SALEM OPERATIONS
1-EOP-FRCC-1 - REV 22

RESPONSE TO INADEQUATE CORE COOLING

REVISION SUMMARY **Biennial Review Performed Yes No X**

This procedure was revised to incorporate changes to a referenced procedure.

1. Flow Chart, Step 26 - Procedure S1.OP-AB.CR-0001(Q), "Control Room Evacuation," Attachment 4 was changed to Attachment 7.

2. Flowchart and procedure step 3 Table A, changed 12SW122 to 12 SW376 and 12SW380 due to design differences between units

Note: Revision bars were not used to identify changes to this EOP.

IMPLEMENTATION REQUIREMENTS
after ECHO license exam

Effective Date:
1-19-2000

APPROVED: John P. Robertson
MANAGER - SALEM OPERATIONS

12-23-99
Date

EMERGENCY OPERATING PROCEDURE
1-EOP-FRCC-1
RESPONSE TO INADEQUATE CORE COOLING

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 Tables

See Checkoff Sheets

3.2 Figures

None

3.3 Graphs

None

3.4 Checkoff Sheets

1 - Safeguards Valve Alignment (Table A)

3.5 Attachments

1 - Major Action Categories

CHECKOFF SHEET 1

SAFEGUARDS VALVE ALIGNMENT

SAFETY INJECTION

VALVE NUMBER	BEZEL NOMENCLATURE	REQUIRED POSITION	INITIALS
1SJ4	BIT INLET	OPEN	
1SJ5	BIT INLET	OPEN	
1SJ12	BIT OUTLET	OPEN	
1SJ13	BIT OUTLET	OPEN	
1CV68	CHARGING DISCHARGE	CLOSED	
1CV69	CHARGING DISCHARGE	CLOSED	
11SJ54	11 ACCUMULATOR OUTLET	OPEN	
12SJ54	12 ACCUMULATOR OUTLET	OPEN	
13SJ54	13 ACCUMULATOR OUTLET	OPEN	
14SJ54	14 ACCUMULATOR OUTLET	OPEN	
1SJ1	RWST TO CHARGING	OPEN	
1SJ2	RWST TO CHARGING	OPEN	
1CV40	DISCHARGE STOP	CLOSED NOTE 1	
1CV41	DISCHARGE STOP	CLOSED NOTE 1	
11SW20	TURBINE AREA	CLOSED	
13SW20	TURBINE AREA	CLOSED	
1SW26	TURBINE AREA	CLOSED	
11SW122	SW TO 11 CC HX	CLOSED NOTE 2	
12SW376	SW TO 12B CC HX	CLOSED NOTE 2	
12SW380	SW TO 12A CC HX	CLOSED NOTE 2	

NOTE 1: CV40 AND CV41 WILL NOT CLOSE UNLESS SJ1 OR SJ2 FULL OPEN

NOTE 2: SW VALVES TO CCHX CLOSE ONLY ON SEC MODE 3

MAJOR ACTION CATEGORIES

- **ESTABLISH SI FLOW TO THE RCS**
- **RAPIDLY DEPRESSURIZE SGs TO DEPRESSURIZE RCS**
- **START RCPs AND OPEN ALL RCS VENT PATHS TO CONTAINMENT**

SALEM GENERATING STATION

1-EOP-FRCC-1
RESPONSE TO INADEQUATE CORE COOLING

BASIS DOCUMENT

EOP Step No: ENTRY CONDITIONS

ERG Step No: ENTRY CONDITIONS

EOP Step:

EOP-CFST-1, CORE COOLING - RED

Purpose:

To provide the plant conditions for entry into this procedure.

ERG Basis:

This EOP is entered from EOP-CFST-1, Critical Safety Function Status Trees, on a RED priority on the Core Cooling Status Tree when CETs are greater than 1200°F or CETs and RVLIS criteria are exceeded.

EOP Basis:

Same as ERG basis.

Supplemental Information:

N/A

Setpoints and Numerical Values:

N/A

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 1

ERG Step No: Caution 1-1

EOP Step:

IF "RWST LEVEL LO" ALARM ACTUATES (15.2 FT),
THEN GO TO EOP-LOCA-3, STEP 1

Purpose:

To guarantee coolant flow to the core by switching to cold leg recirculation if the RWST level decreases below the switchover setpoint.

ERG Basis:

If the switchover level in the RWST is reached, which could happen at any time during the course of EOP-FRCC-1 depending upon the amount of RCS inventory losses, the operator should immediately go to EOP-LOCA-3, TRANSFER TO COLD LEG RECIRCULATION, to maintain coolant flow to the core. When RWST level decreases to 15.2 ft., there should be sufficient water available in the recirculation sump to switch the suction supply to the ECCS pumps. The remainder of RWST water is reserved for CS pump usage.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Number	Description
15.2 ft	U.02	RWST level switchover setpoint.

ERG Deviations:

DEV.1 Deleted the ERG Caution regarding implementing EOP-LOCA-3 on low RWST level.

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 2

ERG Step No: Caution 1-2

EOP Step:

CAUTION RHR PUMPS SHOULD NOT BE RUN LONGER THAN 60 MINUTES WITHOUT CCW TO THE RHR HXs

Purpose:

To prevent damage to the RHR pumps.

ERG Basis:

For the reference plant, the RHR pumps utilize seal coolers and the RHR heat exchangers to remove pump heat. The seal coolers and RHR heat exchangers are, in turn, cooled by CCW. If the RCS pressure is above the shutoff head of the RHR pumps and these pumps are run in the injection mode for an extended period of time without CCW to the seal coolers and the RHR heat exchangers, they may be damaged due to excessive heatup. There are two basic failure mechanisms for the RHR pumps when CCW to the RHR heat exchangers is lost. The failure mechanisms depend on the pump manufacturer and the NPSH requirements of the pump. With no cooling provided to the RHR heat exchangers, the temperature of the pumped fluid will gradually increase. As a result, the NPSH requirements may not be satisfied and cavitation of the pumps may occur, causing excessive vibration, possible pump seizure, bearing damage, gasket and seal leakage, and motor failure.

If NPSH requirements are not maintained, overheating of the pumps may occur. The initial effects of pump overheating may be leakage through the mechanical seals which may show accelerated wear if the pumped fluid exceeds the design temperature of the seals. Due to the tight tolerances between the impeller and wear rings, thermal expansion may cause the impeller to seize on the stationary parts, possibly resulting in significant pump or motor failure. Also, pre-loaded flexitalic gaskets, that are used by most pump manufacturers, may show leakage at their joints when exposed to excessive thermal expansion.

