Vice Chairman
Unit 1

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Revision 0
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THREE MILE ISLAND NUCLEAR STATION
UNIT #1 OPERATING PROCEDURE 1102-16

CENTRAL FILE

RCS NATURAL CIRCULATION COOLING
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CHANGE

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

C E Hartman Date 8/2/79
Chairman of PORC

Unit 2 PORC Recommends Approval

_____ Date —
Chairman of PORC

Unit 1 Superintendent Approval

_____ Date _____

Unit 2 Superintendent Approval

_____ Date —

Manager Generation Quality Assurance Approval _____ Date —

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THREE MILE ISLAND NUCLEAR STATION

UNIT #1 OPERATING PROCEDURE 1102-16

RCS NATURAL CIRCULATION COOLING

CONTROLLED TRANSITION TO NATURAL CIRCULATION

NOTE: This Procedure is to be utilized in the event there is a need to stop reactor coolant pumps. The use of reactor coolant pumps is preferable to natural circulation for maintaining RCS flow.

1.0 INITIAL CONDITIONS

1.1 Reactor has been tripped for at least 10 minutes (In emergency conditions loss of flow may be coincident with reactor trip).

1.2 One or more RCP's operating (one per loop is preferred).

1.3 Feedwater available

1.4 HPI available

1.5 Reactor coolant pressure stable

1.6 T_c is stable (cooldown rate not to exceed $10^{o}F/hr$, no heat up) with steam pressure being maintained by the turbine bypass system.

2.0 LIMITS AND PRECAUTIONS

2.1 Maintain RCS subcooled

2.1.1 Before RCP's tripped (refer to Figure 1).

2.1.2 After RCP's tripped (refer to Figure 2).

2.2 Normal cooldown limits should be maintained (including NDT limits). Refer to Figure 1 and 1A 1102-11

2.3 Maintain pressurizer level 100 inches.

2.4 Prior to stopping the past pair of operating RCP, OTSG level must be established at or above 50% on the operating range and maintained there while on natural circulation.

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2.5 The conditions of pressure and temperature allowed by Figure 2 must be maintained at all times or RCP operation and/or HPI cooling established.

3.0 PROCEDURE

3.1 Establish subcooling in RCS per Figure 1 using the following as required:

3.1.1 Use available pressurizer heaters to increase RCS pressure.

3.1.2 Decrease secondary pressure using turbine bypass system to decrease T_c.

3.1.3 Use additional makeup flow to maintain or increase RCS pressure and pressurizer level.

3.1.4 Initiate HPI if required.

3.1.5 Increase steam generator level.

3.2 Take hand control of FWV16A and B and slowly increase OTSG to 50%.

3.3 Start Emergency Feed pumps EF-P-2A&B and establish control of OTSG level by taking hand control and opening EF-V-30A&B until Emergency Feed Flow can be seen on console.

CAUTION: Do not increase OTSG level above 60% on the operating range.

3.4 Close FWV16A/B

3.5 Establish pressurizer level between 100 and 200 inches with level control in automatic.

3.6 Verify SG level is greater than 50% and stop the operating RCP's simultaneously.

3.7 When OTSG level has decreased to $\leq$ 50% and EFV30A/B have demand to be partially open place the control station in AUTO.

3.8 Maintain constant or slowly decreasing (cooldown rate not to exceed 10^{o}/hr, no heatup) T_c by controlling steam pressure with the turbine bypass system.

3.9 Continuously monitor T_h in both loops to assure the pressure and temperature allowed by Figure 2 are maintained. If the conditions of Figure 2 cannot be maintained, go immediately to Step 3.12.

3.10 Verify natural circulation by one or more of the following methods.

NOTE: Indication of natural circulation may not stablize for 15 30 minutes.

1. RCS ΔT increases to $\sim 40^{o}F$ and stablizes.
2. Verify heat removal from OTSG's.
   a. Turbine bypass valve positions.
   b. Atmospheric dump valve positions.
   c. Feedwater valve positions.
   d. Feedwater flow.

   NOTE: May not indicate for low decay heat case.
3. Incore thermcouple temperatures stablize.

3.11 If natural circulation is confirmed by Step 3.10, continue to remove decay heat with natural circulation.

3.12 If natural circulation cannot be confirmed by Step 3.10, maintain the pressure and temperature limits of Figure 2 or restart one RCP in each loop.

3.13 If the limits of Figure are exceeded and at least one RCP cannot be started, initiate HPI cooling and refer to EP 1202-6 "Loss of Reactor Coolant/Reactor Coolant Pressure".

3.14 If feedwater flow is lost:

1. Start an RCP.

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2. Immediately attempt to restore feedwater flow. If feedwater flow is restored, transition to natural circulation may be attempted again starting at Step 3.2.

