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2104-1.3
Revision 11
06/23/78

THREE MILE ISLAND NUCLEAR STATION
UNIT #2 OPERATING PROCEDURE 2104-1.3
DECAY HEAT REMOVAL SYSTEM

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25.0	11/07/77	3						

Unit 1 Staff Recommends Approval

Approval _____ Date _____
Cognizant Dept. Head

Unit 2 Staff Recommends Approval

Approval _____ Date _____
Cognizant Dept. Head

Unit 1 PORC Recommends Approval

_____ Date _____
Chairman of PORC

Unit 2 PORC Recommends Approval

_____ Date 6/22/78
Chairman of PORC

Unit 1 Superintendent Approval

_____ Date _____

Unit 2 Superintendent Approval

_____ Date 6/22/78

Manager Generation Quality Assurance Approval _____ Date _____

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TMI 55 A Rev 8/77

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2104-1.3

DECAY HEAT REMOVAL SYSTEM

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DECAY HEAT REMOVAL SYSTEM

1.0 REFERENCES

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1.1.1 Burns & Roe Flow Diagrams.

1. Reactor Coolant Make-Up Purification (2024).
2. Spent Fuel Cooling and Decay Heat Removal (2026).
3. Nuclear Sampling (2031).
4. Reactor Building Emergency Cooling and Fuel Handling (2041).
5. Decay Heat Closed Cooling Water System (2043).

1.2 Procedures Applicable for Operation.

1. 2103-1.4 RC Pump Operation.
2. 2102-3.1 Unit Shutdown.
3. 2102-3.2 Unit Cooldown.
4. 2104-1.2 Make-Up and Purification.
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1.3 System Descriptions

1. Decay Heat Removal System (Index No. 20)
2. Decay Heat Closed Cooling Water System (Index No. 29)
3. Spent Fuel Pool Cooling System (Index No. 21)

1.4 Figures

1. Maximum-minimum RC pressure during simultaneous operation of RC pumps and Decay Heat System, Figure 1.
2. Maximum-minimum RC pressure during operation of DH System with no RC pumps operating, Figure 2.

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3. Reactor coolant water level required to avoid vortex formation and provide the NPSH required for DH pumps, Figure 3.

2.0 LIMITS AND PRECAUTIONS

2.1 Equipment

1. Do not exceed a maximum DH Pump bearing temperature of 180°F. (Computer points 336, 338 for DH-P-1A and 337, 339 for DH-P-1B).
2. Minimum allowable continuous DH pump flow is 30 GPM.
3. Do not exceed a motor winding temperature of 130°F. (Computer points 340, 342 for DH-P-1A and 341, 343 for DH-P-1B.
4. Do not exceed a motor stator temperature of 139°C, (computer points 1666 for DH-P-1A and 1667 for DH-P-1B).
5. Do not exceed 2 successive D.H. pump motor starts. A subsequent restart is allowed after the motor stator temperature drops below 8°C of the normal operating temperature.
6. Ensure that the maximum allowable ΔT of 200°F between D.H. cooler tube and shell is not exceeded. (Loop "A" - DH-6-TI1, DC-TI-957, Loop "B" - DH-6-T2, DC-TI-958, located on Panel #8).
7. Ensure that the maximum allowable flow per D.H. cooler of 3750 GPM is not exceeded, (DHI-FI1,2, located on Panel #8).
8. Before initiating cooling water flow on either side of D.H. coolers ensure that the coolers and all connecting piping is filled and vented.
9. When changing flow on either side of the D.H. coolers ensure that the maximum allowable cooler flow (3750 GPM) is not exceeded.

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10. Ensure that the flush water supply to the decay heat pump mechanical seal does not exceed 500 PSIG as read on PI 464 & 466 located on Panel #8, (Computer points 115 & 116).

11. Ensure that the return pressure from the mechanical seal cyclone separator does not exceed 300 PSIG. Since the seal water is returned to the Decay Heat Removal Pump Suction this pressure limit can be read from Decay Heat Removal Pump Suction Pressure, [illegible] (Panel).

12. When purifying the RCS using the D.H. system, limit the D.H. cooler outlet temperature to ≤ 110°F as indicated on TI R-111 and 2 on coolant system monitoring Panel #8. This will insure that the temperature limit of the spent fuel demineralizers is not exceeded.

13. When the Reactor Coolant System has been shutdown and depressurized isolate the Borated Water Storage Tank from the Decay Heat System by checking closed DH-V8A and 8B. Also isolate the sodium hydroxide storage tank from the Decay Heat Removal System by checking closed DH-V8A and 8B.

2.2 Administrative

1. Do not operate DH pumps in the recirculation mode for more than 10 minutes without cooling water cut in to coolers.

2. Should pump cavitation occur or if a high flow alarm annuciates (3750 GPM) throttle decay heat cooler discharge valves DHV-128 A/B.

3. The D.H. System shall be isolated from the RC system when RC pressure and temperature is greater than that shown on Figures 1 and 2.

4. Ensure that RCS pressure is maintained above that shown on Figure 2 to prevent the formation of a steam bubble at the highest point of the 36" reactor coolant piping.

5. When operating the decay heat system simultaneously with the RC pumps ensure that the maximum RC pressure for various RC pump combinations is not exceeded. Refer to Figure 1.

6. When operating the decay heat removal system with no RC pumps running ensure that the [illegible] RC pressure is [illegible] as defined on Figure 2 [illegible].

7. When cooling down with the Decay Heat system ensure that a maximum cooldown rate of 100°F in any one hour, 75°F step change, or 50°F in any 1/2 hour period, is not exceeded.

8. Verify that MU-V16A, B, C, D are closed and their respective breakers open prior to placing the Decay Heat System in operation to prevent overpressurization of the Decay Heat System in the event of an inadvertent actuation of E.S.

9. Verify that CF-V1A, B are closed and their respective breakers are open prior to placing the Decay Heat System in operation to prevent overpressurization of the Decay Heat System.

10. Following system Cooldown, the R.C. System will be sampled at the Decay Heat Cooler Discharge to assure water quality, as specified in the Tech. Specs.

11. Insure the sodium hydroxide tank temperature is maintained between 50°F and 120°F as read from panel 8 DH-8-TI.

12. CAUTION: Do not open DH-V6A/B simultaneously with DH-V5A/B or the BWST will drain into the RB sump.

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13. When draining the RCS for RCS component repair, insure DHR flow is throttled (using DHV-128A and/or B) as Per Figure

4 to prevent vortex formation and possible loss of suction to the DHR pumps

NOTE: This is to prevent the accidental flooding of the R.C. System during component maintenance when R.C. System level is reduced.

14. When the DHR System is in operation, without any RCP's operating, indicated DH return temperature (DH2-TI-102 on Panel #8) shall be used as the RCS temperature on Figure 2.

15. DH-V16A and B must be left in operation in the ES mode to insure the valve stroke time does not exceed the required response time.

16. Maintenance shall be allowed during power operations on any components in the decay heat system which will not remove more than one decay heat train from service. Components shall not be removed from service such that the affected system train is inoperable for more than 72 consecutive hours. If the system is not restored within 72 hours the reactor shall be placed in a hot shutdown condition within 12 hours.

17. While operating in the E.S. mode ensure that when the BWST low-low level alarm annunciates, (approx. 7 ft. from bottom of tank), the decay heat pump suction automatically shifts from the BWST to the RB sump by the opening of DH-V6A/B. When DH-V6A/B are full open, CLOSE DH-V5A/B. Failure to transfer suction will result in loss of ECC injection.

3.0 PREREQUISITES (Indicate satisfactory completion by Initialing each step)

3.1___ The Reactor Coolant System is cooled down to approximately 250°F and depressurized to <320 PSIG.

3.2___ The decay heat closed cooling water system is operating per operating procedure 2104-3.3 (DC-V8A/B, Inlet valves to the decay heat removal coolers are open and DC-V73A(B) is throttled to maintain minimum flow through the DC System).

