS pressure and, therefore, reinitiate primary-to-secondary leakage, they should be used only as necessary to maintain RCS pressure equal to the ruptured SG pressure. Guidance on controlling PZR heaters to minimize primary-to-secondary leakage is presented in EOP Step 41.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: PZR heaters are not essential for success of subsequent recovery actions. However, the operator should be aware that changes in RCS pressure may occur more rapidly and may be greater if the PZR water is subcooled. In addition, RCS pressure may slowly decrease and PZR level slowly increase as the steam and water temperatures equalize.

ERG Knowledge Item: If PZR heaters are available, the PZR water should be saturated before restarting an RCP (ERG Step 36). This will minimize the decrease in PZR level and RCS subcooling if the pump is started with a steam bubble in the upper head.

EOP Step No: Step 42 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: N/A

ERG Step No: N/A

EOP Step:

NOTE IF RCPs ARE NOT RUNNING, RESUME USING RUPTURED LOOP T-COLD INDICATION WHEN MONITORING THE THERMAL SHOCK STATUS TREE.

Purpose:

Added note as a reminder to the operator to resume using ruptured loop T-cold indication when monitoring the Thermal Shock Status Tree if RCPs are not running. The caution prior to Step 15 provides guidance to disregard the ruptured loop T-cold indication until Step 43 is reached or transition is made to another procedure, if RCPs are not running.

ERG Basis:

N/A

EOP Basis:

Reminder for the operator to resume using ruptured loop T-cold indication when monitoring the Thermal Shock Status Tree if RCPs are not running.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added NOTE as a reminder to the operator to resume using the ruptured loop T-cold indication when monitoring the Thermal Shock Status Tree if RCPs are not running. The CAUTION prior to Step 15 provides the following guidance, "IF RCPs ARE NOT RUNNING, THE FOLLOWING STEPS MAY CAUSE A FALSE THERMAL SHOCK STATUS TREE INDICATION FOR THE RUPTURED LOOP. DISREGARD THE RUPTURED LOOP T-COLD INDICATION UNTIL STEP 43 IS REACHED OR A TRANSITION IS MADE TO ANOTHER PROCEDURE". The purpose of the caution prior to Step 15 allows the operator to remain in SGTR-1 in the event of a false red or purple path on the Thermal Shock Status Tree during natural circulation cooldown.

JUST. This change is in accordance with DW 94-26 and Order 80054899, Operation 0110.

EOP Step No: Step 43

ERG Step No: Step 31

EOP Step:

ARE ALL 4 KV VITAL BUSES ENERGIZED BY OFFSITE POWER
[STOPPING UNLOADED DGs]

Purpose:

To stop emergency DGs if they have started and are running unloaded.

ERG Basis:

Manufacturers typically recommend that diesels not run for a long period of time unless carrying load. Since the DGs should start automatically on a SI signal but will not load if offsite power is available, the emergency diesels should be stopped at this time if the emergency AC buses are energized by offsite power.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Plant Specific Information: The time limit for running DGs unloaded should be evaluated on a plant specific basis. For the reference plant, it is expected that the operator will reach this step within approximately 30 minutes. Although this step should be performed after primary-to secondary leakage has been terminated to expedite recovery, for some plants it may have to be performed earlier. In that case, one should consider merging this step with ERG Step 11.

Setpoints and Numerical Values:

None

EOP Step No: Step 43 (CONTINUED)

ERG Deviations:

DEV.1 Did not specify placing the DG(s) in standby after stopping.

JUST. When a DG is stopped, it is electrically aligned to automatically start when required. No additional action is necessary to required to place the DG in standby. [SD-19]

DEV.2 Added step to consult the TSC to restore power.

JUST. At this point in the SGTR recovery, the TSC is activated. Therefore, the TSC is available to assist the operator in assessing the best methods to restore offsite power.