In conclusion, the two main failure mechanisms are pump overheating and cavitation. Either or both of these mechanisms may lead to pump and motor failure, depending on the factors described above.

EOP Step No: Step 2 (CONTINUED)

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
60 minutes	V.03	Time for which RHR pumps can run dead headed without CCW to the RHR heat exchangers.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 3

ERG Step No: Step 1

EOP Step:

PLACE VALVES IN SAFEGUARDS POSITION
[SAFEGUARDS VALVE ALIGNMENT]

Purpose:

To verify proper emergency SI valve alignment.

ERG Basis:

In order to provide ECCS flow to the RCS, ECCS valves must be positioned properly.

EOP Basis:

Same as ERG basis, with the following additional information:

Table A provides a list of equipment which is verified to ensure that valves are in safeguards positions.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added plant-specific details for verifying that SI valves are in safeguards positions.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

EOP Step No: Step 4

ERG Step No: N/A

EOP Step:

RESET SI
[SAFEGUARDS RESET ACTIONS]

Purpose:

To utilize the reset function which is part of the safeguards actuation logic such that equipment can be realigned.

To remove the "locked-in" signal such that equipment can be realigned.

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:

N/A

EOP Basis:

Prior to realigning safeguards equipment, the SI signal must be reset. In addition, 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 realign these valves, as required in subsequent steps, these signals must be reset. No valve will reposition upon resetting the isolation signals, but by resetting the signals subsequent actions to manipulate the valves can be accomplished. These valves should remain closed unless explicitly called out in the procedure to open them when process streams are being established, until the cause of the isolation signals is determined or corrected.

Since the instrument air receiver is located outside containment, the control air isolation valves must be opened to supply air operated valves inside containment.

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.

EOP Step No: Step 4 (CONTINUED)

EOP Basis: (CONTINUED)

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, 11 and 12 CCP aux lube pumps, and DG aux 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. Salem typically resets this lockout manually as a backup to this automatic reset.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added this step on resetting SI, Containment Isolation, and the SECs.

JUST. These steps were added because these reset actions may be needed prior to using and realigning equipment. Since this procedure is an FRP, the procedure may be entered prior to the performance of these actions in another procedure. These actions are consistent with the intent of DW-91-015 and DW-94-002.

EOP Step No: Step 5

ERG Step No: Step 2

EOP Step:

START THE FOLLOWING PUMPS:
- 11 AND 12 CHARGING PUMPS
- BOTH SI PUMPS
- BOTH RHR PUMPS

[ECCS FLOW VERIFICATION]

Purpose:

To verify delivery of ECCS flow to the RCS.

ERG Basis:

This step will alert the operator to the existence of a degraded SI System. The most effective method to restore adequate core cooling is to increase RCS inventory via safety injection. The operator should verify or establish maximum ECCS flow to the RCS. If ECCS flow to the RCS cannot be verified, the operator should establish any other high pressure injection flow to the RCS.

The RHR pumps are started at this time even if the RCS pressure is still above their shutoff head. Since the RCS depressurization performed in this procedure is very fast (at maximum rate), it will not take long before the RHR pumps are injecting. Note that this step is structured differently than the equivalent step in EOP-FRCC-2 because the RCS depressurization rate is much slower in EOP-FRCC-2.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

EOP Step No: Step 5 (CONTINUED)

Setpoints and Numerical Values:

Value	Number	Description
1540 psig	B.05	Shutoff head pressure of the high-head SI pumps plus allowances for normal channel accuracy.
1660 psig	B.06	Shutoff head pressure of the high-head SI pumps plus allowances for normal channel accuracy and post accident transmitter errors, not to exceed 2000 psig.
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.
300 gpm	S.03	The minimum RHR pump flow into the RCS cold legs that indicates injection into the RCS.
100 gpm	S.08	Minimum SI flow (per the SI pump flow meter) which indicates injection into the RCS.
100 gpm	S.07	Minimum charging flow (per the SI systems charging flow meter) which indicates injection into the RCS.

EOP Step No: Step 5 (CONTINUED)

ERG Deviations:

DEV.1 Directed the operator to immediately start the ECCS pumps whereas the ERG first checks for flow and if flow cannot be verified, then starts the pumps as necessary.

JUST. EOP step intent is the same as the ERG. By starting the pumps, the operator ensures that they are running. The EOP then verifies flow from each set of ECCS pumps.

DEV.2 Added plant-specific flow values for each flow verification.

JUST. Ensures that flow indication is greater than instrument errors and is therefore a valid indication of flow. [SD-77]

DEV.3 Added the plant specific setpoint values for each ECCS pump shutoff head.

JUST. The shutoff head for each set of ECCS pumps was added since flow would not be expected unless the RCS pressure is below these values.

DEV.4 Did not direct valve alignment per ERG RNO actions.

JUST. This was already directed in EOP Step 3 (Table A). Specifying it again here would be redundant.

EOP Step No: Step 6

ERG Step No: Step 3

EOP Step:

ESTABLISH PREREQUISITES FOR RCP OPERATION
[RCP SUPPORT SYSTEM CHECK]

Purpose:

To ensure support conditions are available for running the RCPs.

ERG Basis:

Subsequent actions in this procedure may involve starting RCPs to provide forced two phase coolant flow through the core. If the RCPs are required, they will be started even if all of the support conditions are not available. Without proper support conditions, potential damage to the RCPs is possible. Therefore, the operator should attempt to establish the minimum support conditions required to operate the RCPs.

EOP Basis:

Same as ERG basis, with the following additional information:

This step uses S1.OP-SO.RC-0001(Q) "REACTOR COOLANT PUMP OPERATION" to attempt to satisfy conditions to start an RCP.

Supplemental Information:

ERG Knowledge Item: If RCP support conditions are not available, actions should be initiated in the control room to reestablish the support conditions. These actions should not delay the operator from continuing with other steps in this procedure to restore core cooling.

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 7

ERG Step No: Step 4

EOP Step:

ARE 11 THRU 14 SJ54 (ACCUMULATOR OUTLET VALVES) OPEN
[SI ACCUMULATOR ISOLATION STATUS]

Purpose:

To ensure that the SI accumulator isolation valves are open.

ERG Basis:

The accumulator isolation valves should be open. Accumulator injection may be required to recover the core. It is assumed that complete accumulator water injection has not previously occurred.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added a check to determine if the accumulators were previously discharged prior to opening the accumulator outlet valves.

JUST. The addition of the check improves the implementation of the procedure by ensuring that accumulator nitrogen does not inject into the RCS due to having little or no water in the accumulators.