CAUTION: Insure Leakage Closed Cooling Pump is operating in the Decay Heat Closed Loop not being put in service. This will prevent deadheating DC P-2A(B) and greatly overheating the RCDT.

3.3 Power is available at the switch gear listed below:

___ 1. 4160V - Engineered safety features Bus 2-1E.

(1) Unit 1E9 - Decay Heat Removal Pump (DH-P1A).

___ 2. 4160V - Engineered safety features bus 2-2E

(1) Unit 2E11 - Decay Heat Removal Pump (DH-P1B)

3.4 Power is available at the motor control centers listed below and associated breakers are closed.

1. 480V - Eng. safety system valves MCC 2-11EA.

E.S. Valves Motor Control Center

___ (1) Unit 8CF - DH-V4A - Decay Heat Discharge Isolation at Containment Vessel.

___ (2) Unit 3DR - DH-V5A - Decay Heat Suction from BWST.

___ (3) Unit 1AF - DH-V6A - R.B. Sump Recirculation Suction.

___ (4) Unit 1CF - DH-V7A - D.H. Heat Exchanger Discharge to MU pumps.

___ (5) Unit 4A - DH-C-2 - Sodium Hydroxide Storage Tank Heater

___ (6) Unit 2DR - DH-V8A - Sodium Hydroxide Tank Discharge Values.

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___ (7) Unit 6DR - DH-V3 - Primary Loop to Decay Heat Pumps.

___ (8) Unit 13DR - DH-V100A - Decay Heat Pump suction cross connect.

___ (9) Unit 10BR - DH-V102A - Decay Heat Removal Pump DH-P-1A suction.

___ (10) Unit 14BR - DH-V128A - Decay Heat Removal Cooler DH-C-1A Discharge.

2. 480V - Eng. Safety System valves MCC2-21EA

___ (1) Unit 8CF - DH-V4B - Decay Heat Discharge Isolation at Containment Vessel.

___ (2) Unit 3BR - DH-V3B - Decay Heat Suction from BWST.

___ (3) Unit AAF - DH-V6B - R.B. Sump Recirculation Suction.

___ (4) Unit 7BR - DH-V7B - D.H. Heat Exchanger Discharge to MU Pumps

___ (5) Unit 13DR - BWST Heaters DH-C-1 4BR DH-V8B.

___ (6) Unit 4BR- DH-V8B - Sodium Hydroxide Tank Isolation Valve.

___ (7) Unit 7CF - DH-V2 - Primary Loop to Decay Heat Pumps.

___ (8) Unit 10AF - DH-V100B - Decay Heat Pump suction cross connect.

___ (9) Unit 11BR - DH-V102B - Decay Heat Pump DH-P-1B suction.

___ (10) Unit 15BR - DH-V128B - Decay Heat Removal Cooler DH-C-1B Discharge.

3. 480V 2-32B - Valve Motor Control Center.

___ (1) Unit 2AF - DH-V157 - BWST to SF Cooling System.

___ (2) Unit 2CF - DH-V193A - Decay Heat Cooler Discharge Cross-Connect.

4. 480V 2-42B - Valve Motor Control Center

___ (1) Unit 2DR - DH-V193B - Decay Heat Cooler Discharge Cross-connect.

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5. 480V MCC 2-11EB

___ (1) Unit 1BF - DH-V171, Primary Loop to DH Pumps.

___ (2) Unit 2BF - DH-V1, Primary Loop to DH Pumps.

3.5___ Perform valve line-up per Decay Heat System valve line-up Check Sheet Appendix A. Upon satisfactory completion sign valve line-up Signature Sheet Appendix B.

3.6___ Decay Heat Pump control switches are in PULL-TO-LOCK.

3.7___ DH-V1/DH-V171 Selector Switch at MCC 2-11EB Unit 2BF is in the DH-V1 position.

3.8___ 120 VAC Cable Room Cabinet No. 163, C.B. Panel No. 3 is energized and the following breaker is closed:

3.8.1 Ckt #6 - DH-V1/171 RCS Pressure interlock.

___3.9 Insure the Decay Heat Removal System is filled and vented.

4.0 START-UP PROCEDURE (Indicate satisfactory completion by initaling each step).

4.1 When the RCS temperature and pressure is in the range allowable for simultaneous operation of both the RC pumps and the decay heat removal system as per Figure 1, start the DHR system as follows:

4.1.1 To prevent overpressurization of the DHRS on an inadvertent initiation of E.S., de-energize MUV-16A, B, C & D (high Press. Injection Valves) open the following breakers:

1. On Eng. safety system valves MCC 2-11EA

___ (1) Unit 8DR - MU-V16A

___ (2) Unit 9DR - MU-V16B

2. On Eng. safety system valves MCC 2-21EA

___ (1) Unit 9DR - MU-V16C

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(2) Unit 1ODR - MU-V16D

CAUTION: Insure recirculation path for the Makeup pumps is lined up in accordance with "Makeup & Purification" Procedure 2104-1.2.

4.1.2____ Read and record RCS wide range Tc as indicated on RC5A-TI-1 _____°F and RC5B-TI _____°F on control panel #4.

4.1.3____ Open DH-V4A (DH-P1A Disch. Isol. Valve to Reactor Vessel) and DH-V4B (DH-P1B Disch. Isol. Valve to Reactor Vessel) from panel #4.

4.1.4____ Open DH-V2&V3 Decay Heat Suction Isol. Valves from Auxiliary Systems control Panel #3.

4.1.5____ Open DH-V1 (Decay Heat Suction Isolation Valve) from Auxiliary systems control Panel #3.

NOTE: If DH-V1 does not open, place the MCC 2-11EB, DH-V1/171 Selector Switch in the DH-V171 position and open DH-V171.

4.1.6____ Close DH-V102A&B (DH-A&B split suction from sodium hydro. tk/BWST) from Panel #8.

4.1.7____ Open DH-V100 A&B (RCS to DH split suction valves).

4.1.8____ Throttle DC-V73A(B) to minimum flow allowable.

CAUTION: Do not exceed a 100°F temperature change in any one hour period.

4.1.9____ From Panel #3 start DH-P1A(B) at Panel #8. Check flow on "A"(B) DH Flow Indicator DH-1-F11(12) and throttle to 800

GPM flow with D.H. Cooler "A"(B) outlet throttle valve DH-V128A(B).

4.1.10____ Read and record the DH return temp. to the reactor vessel as indicated by DH2-TI-1 _____ and DH2-TI-2 _____ on Panel #8. Compare these temperatures to those recorded in Step 4.1.2.

CAUTION: Do not exceed a cooldown rate of 100°F in any one hour, 75°F step change, or 50°F in any 1/2 hour period.

NOTE: After the Decay Heat Removal System temperature as indicated by DH2-TI-1 and 2 on Panel #8 is equal to Reactor Coolant System temperature as indicated by RC5A and B-TI-1 on Panel #4, with Decay Heat Removal System in operation and Reactor Coolant pumps operating, transfer removal of decay heat from the once through steam generator to the Decay Heat Removal System, as indicated in Step 4.1.11.

4.1.11____ Adjust Decay Heat Closed Cooling Water flow thru the DHR cooler by throttling open DC-V73(B) B from Panel #8 (DH coolers A(B) outlet valves). At the same time, from Panel #5, using the ICS hand/auto station for turbine bypass valves (MSV-25A/B & 26 A/B), slowly close the turbine bypass valves (MSV-25A/B & 26A/B) to maintain the RCS temperature at the desired level. Continue this operation until all bypass valves are closed, as indicated on Panel #5, and decay heat is being removed by the Decay Heat Removal System.

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4.1.12____ With both the Decay Heat System and RC pumps running establish cooldown flow to pressurizer spray line as follows:

___ 1. Open decay heat loop A/B to pressurizer spray line manual isolation valves DH-V186 A/B.

___ 2. Open decay heat to pressurizer spray line common manual isolation valve DH-V187.

NOTE: The decay heat system is now lined up to provide cooldown flow to the pressurizer via RC-V149 per procedure 2103-1.3 "Pressurizer operations".

