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THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2102-3.3
DECAY HEAT REMOVAL VIA OTSG

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Cognizant Dept. Head

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Unit 1 PORC Recommends Approval

N/A Date —
Chairman of PORC

Unit 2 PORC Recommends Approval

J. F. Wilson Date 4/14/78
V. Chairman of PORC

Unit 1 Superintendent Approval

N/A Date —

Unit 2 Superintendent Approval

J. K. Seelinger Date 4/17/78

Manager Generation Quality Assurance Approval N/A Date —

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2102-3.3

DECAY HEAT REMOVAL VIA OTSG

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THREE MILE ISLAND NUCLEAR STATION

UNIT #2 OPERATING PROCEDURE 2102-3.3

DECAY HEAT REMOVAL VIA OTSG

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1.1.1 Main and Reheat Steam - B&R 2002.

1.1.2 Feedwater and Condensate - B&R 2005.

1.1.3 Reactor Coolant Makeup and Purification - B&R 2024.

1.1.4 Spent Fuel Cooling and Decay Heat Removal - B&R 2026.

1.1.5 Circulating and Secondary Services Water - B&R 2023.

1.2 Operating Procedures.

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1.5 Curves, Tables, etc.

1.5.1 Turbine Header Pressure Setpoint vs Reactor Coolant System Temperature.

1.5.2 Reactor Coolant System Cooldown Limitations.

1.5.3 Reactor Coolant System Cooldown Limitations (<500 psig).

2.0 LIMITS AND PRECAUTIONS

2.1 Equipment.

2.1.1 Reactor coolant temperature, pressure, and cooldown rates shall be maintained within the limits specified in Figure 3.4.2 of T.S. 3.4.9.1 (Refer to Figure 1.5.2 attached).

2.1.2 Except when drying an OTSG for shutdown, the minimum water level is (24") on startup range indicators SP-1A-LT4 and 5 and SP-1B-LT4 and 5 on Panel 4.

2.1.3 The pressurizer maximum allowable cooldown rate shall be limited to 100°F/hr, 75°F step change, or 50°F in any 1/2 hour period. (T.S. 3.4.9.2).

2.1.4 For the Emergency Feedwater header/nozzle fatigue limits, see Table 5-7.1 of Tech Specs.

2.1.5 During cooldown by natural circulation, the RCS shall be protected against thermal stress, caused by cold injection water accumulating in pockets at the point of injection and lower elevations by maintaining the cooldown rate so that the maximum ΔT between RC temperature, Tc, (as indicated by RC-5A-TI-1 or 2 on Panel 4) and S.G. upper downcomer temperature (as indicated on Computer points 487, 488, 489 & 490) is less than or equal to 25°F.

2.1.6 If Decay Heat Removal by natural circulation is due to a blackout condition, then once power is restored, place the Turbine Bypass Valves in "Manual" prior to resetting Control Rod Drive breakers. This will prevent excessive cooldown when Turbine Header Pressure control reverts to setpoint.

2.1.7 During Decay Heat Removal by natural circulation, maintain Th (as indicated by RC-4A/4B-TI1 or TI2) 30°F below the saturation temperature corresponding to pressurizer pressure in order to prevent boiling in the hot legs.

2.2 Administrative.

Not Applicable.

3.0 PREREQUISITES

_____3.1 The reactor is at Hot Shutdown (Mode 3) in accordance with 2102-3.1, Unit Shutdown, with safety rod groups 1-4 fully withdrawn and group 8 in its operating position.

_____3.2 Feedwater flow is via the Startup Feedwater Valves (FW-V25A & B) and OTSG level is being maintained at 97-99% on the operating range level instruments (SG-1A/1B-LT2 or LT3) with the Startup Feedwater Valves FW-V25A & B in "Manual".

_____3.3 Decay Heat is being removed via the Turbine Bypass Valves (MS-V25A and B and MS-V26A and B) with Turbine Header Pressure setpoint at 855 psig (47.2% on Turbine Header Pressure ICS Station) maintaining Reactor Coolant System Temperature (Tc) at 532°F as indicated by RC-5A-TI-1 or 2 on Panel 4.

