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FLORIDA POWER & LIGHT COMPANY
ST LUCIE PLANT UNIT 1
EMERGENCY OPERATING PROCEDURE 0120040
REVISION 11

1.0 Title:

NATURAL CIRCULATION/COOLDOWN

2.0 Approval:

Reviewed by Plant Nuclear Safety Committee July 2 1974
Approved by K N Harris Plant Manager August 10 1974

Revision 11 Reviewed by FRG ______ 19__
Approved by J H Barrow Jr Plant Manager Dec. 20 1982

3.0 Purpose and Discussion:

3.1 Purpose

1. This procedure provides instructions to the operator in the event of a total loss of Reactor Coolant Pump (RCP) flow to the reactor core.

2. This procedure also provides guidance to the operator in the event that the plant must be cooled down using natural circulation flow.

3.2 Precautions - See Appendix A.

3.3 Discussion - See Appendix B.

4.0 Symptoms:

4.1 Loss of off-site power.

4.2 Loss of or low voltage on 6.9 KV busses as indicated by:

1. 6.9 KV switchgear 1A1, 1B1 differential current trip.

2. 6.9 KV switchgear 1A1, 1B1 UNDERVOLTAGE alarm.

4.3 RCP OVERLOAD alarm.

4.4 REACTOR COOLANT LOW FLOW channel pre-trip alarm.

4.5 REACTOR COOLANT LOW FLOW channel trip.

4.0 Symptoms: (cont)

4.6 Loss of Component Cooling Water (CCW) flow to RCPs for greater than 10 minutes, requiring manual trip of all four pumps.

4.7 Valid SIAS-CIS caused by low RCS pressure, requiring all RCPs to be tripped after all Control Element Assemblies have been inserted for 5 seconds.

5.0 Instructions:

5.1 Automatic Action

1. Reactor coolant low flow reactor trip (Setpoint: 95% of full RCS flow).

5.2 Immediate Operator Action

5.2.1 Carry out immediate operator actions for reactor trip as follows:

1. Trip the turbine and reactor manually.
2. Ensure all CEA's are fully inserted and reactor trip breakers are open.
3. Verify decreasing reactor power level.
4. Ensure the turbine valves are closed.
5. Ensure generator field and 240 KV breakers are open.
6. Ensure transfer of electrical power from auxiliary transformer(s) to startup transformer(s)

   <u>OR</u>

   Ensure that the diesel generators have started and are feeding emergency busses, and are not overloaded.
7. Close MV-08-4, MV-08-6, MV-08-8, and MV-08-10 (MSR Reheat Block Valves).
8. Ensure that the Main Feedwater (MFW) System is restoring or maintaining steam generator level, and that FCV-9011 and FCV-9021 (MFW Regulating Valves) are closed, and FCV-9005 and FCV-9006 (MFW 15% Bypass Valves) open to approximately 5% of full load flow.

   <u>OR</u>

   Initiate Auxiliary Feedwater (AFW) flow to both steam generators, and ensure flow to both steam generators.

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5.0 Instructions (Cont'd)

5.2.1 (Cont'd)

9. If all feedwater flow is stopped or lost and steam generator level is less than 42% then:

   a) Reinitiate auxiliary feedwater flow as soon as possible; however, do not exceed a flow rate of 150 gpm per steam generator.

   b) Limit feedwater flow rate to 150 gpm per steam generator until continuous feedwater flow to the steam generator has been maintained for five minutes.

   NOTE: If 'A' and 'B' AFW pumps are in operation and 'C' AFW pump is not needed to restore steam generator levels to normal levels, place the "C" AFW AUTO START BYPASS switch in BYPASS.

10. Ensure that Tav is being reduced to reference setpoint by the steam dump valves to the condenser. If the bypass valves or the condenser are not available, use the atmospheric dump valves.

11. If any of the above automatic functions have failed to occur, manually initiate that function.

5.2.2 Verify that shutdown margin (SDM) is $\geq$ 5.0% $^{\Delta K}/_{K}$. IF SDM is less than specified, emergency borate the RCS until SDM is $\geq$5.0% $^{\Delta K}/_{K}$.

5.2.3 Continue to perform in parallel with this procedure any applicable operator actions that are required by the initiating event procedure (s).

5.2.4 Implement the Emergency Plan as necessary in accordance with EPIP 3100021E, "Duties of the Emergency Coordinator".

5.3 Subsequent Actions

5.3.1 Establish and maintain hot let temperature (T_h) at least 20°F below the saturation temperature corresponding to RCS pressure (refer to Figure 1) by doing the following:

1. Operate presurizer heaters or auxiliary spray to increase or maintain pressurizer pressure, and to provide sub-cooling margin.

5.0 Instructions (Cont'd)

5.3.1 (Cont'd)

2. Increase turbine bypass or atmospheric steam dump flow to reduce or maintain RCS temperature and prevent lifting secondary safeties.

5.3.2 Verify that the pressurizer level control system is functioning to maintain pressurizer level. If necessary, manually operate charging and letdown to restore and maintain normal pressurizer level. If operable charging pumps cannot restore RCS inventory and pressurizer level, observe RCS and containment parameters for indications of a LOCA.

5.3.3 Restore and maintain steam generator levels at approximately 65%. When feeding the steam generators use caution to avoid excessively cooling the RCS.

CAUTION: Do <u>not</u> exceed a cooldown rate of 75°F/hr.

5.3.4 Verify the following indications that natural circulation flow has been established within approximately 15 minutes after RCPs were tripped:

1. Loop ΔT (T_h - T_c) less than normal full power T (<46°F).

NOTE: The effective core ΔT with only one steam generator in operation is determined as $Th\text{-}Tc_{core}$ where

$$Tc_{core} = \frac{2x(\text{Tc operating loop}) + \text{Tc non-operating loop}}{3}$$

2. Cold leg temperatures (Tc) constant or decreasing.

3. Hot leg temperatures (Th) stable (i.e., not steadily increasing).

4. No abnormal differences between Th RTD's and core thermocouples.

5.3.5 Confirm boron concentration in the RCS by sampling from as many different points as possible.

5.3.6 Maintain the plant in a stabilized condition based upon auxiliary plant systems availability (e.g., condensate inventory).