CAUTIONS: DH-V187 is a manual containment isolation valve. If a Reactor Building Isolation and cooling signal is received while this valve is OPEN: CLOSE DH-V187

4.1.13____ When satisfactory reactor coolant pressure control can be maintained by using RC-V149 only, and as directed by the unit cooldown procedure 2102-3.2. Secure the operating RC pumps in accordance with RCP procedure 2103-1.4.

4.1.14____ Continue with cooldown, in accordance with procedure 2102-3.2 "Unit Cooldown", to the desired RCS temperature as read on DH-6-TI/T2 by throttling DHCCw cooler discharge valve DC-V73A(B) and/or DH flow control valve DH-V128A(B).

CAUTION: Do not exceed a maximum cooldown rate of 100°F in any one hour period, 75°F step change, or 50°F in any 1/2 hour period.

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4.1.15 ____ When the desired RCS temperature is reached and prior to RCS reduction to reactor building pressure, isolate the BWST and sodium hydroxide tank from the D.H. system to prevent inadvertant flooding of the RCS by the following procedure.

____ 1. Verify that the requirements for Technical Specification 3.1.2.8 for modes 5 & 6 are met.

The RBAT or BAMT should be used to satisfy T.S. 3.1.2.8 as long as a makeup pump is operational. If using the RBAT the applicable valve lineup is Attachment 2B of 2301-M2. The applicable valve lineup for the BAMT is Attachment 2A of 2301-M2.

If RCS pressure is $\leq$ 150 psig the BWST may be used to satisfy T.S. 3.1.2.8 and valve lineup Attachment 3 of 2301-M2 must be completed.

At $\leq$ 60 psig RCS pressure, the BWST may remain the T.S. source, or the BAMT or RBAT may be used and either Attachment 4A or 4B of 2301-M2 is the applicable valve lineup.

NOTE: The makeup pumps must not be operational when Attachment 4A or 4B is used.

____ 2. At the 480V Eng. Safety Features Bus 2-11EA, open the following breakers:

a. Unit 2DR - DH-V8A (Sod. Hydroxide Tk. Isolation Valve)

b. Unit 3DR - DH-V5A (DH Suction from BWST Isol. Valve)

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3. At the 480V Eng. Safety Features Bus 2-21EA, open the following breakers:

   a. Unit 4BR - DH-V8B (Sod. Hydroxide Tk. isolation valve)

   b. Unit 3BR - DH-V5B (DH Suction from BWST Isol. Valve).

4.2 DH System Normal Operation for DHR.

4.2.1 The DHR system will be regulated to maintain the desired RCS temperature (as indicated by DH-TI-1(2) on panel #8) for refueling and/or RCS component repair by throttling DC-V73A and/or B or DH-V128A and/or B.

4.2.2 RCS clean-up via the decay heat system can be accomplished in accordance with the spent fuel cooling system procedure 2104-1.5. Draining and RCS pressure reduction to reactor Bldg. pressure for head removal and/or RCS component repair will be performed in accordance with operating procedure 2103-1.5 Draining and blanketing N_2 the RCS.

4.3 SHUTDOWN PROCEDURE

The shutdown of the decay heat removal system will be accomplished in conjunction with "unit heat-up" procedure 2102-1.1.

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4.3.1 At the 480V 211EA E.S. valve motor control center CLOSE the following breakers:

___ 1. Unit 2DR DHV-8A, (Sod. Hydroxide Tk. Isolation Valve).

___ 2. Unit 3DR DHV-5A D.H. (suction from BWST Isolation Valve).

4.3.2 At the 480V 2-21EA E.S. valve motor control center close the following breakers.

___ 1. Unit 4BR-DHV-8B, (Sod. Hydroxide Tk. Isolation Valve).

___ 2. Unit 3BR DHV-5B (D.H. Suction from BWST Isolation Valve).

4.3.3____ In conjunction with Unit Heat-Up procedure using DCV-73A/B adjust RCS temperature as indicated by DH2-TI-1 & 2 on Panel #8 within the limits of Figure 1 for simultaneous operation of RC pumps and decay heat removal system.

CAUTION: Prior to starting RC pumps, insure all prerequisite steps per 2102-1.1 Unit Heat-Up are completed. Ensure the RCS pressure and temperature limits required for RC pump operation Figure 1 are met prior to starting an RCP.

4.3.4____ START two R.C. pumps in accordance with RCP operation procedure 2103-1.3.

After the 2nd RC pump is started and in conjunction with the unit heat-up procedure 2102-2.1 the decay heat system will be secured as follows:

CAUTION: Pressurizer spray flow should be in manual control thru the normal spray flow path in accordance with procedure 2103-1.3 "Pressurizer Operations". Ensure a heat-up rate of $\leq 100^{o}F$ in any one hour period is being maintained by operation of the turbine bypass valves prior to securing the decay heat system.

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4.3.5____ From Panel #3 STOP decay heat pump DH-P-1A(B).

4.3.6____ From Panel #4 CLOSE DHV-4A.

(Decay Heat Loop "A" & "B" Discharge to RCS.)

4.3.7____ From Panel #3 CLOSE DHV-1,2,3 Decay Heat Suction from RCS.

4.3.8____ From Panel #8 CLOSE DH-V100 A&B.

(Decay Heat Suction split isolation).

4.3.9____ CLOSE and LOCK DHV-187 (local) D.H. to Pzr. spray line.

4.3.10____ CLOSE DHV-186 A&B D.H. Loop A&B to pzr. spray line.

4.3.11 With DHR System isolated from the RCS, energize MUV-16A, B, C & D (High Press. Injection Isolation Valves) CLOSE the following breakers:

___ 1. On Eng. Safety Features Valves MCC 2-11EA.

(1) Unit 8DR - MUV-16A (Check green closed indication on Panel #3).

___ (2) Unit 9DR - MUV-16B (Check green closed indication on Panel #3.

___ 2. On Eng. Safety Features Valves MCC 2-21EA

(1) Units 9DR, MUV-16C. (Check green closed indication on Panel #3.

___ (2) Unit 10DR - MUV-16D Check Grn. closed indication on Panel #3.

NOTE: When the decay heat system is shutdown the DHCCW pumps DC-P-1A and 1B may be secured in accordance with DHCCW system procedure 2104-3.3.

4.4 Special or Infrequent Operations.

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NOTE: With the decay heat system in a shutdown mode and unit heat-up in progress per 2102-1.1 Unit Heat-Up 2102-1.1, perform line-up of the decay heat system for E.S. operation as follows:

4.4.1 Placing the D&R System in SFAS standby.

4.4.1.1____ Verify that the decay heat closed cooling water system is lined up for E.S. operation in accordance with procedure 2104-3.3.

4.4.1.2____ Verify that the nuclear service river water system is lined up for E.S. operation in accordance with procedure 2104.3.1.

4.4.1.3_____ Verify that power is available to the following decay heat system E.S. valves and the valves are lined up as follows:

INITIALS	POSITION		
___	CLOSED	(1)	DH-V4A - Panel #4 Decay Heat Loop "A" discharge to RCS.
___	CLOSED	(2)	DH-V4B - Panel #4 Decay Heat Loop "B" Discharge to RCS.
___	CLOSED	(3)	DH-V5A - Panel #8 BWST Discharge to D.H. Loop "A".
___	CLOSED	(4)	DH-V5B - Panel #8 BWST Discharge to D.H. Loop "B".
___	CLOSED	(5)	DH-V8A - Panel #8 Sodium Hydroxide Tk. Discharge to D.H. Loop "A".
___	CLOSED	(6)	DH-V8B - Panel #8 Sodium Hydroxide Tk. Discharge to D.H. Loop "B".
___	OPEN	(7)	DH-V102A - Panel #8 D.H. Loop "A" combined RB Sump/BWST Suction. At MCC 2-11EA Lock open the breakers for DH-V102A, Unit 10BR.
___	OPEN	(8)	DH-V102B - Panel #8 D.H. Loop "B" combined RB Sump/BWST Suction. At MCC 2-21EA Lock open the breakers for DH-V102B, Unit 10BR.