EOP Step No: Step 44

ERG Step No: Step 32

EOP Step:

BYPASS CONDENSATE POLISHERS AS FOLLOWS:
1. OPEN 21 THRU 23 CN108 (POLISHER BYPASS VALVES)
2. CLOSE 2CN109 (POLISHER INLET VALVE)

[MINIMIZING SECONDARY CONTAMINATION]

Purpose:

To minimize the spread of contamination throughout the secondary system

ERG Basis:

Prior to isolation of the ruptured SG, steam flow from that SG may have contaminated the secondary system, including the condenser hot well and the Blowdown System. Since leakage into the ruptured SG has been terminated, time is available for plant specific steps to minimize the spread of this contamination, including isolating recirculation from the hot well to the AFST, bypassing the condensate polishing demineralizers, and transferring auxiliary steam to the auxiliary boiler.

EOP Basis:

Same as ERG basis, with the following additional information:

Bypassing the condensate polishers will direct potentially contaminated condensate water around the condensate polishers to prevent further contamination of these components. The following operations are performed in addition to bypassing the polishers to help minimize contamination to the secondary systems: steam is dumped from the intact SG PORVs, the condenser-to-raw water valve is closed, various blowdown sample discharges are isolated, and condenser steam dumps are isolated when hotwell level reaches 71 inches.

EOP Step No: Step 44 (CONTINUED)

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
71"	U.07	Safe upper limit for hotwell operation.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 45

ERG Step No: Step 34

EOP Step:

OPEN THE FOLLOWING VALVES:
- 2CC30 OR 2CC31 (CCHX OUT TO AUX HDR)
- 2CC117 AND 2CC118 (RCP COOLING INLET)
- 2CC136 AND 2CC187 (RCP BEARING OUTLET)

[RCP COOLING VERIFICATION]

Purpose:

To check that RCPs are properly cooled to prevent RCP seal damage and to establish or maintain conditions for RCP operation.

ERG Basis:

CCW is used for RCP motor oil cooling as well as thermal barrier cooling. Seal injection is only for seal cooling. If these normal cooling alignments are not present, the appropriate system procedures should be used for establishing normal cooling to the RCPs.

If all seal cooling has been lost long enough that the maximum RCP seal parameters identified in the RCP Vendor Manual have been exceeded, seal injection and CCW thermal barrier cooling should not be established to the affected RCP(s). Both of these methods of seal cooling could have unintended consequences that result in additional pump damage or the failure of plant safety systems. Seal cooling should instead be restored by cooling the RCS, which will reduce the temperature of the water flowing through the pump seals.

EOP Basis:

Same as ERG basis, with the following additional information:

Two CCW pumps can provide adequate cooling water to all systems and components requiring CCW. If only one CCW pump is operating, then CCW must be diverted from some non-vital equipment and the equipment stopped.

Supplemental Information:

ERG Plant Specific Information: Restoration of RCP seal cooling should be performed consistent with the limitations and requirements in the Westinghouse RCP Instruction and Operating Manual. Refer to ERG background document ECA-0.0, LOSS OF ALL AC POWER, for additional information.

EOP Step No: Step 45 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 46

ERG Step No: Step 35

EOP Step:

IS CCW FLOW ESTABLISHED TO SEAL WATER HX
[RCP SEAL RETURN RESTORATION]

Purpose:

To open the normal seal return path (which was isolated by the SI signal) if proper conditions exist.

ERG Basis:

Normal seal return to the VCT is isolated on a SI signal. In this case, seal leak-off flows to the PRT via a relief valve in the return line. Opening of the normal return path is part of establishing normal system operation, limits discharge to the PRT, and ensures proper seal return flow at low RCS pressures. However, certain conditions should be present before establishing normal seal return flow, such as CCW to seal water heat exchanger.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: If the reactor coolant drain tank pressure is high compared to the VCT pressure and the number one seal leakoff is realigned to the VCT, the number 2 seal could open up and reverse flow could occur possibly resulting in seal damage. Under those conditions, the operator may want to reduce reactor coolant drain tank pressure prior to reestablishing the number one seal leakoff lineup to the VCT.