5.3.7 If one or more RCP's are restored to an operable condition within 10 minutes, start an RCP in each loop if the following criteria are satisfied:

1. At least one steam generator is removing heat from the RCS.

2. Pressurizer level and pressure are responding normally to the Pressurizer Level and Control System.

3. The RCS is at least 20°F subcooled (refer to Figure 1).

4. The yellow PERMISSIVE light on the associated pump control switch is lit.

5. No indication of voids in RCS are present.

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5.0 Instructions: (cont)

5.3 (cont)

5.3.8 If all four RCPs can be returned to operable status within 10 minutes, power operation may be resumed under the direction of the Nuclear Plant Supervisor. If RCS cooldown is required under these conditions, the cooldown should be accomplished using forced circulation.

5.3.9 If required to conduct a plant cooldown to shutdown cooling (SDC) conditions using natural circulation, proceed as follows:

1. Establish as stable plant conditions as circumstances permit.

2. Verify that RCS boration has progressed to the point that the required SDM can be maintained during the cooldown.

3. Commence supplying makeup water to the Condensate Storage Tank. If off-site power is not available, place the Water Treatment Plant in service as per Appendix C.

4. Commence an RCS cooldown by utilizing one of the following methods:

   a. If the condenser is available, use the Steam Dump Bypass System and Main or Auxiliary Feedwater.

   b. If the condenser is not available, use the atmospheric dump valves and Main or Auxiliary Feedwater.

5. Continuously verify natural circulation flow throughout the cooldown process.

6. Observe all available indications to determine conditions within the RCS.

   a. Use the Subcooled Margin Monitor (SMM), Th, Tc, and RCS pressure to verify that the RCS is subcooled.

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5.0 Instructions: (cont)

5.3 (cont)

5.3.9 (cont)

6. (cont)

b. Figure 1 or the nomograph on RTGB-103 should be used for comparison with the SMM; subcooled margin can also be determined by subtracting Th from pressurizer temperature (TE-1101).

c. Incore thermocouples, recorded on the DDPS, can also be used for indication of Th.

7. Establish and maintain a RCS cooldown rate of 50°F/hr. (See Figure 2). The highest RCS cold leg temperature shall be plotted every 30 minutes on a copy of Figure 4. The RCS temperature and pressure shall be determined to be within the limits of Technical Specification Figure 3.4-2B at least once per 30 minutes during cooldown.

8. The pressurizer water phase shall be recorded on Figure 5 and plotted every 30 minutes on Figure 4. This temperature shall also be compared with the lowest spray water temperature to ensure that differential temperature does not exceed 350°F.

9. Maintain RCS pressure above and to the right of the curve values shown on Figure 3.

10. During the cooldown, maintain a minimum of 20°F subcooling by the following methods (listed in order of preference):

a. Manual control of pressurizer heaters and auxiliary spray.

NOTE: Use only one charging pump.

b. Operating charging or HPSI pumps.

11. During the cooldown, maintain pressurizer level by the following methods (listed in order of preference):

a. Control charging and letdown.

b. Operating HPSI pumps.

5.0 Instructions: (cont)

5.3 (cont)

5.3.9 (cont)

12. Monitor the available condensate inventory and replenish the CST as required.

    CAUTION: Condensate Storage Tank volume shall be maintained 116,000 gallons per Technical Specifications 3.7.1.3. If this limit cannot be maintained, proceed to Appendix E.

13. During RCS cooldown and depressurization, perform the evolutions specified in Appendix D.

14. During RCS depressurization monitor for void formation in the reactor vessel upper head region. Indications of possible void formation include:

    a. RCS temperature >Tsat for the corresponding RCS pressure.

    b. A pressurizer level increase significantly greater than expected while operating auxiliary spray.

    c. A pressurizer level decrease while operating charging.

    d. If the Pressurizer Level Control System is in automatic, an unanticipated letdown flow greater than charging flow.

15. If voiding in the RCS is indicated, perform the following:

    a. Isolate letdown by closing V-2515 and V-2516 (Letdown Containment Isolation).

    b. Stop the RCS depressurization.

    c. Stop the RCS cooldown.

    d. If possible, review and select one RCP in each loop for restarting.

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5.0 Instructions: (cont)

5.3 (cont)

5.3.9 (cont)

15. (cont)

e. Repressurize the RCS to eliminate the void by operating pressurizer heaters or HPSI and charging pumps.

NOTE: If the HPSI or charging pumps are utilized to charge the RCS solid, the pumps should be stopped after solid RCS conditions are indicated.

f. If required to continue the cooldown with the known presence of a steam void in the reactor vessel head, proceed using the Fill and Drain method (Appendix E).

g. When conditions permit, re-initiate letdown and resume depressurization to SDC initiation pressure.

16. If off-site power has been lost, and it becomes necessary to augment the cooldown rate refer to Appendix F.

17. When RCS temperature reaches 325°F, maintain the RCS at this temperature for an additional 20.4 hours (See Figure 2).