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___ CLOSED (9) DH-V100A Panel #8 D.H. Loop "A" Suction from RCS.

___ CLOSED (10) DH-V100B Panel #8 DH Loop "B" suction from RCS.

4.4.1.4 Verify that power is available to the decay heat pumps DH-P-1A and DH-P-1B.

___ (1) 4160 2-1E-Engineered safeguards switchgear unit 1CR breaker racked in and green control power light lit, (D.H. PP DH-D-1A).

___ (2) 4160 2-2E-Engineered safeguard switchgear unit 1CF breaker racked in and green control power light lit, (D.H. PP. DH-P-1B).

4.4.1.5 Verify that power is available to the following decay heat system non ES valves and the valves are lined-up as follows:

INITIALS	POSITION		
___	CLOSED	(1)	DHV-1 Panel #3 decay heat suction from RCS.
___	CLOSED	(2)	DHV-171 Panel #3 DHV-1 bypass.
___	CLOSED	(3)	DHV-2 Panel #3 decay heat suction from RCS.
___	CLOSED	(4)	DHV-3 Panel #3 decay heat suction from RCS.
___	CLOSED	(5)	DHV-6A Panel #15 decay heat loop "A" suction from RB sump.
___	CLOSED	(6)	DHV-6B Panel #15 decay heat loop "B" suction from RB sump.
___	CLOSED	(7)	DHV-7A Panel #8 decay heat loop "A" discharge to MU system.
___	CLOSED	(8)	DHV-7B Panel #8 decay heat loop "B" discharge to MU system.
___	THROTTLED OPEN	(9)	DHV-128A Panel #8 decay heat cooler DH-C-1A discharge.

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___ THROTTLED OPEN (10) DHV-128B Panel #8 decay heat cooler DH-C-1B discharge.

___ CLOSED (11) DHV-106A Panel #8 decay heat loop "A" to SFP cooling system.

___ CLOSED (12) DHV-106B Panel #8 decay heat loop "B" to SFP cooling system.

___ CLOSED (13) DHV-157 Panel #8 BWST to SFP cooling/BWST recirc. pump.

___ CLOSED (14) DHV-193A (Local) decay heat Loop "A" cross connect.

___ CLOSED (15) DHV-193B (local) decay heat Loop "B" cross connect.

___ CLOSED (16) DHV-112A Panel #8 decay heat Loop "A" sample.

___ CLOSED (17) DHV-112B Panel #8 decay heat loop "B" sample.

4.4.1.6___ The decay heat removal system is lined up for E.S. actuation and will start on an E.S. signal when RCS pressure drops below 1650 PSIG or reactor building pressure increases to 4 PSIG. The system will operate in the recirculation mode, taking suction from either the BWST or the RB sump, until RCS pressure drops to approximately 250 PSIG at which time the system provide L.P. injection to the RCS via DHV-4A & 4B.

4.4.2 Long-Term Core Circulation Modes to Prevent Boron Concentration Effects.

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Background:

To prevent concentration of boron in the reactor vessel post LOCA, one of the long-term circulation modes described below should be placed into operation within 24 hours of the LOCA. Action within this time frame is more than adequate to avoid significant boron concentration effects which may occur during natural circulation flow patterns within the reactor vessel, even for the limiting condition of a large reactor vessel inlet pipe break.

Injection flow to the RC System should be maintained through two paths while attempting to place the systems in one of the long-term circulation modes whenever possible. The two injection paths can be either the two L.P. injection lines or one LP injection line combined with one HP injection string (DH pump acting as booster pump for MU pump).

The third method for long-term circulation (mode 3) is by hot leg injection using the auxiliary spray line. This method can accommodate a single failure in that the decay heat drop line is not required. The flow path for this mode of circulation is from the sump to the operating DH pump through the pressurizer auxiliary spray line into the pressurizer. This flow path will be able to be implemented as required for backup of the first two modes. In the event MCC 2-42B is lost and RC-149 cannot be operated, connect temporary power to RC-V1, 3, and 149 using Standing Maintenance Procedure later.

The fourth method of long-term circulation (mode 4) is established by providing reverse flow through the Decay Heat drop line

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into the "B" RC Loop hot leg. This flow path provides flow from the operating DH pump through the DH pump discharge cross-connect line and back through the idle DH pump recirc and suction line, and back up the DH drop line in reverse flow to result in hot leg injection to the core. This method should be used if the methods discussed above are not functional, (i.e. use Mode 4 if Modes 1 and 2 are not operable).

4.4.2.1 Mode 1 Forced Circulation Using Decay Heat Drop Line.

NOTE: This procedure will establish DH drop line flow through the "A" DH pump. This mode should only be attempted if both LP injection strings A and B are operable. This mode further assumes that the "B" DH pump is taking suction from either the Reactor Building Sump or the BWST and is discharging either through the DH-V48 valve or both through the DH-V48 and into the appropriate make-up pump suction valve.

4.4.2.1.1_____ OPEN motor-operated DH drop line valves DH-V1 or 171 and DH-V2.

4.4.2.1.2_____ ENSURE that cross-connect valves DH-V193A, DH-V193B, DH-V100A, DH-V100B between LP injection strings A and B are closed. SECURE DH-P-1A and BS-P-1A (Reactor Building Spray Pump connected to the same suction line).

4.4.2.1.3_____ CLOSE DH-V102A and OPEN valve DH-V100A in DH drop line.

4.4.2.1.4_____ CLOSE DH-V123A and DH-V6A. OPEN DH-V3.

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4.4.2.1.5____ START DH-P-1A and slowly increase flow by throttling open DH-V128A. Minimize the duration of time that DH-P-1A is on recirculation to reduce pump overheating. Observe pump flow indicator DH-1-FI2 and pump discharge pressure for symptoms of cavitation and entrainment of vapor or gas (i.e. erratic flow and abnormal pump noise). When time permits, throttle DH-V128A as necessary. DH-P-1A is now taking suction from the loop "B" hot leg only.

4.4.2.1.6____ If the MU pump is taking suction from DH-P-1B, the makeup pump may now be secured if flow has been satisfactorily established in Step 4.4.2.1.5 above.

NOTE: If satisfactory flow cannot be established, maintain the two injection paths with LP injection from DH-P-1B and HP injection flow through MU-V16C and MU-V16D and then establish one of the long-term circulation flow paths described in the following sections.

4.4.2.1.7____ After completion of Step 4.4.2.1.6 above, if it is desired to determine if the break location is high enough in elevation to operate only one low pressure injection string (i.e. is the hot leg flooded?) proceed as follows:

NOTE: Do not attempt unless DH flow in A loop is 1500-2000 gpm or more (i.e., indicative that break has occurred in an elevated

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portion of hot or cold leg piping, on OTSG side of cold leg piping, or in DH or CF piping). This flow rate is necessary to ensure that sufficient heat removal capability is available to prevent boil-off assuming "A" DH line is intact.

While continuously observing low pressure injection string A indicated flow rate (DH-1-FI2) for erratic behavior, slowly decrease flow rate in low pressure injection string B by throttling DH-V128B and then secure DH-P-1B. Coolant from the sump is not being pumped to the reactor vessel at this point (i.e., not providing overflow out the break). If suction to the "A" low pressure injection pump is maintained, it is indicative that (1) the RC System is filled to above the hot leg elevation (2) the break in the RC System is above this elevation and (3) the "A" low pressure injection string is intact. The "B" low pressure injection string may then be placed back in operation (taking suction from the Reactor Building Sump) or operated periodically to makeup for volume contraction as "A" low pressure injection string reduces the reactor coolant temperature.

4.4.2.2 Mode 2 Gravity Draining Reactor Coolant Hot Leg to the Reactor Building Sump Via the D.H. Drop Line.

4.4.2.2.1 . Install portable flow indication at DH-V237 and DH-V238.

4.4.2.2.2 DH-P-1A (if DH-P-1B is idle, use component numbers in parenthesis) is idle from an unsuccessful forced circulation mode (Mode 1) attempt.