4.0 PROCEDURE

4.1 Normal System Startup.

_____4.1.1 To maintain reactor coolant system temperature above 480°F (as indicated by RC-5A-TI-1 or 2 on Panel 4) adjust the Turbine Header Pressure Setpoint to maintain the turbine header pressure corresponding to the desired Reactor Coolant System temperature as per Figure 1.5.1.

_____4.1.2 To decrease Reactor Coolant System temperature adjust the Turbine Header Pressure Setpoint downward, thereby, increasing steam flow from the OTSG's and decreasing the Reactor Coolant System temperature, Tc (as indicated by RC-5A-TI-1 or 2 on Panel 4) Correlate Reactor Coolant System temperature and Turbine Header Pressure Setpoint by using Figure 1.5.1. Cooldown must be limited to 100°F/hr, 75°F step change, or 50°F in any 1/2 hour period, and the cooldown limitations of Figure 1.5.2 must be met. Maintain this method of cooldown until Reactor Coolant System temperature Tc (as indicated by RC-5A-TI-1 or 2 on Panel 4) is below 500°F.

_____4.1.3 When Reactor Coolant System temperature, Tc (as indicated by RC-5A-TI-1 or 2 on Panel 4) is below 500°oF, place the Turbine Bypass Valves in Manual in accordance with 2105-1.4, Integrated Control System. Continue cooldown to the desired Reactor Coolant System temperature, Tc (as indicated by RC-5A-TI-1 or 2 on Panel 4), in accordance with 2102-3.2, Unit Cooldown. Cooldown must be limited to 100°F/hr, 75°F step change, or 50°F in any 1/2 hour period, and the cooldown limitations of Figure 1.5.2 must be met. Maintain this method of cooldown until Reactor Coolant System temperature, Tc (as indicated by RC-5A-TI-1 or 2 on Panel 4) is at 280°F.

4.2 RCS Cooldown Operation.

_____4.2.1 The Reactor Coolant System is cooled down to 280°F (as indicated by RC-5A-TI-1 or 2 on Panel 4) using the

Turbine Bypass Valves to dump steam to the main condenser in accordance with 2102-3.2, Unit Cooldown.

____4.2.2 The Reactor Coolant System pressure (as indicated by RC-3A-PI2) has been reduced to the midpoint of the "Window" for simultaneous operation of the RC pumps and DH pumps in accordance with 2102-3.2, Unit Cooldown.

____4.2.3 The Decay Heat Removal System is in operation per 2104-1.3, Decay Heat Removal.

NOTE: The shutdown of Decay Heat Removal via OTSG will be correlated with 2104-1.3.

____4.2.4 Secure Decay Heat Removal via OTSG when RCS temperature is less than 220°F by closing the turbine bypass valves, MS-V25A and B, and MS-V26A and B.

4.3 Heat Removal by Natural Circulation.

On loss of all four (4) RC Pumps, the Emergency Feedwater Pumps (EF-P-1, EF-P-2A, and EF-P-2B) will start and the Emergency Feedwater Valves (EF-V11A and B) will open to supply emergency feedwater directly from the condensate storage tanks to the OTSG's through the Emergency Feedwater Nozzles. This introduction of cold feedwater to the upper half of the OTSG will cause a reduction in RC System temperature in the upper section of the OTSG. This reduction in RC System temperature will induce the natural circulation required for decay heat removal.

____4.3.1 All four (4) RC Pumps are tripped, the reactor is tripped, and the turbine is tripped.

____4.3.2 Steam pressure is being maintained at Turbine Header setpoint (i.e. - 855 psig during noraml operation plus 125 psig) dumping steam to the main condenser through the Turbine Bypass Valves (MS-V25A and B and MS-V26A and B)

or dumping steam to the atmosphere through the Atmospheric Dump Valves (MS-V3A and B) if a low vacuum condition of less than 24" H_2O exists in the main condenser or less than three (3) Circulating Water Pumps are running. Steam safety valves and pressurizer electromatic and code safety valves are closed.

____4.3.3 The Emergency Feedwater Pumps (EF-P-1, EF-P-2A, and EF-P-2B) are running (as indicated by Panel 3 indicating lights), supplying emergency feedwater to the OTSG's from the Condensate Storage Tanks, through the Emergency Feedwater Valves (EF-V11A and B) OTSG level is increasing to, or at, 21' (50% as indicated on operating range level instrumentation SG-1A/1B-LT2 or 3 on Panel 3).