ERG Knowledge Item: If excess activity levels in the RCS are suspected, then an evaluation of the consequences of re-establishing seal return flow should be made prior to taking that action.

Setpoints and Numerical Values:

None

EOP Step No: Step 46 (CONTINUED)

ERG Deviations:

DEV.1 Added a continuous action step to establish RCP seal return when prerequisite conditions are established.

JUST. Since EOP Step 49 (starts an RCP) is a continuous action step, this step was also made continuous action in support of that step.

EOP Step No: Step 47

ERG Step No: Caution 36-1

EOP Step:

IF ALL SEAL COOLING WAS LOST TO ANY RCP,
THEN PERFORM AN ENGINEERING EVALUATION BEFORE STARTING AFFECTED RCP
[RCP STATUS CHECK]

Purpose:

To alert the operator that RCP seal damage may have occurred if RCP cooling had previously been lost. In that case, starting the affected RCP may further damage the seal and RCP.

ERG Basis:

The potential for degradation in RCP seal performance and seal life increases with increasing temperature above 300°F. Hence, if seal cooling is lost for a significant period of time, seal or bearing damage may occur. The potential non-uniform sealing surfaces and seal crud blockage that may exist prior to RCP start can aggravate bearing and seal damage if the RCP is started. Following restoration of seal cooling, the RCP should not be started prior to a complete RCP status evaluation in order to minimize potential RCP damage on restart. Refer to Subsection 2.1 of the background document for guideline ECA-0.0, LOSS OF ALL AC POWER, for additional information.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: If RCP seal cooling is lost for only a few minutes, the inventory of cold water in the seal area should prevent excessive seal heatup. For longer periods of time, seal and bearing temperatures may increase greater than 300°F. If excessive temperatures develop, the affected RCP should not be restarted prior to a complete RCP evaluation.

ERG Knowledge Item: RCPs should not be started prior to a status evaluation unless an extreme (RED) or severe (PURPLE) CSF challenge is diagnosed. Under such a CSF challenge, the "rules of usage" apply and an RCP should be started if so instructed in the associated FRP. Under a CSF challenge, potential RCP damage is an acceptable consequence if RCP start is required to address a CSF challenge (e.g., to mitigate an inadequate core cooling condition). This is consistent with the intent of these FRPs which attempt to first establish support conditions to start on RCP, but then start an RCP whether or not the support conditions are established.

EOP Step No: Step 47 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted ERG caution regarding losing RCP seal cooling.

JUST. Since the EOP Writer's Guide does not allow hidden actions in cautions and notes, the ERG caution was converted into a continuous action step. [SD-20]

EOP Step No: N/A

ERG Step No: Caution 36-2

EOP Step:

N/A

Purpose:

To alert the operator that the RTD bypass temperatures will not be accurate during natural circulation.

ERG Basis:

The RCS bypass manifolds are used to obtain fast and accurate temperature measurements when RCPs are operating. With natural circulation flow, the manifolds receive inadequate flow to produce accurate readings so that RTD temperatures should be considered invalid and the associated interlocks should be bypassed if necessary.

EOP Basis:

N/A

Supplemental Information:

None

Setpoints and Numerical Values:

N/A

ERG Deviations:

DEV.1 Deleted ERG Caution on impact of low flow to the RTD bypass manifolds on RTD measurements during natural circulation.

JUST. The plant design does not include RTD bypass manifolds. The RCS loop RTDs are located in thermowells in the main loop piping. Therefore, this caution is not applicable. [SD-24]

EOP Step No: Step 48

ERG Step No: Note 36-1

EOP Step:

NOTE 23 RCP PROVIDES NORMAL PZR SPRAY CAPABILITY
[RCP STATUS CHECK]

Purpose:

To inform the operator that an RCP should be run in a loop which provides PZR spray if possible.