18. Upon completion of the required "soak" period, initiate SDC in accordance with Appendix G.

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Figure 1
SATURATION

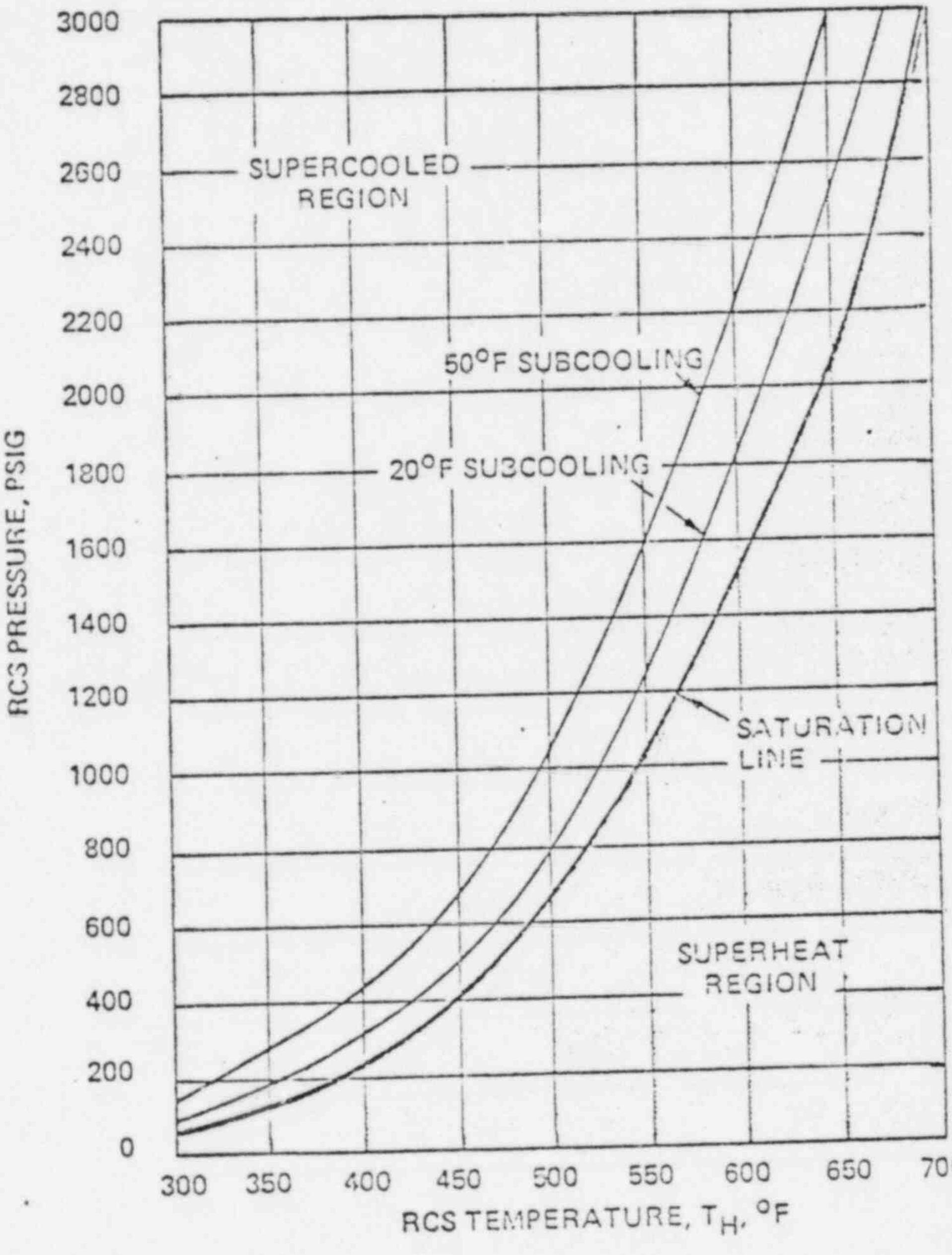

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FIGURE 2

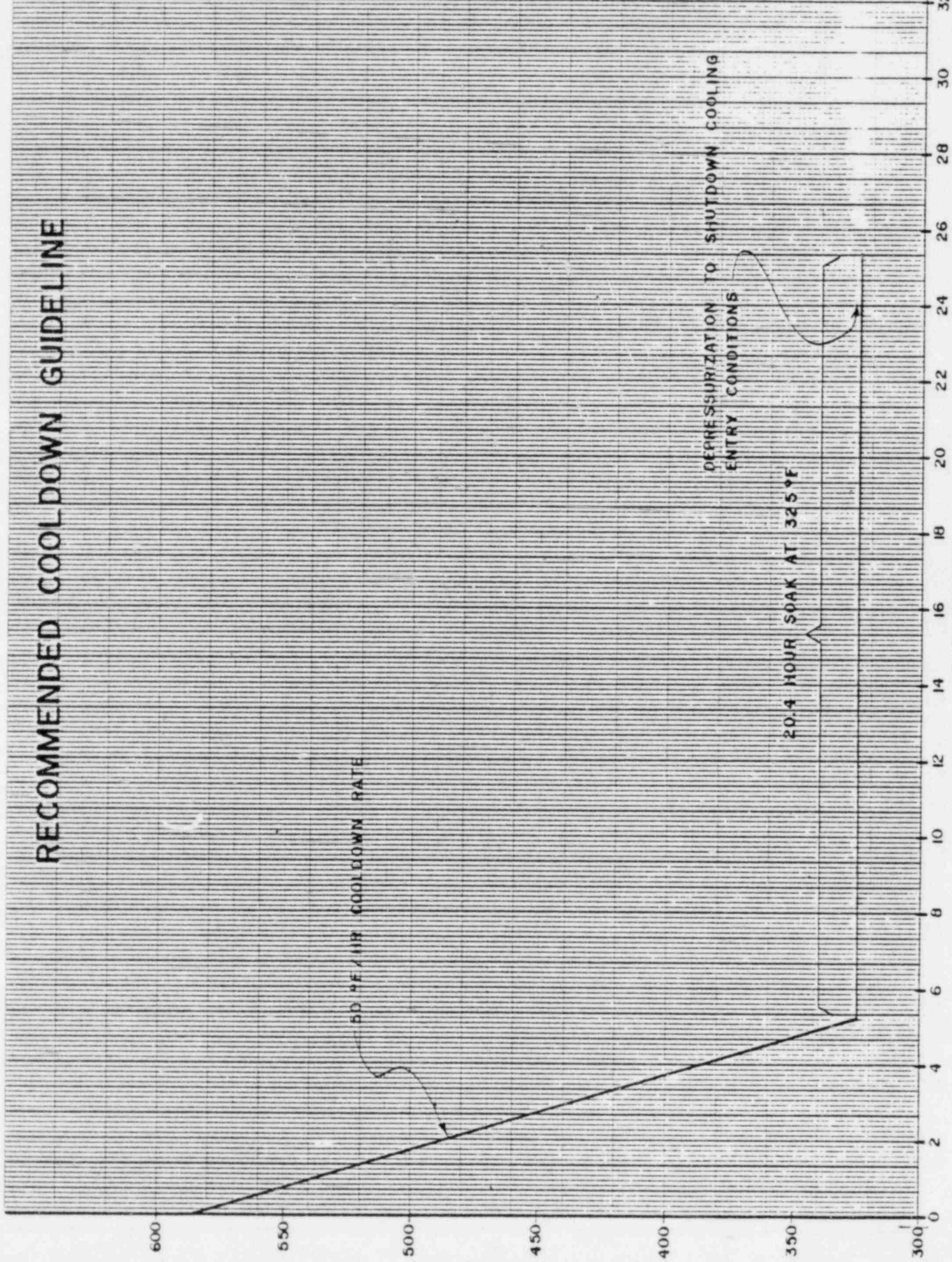
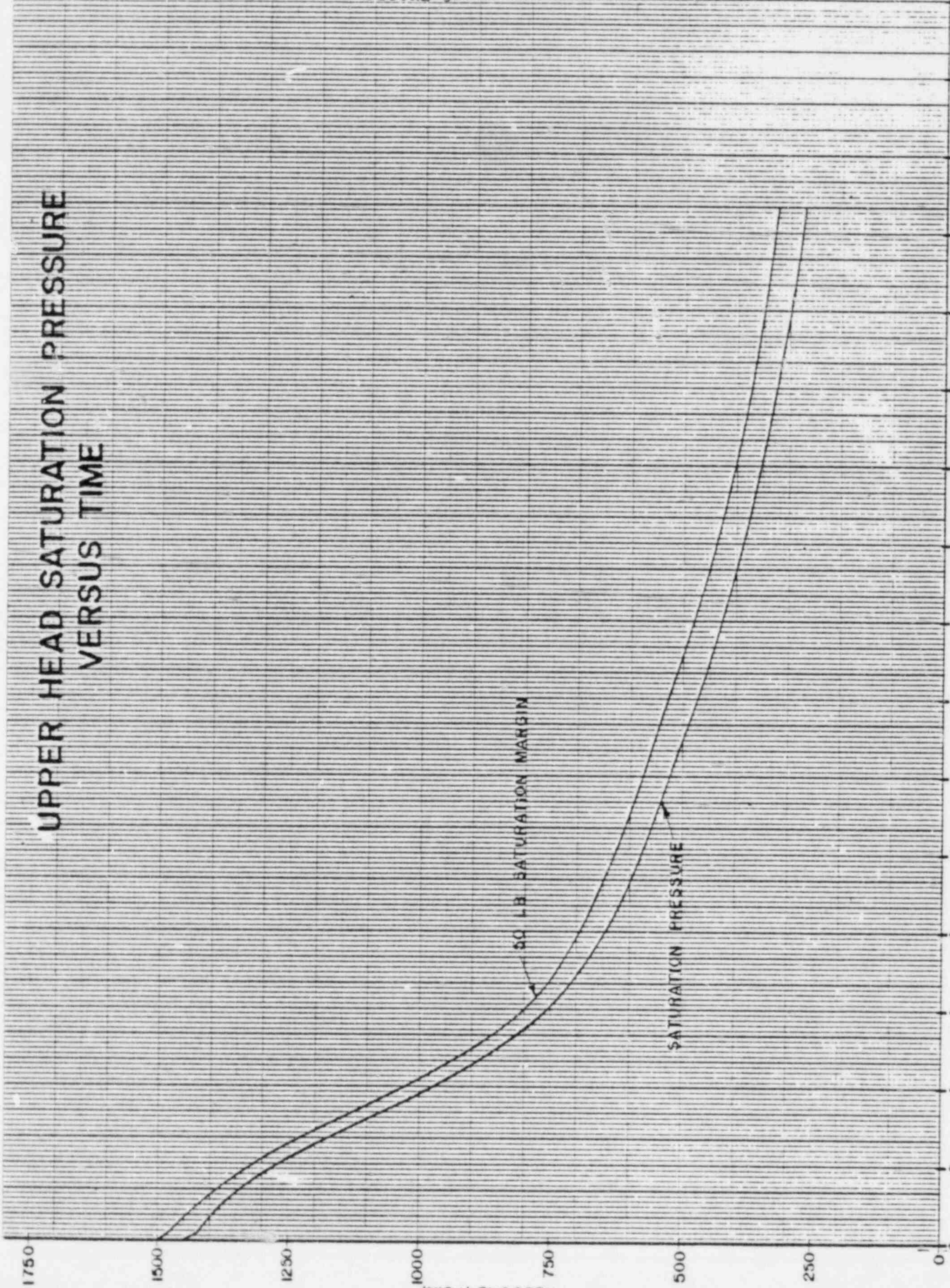


