REV. 0

DATE 5/4/79

EMERGENCY PROCEDURE EP-34

TITLE: Loss of Natural Circulation

APPROVALS: FORC (Vice-Chairman) RP Warren DATE 5/4/79

UNIT SUPT.: [signature] DATE 5/4/79

BSH [signature] DATE 5/4/79 NRC [signature] DATE 5/4/79

ALARA [signature] DATE 5-4-79

Note: 3.0 (E.N.) are in contention with NRC ~~and~~ with regard to "the hottest in-core thermocouples". With that exception BSH, ALARA, GPU, & NRC have reviewed and are ready to sign

Received 1915hrs 5/4/79

NRC agreed to use "third hottest in-core thermocouple".
NRC (Gallo) / Arnold discussion and agreement

EP-34
LOSS OF NATURAL CIRCULATION

1.0 Purpose

To reestablish core cooling if natural circulation is lost.

2.0 References

2.1 EP-32, Rev. 2 4/23/79

2.2 EP-33, Latest Revision

3.0 Limitations and Precautions

3.1 Contact R. C. Arnold before changing the present method of maintaining natural circulation or if any of the following notification levels are exceeded. Exceeding these levels may indicate natural circulation is being lost.

a. Loop A ΔT greater than $20^{\circ}F$
b. Loop A T_H increasing for 8 hours
c. Hottest in core thermocouple exceeds $350^{\circ}F$
d. Any in-core thermocouple increases by more than $30^{\circ}F$ in one hour.

3.2 Operational limits of RCP with backup RCPs available:

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

3.3 Operational limits of RCP with no backup RCP available

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

3.4 Observe normal limits and precautions, as modified for plant conditions, on starting RCP s.

3.5 The following limitations should be maintained while in natural circulation:

a. OTSG level maintained at 400 to 430" on the operating OTSG (s).

b. Balance leakage and letdown flows with makeup and seal injection in a continuous mode rather than using periodic makeup.

c. If both OTSGs are steaming their respective turbine bypass valves should be open equally.

3.6 RCS pressure shall be kept at least 100 psi above saturation pressure for the third hottest in-core thermocouple or the hottest T_H, whichever is more limiting, at all times until a maximum pressure of 1000 psig is reached.

3.7 Makeup tank temperature should be maintained as high as possible but below 150°F or the operating loop T_c(s) whichever is lower.

3.8 All makeup to the Makeup Tank shall be deaerated (degassed). Makeup boron concentration shall be such as to maintain the specified boron concentration in the RCS.

3.9 If the pressurizer is solid maintain pressurizer water temperature in accordance with 2-6).

.0 Loss of Natural Circulation Symptoms:

4.1 Loss of natural circulation could be indicated by the following which should be monitored at all times.

a. Loop A Δ T greater than 20°F
b. Loop A T_H increasing for 0 hours
c. Hottest in core thermocouple exceeds 350°F
d. Any in-core thermocouple increases by more than 30°F in one hour.

5.0 Recovery of Natural Circulation

5.1 Immediate Actions

5.1.1 Maintain RCS pressure at least 100 psi above the saturation pressure of the third hottest in-core thermocouple or the hottest T_H, whichever is more limiting, until an RCS pressure of 1000 psig is reached. Once a pressure of approximately 1000 psig is reached, no further increases are necessary and RCS pressure should be maintained at about 1000 psig until conditions conducive to lower pressure are achieved. Maintain pressurizer water temperature consistent with saturation temperature. If solid, refer to F-0.

5.1.2 Maintain level and turbine bypass valve position for the operating OTSG (s) at the values in use prior to loss of natural circulation.

5.1.3 Notify the Shift Supervisor of the loss of natural circulation. He will in turn notify R. C. Arnold and J. Herbein.

NOTE: No further immediate actions are required. The RCS heat up rate will be very slow and natural circulation should restart with no further actions required. Guidance and direction on further action (outlined in succeeding sections) will be provided by R. C. Arnold (J. Herbein).

5.2 Follow up Actions

5.2.1 The following steps should be performed until the conditions of 3.1 (4.1) are completely satisfied. Steady state operation within these limits is demonstration of satisfactory natural circulation.

NOTE: When equilibrium natural circulation conditions are re-established, RCS temperature T_H should stabilize about 160 - 180°F. Natural circulation will result in a RCS ΔT for the operating OTSG (s) of less than 20°F when equilibrium conditions of flow have been achieved. Initially, however, ΔT may increase to greater values which could be as high as 100°F, followed by a decrease to the equilibrium ΔT. The ΔT values in this paragraph are provided for information only.