ERG Basis:

Subsequent steps require operator actions to control RCS pressure. The preferred means of control is normal PZR spray since this conserves reactor coolant inventory. Since spray line connections are provided in only two loops, an RCP should be run in one of those loops, if possible. Refer to the document RCP TRIP/RESTART in the Generic Issues section of the ERG Executive Volume for additional information on RCP restart.

EOP Basis:

Same as ERG basis, with the following additional information:

Loop 3 provides the best spray capability since it has both a normal PZR spray line and the PZR surge line. If RCP 23 is unavailable, then RCP 21 in conjunction with any other RCP will also be capable of providing normal spray. Procedure S2.OP-SO.RC-0001(Q) contains guidance for starting an RCP, including the RCP starting priorities.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
23	W.03.2	Loop designation for RCP which provides best PZR spray capability - Unit 2.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Steps 49 and 50

ERG Step No: Step 36

EOP Step:

(Step 49) IS ANY RCP RUNNING
[RCP STATUS CHECK]

(Step 50) MONITOR FOR NATURAL CIRCULATION FLOW IN RCS LOOPS WITH INTACT SGs
[NATURAL CIRCULATION FLOW VERIFICATIOM]

Purpose:

To establish forced coolant flow, if possible, or to verify natural circulation flow if RCPs cannot be started.

ERG Basis:

RCP operation is preferred during recovery from a SGTR to provide normal PZR spray and to ensure homogeneous fluid temperatures and boron concentrations. In addition to minimizing pressurized thermal shock and boron dilution concerns, this also aids in cooling the ruptured SG. This step provides guidance on establishing conditions for starting an RCP to prevent RCP damage and minimize any perturbations in RCS conditions.

Depressurization of the RCS may generate a steam bubble in the upper head region of the reactor vessel if no RCP is running. This bubble could rapidly condense during pump startup, drawing liquid from the PZR and reducing reactor coolant subcooling. If PZR inventory is not sufficient, level may decrease off span. In addition, local flashing of reactor coolant could occur if RCS subcooling is not adequate. These conditions would require SI reinitiation, thereby increasing leakage into the ruptured SG, and may confuse the operator if such behavior was unexpected.

An evaluation of RCP restart criteria has been performed to assess the potential for coolant flashing and loss of PZR pressure control during pump startup. Refer to document RCP TRIP/RESTART in the Generic Issues section of the ERG Executive Volume for results of this evaluation and plant specific criteria for RCP restart. Normal RCP startup requirements, such as RCP cooling and seal leakoff flows, should also be enforced to prevent pump damage.

EOP Step No: Steps 49 and 50 (CONTINUED)

ERG Basis: (CONTINUED)

If all RCPs are stopped and none can be started, the operator should monitor system conditions to verify natural circulation flow. The conditions indicative of natural circulation are provided as ERG ATTACHMENT A and include RCS subcooling, stable or decreasing CETs, and cold leg temperatures in the active loops approximately equal to saturation at the associated SG pressure. Refer to document NATURAL CIRCULATION in the Generic Issues section of the ERG Executive Volume for additional discussion on natural circulation and the conditions listed in ERG ATTACHMENT A. If these conditions are not verified, the operator should increase steam flow from the intact SGs to establish and maintain natural circulation.

To limit the pressure decrease upon RCP restart, saturated conditions should first be established in the PZR. If the PZR is not saturated, starting an RCP will cause the PZR level and pressure to decrease faster than if the PZR were saturated. The PZR pressure and level will still decrease when an RCP is started under saturated conditions, but the rate of decrease is slower since vapor is created as the pressure drops.

