

NRC

REV. 1

DATE 4/22/79

EMERGENCY PROCEDURE EP-32

TITLE: LOSS OF RCP'S SUCCESSFUL NATURAL CIRCULATION

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EP-32 - Loss of Operating RCP
Successful Natural Circulation

1.0 Purpose:

To provide adequate core cooling through natural circulation in the event of loss of the operating RCP.

2.0 References

<u>Ref. No.</u>	<u>Description</u>
Contingency Plan C-1,2,3	Loss of Reactor Coolant Pumps of 8 April, 1979
Ref. A	Bill Lowe to (Illegible) Telecon Note of 0800, 4/12/79
Ref. #180	NDT Pressure/Temperature Curve
Ref. #10	Natural Circulation - Minimum RCS Pressure vs that curve with saturation curve added
Ref. #48	Preparation for an initiation of natural circulation.
Ref. #168	Effect of Partial Flow Blockage on N.C.
Ref. #156	RCP Startup Procedure (B&W procedure 15, Rev. 4)
Ref. #11	Loss of RC Flow/HPI
Ref. # (B&W) 77	Loss of RCP - Successful Natural Circulation (B&W 486, 4/19/79)
Ref. #TSG 071	Loss of Reactor Coolant Pump (R. Keaten 4/19/79)

3.0 Limitations and Precautions

3.1 Operational limits of RCP with backup RCP's available:

- a. frame vibration exceeds 5 mils.
or
- b. shaft vibration exceeds 30 mils
and
upper seal leakage & return flow increases to greater than 1.9 GPM.

3.2 Operational limits of RCP with no backup RCP available.

- a. Shaft vibration > 70 mils
- or
- b. Upper seal leakage > MU system capability to maintain RC system water level.

4.0 Symptoms

- 4.1 RC Flow in the operating loop decreases or becomes erratic
- 4.2 Complete loss of RC flow in operating loop.
- 4.3 RC Pump Trip annunciator.
- 4.4 RCP limits (section 3) exceeded.
- 4.5 Indications the RCP has stopped as observed by no running current (amps) or vibration.

NOTE: Initial Condition

Heat removal through A OTSG in Steaming Mode
 B OTSG H₂O/H₂O loop not yet ready.

Feedwater to OTSG supplied thru ~~secondary~~ ^{MAIN} Fil nozzles. *off 2130 4/24/79*

5.0 Immediate Actions

- 5.1 Attempt to establish natural circulation
 - 5.1.1 Immediately begin raising RCS pressure to approximately 900 psig ± 100 psig (to increase margin to saturation).
 - 5.1.2 Trip the turbine
 - 5.1.3 Without altering the feedwater lineup or flow rate allow, OTSG "A" level to slowly increase to 430" on the wide range instrument. Secure feedwater flow, and allow OTSG "A" level to decrease to 400". Re-establish feedwater flow at the previous rate to increase level to 430". Repeat as necessary to maintain level between 400" - 430".

NOTE 1 - Following the above actions and when equilibrium conditions are established, RCS temperature T_c should stabilize at about 200 °F.

Note 2 - Natural Circulation is indicated by an increase in RCS ΔT to a new value greater than the approximately zero ΔT of forced circulation. This ΔT is expected to be approximately 10 to 35° when equilibrium conditions of flow have been achieved. Initially, however, ΔT will increase to greater values which could be as much as 15 to 40°F in the five to ten minute period after the loss of RCP, followed by a decrease to the equilibrium ΔT . The ΔT values in this paragraph are provided for information only and are a result of interpretation of analytical data. It should take about 25 to 35 min. to establish natural circulation.

Note 3 - The system will respond slowly to changes while in the natural circulation mode. The loop transport-time is about 20 minutes, therefore, changes in steam demand and feed rate should be made slowly and the system should be given time to equilibrate before additional changes are made.

5.1.4 Manually record and plot T_H , T_C and T_{stm} every twenty (20) minutes. Read and record T_{stm} all operable in-core thermocouples every ten (10) minutes.

5.1.5 If any of the (4) criteria provided below are exceeded, adequate Natural Circulation has not been established, therefore, proceed to step 5.2.