EOP Step No: Step 8

ERG Step No: Steps 5, 6, and 7

EOP Step:

ARE 5 OR MORE CETs GREATER THAN 1200°F
[CORE COOLING CHECK]

Purpose:

To check if excessive CET temperatures symptomatic of an inadequate core cooling condition still exist.

To check if an RCS inventory condition symptomatic of an inadequate core cooling conditions still exists.

To check if CET temperatures indicative of an inadequate core cooling condition still exist.

ERG Basis:

(ERG Step 5) This step will check the effectiveness of safety injection in improving core cooling. If safety injection has not been successful in reducing the CET temperatures below 1200°F, this procedure must be expeditiously continued in order to perform the alternative actions for establishing core cooling.

(ERG Step 6) A check is made for RCP operation in the first part of this step since the RVLIS full range indication would not be applicable with RCPs running. The only possible entry into FR-C.1 with RCPs running is if the core exit thermocouples are reading greater than 1200°F, and realistically, the core exit temperatures are not expected to reach 1200°F with RCPs running.

The trend in RVLIS full range indication is used to check the effectiveness of safety injection in restoring RCS inventory. If increasing, then no further action may be necessary. The operator is instructed to return to EOP Step 1 and repeat the initial procedure steps until the RVLIS full range indication is greater than 39%.

If the RVLIS full range indication is greater than 39%, then safety injection has been successful in restoring RCS inventory and core cooling. This step will transfer the operator to the procedure and step in effect.

If the RVLIS full range indication is not increasing, then the operator is instructed to check CETs in the next step to determine if an inadequate core cooling condition still exists.

EOP Step No: Step 8 (CONTINUED)

ERG Basis: (CONTINUED)

(ERG Step 7) The trend in CET temperatures is used to check the effectiveness of safety injection in restoring core cooling. If decreasing, no further action may be necessary.

If CET temperatures are less than 670°F, plus adverse containment errors or 700°F, whichever is greater, then safety injection has been successful in restoring core cooling. This step will transfer the operator to the procedure and step in effect.

If CET temperatures are greater than 670°F plus adverse containment errors or 700°F, whichever is greater, and not decreasing in conjunction with a low RVLIS indication (EOP Step 8), then this procedure must be expeditiously continued in order to perform the alternative actions for restoring core cooling.

EOP Basis:

Same as ERG basis.

Supplemental Information:

ERG Knowledge Item: Understanding of RVLIS function, configuration, and interpretation.

DW-93-030: In EOP-FRCC-1, RCP status should be determined prior to checking the RVLIS full range indication unless the actions in the procedure ensure that the RCPs are stopped.

Setpoints and Numerical Values:

Value	Setpoint	Description
39%	K.01	RVLIS full range value which is 3.5 feet above the bottom of the active fuel in core with zero void fraction plus uncertainties.
700°F	G.03	Core exit temperature corresponding to 670°F plus normal channel accuracy or 700°F, whichever is greater.
1200°F	G.04	Core exit temperature indicative of superheat conditions.

ERG Deviations:

DEV.1 Added a minimum number of CETs that must indicate above 1200°F for ICC determination.

JUST. The information on the number of CETs required gives the operator additional information needed to perform this step. The information is based upon information found in the ERG Executive Volume.

EOP Step No: Step 9

ERG Step No: Step 8

EOP Step:

IS CONTAINMENT HYDROGEN CONCENTRATION LESS THAN 0.5%
[CONTAINMENT HYDROGEN CONCENTRATION]

Purpose:

To check if an excessive containment hydrogen concentration is present.

ERG Basis:

This step instructs the operator to obtain a current hydrogen concentration measurement. Depending upon the magnitude of the hydrogen concentration, the operator will either continue with procedure EOP-FRCC-1, turn on the hydrogen recombiners or notify the plant engineering staff to determine additional recovery actions before continuing with the procedure.

When inadequate core cooling has occurred, the containment hydrogen concentration may be as much as 10 to 12 volume percent, depending on the amount of metal-water reaction (to produce hydrogen) that has occurred in the core. The hydrogen concentration is of concern since a flammable mixture can burn, if an ignition source is available, and cause a sudden rise in containment pressure which may challenge containment integrity. The operator is instructed to obtain a current containment hydrogen concentration measurement at this point in order to ascertain the potential flammability of the combustible gases in the containment. Note that in order to have the potential for flammable hydrogen concentrations, an inadequate core cooling situation must have already existed. Without an inadequate core cooling situation, sufficient hydrogen would not be expected to have been produced to cause potentially flammable mixtures.

A determination is made of the flammability of the hydrogen mixture with respect to the possible containment pressure rise. If the containment mixture is between 0.5 volume percent and 4% volume percent in dry air, either no hydrogen burn is possible or a limited burn may occur which does not produce a significant pressure rise. In this case the operator is instructed to start the Hydrogen Recombiner System to slowly reduce containment hydrogen concentration. If the concentration is greater than 4% volume percent in dry air, the operator is instructed to immediately notify the plant engineering staff of the situation.

All hydrogen measurements are referenced to concentrations in dry air even though the actual containment environment may contain significant steam concentrations. The reason for this is twofold: 1) most hydrogen measurement systems remove moisture from the sample thus approximating a dry air condition and 2) the indication of the potential of hydrogen flammability is conservative when based upon using hydrogen concentration in dry air.

EOP Step No: Step 9 (CONTINUED)

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
0.5%	T.17	Minimum containment hydrogen concentration in dry air that requires action by the operator.
4%	T.18	Containment hydrogen concentration corresponding to the limit of the hydrogen recombiners, not to exceed 6%.

ERG Deviations:

DEV.1 Did not add a plant specific means for obtaining Containment hydrogen concentration.

JUST. The hydrogen analyzers are continuously in service as required by Technical Specifications. Hydrogen analyzer indication is located in the Control Room on 1RP5 and is available at all times.

DEV.2 Added plant specific details for placing the Hydrogen Recombiners in service.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

DEV.3 Did not specify "based on dry air conditions."

JUST. The hydrogen concentration monitor used to determine containment hydrogen concentration will indicate concentration based on dry air conditions since all steam is removed from the atmosphere sample prior to determining the hydrogen concentration. Thus there are no additional steps that the operator needs to take to obtain a "dry-air" measurement.

EOP Step No: N/A

ERG Step No: Note 8-1

EOP Step:

N/A

Purpose:

To inform the operator to continue with the procedure while waiting for the results from the containment hydrogen measurement.

ERG Basis:

Since obtaining a hydrogen concentration measurement may take some time, the operator is instructed to continue to perform the remainder of this procedure which provides alternative actions for restoring core cooling.