If all seal cooling has been lost long enough that the maximum RCP seal parameters identified in the RCP Vendor Manual have been exceeded, seal injection and CCW thermal barrier cooling should not be established to the affected RCP(s). Both of these methods of seal cooling could have unintended consequences that result in additional pump damage or the failure of plant safety systems. Seal cooling should instead be restored by cooling the RCS, which will reduce the temperature of the water flowing through the pump seals.

EOP Basis:

Same as ERG basis, with the following additional information:

S2.OP-SO.RC-0001(Q) "REACTOR COOLANT PUMP OPERATION" contains conditions for starting an RCP.

Supplemental Information:

ERG Knowledge Item: PZR level and subcooling requirements to accommodate a void in the upper head are designed to address operational concerns due to the collapse of an upper head void. If these conditions cannot be established but all other startup conditions have been established, the operator should consider starting the RCP particularly if this will preclude the use of a PZR PORV during subsequent recovery. However, in that case, one should be aware that PZR level and RCS subcooling may decrease when the RCP is started if an upper head bubble exists. SI pumps should be started following RCP restart if necessary to maintain PZR level on span or adequate RCS subcooling.

ERG Knowledge Item: This step applies throughout the remainder of this procedure and procedure EOP-SGTR-2, POST SGTR COOLDOWN.

EOP Step No: Steps 49 and 50 (CONTINUED)

Supplemental Information: (CONTINUED)

ERG Knowledge Item: Plant specific procedures for starting an RCP may require a steam bubble to be present in the PZR. RCP restart should be permitted if an RCS leakage path is certain since the leak ensures that there will not be a significant surge when the RCP is started.

ERG Knowledge Item: When establishing sufficient PZR inventory to accommodate the collapse of an upper head void, both charging flow and RCS pressure must be controlled to limit primary-to-secondary leakage. Guidance provided in EOP step 41 to increase PZR level is appropriate. However, note that the maximum level permitted in EOP step 41 may be less than that necessary for RCP restart. In that case, the criteria for RCP restart takes priority.

ERG Knowledge Item: Means to verify natural circulation flow.

Setpoints and Numerical Values:

Value	Setpoint	Description
69%	D.10	Pressurizer level to accommodate upper head void collapse. Refer to document RCP TRIP/RESTART in Generic Issues section of the ERG Executive Volume.
77%	D.11	Pressurizer level to accommodate upper head void collapse, including allowances for post-accident transmitter errors and reference leg process errors. Refer to document RCP TRIP/RESTART in Generic Issues section of the Executive Volume.
100%	J.01	RVLIS upper range value indicating upper head region full.
0°F	R.01	The sum of temperature and pressure measurement system errors including allowances for normal channel accuracies, translated into temperature using saturation tables - based on Subcooling Margin Monitor.
22°F	R.05	RCS subcooling necessary to accommodate upper head void collapse. Refer to document RCP TRIP/RESTART in Generic Issues section of Executive Volume.

ERG Deviations:

DEV.1 Deleted Attachment A.

JUST. Moved ERG attachment information directly into step to make this needed information immediately accessible to the operator.

EOP Step No: Step 51

ERG Step No: Step 37

EOP Step:

ARE BOTH IR CHANNELS LESS THAN 7E-11 AMPS
[SOURCE RANGE STATUS CHECK]

Purpose:

To verify that SR detectors are energized and to transfer nuclear recorders to the SR scale when the core neutron flux is in the SR.

ERG Basis:

When IR flux decreases below the IR permissive to block SR high flux trip (P-6), the SR detectors should be automatically energized, and subsequent flux monitoring should use the SR indicators.

DW-90-020: States to use trip setpoint, not the reset setpoint.

EOP Basis:

Same as ERG basis, with the following additional information:

Following a reactor trip, the operator monitors nuclear instrumentation to ensure that nuclear flux levels are decreasing normally. When flux levels are approaching or decrease to 7E-11 amps, the IR channels are checked for undercompensation. This will ensure that IR channels are accurately indicating flux levels. In addition to monitoring flux level and proper response of the nuclear instrumentation, the operator also ensures that the SR detectors automatically energize when IR flux levels decrease to 7E-11 amps. After the SR detectors are energized, subsequent flux level monitoring will be performed using SR indication. As flux level continues to decrease, the operator will adjust the SR Audio Count Rate Circuit scale.