NOTE: Decay heat removal by natural circulation will be accomplished in conjunction with 2202-2.1, Blackout. 2202-2.1 covers two possibilities:

1. Blackout with diesels - use step 4.3.4.
2. Blackout without diesels - use step 4.3.5.

With either of these two conditions, the following considerations prevail:

1. Normal pressurizer pressure control is lost due to loss of spray capability and loss of pressurizer heaters.
2. System pressure will decay due to heat losses to ambient from the pressurizer (100-200 psig/hr).

Assuming continued efforts to reenergize the Auxiliary transformers fail, the operators must follow the pressurizer pressure decrease and maintain the pressure/temperature limits for cooldown in Figure 1.5.2 by following the appropriate procedure below:

4.3.4 Decay Heat Removal by Natural Circulation with Emergency Diesels.

4.3.4.1 Establish seal injection flow by the following procedure:

_____4.3.4.1.1 Place MU-V32 Seal Injection Flow Control Valve in Manual and close (Panel 3).

_____4.3.4.1.2 Close MU-V25 or 377.

_____4.3.4.1.3 Start MU-P1A (Panel 3) per 2104-1.2.

_____4.3.4.1.4 Open MU-V32 in Manual slowly to establish Seal Injection Flow Rate of 2 GPM per RCP for two minutes.

_____4.3.4.1.5 Establish seal injection flow of 6 GPM per RCP for two minutes.

_____4.3.4.1.6 Open seal return valves MU-V33 A, B, C, D if closed, and open MU-V25 or 377 closed in step 4.3.4.1.2.

_____4.3.4.1.7 Establish full 10 GPM seal injection per RCP.

_____4.3.4.1.8 Place MU-V32 in AUTO.

NOTE: These steps are to avoid thermally shocking the RCP seals.

_____4.3.4.2 Using Turbine Header Pressure setpoint, adjust OTSG pressure to maintain RCS temperature within the pressure/temperature limitations of cooldown curve, Figure 1.5.2.

NOTE: With CRD breakers tripped, a 125 psig bias is added to Turbine Header Pressure setpoint to prevent excessive cooldown of the reactor.

_____4.3.4.3 When RC System temperature decreases to 510°F (as indicated by RC-5A-T11/2 on Panel 4) place the Turbine Bypass Valves Hand/Auto control station in Manual and continue cooldown in accordance with 2102-3.2, Unit Cooldown, maintaining pressure/temperature relationship dictated by the cooldown curve, Figure 1.5.2.

NOTE: During blackout conditions, the Turbine Bypass Valve ICS Hand/Auto station will be controlling Atmospheric Steam Dump Valves, MS-V3A and B due to loss of all circulating water pumps.

_____4.3.4.4 When RCS temperature decreases to 250°F, the DHR system will be placed in operation in accordance with 2104-1.3, Decay Heat Removal and transfer of decay heat removal to the DH system will be accomplished in accordance with Section 4.2.

4.3.5 Decay Heat Removal by Natural Circulation Without Emergency Diesels.

_____4.3.5.1 Stop letdown from the RC System by closing MU-V376 (Panel 3).

_____4.3.5.2 Prior to total loss of Instrument Air System (60 psig) station personnel at following locations to manually control associated valves on orders from the Control Room.

(1) Atmospheric Dump valves MS-V3A and B.

(2) EFP Steam supply valve MS-V14.

(3) Emergency FW valves EF-V11A and B.

_____4.3.5.3 Maintain Th 30°F below the saturation temperature corresponding to pressurizer pressure by manual operation of the above

listed valves to prevent boiling in the hot legs and to allow minimum RC System shrinkage until makeup is restored.

____4.3.6 Discontinuing the removal of decay heat by natural circulating after an Auxiliary transformer is returned to service. When an Auxiliary transformer is returned to service, return required system to normal, as determined by plant conditions in accordance with appropriate procedures.