The system responds slowly to changes while in the natural circulation mode. The loop transport time is a half hour or longer, therefore, changes in the system should be given time to equilibrate before additional changes are made. It may take several hours to several days to reestablish natural circulation.

5.2.2 Record and plot T_H and T_C for both loops as well as level for both OTSG's every twenty (20) minutes.

5.2.3 Read and record all operable in-core thermocouples every ten (10) minutes. Plot the six (6) lowest and six (6) highest thermocouples.

5.2.4 If the pressurizer is not solid, increase and maintain pressurizer level to 350" ± 25" by best estimate in accordance with EP-21. During this increase in level be observant for indications of taking the pressurizer solid. Use procedure I-63 for information on solid symptoms. If these symptoms are encountered use I-63 and establish solid pressurizer operation. This will protect against uncovering pressurizer heaters during RCP trips or operation.

5.2.5 Natural circulation should be re-established without resorting to RCP's or solid operation of the OTSG's. Violation of any of the following criteria requires immediate further action in accordance with 5.2.6. The basis for these criteria are an RCS pressure of 1000 psig.

5.2.5.1 T_H for the operating OTSG(s) $\leq 420^{\circ}F$

5.2.5.2 All in-core thermocouples $\leq 1000^{\circ}F$

5.2.5.3 No more than three (3) in-core thermocouples $\geq 800^{\circ}F$

5.2.5.4 At least six (6) in-core thermocouples $\leq 500^{\circ}F$

5.2.6 The following steps are listed in expected order of performance if they become necessary. Plant or component status may dictate skipping or reordering of steps. Steps 5.2.8 through 5.2.16 should be executed only on direction from R.C. Arnold (J. Herbein). After performance of each step a wait time of at least one hour should be allowed, if practical, to determine if that step has improved core cooling and/or re-established natural circulation before proceeding to another step.

5.2.7 The criteria of this step represent RCS conditions indicative that natural circulation is not being re-established. These criteria are an indication that further efforts to re-establish natural circulation should be made.

5.2.7.1 T_H for the operating OTSG(s) greater than $260^{\circ}F$ and increasing.

5.2.7.2 Any in-core thermocouple greater than $700^{\circ}F$ and increasing.

5.2.7.3 Three or more in-core thermocouples greater than $600^{\circ}F$ and increasing.

5.2.7.4 Less than ten (10) in-core thermocouples below $400^{\circ}F$.

5.2.8 Open the turbine bypass valves on the operating OTSG(s) to wide open. Maintain steam generator levels. When natural circulation is re-established, provide equal throttling of turbine bypass valves for the operating OTSG(s) to achieve the desired heat removal.

5.2.9 Commence steaming "B" OTSG to the condenser using wide open turbine bypass valves. Maintain steaming of "A" OTSG and fully open its turbine bypass valves. Establish and maintain 400" to 430" levels in both OTSG's using normal feed. When natural circulation is re-established, provide equal throttling of turbine bypass valves for both generators to achieve the desired heat removal.

CAUTION: Prior to starting the emergency feedwater pumps, insure the feedwater valve lineup is consistent with use of the emergency flow path as well as the feed thru the main nozzles.

5.2.10 Initiate flow thru the auxiliary feed nozzels using the emergency feedwater pumps and raise level five (5) feet (1500 gal) in both generators. The auxiliary feed flow should be at a high rate but do not exceed 500 gpm/generator. Maintain normal feed during the injection. When auxiliary injection is completed, maintain generator levels at the new value using feed thru the main nozzles. When natural circulation is re-established, allow the levels to slowly decrease to the 400" to 430" range.

5.2.11 Jog RCP 1A or 2A for approximately 5 seconds.

5.2.12 Run RCP 1A or 2A for approximately 30 seconds.

5.2.13 Secure steaming of "B" OTSG and go solid in "B" (2-110) while continuing to steam on "A" OTSG.

5.2.14 Jog RCP 1B or 2B for approximately 5 seconds.

5.2.15 Run RCP 1B or 2B for approximately 30 seconds.

5.2.16 Establish long term cooling using the new "B" OTSG cooling system.

5.2.17 If T_H for the operating OTSG(s) exceeds 500°F or any in-core thermocouple exceeds 1200°F, forced circulation must be restarted. It is preferable that RCP 1A or 2A be used to provide forced circulation. Do not overcool the RCS and uncover the pressurizer heaters. If forced circulation cannot be achieved, proceed to EP-33 or to DHR (ACHR) as directed by R.C. Arnold (J. Herbein). Note that proceeding to EP-33 or DHR (ACHR) is a last resort only.