Supplemental Information:

None

EOP Step No: Step 51 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
$7x10^{-11}$ amps	P.01	Value for intermediate range permissive to block source range high flux trip (P-6).

ERG Deviations:

DEV.1 Added an action step for adjusting the Audio Count Rate Circuit scale.

JUST. Adjusting the Audio Count Rate Circuit scale is a normal operating practice after energizing SR instrumentation. In addition, it provides a measure of protection against a subsequent dilution accident or inadvertent criticality by providing an audible warning to the operator in case of an unexpected increase in SR count. [SD-25]

DEV.2 Added a check for undercompensation of the IR Channels if they are reading greater than 7E-11 amps.

JUST. Undercompensation could prevent the IR channels from dropping below the setpoint which would automatically re-energize the SR channels. In this case, the operator must re-energize the SR channels manually to reinstate neutron flux monitoring and trending capability. [SD-26]

DEV.3 Used reset setpoint instead of trip setpoint as required by the ERG.

JUST. ERG convention is generally to use trip setpoints instead of reset setpoints, as explained in DW-90-020. This plant has chosen to use the reset setpoint in this case based on operator validation comment VA-006. [SD-78]

EOP Step No: Steps 52 and 53

ERG Step No: Steps 38 and 39

EOP Step:

(Step 52) STOP THE FOLLOWING SECONDARY PUMPS:

- BOTH SGFPs
- ALL HEATER DRAIN PUMPS
- BOTH BSCDT PUMPS
- ALL BUT ONE CONDENSATE PUMP

[UNNECESSARY EQUIPMENT SHUTDOWN]

(Step 53) OPEN 21 AND 22 CN48 (SGFP BYPASS VALVES)
[UNNECESSARY EQUIPMENT SHUTDOWN]

Purpose:

To stop equipment not needed during cooldown to cold shutdown.

To select optimum post-SGTR recovery procedure.

ERG Basis:

(ERG Step 38) Since the plant may have been operating at full power prior to the trip, certain equipment may be in operation and not needed at this time, e.g., two condensate pumps, circulating water pumps, etc.

(ERG Step 39) Previous recovery actions were designed to terminate release from the ruptured SG, stop primary-to-secondary leakage, and restore RCS pressure, temperature, and inventory control. Consequently, all safety concerns should have been resolved. However, the plant must be cooled and depressurized to cold shutdown conditions without jeopardizing safety in order to effect repairs. Three alternate means of performing this post-SGTR cooldown have been developed and are presented in ERG ES-3.1, POST-SGTR COOLDOWN USING BACKFILL; ERG ES-3.2, POST-SGTR COOLDOWN USING BLOWDOWN; and ERG ES-3.3, POST-SGTR COOLDOWN USING STEAM DUMP. This step instructs the operator to select the optimum recovery method for the particular plant and event.

EOP Step No: Steps 52 and 53 (CONTINUED)

ERG Basis: (CONTINUED)

Each of the alternate methods has its advantages and limitations. In general, post-SGTR cooldown using backfill is the preferred method since it minimizes radiological releases and facilitates processing of contaminated primary coolant. However, this process will be slow, particularly if no RCP is running. In addition, the chemistry of the secondary side water should be considered with respect to potential boron dilution and adverse effects on primary system components prior to initiating backflow of secondary side fluid. The SG blowdown method also minimizes radiological releases. In addition, boron dilution and adverse secondary side water chemistry effects are eliminated. However, the storage and processing capabilities of the Blowdown System are limited, and, similar to the backfill method, RCS depressurization is likely to proceed slowly. The third alternate method requires steam release from the ruptured SG. This method provides the fastest means of depressurizing the RCS which may be important particularly if feedwater supply is limited. However, the radiological consequences must be considered particularly if steam dump to condenser is unavailable. In addition, if water exists in the steamline, steam release may cause water hammer effects resulting in damage to secondary side equipment. Consequently, this method should not be used if water may exist in the main steamlines.