FIGURE 3


UPPER HEAD SATURATION PRESSURE
VERSUS TIME
50 LB SATURATION MARGIN
SATURATION PRESSURE
TIME (HOURS)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
PRESSURE (PSIA)
0
250
500
750
1000
1250
1500
1750

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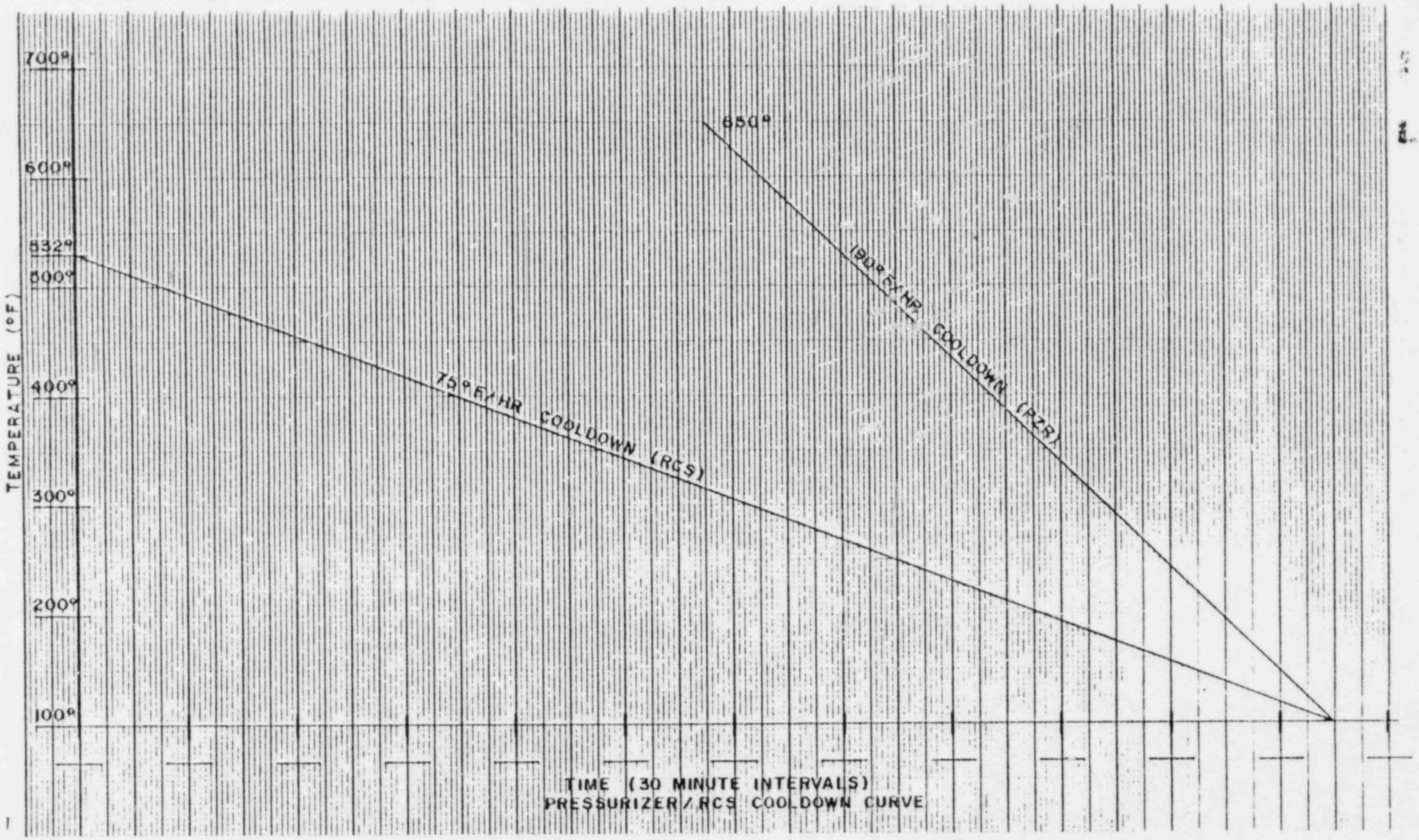
INSTRUCTIONS:

1. Plot Cooldown Rate Every 30 Minutes
2. Use as Many Sheets as Necessary
3. Upon Completion of Cooldown, Attach Sheets to Procedure

DATE: ______________________

OPERATOR: ______________________



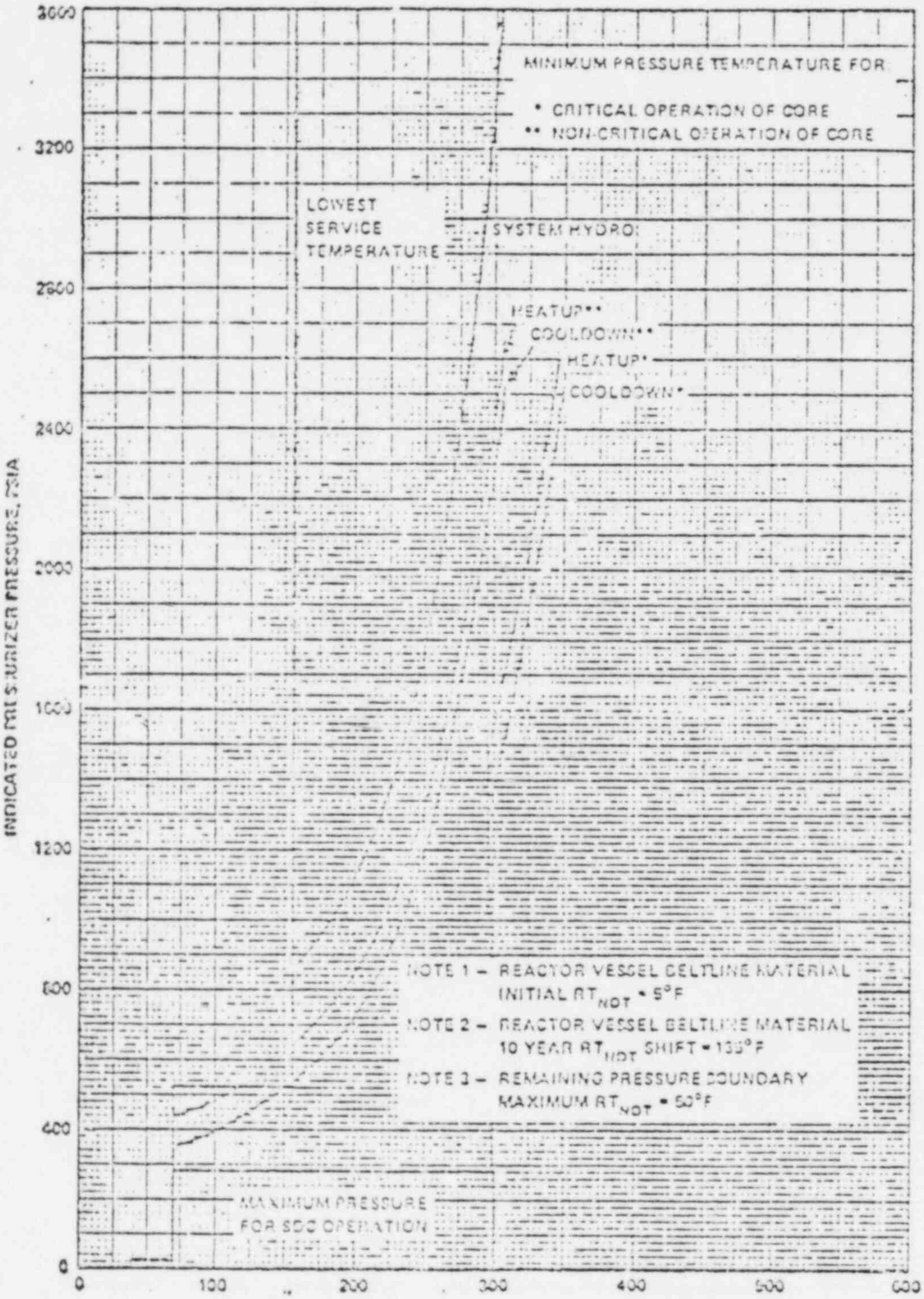


FIGURE 3.4-2b

ReactorCoolant System Pressure Temperature Limitations
for up to 10 Years of Full Power Operation

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FIGURE 5

DATE ____________________

TIME every 30 minutes	Column 1 Pressurizer Temp TI-1101	Column 2 Lowest Spray Line Temp TIA 1103/1104	Column 3 Pressurizer Press PIC 1103/1104	* Difference Column 1 minus Column 2

*Limited to $\leq 350^\circ$ and $\geq 50^\circ$

RCS TEMP AND PRESSURE SHALL BE WITHIN LIMITS OF FIGURE 3.4-2b FOR EACH 30 MINUTE PERIOD.