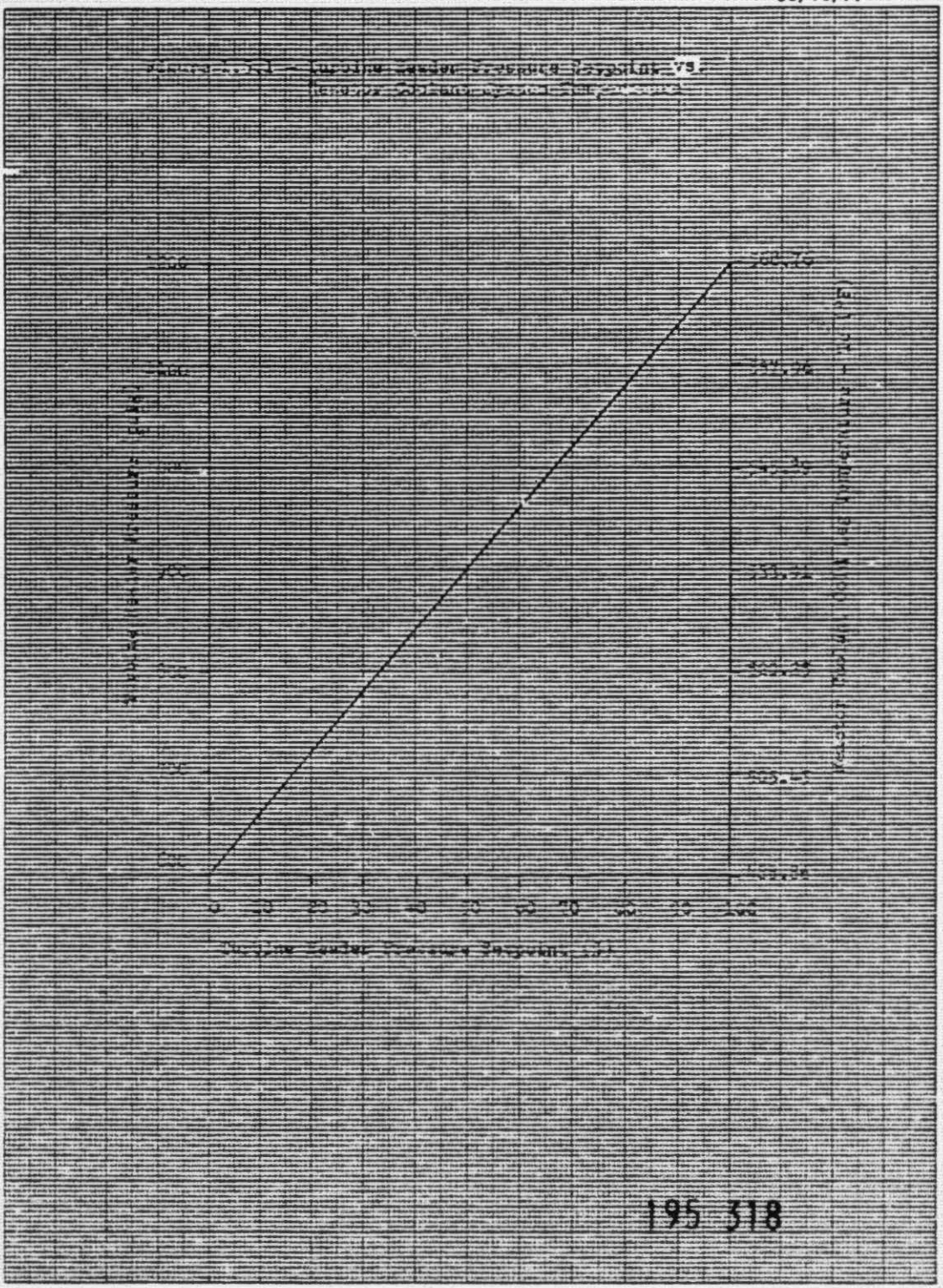