EOP Basis:

Same as ERG basis, with the following additional information:

ERG ES-3.2 has been deleted from the EOP set since the Blowdown System has such a low capacity and its use would require overriding various radiation-related design interlocks. Additionally, ERGs ES-3.1 and ES-3.3 have been combined into a single EOP (EOP-SGTR-2, Post-SGTR Cooldown). Therefore, the operator is sent to EOP-SGTR-2, which will then determine whether to implement ES-3.1 or ES-3.3 strategy, both of which are contained within that EOP.

Supplemental Information:

ERG Knowledge Item: The operator should be familiar with the benefits and limitations of each post-SGTR cooldown method. Refer to Section 3.2 of the ERG Background Document, Key Utility Decision Points, for further discussion.

ERG Knowledge Item: Recovery does not necessarily have to be completed using the method originally selected. Any combination of the three can be used provided the limitations of each are considered.

Setpoints and Numerical Values:

None

EOP Step No: Steps 52 and 53 (CONTINUED)

ERG Deviations:

DEV.1 Reduced ERG Step 39's three choices to a single choice.

JUST. ERG ES-3.2 has been deleted from the EOP set since the Blowdown System has such a low capacity and its use would require overriding various radiation-related design interlocks. Additionally, ERGs ES-3.1 and ES-3.3 have been combined into a single EOP (EOP-SGTR-2, Post-SGTR Cooldown). Therefore, the operator is sent to EOP-SGTR-2, which will then determine whether to implement ES-3.1 or ES-3.3 strategy, both of which are contained within that EOP.

APPENDIX A

EOP/ERG CORRELATION

2-EOP-SGTR-1: STEAM GENERATOR TUBE RUPTURE
EOP/ERG CORRELATION

EOP Step	ERG Step
ENTRY CONDITIONS	ENTRY CONDITIONS
CAS	FOLDOUT PAGE
N/A	Note 1-1 (1)
N/A	Note 1-2 (1)
1	Note 1-3 (1)
N/A	1 (1)
2, 3	2 (2)
4	Caution 3-1 (3) Caution 3-2 (3) 3 (3)
5	Caution 4-1 (3)
6	4 (3)
7	Caution 5-1 (4) 5 (4)
8	6 (4)
9	7 (4)
10	Caution 8-1 (4a) 8 (4a) 9(4b) 10 (4c)
11	Caution 12-1 (4b-c)
12	12 (4b-c)
13	Caution 13-1 (5)
14	13 (5)
N/A	Note 14-1 (6) Note 14-2 (6)
15	14 (6)
N/A	Caution 15-1 (7)
16	15 (7), 16 (7)
17	17 (8)
18	18 (9)
19	Caution 18-1 (9)
20	Caution 18-2 (9)
21	Note 18-1 (9)
22	18 (9)
23	19 (10)

EOP Step	ERG Step
24	18 (9)
25	Caution 20-1 (11)
26	20 (11)
27	21 (12)
28	22 (13a) 23 (13b) 24 (14)
29	N/A
30	25 (15)
31	26 (16)
32, 33	11 (4)
34	28 (16)
35	27 (16)
36	29 (16)
37	Caution 30-1 (17)
38	N/A
39	N/A
40, 41	30 (17)
42	33 (18a)
43	31 (18)
44	32 (18)
45	34 (18a)
46	35 (18b)
47	Caution 36-1 (18b)
N/A	Caution 36-2 (18b)
48	Note 36-1 (18b)
49, 50	36 (18b)
51	37 (18)
52, 53	38 (18) 39 (19)