EOP Basis:

N/A

Supplemental Information:

None

Setpoints and Numerical Values:

N/A

ERG Deviations:

DEV.1 Deleted the ERG Note regarding continuing with the procedure while obtaining a hydrogen sample.

JUST. This note is not applicable since the Hydrogen Analyzer provides a continuous indication of the hydrogen concentration.

EOP Step No: Step 10

ERG Step No: Caution 9-1

EOP Step:

IF "AFWST LEVEL LO-LO" ALARM ACTUATES (10.3%),
THEN SHIFT AFW PUMP SUCTION TO AN ALTERNATE SOURCE

Purpose:

To alert the operator that AFST level should be monitored, and that an alternate supply may be necessary.

ERG Basis:

When AFST level decreases below 10.3%, inadequate suction pressure may result in AFW pump trip. An alternate suction source should be provided.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
10.3%	U.01	AFST low-low level switchover setpoint.

ERG Deviations:

DEV.1 Deleted the ERG Caution regarding the shifting of AFW to alternate water sources.

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 11

ERG Step No: Caution 9-2

EOP Step:

CAUTION ANY FAULTED OR RUPTURED SG SHOULD NOT BE USED FOR SUBSEQUENT STEPS UNLESS NO INTACT SG IS AVAILABLE
[SG LEVEL CHECK]

Purpose:

To minimize potential radioactive releases to the atmosphere during the subsequent RCS cooldown.

ERG Basis:

Depressurizing a ruptured SG may create a path to the atmosphere for release of radioactive materials. In addition, a faulted SG has probably already depressurized. Therefore, to obtain the most effective RCS depressurization, intact SGs should be used if available. If no intact SGs are available, this caution permits the operator to feed a faulted SG or steam a ruptured SG.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: Steps 12, 13, and 14

ERG Step No: Step 9

EOP Step:

(Step 12) MAINTAIN TOTAL FEED FLOW GREATER THAN 22E04 LB/HR
UNTIL AT LEAST ONE SG NR LEVEL IS GREATER THAN 9% (15% ADVERSE)
[SG LEVEL CHECK]

(Step 13) IS ANY SG NR LEVEL GREATER THAN 9% (15% ADVERSE)
[SG LEVEL CHECK]

(Step 14) IS TOTAL AFW FLOW GREATER THAN 22E04 LB/HR
[SG LEVEL CHECK]

Purpose:

To ensure adequate feed flow or SG inventory for secondary heat sink requirements.

ERG Basis:

The minimum feed flow requirement of 22E04 LB/HR satisfies the feed flow requirement of the Heat Sink Status Tree. SG NR level is reestablished in all intact SGs to maintain symmetric cooling of the RCS. The control range ensures adequate inventory with level readings on span.

If the inadequate core cooling symptoms were caused by a loss of secondary heat sink, i.e., total feed flow is less than 22E04 LB/HR in combination with a loss of high pressure safety injection, then the operator is instructed to go to EOP Step 23. EOP Step 23 will provide temporarily improved core cooling until either feedwater or safety injection is restored.

EOP Basis:

Same as ERG basis.

EOP Step No: Steps 12, 13, and 14 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: This step is a continuous action step. However, if SG level less than 9% [15% for adverse containment] and total feed flow above 22E04 LB/HR cannot be established, the operator should go to EOP Step 23 only if he is before EOP Step 23 in the procedure.

ERG Knowledge Item: At this point during an ICC condition, auxiliary feedwater should be delivering to the intact SG(s). If auxiliary feedwater is not available or cannot be established, the operator should try to establish main feedwater. If main feedwater is not available, then the operator should try to establish condensate flow or some other low pressure feed source once the intact SGs are depressurized.

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

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 S/G level just in the narrow range including allowances for normal channel accuracy and reference leg process errors.
15%	M.03	Value showing S/G 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%.
33%	M.09	Normal SG narrow range level representing the upper control band limit.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 15

ERG Step No: Step 10

EOP Step:

ARE BOTH PZR PORVs CLOSED
[RCS VENT PATH CHECK]

Purpose:

To try to terminate loss of RCS inventory through RCS vent paths.

ERG Basis:

Any open, isolable RCS vent path should be closed to reduce or eliminate the loss of RCS inventory through that path. Therefore, this step particularly checks PZR PORVs and block valves in addition to other plant specific RCS vent paths.

To ensure operability of the PZR PORV block valves, it should be verified that power is available to them. PZR PORVs are closed to preclude the possibility of an undetected stuck open valve. At least one block valve is left open to ensure availability of at least one PORV for pressure excursions in the RCS (due to degraded conditions). Also, it is desirable to have at least one PORV available to preclude the use of PZR safety valves.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Deleted check if power is available to the PORV block valves.

JUST. The PORV block valves are normally kept open and energized unless the PORV is inoperable AND not capable of being manually cycled. If a PORV block valve is closed and deenergized intentionally for Technical Specifications, the operator would be well aware of this plant condition. Also the control board bezel for the deenergized PORV stop valve would be required to be placed under administrative control. [SD-66]

EOP Step No: Step 16

ERG Step No: Note 11-1

EOP Step:

NOTE LOSS OF SG NR LEVEL IS PERMITTED DURING SG DEPRESSURIZATION
[SG DEPRESSURIZATION TO INJECT ACCUMULATORS]

Purpose:

To inform the operator that partial SG tube uncovery, which may occur as a result of actions taken in the next step to rapidly depressurize the intact SGs, is acceptable.

ERG Basis:

Maintenance of SG level during the rapid depressurization will be difficult. Partial uncovery of the SG tubes may occur if the steam mass removal rate exceeds the maximum feedwater mass addition rate. This is an anticipated result of the rapid SG depressurization. The operator should maintain adequate feed flow in an attempt to keep the SG tubes covered since this will maximize primary-to-secondary heat transfer.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

No deviation from the ERG.

EOP Step No: N/A

ERG Step No: Note 11-2, 11-3

EOP Step:

N/A

Purpose:

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

ERG Basis:

N/A

EOP Basis:

N/A

Supplemental Information:

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

Setpoints and Numerical Values:

N/A

ERG Deviations:

DEV.1 Deleted ERG Notes regarding blocking low steamline pressure SI.