4.4.2.2.3 VERIFY that valves DH-V1 or 171, DH-V2, DH-V100A (100B) are open.

4.4.2.2.4 VERIFY that valves DH-V3, DH-V6A (6B) and DH-V102A (102B) are closed.

4.4.2.2.5 CLOSE idle DH Pump Cooler Outlet Valve, DH-V128A (128B) and close Cross-connect Valve, DH-V193A (193B).

4.4.2.2.6 OPEN RB Sump Outlet Valve DH-V6A (6B), and DH-V102A (102B).

4.4.2.2.7 OPEN DH-V3 and OBSERVE the DH drop line flow at local flow indicator installed in step 4.4.2.2.1.

4.4.2.2.8 If no flow is indicated go to step 4.4.2.2.9. If flow is indicated, proceed to step 4.4.2.2.10.

4.4.2.2.9 This step will provide cool water flow back up the D.H. drop line. With the gravity drain flow path established, open D.H. discharge cross-connect valves DH-V193A and DH-V193B and then open pump suction valve DH-V100A (DH-V100B). Close RB sump outlet valve DH-V6A (DH-V6B) and DH-V102A (102B) Monitor the operating low pressure injection flow rate to ensure no significant decrease occurs as this lineup established a flow path from the operating low pressure injection string through the cross-connects and the idle DH pump recirc line and backwards up through the DH drop line. When the flow is established in the

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DH drop line, close DH-V100A and DH-V102A (DH-V100B and DH-V102B) and re-establish the gravity drain flow path as described above in steps 4.4.2.2.1 through 4.4.2.2.7.

4.4.2.2.10 Maintain injection flow from the Reactor Building Sump to the reactor vessel through two injection flow paths by supplying flow with the operating DH pump through the LP injection lines and/or to the HP injection pump suction as required by 2202-1.3.

4.4.2.3 3 Hot Leg Injection Using Pressurizer Auxiliary Spray Line.

NOTE: This procedure is to be used for long-term core circulation only if one of the low pressure injection strings is inoperable or if satisfactory flow cannot be established by the procedure of mode #1 or of mode #2.

4.4.2.3.1 CLOSE pressurizer spray line motor-operated valves RC-V1 and RC-V3.

4.4.2.3.2 CLOSE the idle Decay Heat Pump Suction Valve DH-V102A (DH-V102B) to prevent possible backflow through the pump recirculation line.

4.4.2.3.3 OPEN the auxiliary spray line isolation valve DH-V186A (DH-V186B) for the operating DH pump, and DH-V187.

4.4.2.3.4 OPEN RC-V149 to establish the spray flow path.

4.4.2.4 Mode 4 Reverse Flow Through The Decay Heat Drop Line Into "B" Reactor Coolant Loop Hot leg.

4.4.2.4.1 ESTABLISH operation with DH-P-1A (or if DH-P-1B is used, refer to component numbers in parenthesis) with discharge cross-connect valves DH-V193A and DH-V193B open and flow split

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between the two low pressure injection lines by throttling control valves DH-V128A and DH-V128B.

4.4.2.4.2 OPEN Decay Heat drop line motor-operated valves DH-V1 or 171 and DH-V2.

4.4.2.4.3 If DH-P-1B (DH-P-1A) is the idle pump, secure BS-P-1B (BS-P-1A) as the pump on the idle suction line. CLOSE the associated motor-operated suction valve, BS-V3B (BS-V3A). CLOSE motor-operated reactor building sump outlet valve associated with the idle decay heat pump, DH-V6B (DH-V6A) and DH-V102B (102A).

4.4.2.4.4 If DH-P-1B (DH-P-1A) is the idle pump, open DH-V100B (DH-V100A). Note operating DH pump discharge pressure as indicated on DH-5-P1A (DH-5-P1B).

4.4.2.4.5 Open motor-operated decay heat drop line valve, DH-V3. This establishes reverse flow from the operating DH pump discharge back through the idle pump recirculation line and the decay heat drop line to the "B" reactor coolant loop hot leg. This reverse flow should be confirmed by a slight decrease in indicated low pressure injection flow rate (DH-1-FI1 and DH-1-FI2) and/or by a slight decrease in DH pump discharge pressure (DH-PI-464 or 466).

APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
REACTOR BUILDING FLOOR ELEVATION 280'6" OUTSIDE SECONDARY SHIELD			
DH-V1	Primary Loop to DHR System	Closed	
DH-V171	DH-V1 Bypass	Closed	
REACTOR BUILDING FLOOR ELEVATION 280'6" OUTSIDE SECONDARY SHIELD			
DH-V172	DH Suction Line to RB Sump Drain	Closed	
DH-V173	DH Suction Line to RB Sump Drain	Closed	
DH-V195	Test Conn. Downstream DH-V172	Closed	
DH-V2	Primary Loop to DHR System	Closed	
DH-V161	DH Suction Line to LWDS Drain	Closed Wired & Sealed	
DH-V162	DH Suction Line to LWDS Drain	Closed Wired & Sealed	
DH-V197	Test Conn. Downstream DH-V161	Closed Wired & Sealed	
DH-V159A	DH Loop "A" to Primary Drain to LWDS	Closed Wired & Sealed	
DH-V160A	DH Loop "A" to Primary-Drain to LWDS	Closed Wired & Sealed	
DH-V211A	Test Conn. Downstream DH-V159A	Closed Wired & Sealed	
DH-V159B	DH Loop "B" to Primary-Drain to LWDS	Closed Wired & Sealed	
DH-V160B	DH Loop "B" to Primary-Drain to LWDS	Closed Wired & Sealed	
DH-V211B	Test Conn. Downstream DH-V159B	Closed Wired & Sealed	
DH-V215	DH to PZR Aux. Spray Line Sump Drain	Closed Wired & Sealed	
DH-V192	DH to PZR Aux. Spray Line Sump Drain	Closed Wired & Sealed	
DH-V203	Test Conn. Downstream DH-V215	Closed Wired & Sealed	

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
FUEL HANDLING BUILDING FLOOR ELEVATION 280'6"			
DH-V225	Inst. Root Valve	Open	
DH-V3	Primary Loop to DHR System	Closed	
DH-V4B	DH Loop "B" to Primary	Closed	
DH-213B	Test Conn. Upstream DH-V4B	Closed Wired & Sealed	
DH-214B	Test Conn. Upstream DH-V4B	Closed Wired & Sealed	
DH-V4A	DH Loop "A" to Primary	Closed	
DH-V213A	Test Conn. Upstream DH-V4A	Closed Wired & Sealed	
DH-V214A	Test Conn. Upstream DH-V4A	Closed Wired & Sealed	
DH-V186A	DH Loop "A" To PZR Aux. Spray Line	Closed	
DH-V186B	DH Loop "B" to PZR Aux. Spray Line	Closed	
MAKE-UP VALVE ALLEY ELEVATION 280'6"			
DH-V199	Test Conn. Downstream DH-V3	Closed Wired & Sealed	
DH-V200	Test Conn. Downstream DH-V3	Closed Wired & Sealed	
DH-V188	From SFC to DH Suction	Locked/Closed	
DH-V7A	DH Loop "A" to MU Pump	Closed	
DH-V147B	BWST to MU Pump	Locked/Open	
DH-V7B	DH Loop "B" to MU Pump	Closed	
DH-V147A	BWST to MU Pump	Locked/Open	
AUXILIARY BUILDING 280'6" ELEVATION			
DH-157	BWST to SF CLNG System	Closed	
DH-120	SF CLNG System to BWST	Closed	193 232