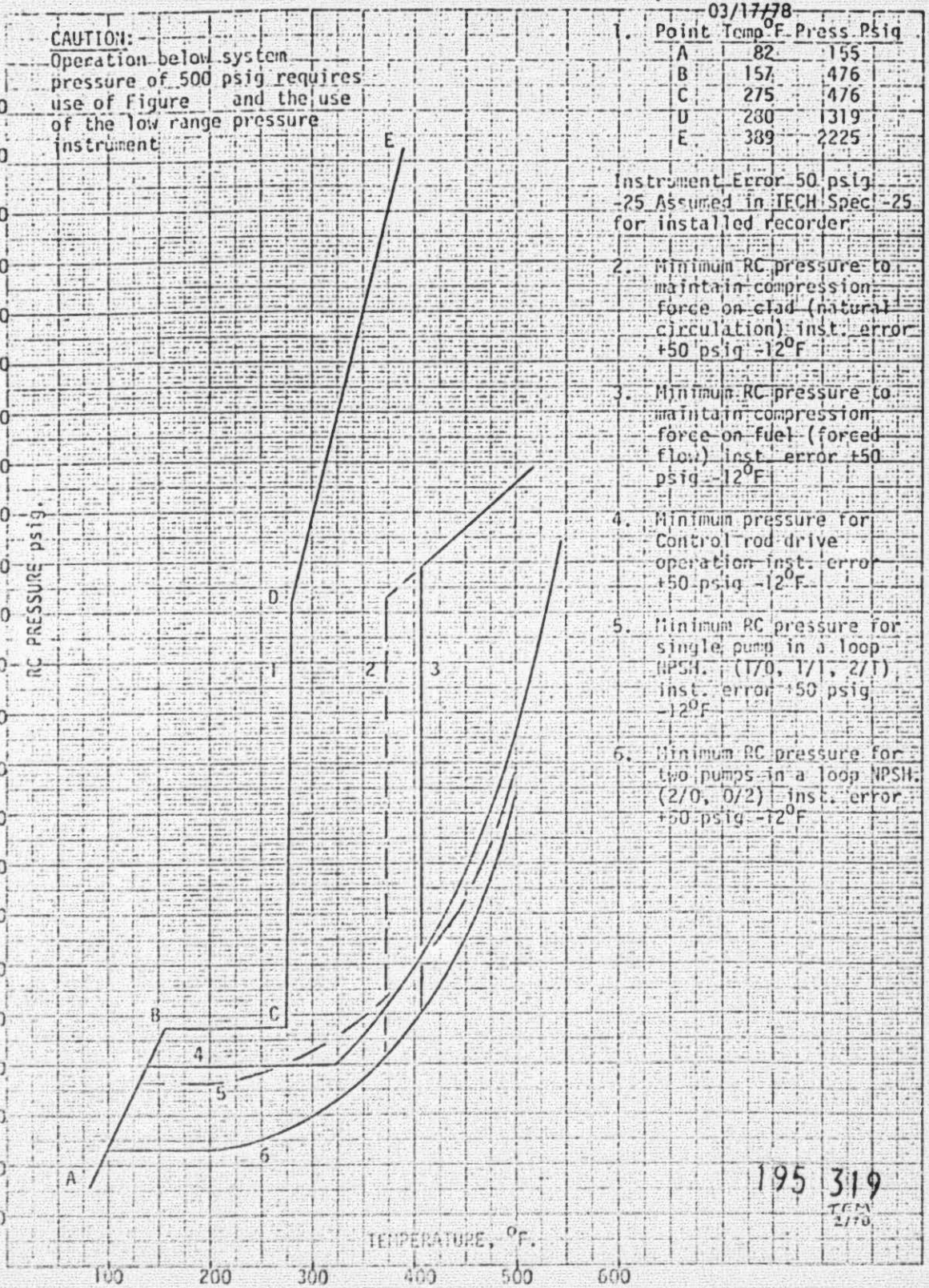