JUST. This signal is not included in the Reactor Protection System (RPS) design. The RPS has an SI and main steamline isolation signal on high steam flow coincident with either low-low T-avg or low steamline pressure. The SI signal is blockable below low-low T-avg but the main steamline isolation signal is not blockable. Therefore, this note is not applicable. [SD-44]

EOP Step No: Step 17

ERG Step No: Step 11

EOP Step:

ARE CONDENSER STEAM DUMPS AVAILABLE
[SG DEPRESSURIZATION TO INJECT ACCUMULATORS]

Purpose:

To recover the core via SI accumulator injection.

ERG Basis:

The rapid secondary depressurization has been shown to be the most effective way to reduce RCS pressure. RCS pressure must be reduced in order for the SI accumulators and RHR pumps to inject.

To prevent accumulator nitrogen injection, the operator should stop the secondary depressurization when the SG pressure reaches 135 psig and when at least two RCS hot leg temperatures fall below 375°F. A SG pressure limit is set to preclude significant nitrogen injection into the RCS. To determine the SG pressure limit, an ideal gas expansion calculation should be performed based on nominal plant specific values for initial accumulator tanks pressure (P_1), initial nitrogen gas volume (V_1), and final nitrogen gas volume (V_2). The final nitrogen gas volume should be equivalent to the total accumulator tank volume.

The RCS pressure at empty tank conditions (P_2) is determined from:

$$P_1V_1^{\gamma} = P_2V_2^{\gamma}$$

where $\gamma = 1.25$ for ideal gas expansion. The SG pressure limit is then determined by subtracting the RCS to SG ΔP from P_2. The RCS to SG ΔP should be calculated as described in the RCP TRIP/RESTART section in the Generic Issues of the ERG Executive Volume. Instrument uncertainties are not included in the determination of the SG pressure limit to preclude a bias toward either having more accumulator water injected into the RCS or having less nitrogen injected into the RCS.

EOP Step No: Step 17 (CONTINUED)

ERG Basis: (CONTINUED)

The hot leg temperature of 375°F should be determined so that the RCS saturation pressure exceeds the accumulator pressure after the accumulator water has been discharged. This precludes nitrogen injection into the RCS. To determine the hot leg temperature, an ideal gas expansion calculation should be performed based on nominal plant specific values for initial accumulator tank pressure (P_1), initial nitrogen gas volume (V_1), and final nitrogen gas volume (V_2). The final nitrogen gas volume should be equivalent to the total accumulator tank volume. The RCS pressure at empty tank conditions (P_2) is determined from:

$$P_1V_1^{\gamma} = P_2V_2^{\gamma}$$

where $\gamma = 1.25$ for ideal gas expansion. The setpoint temperature of 375°F is the saturation temperature corresponding to P_2. Instrument uncertainties are not included in the determination of the RCS hot leg temperature setpoint to preclude a bias toward either having more accumulator water injected into the RCS or having less nitrogen injected into the RCS.

EOP Basis:

Same as ERG basis, with the following additional information:

Due to plant design differences from the reference plant, no attempt is made to block main steamline isolation at this point. The ERG reference plant allows this signal to be blocked. At this plant, both SI and MSIV Isolation signals occur on high steam flow coincident with either low Tavg or low SG pressure. This SI signal is blockable below 543°F, but the MSIV Isolation signal is NOT blockable. Therefore, these notes are NOT applicable to this plant. See Logic Diagram 221057. In addition, per verification comment #049, below 543°F, only three condenser steam dump valves are available (cooldown group), and their combined steam flow capacity is less than the high steam flow setpoint for these SI and MSIV Isolation signals. Refer to verification comment VV-197.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
375°F	F.08	RCS hot leg temperature to prevent accumulator nitrogen injection.
135 psig	O.07	Minimum S/G pressure to preclude injection of accumulator nitrogen into the RCS.
25%	X.07	Steam dump valve demand for the rapid cooldown of SGTR-1.

EOP Step No: Step 17 (CONTINUED)

ERG Deviations:

DEV.1 Added plant-specific details for condenser steam dump operation.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

DEV.2 Did not loop back to ERG Step 9 per FR-C.1 Step 11.RNO but instead looped back to beginning of this step (EOP Step 17).

JUST. Refer to validation comment VA-255.

EOP Step No: Step 18

ERG Step No: Step 12

EOP Step:

REMOVE LOCKOUT FOR 11 THRU 14 SJ54 (ACCUMULATOR OUTLET VALVES)
[SI ACCUMULATOR ISOLATION]

Purpose:

To prevent accumulator nitrogen from being injected into the RCS.

ERG Basis:

SI accumulators are isolated to prevent nitrogen injection into the RCS when the RCS hot leg temperature criterion is satisfied (two RTDs are used to ensure that one RTD is not giving an erroneous reading). Nitrogen could collect in the high places and produce either a "hard" PZR bubble or cause gas binding and reduced heat transfer in the SG U-tubes. Venting the nitrogen gas also prevents injection. If it is necessary to vent the nitrogen, the operator should open the vent lines and then continue with this procedure.

The method of determining the hot leg temperature criterion of 375°F is discussed in the Step Description Table for ERG Step 11.

The ERG reference plant SI accumulators have (1) normally open/fail as is motor operated outlet isolation valves that receive a confirmatory SI signal to ensure that they are open and (2) normally closed/fail closed air operated series vent isolation valves. The air operated vent valves are located inside containment and the air supply to the vent valves is automatically isolated on a containment Phase A Isolation signal which closes the containment isolation valves in the air supply line(s).

As a general rule, the ERGs do not reset the SI signal, reset the containment Phase A Isolation signal or establish instrument air to containment until it is necessary to perform required actions.

This step is at a point where the SI and containment Phase A Isolation signals may not have been reset and where instrument air may not be established to containment. Consequently, directions to perform these actions if needed are included here.

EOP Step No: Step 18 (CONTINUED)

EOP Basis:

Same as ERG basis, with the following additional information:

It should be noted that the accumulator lockout function at this plant prevents valve motion only when going from the safeguards to the non-safeguards position (i.e., prevents inadvertent closure of the SJ54s). It is always possible to open the SI accumulator isolation valves (SJ54s), regardless of the lockout switch position. It should also be noted that, S1.OP-IO.ZZ-0006(Q), *Hot Standby to Cold Shutdown*, directs de-energizing the SJ54 valves to prevent inadvertent operation, but this will only be done when the SI accumulators are no longer required by the EOPs and only when RCS pressure is less than 1000 psig. Refer to verification comment VV-198.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added plant-specific details to isolate SI accumulators, vent any unisolated accumulators, and to close accumulator vent valves when venting is completed.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

DEV.2 The RCS hot leg temperature criterion was deleted from this EOP step.

JUST. The criterion is given in the previous step. If this criterion was not met in the previous step, then the operator would transition to another step in this procedure. Therefore, this criterion is not needed.