________________ Operator ________ Shift

________________ Operator ________ Shift

________________ Operator ________ Shift

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APPENDIX A

PRECAUTIONS

1. Natural circulation flow cannot be verified until the RCP's have stopped coasting down after being tripped.

2. Due to increased loop transit times, verification of plant responses to a plant change cannot be accomplished until approximately 10 to 15 minutes following the action.

3. After a cold shutdown boron concentration is attained in the RCS, makeup water added to the RCS during the cooldown should be at least the same boron concentration as in the RCS to prevent any dilution of RCS boron concentration.

4. Once pressurizer cooldown has begun, pressurizer level indication decalibration will occur (indication on the normal pressurizer level indication will begin to deviate from the true pressurizer level). The temperature compensation correction curve posted on the RTGB should be used to determine true pressurizer water level. Cold calibrated pressurizer level indication is also available for lower pressurizer temperatures.

5. Minimize the use of pressurizer auxiliary spray whenever the temperature differential between the spray water and the pressurizer is greater than 200°F. Any auxiliary spray cycle which results in a spray line temperature change of 650°F to 120°F in $<$ 1.5 seconds shall be recorded in accordance with AP 0010134.

6. If pressurizer spray is not available, boron concentration in the pressurizer may be lower than the RCS loop boron concentration. RCS boron concentration should be increased to avoid being diluted below minimum requirements by a possible pressurizer outsurge.

7. If either the HPSI or LPSI pumps are utilized to collapse any steam voids in the RCS by charging the system solid, the pump(s) should be stopped after solid conditions are indicated. This will minimize the potential for any inadvertant flowpath from the RCS back to the Refueling Water Tank.

8. It the RCS is solid, closely monitor any makeup or draining and any system heatup or cooldown to avoid any unfavorable rapid pressure excursions.

9. During all phases of the cooldown, monitor RCS temperature to avoid exceeding a cooldown rate $>$ 100°F/hr.

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APPENDIX A (cont)

10. If cooling down by natural circulation with an isolated steam generator, an inverted ΔT (i.e., $T_c > T_h$) may be observed in the idle loop. This is due to a small amount of reverse heat transfer in the isolated steam generator and will have no effect on natural circulation flow in the intact steam generator.

11. All available indications should be used to aid in diagnosing the event since it may cause irregularities in a particular instrument reading. Critical parameters must be verified when one or more confirmatory indications are available.

12. When establishing auxiliary feedwater flow to the Steam Generators, use Steam Generator levels as well as header flowrates to ensure each Steam Generator is receiving auxiliary feedwater.

13. Condensate inventory should be monitored periodically to ensure that an adequate supply is available. Makeup to the Condensate Storage Tank should be started as soon as practical. If CST level decreases to $<$116,000 gallons, the plant should be immediately cooled down utilizing the Fill and Drain Method (Appendix E).

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APPENDIX B

DISCUSSION

Reactor Coolant Pump forced circulation and heat transfer to the Steam Generators is the preferred mode of operation for decay heat removal whenever plant temperatures and pressures are above the Shutdown Cooling System entry conditions. The natural circulation capability at the St. Lucie Plant provides an emergency means for core cooling using the steam generators, if the RCPs are unavailable.

Natural circulation is governed by decay heat, component elevations, primary to secondary heat transfer, loop flow resistance, and voiding. Component elevations at St. Lucie Plant are such that satisfactory natural circulation decay heat removal is obtained by density differences between the bottom of the core and the top of the steam generator tube sheet. An additional contribution to natural circulation flowrate is the density difference obtained as the coolant passes through the Steam Generator U-tubes, but this is not required for satisfactory natural circulation. Natural circulation is assured even if the U-tubes are partially uncovered on the Steam Generator secondary side. Because of the temperature distribution in the Steam Generator U-tubes, there is no degradation in primary to secondary heat transfer as long as the secondary level covers at least 1/3 of the tube height. By ensuring that the loop ΔT is less than the full power ΔT, the power-to-flow ratio is assured to be less than 1.0 during natural circulation.

Satisfactory natural circulation heat removal can be obtained with either one or two Steam Generators. Unequal auxiliary feedwater to the Steam Generators will not lead to unsatisfactory natural circulation as long as all of the decay heat is being removed through the Steam Generators.

Assurance that the RCS is being maintained in a subcooled condition can be obtained as follows. With the Subcooling Margin Monitor (SMM) operating normally, the nomograph on RTGB 104 is used in conjunction with the SMM to eliminate dependence on a single instrument. With the SMM inoperable, reference to the nomograph utilizing control room indication such as hot leg temperature, pressurizer pressure, and incore thermocouples will determine the margin to saturation. Subcooling margin can also be determined by subtracting hot leg temperature from pressurizer temperature (TE-1101).

During normal plant operation under conditions of forced circulation flow, there is only a small flow of coolant in the reactor vessel head area. During periods of natural circulation, there is little, if any, effective flow. If the RCS is cooled down using natural circulation, it is possible to generate a steam void in the reactor vessel head when saturation conditions develop. These conditions can be produced by the temperature sustained by the retained metal heat and decreased RCS pressure during cooldown.

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APPENDIX B (cont)

Analyses have demonstrated that the upper reactor head region fluid can be cooled to Shutdown Cooling System (SDC) entry conditions without void formation using a hot leg temperature cooldown rate of 50°F/hr in approximately 14.2 hours. In order to provide additional conservatism, this procedure directs that a cooldown rate of about 50°F/hr to 325°F be utilized, followed by a soak of 325°F for 20.4 hours for a total cooldown time of approximately 25.7 hours from cooldown initiation. (See Figure 1). The condensate supply required for this cooldown is 270,500 gallons. Makeup water can be supplied from the Water Treatment Plant and the two 500,000 gallon City Water Storage Tanks, or Treated Water Storage Tank. Pumping capability from all sources can be supplied from the diesel generators.