FIGURE 1.5.2
HEAT UP/COOLDOWN CURVE



1. Point | Temp °F | Press Psig

Point	Temp °F	Press Psig
A	82	155
B	157	476
C	275	476
D	280	1319
E	389	2225

Instrument Error 50 psig -25 Assumed in TECH Spec -25 for installed recorder

2. Minimum RC pressure to maintain compression force on clad (natural circulation) inst. error +50 psig -12°F

3. Minimum RC pressure to maintain compression force on fuel (forced flow) inst. error +50 psig -12°F

4. Minimum pressure for Control rod drive operation inst. error +50 psig -12°F

5. Minimum RC pressure for single pump in a loop NPSH. (1/0, 1/1, 2/1) inst. error +50 psig -12°F

6. Minimum RC pressure for two pumps in a loop NPSH. (2/0, 0/2) inst. error +50 psig -12°F

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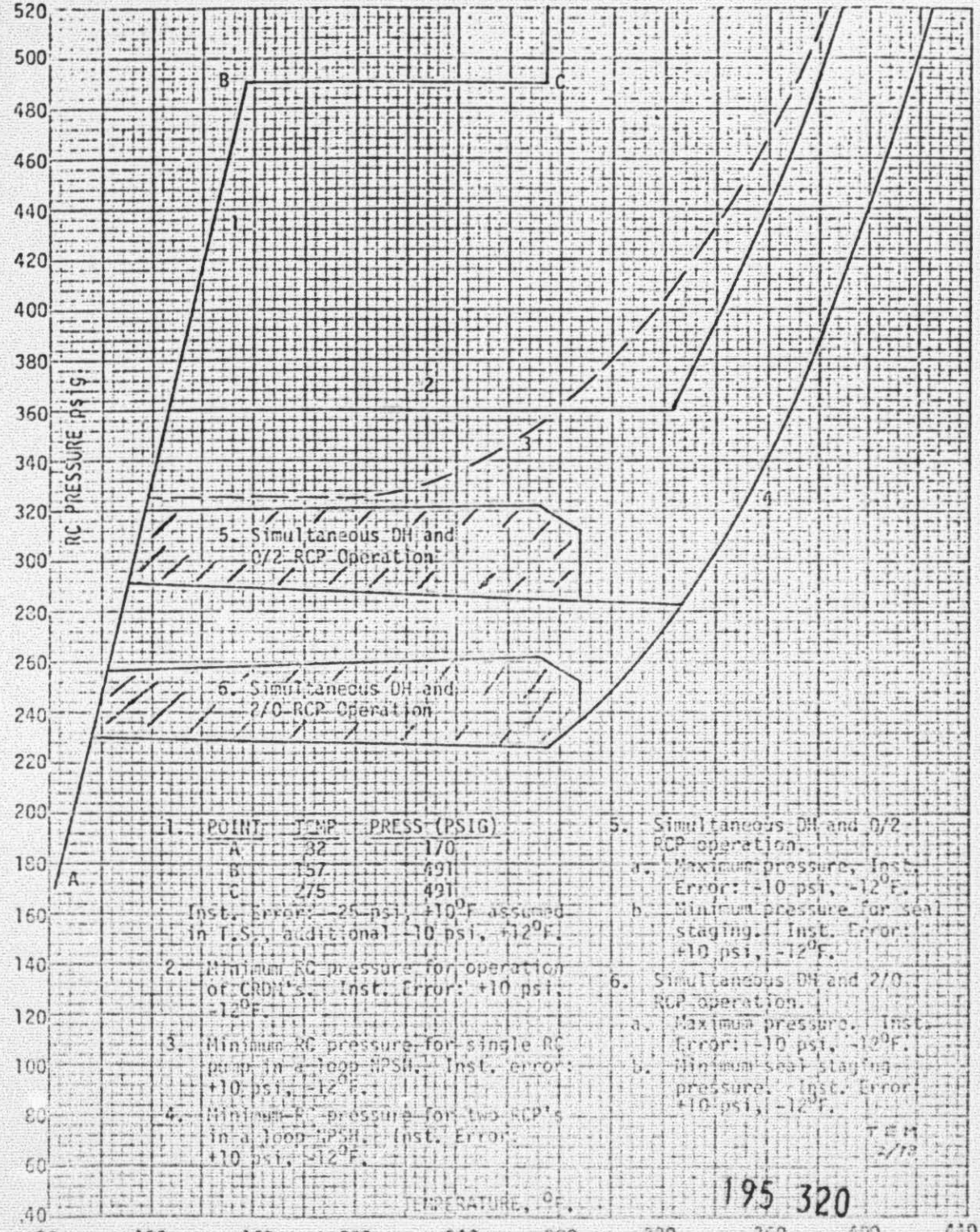
FIGURE 1.5.3
EXPANDED HEAT UP/COOLDOWN CURVE



1. POINT TEMP PRESS (PSIG)
   A 32 170
   B 157 491
   C 275 491
   Inst. Error: ±25 psi, ±10°F assumed in T.S., 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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