DEV.3 Deleted the ERG step which requires resetting SI, resetting containment isolation, and establishing instrument air to containment.

JUST. The intent of the ERG Maintenance Item was satisfied by including these actions in EOP Step 4. Since the procedure may use equipment that requires these actions, it is appropriate to include these actions early in the procedure.

EOP Step No: Step 19

ERG Step No: Step 13

EOP Step:

STOP ALL RCPs

Purpose:

To verify all RCPs have been stopped.

ERG Basis:

In preparation for the subsequent depressurization of the SGs to atmospheric pressure, the RCPs are stopped due to the anticipated loss of Number 1 seal requirements. Continued operation may result in damage to the RCPs.

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: Step 14

EOP Step:

DEPRESSURIZE ALL INTACT SGs AT MAXIMUM RATE TO ATMOSPHERIC PRESSURE

Purpose:

To recover the core via RHR.

ERG Basis:

With continued SG depressurization, RCS pressure should follow secondary pressure until the shutoff head of the RHR pumps is reached. Then, RHR injection should begin to refill the RCS.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Simplified step by combining ERG AER and RNO actions and omitting specific mention of condenser steam dumps or MS10s.

JUST. The operator was directed to dump steam in EOP Step 17, which includes specific guidance to use condenser steam dumps if available and to use MS10s otherwise. It is expected that the operator would continue using the previously established steam dump method. Therefore, that guidance was omitted from this step to simplify the flowchart and avoid excessive redundancy.

EOP Step No: Step 21

ERG Step No: Step 15

EOP Step:

IS CHARGING FLOW AT LEAST 100 GPM ON SI SYSTEMS CHG FLOW METER
[ECCS FLOW VERIFICATION]

Purpose:

To verify ECCS flow delivery to the RCS.

ERG Basis:

The objective of the previous steps was to reduce the RCS pressure below the shutoff head of the RHR pumps. This should cause RHR injection. This step verifies ECCS flow to the RCS. If ECCS flow cannot be verified, then any other source of make-up flow to the RCS should be established.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
100 gpm	S.07	Minimum charging flow (per the SI systems charging flow meter) which indicates injection into the RCS.
100 gpm	S.08	Minimum SI flow (per the SI pump flow meter) which indicates injection into the RCS.
300 gpm	S.03	The minimum RHR pump flow into the RCS cold legs that indicates injection into the RCS.
1200°F	G.04	Core exit temperature indicative of superheat conditions.

EOP Step No: Step 21 (CONTINUED)

ERG Deviations:

DEV.1 Added the plant specific setpoint values for the amount of indicated flow required to satisfy each flow verification.

JUST. Adding a specific setpoint value for the minimum flow that can be indicated assists the operator in determining if adequate flow is being delivered.

EOP Step No: Step 22

ERG Step No: Steps 16 and 17

EOP Step:

ARE 5 OR MORE CETs GREATER THAN 1200°F
[CORE COOLING CHECK]

Purpose:

To check if core cooling has been restored.

To provide a transition to the optimal long-term plant recovery instruction set.

ERG Basis:

(ERG Step 16) In order to exit this procedure, the CET temperatures must be less than 1200°F; at least two RCS hot leg temperatures must be less than 350°F to ensure RCS pressure is less than the shutoff head of the RHR pumps (two RTDs are used to ensure that one RTD is not giving an erroneous reading); and the RVLIS full range indication must be greater than 57%. Core cooling has been restored when the above conditions have been met and ECCS flow or other make-up flow has been established. Note, these conditions are more stringent than earlier transition conditions since the RCS should now be fully depressurized.

(ERG Step 17) Transition to EOP-LOCA-1, LOSS OF REACTOR COOLANT, EOP Step 16, will allow the operator to check the overall plant status with respect to radioactivity leakage and availability of equipment needed for long term plant recovery.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

EOP Step No: Step 22 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
1200°F	G.04	Core exit temperature indicative of superheat conditions.
57%	K.02	RVLIS full range value which is top of core including allowances for normal channel accuracy.
350°F	F.12	RCS hot leg temperature indicative of core cooling following a degraded or inadequate core cooling event.

ERG Deviations:

DEV.1 Added a minimum number of CETs that must indicate above 1200°F for ICC determination.

JUST. The information on the number of CETs required gives the operator additional information needed to perform this step. The information is based upon information found in the ERG Executive Volume.

EOP Step No: Step 23

ERG Step No: Note 18-1

EOP Step:

CAUTION FAILURE TO START AN RCP WHEN DIRECTED BY THIS PROCEDURE CAN RESULT IN CORE DAMAGE. NORMAL CONDITIONS FOR RCP OPERATIONS ARE DESIRED BUT NOT REQUIRED

Purpose:

To inform the operator to start RCPs when required even if all normal startup conditions have not been met.

ERG Basis:

The RCPs could be required to temporarily cool the core under highly voided RCS conditions. The RCPs should be started when required even if all normal startup conditions have not been met. Failure to start the RCPs when required could result in core damage.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 ERG Note 18-1 regarding normal conditions for starting RCPs was incorporated into the flowchart as a Caution.

JUST. Use of a Caution statement versus a Note adds the proper emphasis where the RCPs must be started even if normal RCP support conditions are not available.

EOP Step No: Steps 24 and 25

ERG Step No: Step 18

EOP Step:

(Step 24) ARE 5 OR MORE CETs GREATER THAN 1200°F

(Step 25) CAUTION RCPs SHOULD ONLY BE STARTED IN LOOPS WITH SG NR LEVELS GREATER THAN 9% (15% ADVERSE)
[CORE TEMPERATURE REDUCTION]

Purpose:

To ensure CET temperatures are greater than 1200°F before restarting RCPs.

ERG Basis:

The operator will enter this step if:

a. He is unable to depressurize the SGs; or
b. SG depressurization was not effective in restoring adequate core cooling; or
c. Secondary heat sink is lost

The actions of EOP Step 25 may provide temporary core cooling until some form of makeup flow to the RCS is established or one of the above items is restored.

To temporarily restore core cooling, the operator is instructed to start RCPs one at a time until CETs are less than 1200°F. The RCPs should force two phase flow through the core, temporarily keeping it cool. Even single phase forced steam flow will cool the core for some time provided the RCPs can be kept running and a heat sink is available.

Starting the RCPs in this step when the core exit temperatures are greater than 1200°F will result in the clearing of the water inventory in the RCS intermediate leg (loop seal) and permit the circulation of hot gases from the overheated core to circulate through the steam generators. If the water level in the steam generators is very low at the time the RCPs are started, high steam generator tube temperatures would occur, leading to possible creep rupture failure of the steam generator tubes. Therefore, RCPs are only started in this step if there is sufficient water level in their associated steam generator to protect the steam generator tubes from creep rupture failure.