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2104-1.3

APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
DH HEAT VAULT A FLOOR ELEVATION 258'6"			
DH-V5A	BWST Discharge	Closed	
DH-V129A	DH-DPT-1 Inst. Root	Open	
DH-V130A	DH-DPT-1 Inst. Root	Open	
DH-V201B	Test Conn. Downstream DH-V6B	Closed Wired & Sealed	
DH-V202B	Test Conn. Downstream DH-V6B	Closed Wired & Sealed	
DH-V201A	Test Conn. Downsteam DH-V6A	Closed Wired & Sealed	
DH-V202A	Test Conn. Downstream DH-V6A	Closed Wired & Sealed	
DH-V179A	DH Cooler - 1A Vent	Closed	
DH-V180A	DH Cooler - 1A Vent	Closed	
DH-V128A	DH Cooler 1A Discharge (Motor)	Open	
DH-V193A	DH Loop "A" Cooler Cross Tie	Locked Closed	
DH-V108A	DH Discharge Cross Connect	Locked Closed	
DH-V108B	DH Discharge Cross Connect	Locked Closed	
DH-V109	DH Discharge Cross Conn. to SFC/DH Suction	Closed	
DH-V116	BWST Recirc. Line	Closed	
DH-V106A	DH Loop "A" Discharge to SF	Closed	
DH-V178A	DH Cooler 1A Discharge (Manual)	Open	
DH-V110	DH Discharge to DH Suction	Closed	
DH-V112A	Sample DH Loop "A" Discharge	Closed	
DH-V101A	BWST Recirc. to DH Loop "A" Suction	Closed	
DH-V126A	DH Cooler 1A Press Test Conn.	Closed	193 233

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
DH-V127A	DH Cooler 1A Press Test Conn.	Closed	
DH-V181A	DH Cooler 1A Drain	Closed	
DH-V182A	DH Cooler 1A Drain	Closed	
DH HEAT VAULT A FLOOR ELEVATION 258'6"			
DH-V221	PX Isolation	Closed	
DH-V-222	PX Isolation	Closed	
DH-V170A	DH Pump 1A Combined Drain	Closed	
DH-V184A	DH Pump 1A Drain	Closed	
DH-V169A	DH Pump 1A Drain	Closed	
DH-V167A	DH Pump 1A Vent	Closed	
DH-V168A	DH Pump 1A Vent	Closed	
DH-V122A	Press. Test Conn. DHP 1A Suction	Closed	
DH-V183A	DH Pump 1A Drain	Closed	
DH-V131A	DH-DPI 1447 Inst. Root	Open	
DH-V124A	DH-DPI 1447/DH-Ps 463 Inst. Root	Open	
DH-V123A	DH Pump 1A Discharge Press Test. Conn.	Closed	
DH-V111A	DH-5PI Inst. Root	Open	
DH-V125A	DH-PT 464 Inst. Root	Open	
DH-V100A	Primary to D.H. Loop "A" Suction	Closed	
DH-V102A	BWST/RB Sump to DH Loop "A" Suction	Open	
DH-121A	DH-PI 2003 Inst. Root	Open	
DH-V5B	BWST Discharge	Closed	

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
Later	"A" Pump Cyclone Separator Inlet	Closed	
Later	"A" Pump Cyclone Separator Outlet	Closed	
Later	"A" Pump Cyclone Separator Drain TH	2 turns Closed	
Later	"A" Pump Cyclone Separator Inlet	Open	
Later	"A" Pump Separator Outlet	Open	
Later	"A" Pump Cyclone Separator Drain TH	2 turns Closed	
D.H. VAULT B FLOOR ELEVATION 258'6"			
DH-V129B	DH1-DPT-2 Inst. Root	Open	
DH-V130B	DH1-DPT-2 Inst. Root	Open	
DH-V128B	DH Cooler 1B Discharge (Motor)	Open	
DH-V121B	DH-P1 2004 Inst. Root	Open	
DH-V193B	DH Loop "B" Cooler Cross Tie	Locked Closed	
DH-V112B	Sample DH Loop "B" Discharge	Closed	
DH-V106B	DH Loop "B" Discharge to SF Demin.	Closed	
DH-V102B	BWST/RB Sump to D.H. Loop "B" Suction	Open	
DH-V178B	DH Cooler 1B Discharge (Manual)	Open	
DH-V126B	DH Cooler 1B Press Test Conn.	Closed	
DH-V127B	DH Cooler 1B Press Test Conn.	Closed	
DH-V181B	DH Cooler 1B Drain	Closed	
DH-V182B	DH Cooler 1B Drain	Closed	
DH-V100B	Primary to D.H. Loop "B" Suction	Closed	

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
DH-V101B	BWST Recirc. to D.H. Loop "B" Suction	Closed	
DH-V170B	DH Pump 1B Combined Drain	Closed	
DH-V169B	DH Pump to Drain	Closed	
DH-V184B	DH Pump 1B Drain	Closed	
DH-V167B	DH Pump 1B Vent	Closed	
DH-V168B	DH Pump 1B Vent	Closed	
DH-V223	DH-P-1B Minimum Recirc Px Test	Closed	
DH-V224	DH-P-1B Minimum Recirc Px Test	Closed	
D.H. VALVE FLOOR ELEVATION 258'			
DH-V122B	Press. Test Conn. DHP 1B Suction	Closed	
DH-V183B	DH Pump 1B Drain	Closed	
DH-V131B	DH-DPI 1446 Inst. Root	Open	
DH-V124B	DH-DPI 1446/DH PS 465 Inst. Root	Open	
DH-V123B	DH Pump 1B Discharge Press Test Conn.	Closed	
DH-V111B	DH-5-P1Z Inst. Root	Open	
DH-V125B	DH-PT-466 Inst. Root.	Open	
DH-V179B	DH Cooler 1B Vent	Closed	
DH-V180B	DH Cooler 1B Vent	Closed	

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APPENDIX A

Valve Line-Up

System: Valve No.	Description	Position	Initial
Later	"B" Pump Cyclone Separator Inlet	Open	
Later	"B" Pump Cuclone Separator Outlet	Open	
Later	"B" Pump Cyclone Separator Drain TH	2 turns Closed	
Later	"B" Pump Cyclone Separator Inlet	Open	
Later	"B" Pump Cyclone Separator Outlet	Open	
Later	"B" Pump Cyclone Separator Drain TH	2 Turns Closed	
RB SPRAY VAULT "B" FLOOR ELEVATION 258'6"			
DH-V6A	DH/RBS Suction from RB Sump	Closed	
DH-V6B	DH/RBS Suction from RB Sump	Closed	
DH-V233	Test Conn. Downstream DH-V-6A	Closed	
DH-V234	Test Conn. Downstream DH-V-6A	Closed	
DH-V235	Test Conn. Downstream DH-V-6B	Closed	
DH-V236	Test Conn. Downstream DH-V-6B	Closed	
BORATED WATER STORAGE TANK & SODIUM HYDROXIDE TANK			
DH-V134A	Sodium Hydr. To BWST Discharge	Locked Open	
DH-V134B	Sodium Hydr. to BWST Discharge	Locked Open	
DH-V8B	Sodium Hydroxide Tk. Discharge (Motor)	Closed	
DH-V8A	Sodium Hydroxide Tk. Discharge (Motor)	Closed	
DH-V137A	Demin. Wtr. to Sodium Hydr. Supply Line "B"	Closed	
DH-V137B	Demin. Wtr. to Sodium Hydr. Supply Line "A"	Closed	
DH-V136A	Sodium Hydroxide Supply Line "A" Drain	Closed	

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
DH-V176	Sodium Hydroxide Supply Combined Drain	Closed Locked	
DH-V133B	Sodium Hydroxide Tk. Discharge (Manual)	Open	
DH-V136B	Sodium Hydroxide Supply Line "B" Drain	Closed Locked	
DH-V133A	Sodium Hydroxide Tk. Discharge (Manual)	Open	
DH-V216	BWST Sample Conn.	Closed	
DH-V217	BWST Sample Conn.	Closed Locked	
DH-V158	Sodium Hydro. Tk. Outlet	Open	
DH-V140	N2 Supply	Closed	
DH-V139	DH-9-P1 Inst. Root	Open	
DH-V154	Sodium Hydro. Tk. Drain	Closed	
DH-V144	Sodium Hydro. Tk. Drain	Closed	
DH-V143	Sodium Hydro. Tk. Recirc.	Closed	
DH-V142	From Caustic Mix Tk.	Closed	
DH-V141	Sodium Hydro. Supply to Tk.	Closed	
DH-V145	Sodium Hydro. Tk. Sample	Closed	
DH-V175	Sodium Hydro. Tk. Sample	Closed	
DH-V165	DH-7-LT Inst. Root	Open	
DH-V164	DH-7-LT Inst. Root	Open	
DH-V138	Sodium Hydro. Tk. Vent	Closed	