3. If the limits of Figure 2 are exceeded or OTSG level drops below the low level limit, initiate HPI cooling.

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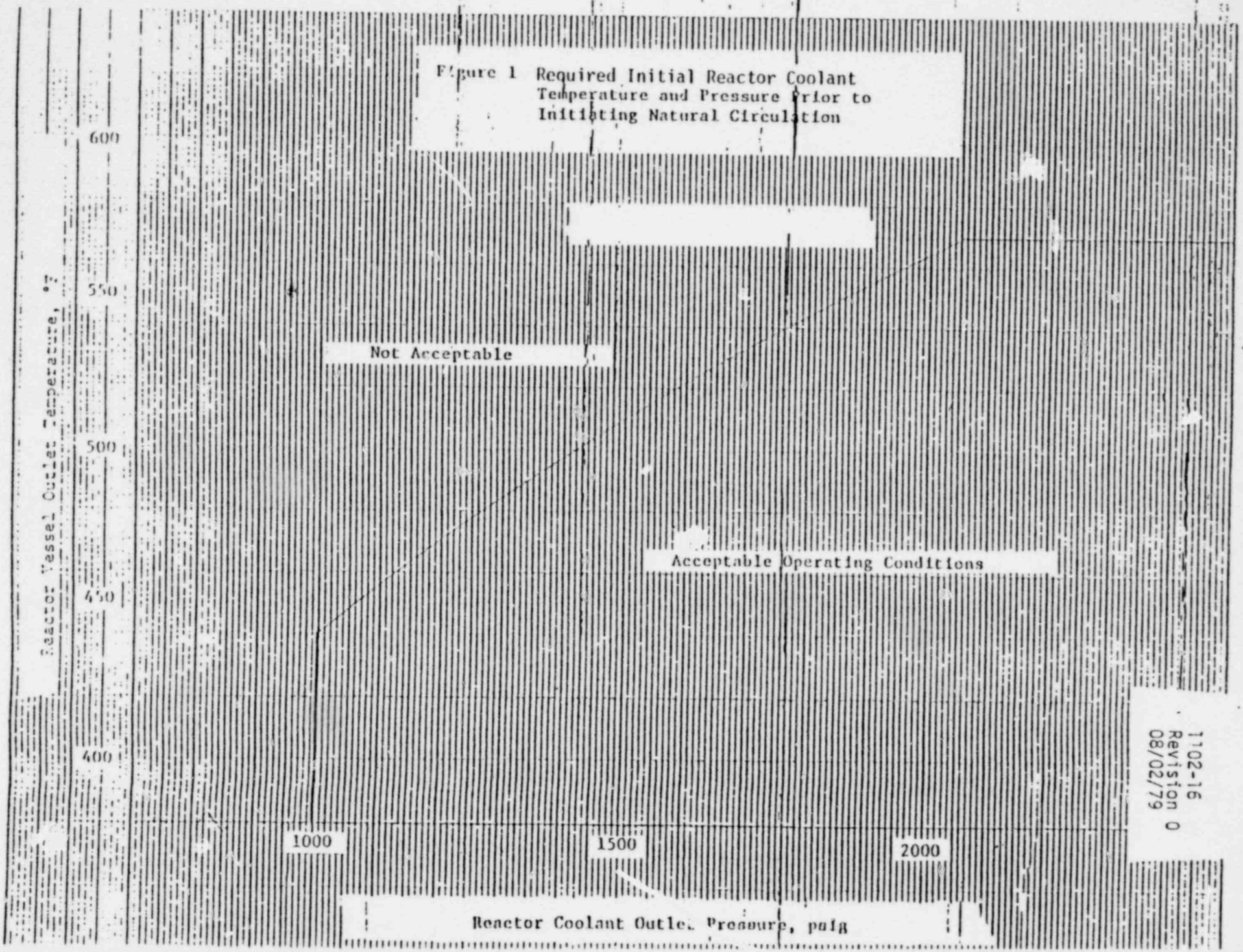
Figure 1 Required Initial Reactor Coolant Temperature and Pressure Prior to Initiating Natural Circulation