If RCP restart is not effective in decreasing CET temperatures below 1200°F, then the PZR PORVs should be opened. Opening the PZR PORVs may help reduce RCS pressure enough to cause RHR injection. If CETs remain above 1200°F after all PZR PORVs and block valves are open, the operator is instructed to open all other RCS vent paths to containment to reduce RCS pressure.

DW-93-019: RCPs should only be started if there is sufficient water level in their associated SG to protect the SG tubes from creep rupture failure.

EOP Step No: Steps 24 and 25 (CONTINUED)

ERG Basis: (CONTINUED)

The PZR PORVs require instrument air for long-term operation, however, instrument air may not be available to the PZR PORVs if the event sequence included: a) initiation of a containment Phase A Isolation signal, or b) a coincident loss of instrument air. For example, small LOCA event sequences may result in initiation of safety injection, initiation of containment Phase Isolation A, subsequent repressurization of the RCS to the PZR PORV setpoint and cycling of the PORVs. If the instrument air supply was lost to the PZR PORVs, a large volume air receiver located inside containment can provide for limited operation (i.e., number of cycles) of the PZR PORVs. Should EOP-FRCC-1 subsequently be implemented, by the time that the operator would perform ERG Step 18, the PZR PORVs may have lost their ability to open. Hence the operators may not be able to open the PZR PORVs and maintain them open to rapidly depressurize the RCS. To address this possibility, the following actions are performed in the RNO column:

Reset SI signal - The action to reset automatic actuation logic is taken so that safeguards equipment that receive the SI signal may be realigned or reset.

Reset containment Phase A Isolation - The action to reset automatic actuation logic is taken so that equipment (e.g., isolation valves) that receive a Phase A Isolation signal can be realigned. No valve will reposition upon actuation of the reset, but subsequent control actions will open the valves. Until the cause of the automatic actuation is determined or corrected, containment Phase A Isolation valves should remain closed unless required to be opened to establish necessary process streams such as instrument air.

Start one air compressor and establish instrument air to containment - The actions to provide a sustained source of instrument air to containment is taken to support operation of air-operated equipment inside containment such as the PZR PORVs. The Instrument Air System for the ERG Reference Plant includes an air receiver inside containment to allow limited equipment operation, however, the line from the air compressor (located outside containment) to the air receiver is isolated with Phase A Isolation. In addition to opening the containment isolation valves, a compressor may also have to be started (with attendant electrical considerations) to establish a sustained source of instrument air to equipment inside containment.

EOP Basis:

Same as ERG basis.

EOP Step No: Steps 24 and 25 (CONTINUED)

Supplemental Information:

ERG Knowledge Item: Understanding of RCP behavior under forced single phase steam and two-phase flow conditions.

Setpoints and Numerical Values:

Value	Setpoint	Description
1200°F	G.04	Core exit temperature indicative of superheat conditions.
9%	M.02	Value showing S/G level just in the narrow range including allowances for normal channel accuracy and reference leg process errors.
15%	M.03	Value showing S/G 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:

DEV.1 Added a minimum number of CETs that must indicate above 1200°F for ICC determination.

JUST. The information on the number of CETs required gives the operator additional information needed to perform this step. The information is based upon information found in the ERG Executive Volume.

DEV.2 Added plant-specific details to start an RCP lift oil pump.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

DEV.3 DW-94-002 was not incorporated in this step. This item requires resetting SI, resetting containment isolation, and establishing instrument air to containment.

JUST. The intent of this DW item was satisfied by including these actions in EOP Step 4. Since the procedure may use equipment that requires these actions, it is appropriate to include these actions early in the procedure.

EOP Step No: Step 26

ERG Step No: Step 19

EOP Step:

CAN ALL INTACT SGs BE DEPRESSURIZED USING STEAM DUMPS OR MS10s
[INTACT SG DEPRESSURIZATION]

Purpose:

To recover the core via accumulator and/or RHR.

ERG Basis:

If the operator is not successful in depressurizing the SGs from the control room, he should try to locally depressurize them.

EOP Basis:

Same as ERG basis, with the following additional information:

The operator is instructed to attempt to locally depressurize the intact SGs using the MS10s. If this is not successful, the operator then attempts to depressurize the SGs using the MS18 warmup valves.

Supplemental Information:

ERG Plant-Specific Information: Means for alternative SG depressurization.

Setpoints and Numerical Values:

None

EOP Step No: Step 26 (CONTINUED)

ERG Deviations:

DEV.1 Added plant specific details regarding locally depressurizing intact SGs.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

DEV.2 Added a substep to run 13 AFW Pump at maximum speed.

JUST. Per Plant-Specific Information item under Supplemental Information, steam-driven 13 AFW Pump is run at maximum speed to maximize its steam draw from the two SGs supplying it, thereby serving as a "means for alternative SG depressurization".

EOP Step No: Step 27

ERG Step No: Step 20

EOP Step:

ARE 5 OR MORE CETs GREATER THAN 1200°F
[SAMG TRANSITION]

Purpose:

To determine if severe conditions exist that require a transition to the SAMGs

ERG Basis:

The Severe Accident Management Guidelines (SAMGs) are entered from the ERGs by the control room operators when core damage occurs. The ERG to SAMG transition uses, as part of the transition criteria, a core exit thermocouple temperature indication of greater than 1200°F to indicate the need to transition from the ERGs to the SAMGs. The 1200°F criteria for transition from the ERGs to the SAMGs is identical to the 1200°F criteria on the Core Cooling Critical Safety Function Status Tree.

If the operator enters this step and core exit TC temperatures are greater than 1200°F and increasing and RCPs are running in all available RCS cooling loops, the operator should transition to the SAMGs. This condition indicates that all attempts to restore core cooling have failed and core damage can not be prevented and the operator should go to the SAMGs.

If the operator enters this step and core exit TC temperatures are greater than 1200°F and decreasing, the operator should return to step 23 and continue attempts to reduce core exit temperature.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
1200°F	G.04	Core exit temperature indicative of superheat conditions.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 28

ERG Step No: Step 21

EOP Step:

(Step 28) IS AT LEAST INTERMITTENT FLOW INDICATED ON 11 OR 12 SJ49 (COLD LEG INJECTION FLOW METERS)

(Step 28.1)REMOVE LOCKOUT FOR 11 THRU 14 SJ54 (ACCUMULATOR OUTLET VALVES) **[SI ACCUMULATOR ISOLATION]**

Purpose:

To minimize nitrogen injection to the RCS.