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
DH-V114	BWST Over-Flow	Closed	
DH-V149	BWST Outlet	Locked Open	
DH-V229	Upstream Valve for DH-U2	Open	
DH-V230	Downstream Valve for DH-U2	Open	
DH-V189	Demin. Wtr. to BWST	Closed	
DH-V232	Inst. Root	Open	
DH-V194	DH-3-LT1 Inst. Root	Open	
DH-V118	BWST Drain to Aux. Bldg. Sump	Closed	
DH-V152	BWST Drain to Aux. Bldg. Sump	Closed	
DH-V163	BS Pump to BWST	Closed	
DH-V132	DH-3-LT2 Inst. Root	Open	
DH-V231	Inst. Root	Open	
DH-V219B	DH-P-2B Suction	Open	
DH-V219A	DH-P-2A Suction	Open	
DH-V226A	DH-P-2A Disch. Inst Root	Open	
DH-V226B	DH-P-2B Disch. Inst. Root	Open	
DH-V-218A	DH-P-2A Discharge	Open	
DH-V-218B	DH-P-2B Discharge	Open	

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APPENDIX A

Valve Line-Up

System:

Valve No.	Description	Position	Initial
FUEL HANDLING BLDG. FLOOR ELEVATION 328'			
DH-V187	DH to Aux. PZR Spray Line	Locked Closed	_____
DH-V205	Test Conn. Downstream DH-V187	Closed Wired & Sealed	_____
DH-V206	Test Conn. Downstream DH-V187	Closed Wired & Sealed	_____
DH-V237	Inst. Root at DH-V187	Open	_____
DH-V207	Test Conn. upstream DH-V187	Closed Wired & Sealed	_____
DH-V208	Test Conn. upstream DH-V187	Closed Wired & Sealed	_____

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APPENDIX B

Signatures of those performing/supervising valve line-up

Valve Line-up Signature Sheet

Operator Initials	Operator Signature	Shift	Date	Shift Foreman or Supervisor Sig.	Remarks

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FIGURE 1
EXPANDED HEAT UP/COOLDOWN CURVE

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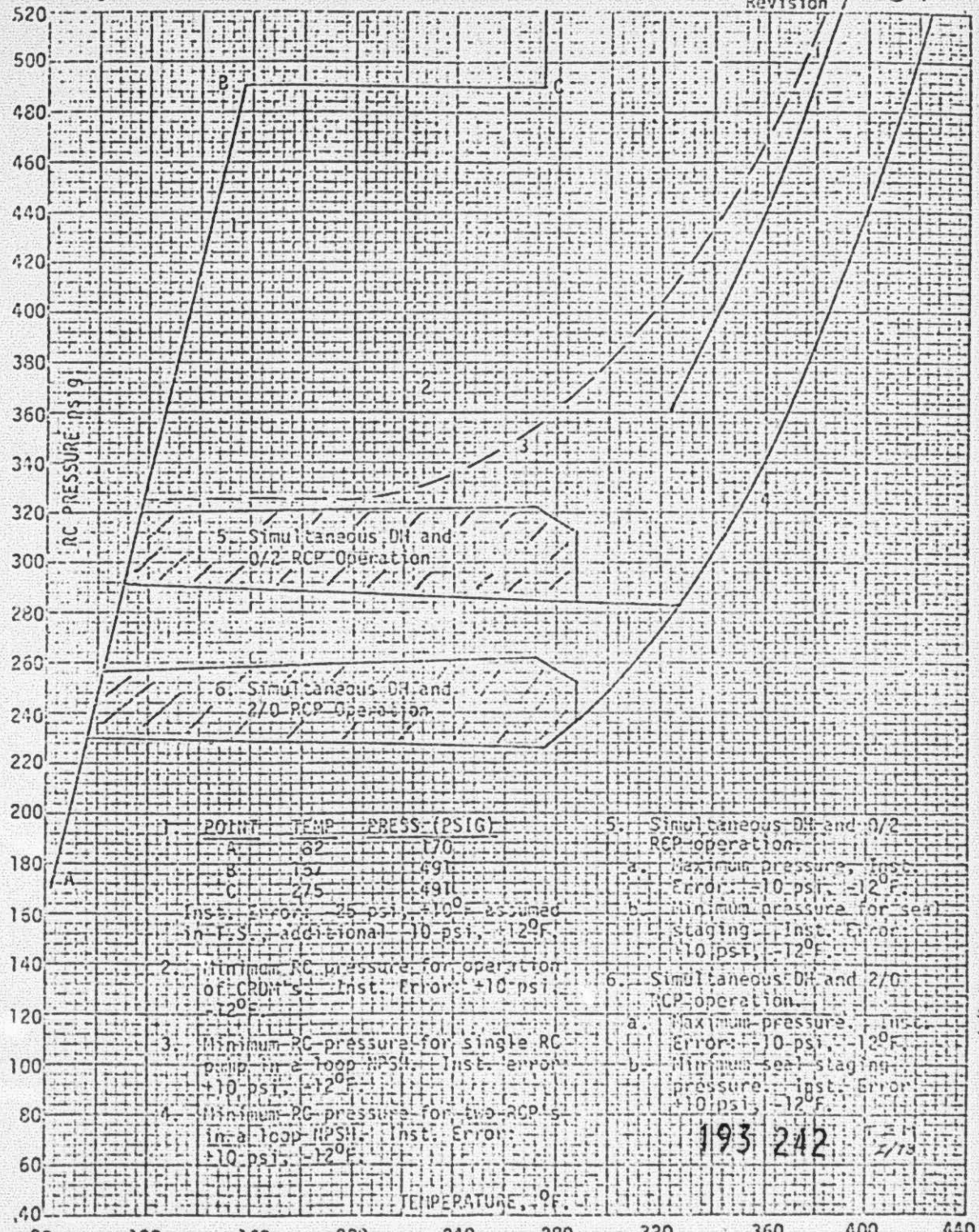
2104-1.3
Revision 7



POINT	TEMP	PRESS (PSIG)
A	82	170
B	134	491
C	275	491

Inst. Error: 25 psi, ±10°F assumed in LSS, additional 10 psi, ±12°F.

2. Minimum RC pressure for operation of CRDM's. Inst. Error: ±10 psi, ±12°F.

3. Minimum RC pressure for single RC pump in a loop NPSH. Inst. error: ±10 psi, ±12°F.

4. Minimum RC pressure for two RCP's in a loop NPSH. Inst. Error: ±10 psi, ±12°F.

5. Simultaneous DH and 0/2 RCP operation.
   a. Maximum pressure, Inst. Error: ±10 psi, ±12°F.
   b. Minimum pressure for seal staging. Inst. Error: ±10 psi, ±12°F.

6. Simultaneous DH and 2/0 RCP operation.
   a. Maximum pressure. Inst. Error: ±10 psi, ±12°F.
   b. Minimum seal staging pressure. Inst. Error ±10 psi, ±12°F.

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FIGURE 2

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CAUTION: No Instrument Error Included.