An alternative to the above cooldown procedure is the fill and drain method (See Appendix E). This method may be employed should an exteremely low probability event occur which could cause a loss of condensate makeup capacity or require a rapid RCS de-pressurization rate. It provides for cooling of the upper reactor vessel head region by using auxiliary spray to the pressurizer to lower RCS pressure and create a void in the upper head. Voiding in the upper head flushes hot upper head fluid into the cooler RCS where it mixes with RCS water. The water flushed out of the upper head will cause a surge of water from the RCS into the pressurizer. The process is halted by stopping the spray. The insurge compresses the pressurizer steam space, raising the pressure, thus stopping the insurge and halting flashing in the upper head. Charging to the RCS will then force fluid into the upper head due to the elevation difference between the reactor vessel upper head and the pressurizer. Mixing of colder loop water with the hot upper head cools the upper head and causes an outsurge from the pressurizer. The process is continued until the upper head is solid. The cycle is then repeated until RCS temperature and pressure have been reduced to SDC entry conditions.

The above procedure has been analyzed and performed successfully twice at St. Lucie and is considered a safe, <u>alternative</u> method of natural circulation cooldown.

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APPENDIX C

PLACING WATER TREATMENT PLANT IN SERVICE

DURING LOSS OF OFF-SITE POWER

NOTE: Makeup to the Condensate Storage Tank (CST) should be initiated as soon as diesel generator loading allows.

1.	Strip the non-vital 4.16 KV busses.	1A2	1B2
	NOTE: All should have opened automatically.		
2.	Insert the Sync Plug and close the 4.16 KV non-vital breaker.	1A2-20109	1B2-20309
3.	Hold the control switch closed while closing 4.16 KV vital breaker.	1A3-20209	1B3-20411
4.	Strip the non-vital 480V Load Center.	1A1	1B1
5.	Close the 4.16 KV non-vital breaker.	1A1-20110	1B2-20310
6.	Close the non-vital Load Center breaker.	1A1-40103	1B1-40403
7.	Strip the 480 V MCC.	1A4	1B4
8.	Close the 480 V Load Center breaker.	1A1-40113	1B1-40413

9. Start only equipment required to transfer water to the CST.

   NOTE: If a shortage of water persists in the CST, it is permissible to overide, as necessary, any automatic trips (e.g., conductivity, silica, etc.).

10. Water may also be supplied to the CST from the Treated Water Storage Tank as follows:

a.	Complete steps 1 thru 6 above		
b.	Strip the 480V MCC	1A3	1B3
c.	Close the 480 V Load Center breaker.	1A1-40116	1B1-40412
d.	Align valves to pump from TWST to CST.		
e.	Close breakers and start treater water transfer pump(s) 1A and/or 1B	1A3-41016	1B3-41816

11. If the Water Treatment Plant cannot be placed in service, transfer water directly from the City Water Tanks to the CST using a fire pump and a temporary fire hose.

    NOTE: City Water Tanks should not be reduced below 300,000 gallons each, per Technical Specification 3.7.11.1.

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APPENDIX D

RCS COOLDOWN/DE-PRESSURIZATION CHECKOFF LIST

1. At RCS pressure of 1750 psig, isolate and bypass the following transmitters:

__________ 1.1 FT-2212 (Charging Header Flow Transmitter)

NOTE: Close the valve on the transmitter marked HIGH SIDE, open the valve marked BYPASS, and close the valve marked LOW SIDE.

__________ 1.2 PT-2212 (Charging Header Pressure Transmitter)

NOTE: Close its isolation valve.

_____ 2. At RCS pressure of 1700 psia, the SIAS Channel BLOCK PERMISSIVE annunciator will come on. Block Channels A and B of SIAS by turning the key-interlocked switches to the BLOCK position.

NOTE: If the channels have been blocked, the two annunciators SIAS ACTUATION CHANNEL A BLOCKED and SIAS ACTUATION CHANNEL B BLOCKED will come on.

3. At RCS pressure <1750 psia, align the NaOH System as follows:

3.1 Close and lock NaOH system injection header isolation valves:

________ V-07255

________ V-07257

________ V-07271

________ V-07272

3.2 De-energize the NaOH system admission valves after ensuring that they are closed:

________	SE-07-1A	RTGB 106	TBCCC	F31,32
________	SE-07-1B	RTGB 106	TBGG	F31,32
________	SE-07-2A	RTGB 106	TBCCC	F49,50
________	SE-07-2B	RTGB 106	TBGG	F49,50

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APPENDIX D (cont)

_____ 4. At Steam Generator pressure of 685 psig, the MSIS ACTUATION CHANNEL A BLOCK PERMISSIVE and MSIS ACTUATION CHANNEL B BLOCK PERMISSIVE annunciators will come on. Block the MSIS channels by turning the key-interlocked switches to the BLOCK position.

NOTE: If the channels have been blocked, the two annunciators MSIS ACTUATION CHANNEL A BLOCKED and MSIS ACTUATION CHANNEL B BLOCKED will come on.

_____ 5. Prior to reaching RCS pressure of 1100 psia, unisolate and place in operation the standby pressurizer level control and letdown pressure control valves.

6. When RCS temperature is <500°F and RCS pressure is <1500 psia, perform the following:

6.1 Close the Safety Injection Tank discharge valves by placing the switch in the BYPASS CLOSE position and racking out its respective breaker:

VALVE	BREAKER
________ V-3614	________ 41312
________ V-3624	________ 41222
________ V-3634	________ 42033
________ V-3644	________ 42113

6.2 Close the Containment Spray (CS) pump discharge valves:

________ V-07145

________ V-07130

6.3 Close and tag the manual valves in the CS header:

________ V-07161 (A Hdr)

________ V-07164 (B Hdr)

6.4 Close containment spray motor operated valves

________ MV-07-3A (A Hdr)

________ MV-07-3B (B Hdr)

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APPENDIX D (cont)

7. When RCS pressure reaches 415 psia or RCS cold leg temperature reaches 275°F, annunciator SELECT LOW RANGE OPERATION will come on.

_____ 7.1 Close MOV-1403 and MOV-1405 (PORV Isolation)

_____ 7.2 Select LOW RANGE on control switches for PORV-1402 and PORV-1404, and ensure that neither PORV opens.

_____ 7.3 Open MOV-1403 and MOV-1405 (PORV Isolation).

8. When RCS temperature reaches 325°F and RCS pressure reaches 260 psia, perform the following:

_____ 8.1 Remove the trip and close fuses on <u>two</u> HPSI pumps, and tag with caution tags.

NOTE: Ensure the remaining HPSI pump is operable.