ERG Basis:

The accumulators will be allowed to inject their entire water inventory if necessary. The selected accumulator isolation criterion, intermittent RHR flow, will ensure safety injection flow to the RCS is established before accumulator isolation occurs. Some nitrogen may be injected as a result of this criteria since the shutoff head pressure of the RHR pumps is less than 250 psig. Refer to document SI ACCUMULATOR ISOLATION/VENTING in the Generic Issues section of the ERG Executive Volume.

The ERG reference plant SI accumulators have (1) normally open/fail as is motor operated outlet isolation valves that receive a confirmatory SI signal to ensure that they are open and (2) normally closed/fail closed air operated series vent isolation valves. The air operated vent valves are located inside containment and the air supply to the vent valves is automatically isolated on a containment Phase A Isolation signal which closes the containment isolation valves in the air supply line(s).

As a general rule, the ERGs do not reset the SI signal, reset the containment Phase A Isolation signal or establish instrument air to containment until it is necessary to perform required actions.

This step is at a point where the SI and containment Phase A Isolation signals may not have been reset and where instrument air may not be established to containment. Consequently, directions to perform these actions if needed are included here.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

EOP Step No: Step 28 (CONTINUED)

Setpoints and Numerical Values:

None

ERG Deviations:

DEV.1 Added plant-specific details to isolate SI accumulators, vent any unisolated accumulators, and to close accumulator vent valves when venting is completed.

JUST. This guidance aids operators in performing these actions in a consistent manner. [SD-12]

DEV.2 Deleted the ERG step which requires resetting SI, resetting containment isolation, and establishing instrument air to containment.

JUST. The intent of the item was satisfied by including these actions in EOP Step 4. Since the procedure may use equipment that requires these actions, it is appropriate to include these actions early in the procedure.

EOP Step No: Step 29

ERG Step No: Step 22

EOP Step:

ARE AT LEAST TWO RCS T-HOTs LESS THAN 350°F

Purpose:

To stop RCPs if the required conditions are satisfied.

ERG Basis:

If the required conditions are satisfied, i.e., at least two RCS hot leg temperatures are less than 350°F and at least intermittent RHR flow is established, then the RCPs are no longer needed for core cooling and can be stopped.

The 350°F temperature criterion ensures that the core is cool and that very little superheat remains in the RCS. Two RTDs are used to ensure that one RTD is not giving an erroneous reading.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
350°F	F.12	RCS hot leg temperature indicative of core cooling following a degraded or inadequate core cooling event.

ERG Deviations:

No deviation from the ERG.

EOP Step No: Step 30

ERG Step No: Step 23

EOP Step:

IS CHARGING FLOW AT LEAST 100 GPM ON SI SYSTEMS CHG FLOW METER

Purpose:

To verify ECCS flow delivery to the RCS.

ERG Basis:

The objective of the previous steps was to reduce the RCS pressure below the shutoff head of the RHR pumps. This should cause RHR injection. This step verifies ECCS flow to the RCS.

EOP Basis:

Same as ERG basis.

Supplemental Information:

None

Setpoints and Numerical Values:

Value	Setpoint	Description
300 gpm	S.03	The minimum RHR pump flow into the RCS cold legs that indicates injection into the RCS.
100 gpm	S.07	Minimum charging flow (per the SI systems charging flow meter) which indicates injection into the RCS.
100 gpm	S.08	Minimum SI flow (per the SI pump flow meter) which indicates injection into the RCS.

ERG Deviations:

DEV.1 Added the plant specific setpoint values for the amount of indicated flow required to satisfy each flow verification.

JUST. Adding specific setpoint values for the minimum flow that can be indicated assists the operator in determining if adequate flow is being delivered.

EOP Step No: Step 31

ERG Step No: Steps 24 and 25

EOP Step:

ARE ALL RCPs STOPPED
[CORE COOLING STATUS]

Purpose:

To check if core cooling has been restored.

To provide a transition to the optimal long-term plant recovery instruction set.

ERG Basis:

(ERG Step 24) A check is made for RCP operation in the first part of this step since the hot leg temperature criterion would not be met with RCPs running and the RVLIS full range indication would not be applicable with RCPs running.

In order to exit this procedure, at least two RCS hot leg temperatures must be less than 350°F to ensure RCS pressure is less than the shutoff head of the RHR pumps (two RTDs are used to ensure that one RTD is not giving an erroneous reading); and the RVLIS full range indication must be greater than 57%. Core cooling has been restored when the above conditions have been met and SI flow or other make-up flow has been established. Note, these conditions are more stringent than earlier transition conditions since the RCS should now be fully depressurized.

(ERG Step 25) Transition to EOP-LOCA-1, LOSS OF REACTOR COOLANT, EOP Step 16, will allow the operator to check the overall plant status with respect to radioactivity leakage and availability of equipment needed for long term plant recovery.

EOP Basis:

Same as ERG basis.

Supplemental Information:

DW-93-030: In EOP-FRCC-1, RCP status should be determined prior to checking the RVLIS full range indication unless the actions in the procedure ensure that the RCPs are stopped.

EOP Step No: Step 31 (CONTINUED)

Setpoints and Numerical Values:

Value	Setpoint	Description
350°F	F.12	RCS hot leg temperature indicative of core cooling following a degraded or inadequate core cooling event.
57%	K.02	RVLIS full range value which is top of core including allowances for normal channel accuracy.

ERG Deviations:

No deviation from the ERG.

APPENDIX A

EOP/ERG CORRELATION

EOP/ERG CORRELATION

EOP Step	ERG Step
ENTRY CONDITIONS	ENTRY CONDITIONS
1	Caution 1-1 (1)
2	Caution 1-2 (1)
3	1 (1)
4	N/A
5	2 (1)
6	3 (2)
7	4 (2)
8	5 (3) 6 (4) 7 (5)
9	8 (6)
N/A	Note 8-1 (6)
10	Caution 9-1 (7)
11	Caution 9-2 (7)
12, 13, 14	9 (7)
15	10 (8)
16	Note 11-1 (9)
N/A	Note 11-2 (9) Note 11-3 (9)
17	11 (9)
18	12 (10)
19	13 (11)
20	14 (12)
21	15 (13)
22	16 (14) 17 (15)
23	Note 18-1 (16)
24, 25	18 (16)
26	19 (17)
27 28	20 (18) 21 (19)
29	22 (20)
30	23 (21)
31	24 (22) 25 (23)