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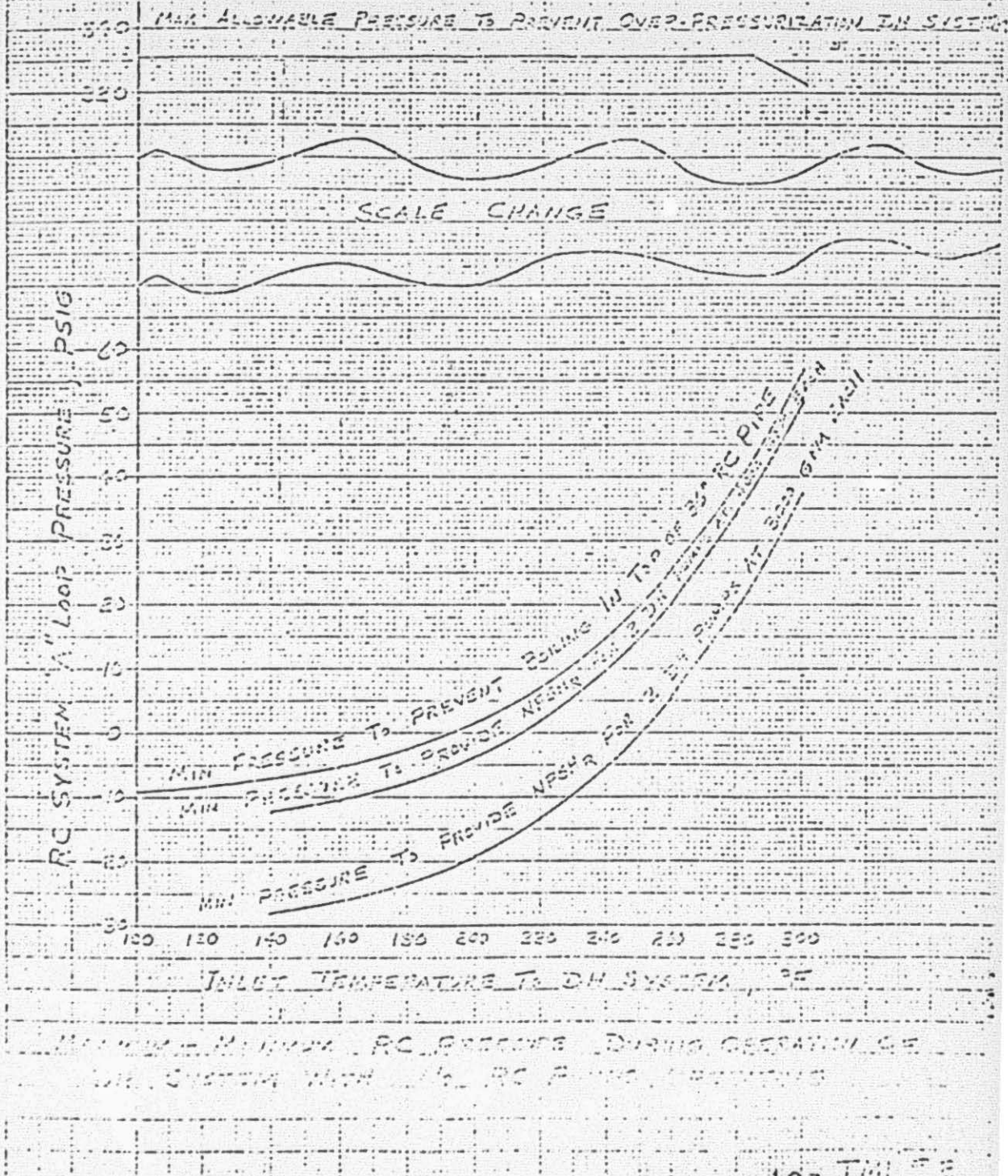
Revision 3
11/07/77



MAXIMUM MINIMUM RC PRESSURE DURING OPERATION OF DH SYSTEM WITH "A" RC PUMP RUNNING

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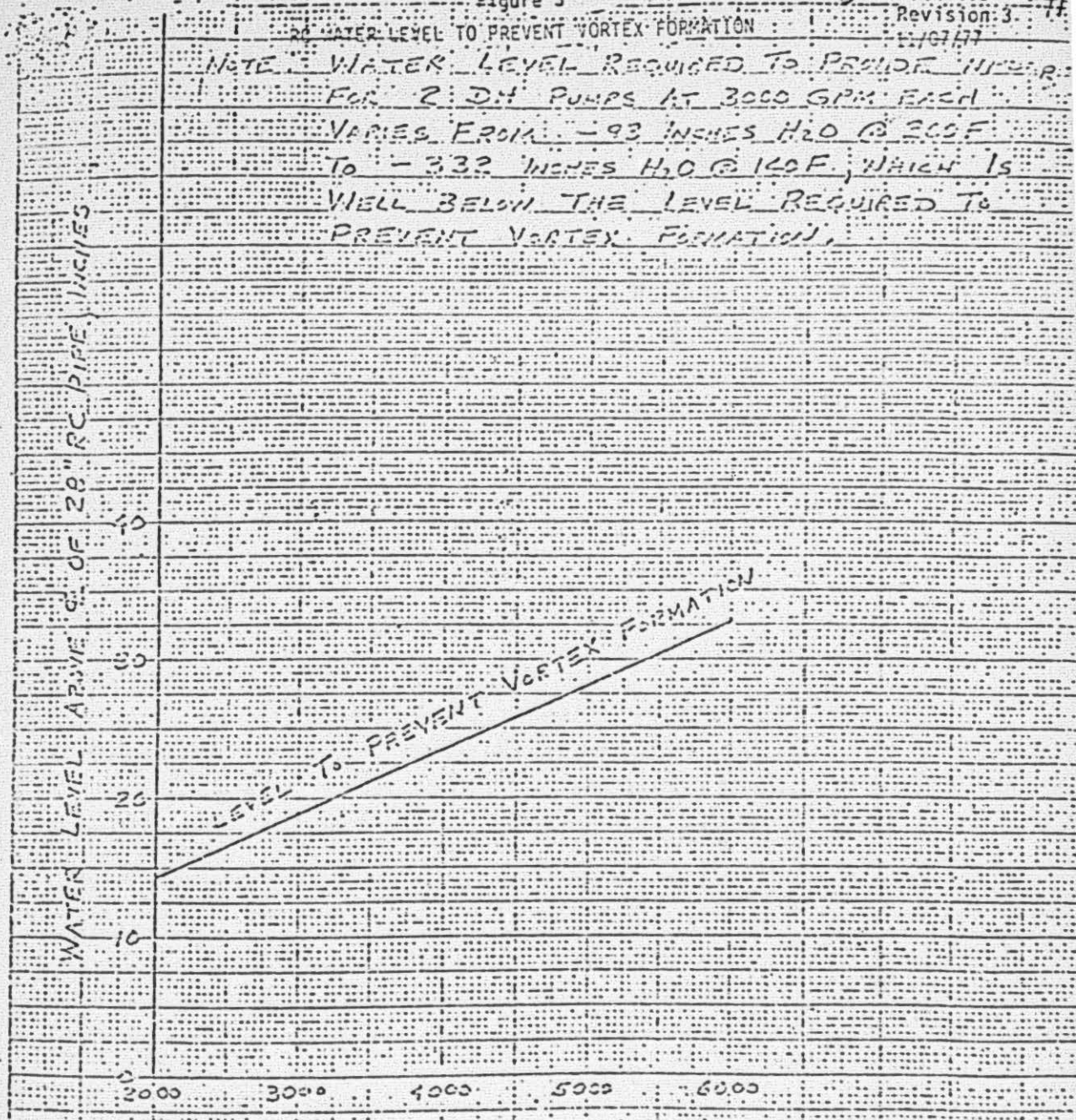
Figure 3

RC WATER LEVEL TO PREVENT VORTEX FORMATION

NOTE: WATER LEVEL REQUIRED TO PROVIDE NPSHR FOR 2 DH PUMPS AT 3000 GPM EACH VARIES FROM -93 INCHES H_2O @ 200F TO -332 INCHES H_2O @ 140F, WHICH IS WELL BELOW THE LEVEL REQUIRED TO PREVENT VORTEX FORMATION.



REACTOR COOLANT WATER LEVEL REQUIRED TO AVOID VORTEX FORMATION AND PROVIDE NPSH REQUIRED FOR DH PUMPS

5.244

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Wilda R. Mullinix, NRC

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