_____ 8.2 Remove the trip and close fuses on the A and B CS Pumps, and tag with caution tags.

9. When RCS temperature reaches 200°F, perform the following:

_____ 9.1 Remove the trip and close fuses on the remaining HPSI pump and tag with caution tags.

_____ 9.2 Tag out one charging pump such that no more than two charging pumps are available for dilution below 200°F.

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APPENDIX E

RCS FILL AND DRAIN METHOD OF COOLING

REACTOR VESSEL HEAD REGION

NOTE: This method of RCS cooldown should only be employed in the event that rapid de-pressurization of the RCS is required, or Condensate Storage Tank level decreases below 116,000 gallons.

CAUTION: During this evolution, pressurizer level is not a valid indicator of RCS inventory during transient conditions. Care should be exercised to observe other parameters which would indicate any loss of RCS inventory.

1. Take manual control of the charging and letdown system.

2. Lower RCS pressure by using auxiliary sprays into the pressurizer.

3. As voiding occurs in the upper reactor vessel head, a surge of water from the RCS will cause pressurizer level to increase rapidly. Terminate auxiliary spray prior to pressurizer level increasing to 70% indicated level.

4. Cool the upper reactor vessel head region by charging with a charging pump to the RCS loop(s). Continue charging until either of the following conditions occur:

   4.1 Pressurizer level decreases to 30% indicated level

   or

   4.2 The upper reactor head is charged solid.

   NOTE: A solid upper head condition will be evident by an increasing pressurizer level as charging to the loops is continued.

5. Repeat steps 1 thru 4 above until SDC entry conditions are established.

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APPENDIX F

AUGMENTED COOLDOWN WITH THE STEAM DUMP

BYPASS SYSTEM (SBCS)

If the desired RCS cooldown rate cannot be attained, the SBCS can be used either by itself or in conjunction with the atmospheric dump valves. Since condenser vacuum will not be available, the following actions should be taken to place the SBCS in service:

1. Call available maintenance personnel on site to remove the target flange on a SBVS valve (preferably V-8803).

   NOTE: If no maintenance personnel are on site, call the Duty Call Supervisor.

2. Isolate all other SBCS valves from the condenser (except the selected valve).

3. Jumper V-8803 by placing a jumper on termination box EM 104, leads 10 to 11 (located behind and in the lower portion of RRS #2 cabinet in RTGB-104).

4. Reset the condenser vacuum interlock by depressing the reset button (on the outside of the RRS #2 cabinet) and observe that the condenser vacuum interlock yellow light goes out.

   NOTE: This will bypass the vacuum permissive and allow operation of V-8803 to atmosphere after removal of the target flange.

5. Place all SBCS controllers in MANUAL.

6. When the target flange for V-8803 has been removed and the vacuum interlock jumpered, manually adjust the controller for V-8803 to control RCS cooldown rate.

   CAUTION: Do not exceed a cooldown rate $\geq$ 75°F/hr.

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APPENDIX G

INITIATION OF SHUTDOWN COOLING

_____ 1. Open V-3657 (SDC discharge to LPSI header).

_____ 2. Open MV-3452 and MV-3453 (LPSI pump supply to SDC HX).

_____ 3. Check to be open FCV-3306 (SDC HX bypass).

_____ 4. Close MV-03-2 (FCV-3306 bypass).

_____ 5. Open MV-03-1A and MV-03-1B (SDC recirc warmup).

_____ 6. Open MV-3456 and MV-3457 (SDC HX isolation).

_____ 7. Check to be open V-3204 and V-3205 (LPSI mini-flow).

_____ 8. Check to be open V-3659 and V-3660 (Mini-flow header stop).

_____ 9. Start 1A and 1B LPSI pumps.

_____ 10. Check to be closed V-3661 (Check valve leakage drain).

_____ 11. Open HCV-3615, HCV-3625, HCV-3635, and HCV-3645 (LPSI isolation).

_____ 12. Open HCV-3618, HCV-3628, HCV-3638, and HCV-3648 (Check valve leakage control).

_____ 13. Open V-3459, V-3463, and V-07009 (RWT recirc stop).

_____ 14. Check the boron concentration in the system after circulating for ten minutes. Continue circulation until the boron concentration is $\geq$ to the concentration in the RCS.

_____ 15. Close HCV-3618, HCV-3628, HCV-3638, and HCV-3648 (Check valve leakage control).

_____ 16. Close V-3459, V-3463, and V-07009 (RWT recirc stop).

_____ 17. Close HCV-3615, HCV-3625, HCV-3635, and HCV-3645 (LPSI isolation).

_____ 18. Close V-3657 (SDC HX discharge to LPSI header).

_____ 19. Continue to run the LPSI pumps to heatup the SDC system as much as practical.

CAUTION: ENSURE LPSI PUMP MINIMUM FLOW IS MAINTAINED IN THE SDC SYSTEM WHEN ONE OR BOTH MINIFLOW VALVES ARE CLOSED.

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APPENDIX G (cont)

_____ 20. Verify flow on FI-3306 and close V-3205 (manual LPSI pump recirc).

_____ 21. Close V-3204 (manual LPSI pump recirc).

_____ 22. Stop the A and B LPSI Pumps.

_____ 23. Close MV-3444 and MV-3432 (LPSI pump suction from RWT).

_____ 24. Close MV-03-1A and MV-03-1B (SDC recirc warmup).

_____ 25. Check RCS pressure < 265 psia, then open V-3651, V-3652, V-3480 and V-3481 (SDC return valves).

_____ 26. Open HCV-14-3A and HCV-14-3B (CCW to SDC HX).

_____ 27. Start A or B LPSI pump.

_____ 28. Slowly inch open either HCV-3625 or HCV-3635 in approximately 5% increments to bring the SDC system up to temperature.

_____ 29. Adjust FIC-3306 to maximum flow in AUTO mode.

_____ 30. When temperature has stabilized, slowly open V-3615, V-3625, V-3635, and V-3645 (LPSI discharge valves) and adjust FIC-3306 to control flow at 3000 gpm in AUTO.

_____ 31. Adjust HCV-3657 (SDC return) to maintain the desired cooldown rate.

NOTE: When the cooldown is completed, all of the flow should be going through HCV-3657, and FCV-3306 should be closed.