5.1.5.1 If T_H in the loop with the OTSG in the steaming mode exceeds 420°F, go to step 5.2.

5.1.5.2 If any thermocouple excess 1000°F go to step 5.2.

5.1.5.3 If any three (3) thermocouples have readings exceeding 800°F go to step 5.2.

5.1.5.4 At least 6 thermocouples must be below ~~570°F~~ ^{500°F}, otherwise go to step 5.2. *500°F 4/24/79 2130*

NOTE: After natural circulation has been established it is expected that T_H and T_{stm} will be nearly equivalent. However, T_{stm} should not be less than T_C for natural circulation to occur. In making the above comparisons, an instrument error of up to \pm 50F must be considered.

5.1.6 After temperatures have stabilized (1/2 - 1 hr expected), decrease steam flow from the "A" OTSG by shutting the MS supply valves to the MSR "A", MS-V35A and MS-V36A.

NOTE: Following the above actions and when equilibrium conditions are established, T_c from the plot in step 5.1.4 should have increased to about 205 OF.

5.2 If natural circulation is not established, attempt to regain flow by starting RCP's in the following sequence.

5.2.1 Attempt to restart RC-P-2A as follows:

- a) Start and run RC-P-2A High Pressure Lift and Backstop oil pumps *and establish seals to pump.*

NOTE: The motors can be started with acceptable risk without the backstop lube oil pumps. RC pressures between 800 and 1200 P.S.I. should allow operation of the motors without the high pressure oil lift system. At pressures below 800 psi, start up without high pressure lift system may not be successful but may be attempted.

- b) Start RC-P-2A.
- c) Open or check open seal return valve MU-V-33B.

NOTE: Three start attempts are allowed from cold condition.

5.2.2 If RC-P-2A cannot be started, attempt to start RC-P-1A as follows:

- a) Start and run RC-P-1A High Pressure Lift and Backstop Oil Pumps
- b) Start RC-P-1A
- c) Open/check open seal return valve MU-V-33A.

5.2.3 If RC-P-1A cannot be started, start RC-P-1B or 2B as follows:

- a) Obtain HP person to accompany A.O. to establish seal injection on RC-P-1B and 2B by opening MU-V-379 and MU-V-380.

NOTE: RHP must be prepared each shift designating personnel who will make entry.

5.2.4 Start AC Oil Lift and AC Backstop Pumps for RC-P-1B and 2B.

5.2.5 Verify intermediate and MSCCH is operating.

5.2.6 Verify Seal Injection Flow on RC-P-1B and 2B.

5.2.7 Open MU-V33 C & D. Verify RC Pump Seal staging by observing seal cavity pressure.

5.2.8 Verify RC Pump Seal Return Flow (< 1.91 gpm) on RC-P-1B and 2B.

5.2.9 ~~With steps 2.2.2 through 2.2.7 complete, start RC-P-1B. 2B~~ ⁵ ~~2B~~

5.2.10 ~~If RC-P-1B start attempt unsuccessful, start RC-P-2B.~~ ⁵ ~~2B~~ _{1B}

5.2.11 Monitor the following during startup through the transient and thereafter for proper indication. Upper seal cavity pressure, lower seal cavity pressure, seal return temperature, upper seal leakage, seal return flow, pump shaft vibration and motor bearing temperatures.

5.2.12 Close MU-V33 on non-operating pumps.

5.2.13 Close seal injection valves on all but standby pump and readjust seal injection to minimize makeup.

5.2.14 Secure oil lift pumps on all non operating pumps.

5.2.15 If an RCP was successfully started, return RCS pressure and "A" OTSG level to the previous condition.

5.3 If no RC pumps can be started, attempt to establish natural circulation.

5.3.1 Verify RCS pressure is 900 + 100 psig and "A" OTSG level 400-430". Adjust RCS pressure and OTSG level to reach and maintain those parameters.

5.3.2 Allow temperatures to stabilize for 1 hour. During this period of time, read and record all operable thermocouples every ten minutes.

- 5.3.3 If any thermocouple exceeds 1200°F prior to successfully establishing Natural Circulation, go to step 5.4.
- 5.3.4 If any 3 thermocouples exceed 1000°F prior to successfully establishing Natural Circulation, go to step 5.4.
- 5.3.5 If at any time during stabilization or natural circulation attempts T_h in the loop with the OTSG in the steaming mode exceeds 500°F proceed to step 5.4.

NOTE: Continue plotting T_h , T_c , and T_{stm} as in step 5.1.4.

- 5.4 If natural circulation is not established, go into HPI per EP33, starting with Step 3.2.