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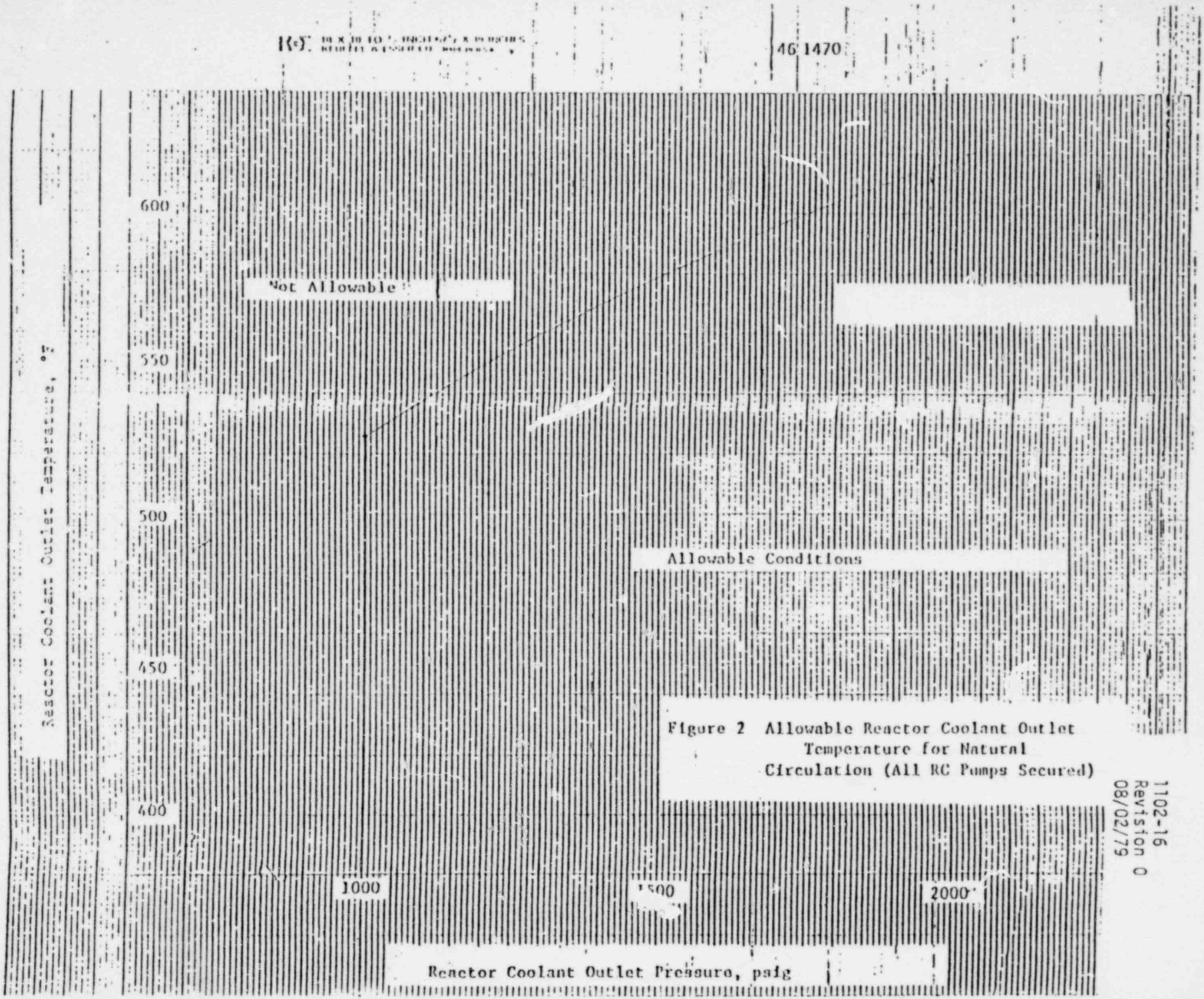

Figure 2 Allowable Reactor Coolant Outlet Temperature for Natural Circulation (All RC Pumps Secured)

ENCLOSURE I

4.0 EXPECTED PLANT RESPONSE

4.1 General

This procedure is to be utilized in the event that there is a need to secure reactor coolant pumps with initial conditions as defined in Section 1.0. The principles which form the basis of this procedure are:

1. It is preferred to use reactor coolant pumps to supply core flow.
2. The hot leg of the RCS must be maintained subcooled to prevent formation of a steam bubble which could inhibit natural circulation.
3. With natural circulation or reactor coolant pumps unavailable, the alternative is the HPI cooling mode.

4.2 Plant response to long term actions

4.2.1 Establishing desired conditions i the RCS Paragraphs 3.1 through 3.3 will establish conditions in the RCS favorable to the initiation of natural circulation.

First adequate subcooling must be established in the RCS preferably by raising RC pressure using pressurizer heaters or by lower primary temperature using turbine bypass system valves.

Next, steam generator level must be raised to a level known to promote natural circulation.

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Caution must be exercised during the feeding of the generators since overcooling may result in a fairly rapid decrease in pressurizer level and RC pressure. The attached Figures 3 and 4 provide guidance on the expected system response during the feed operation.

It should be noted that it may be desirable to raise OTSG level above the 50% level in the operating range. Since it is known that the 50% level is adequate for initiation of natural circulation, this procedure was based on that level. If the decision is made to raise level above the 50% level caution must be exercised to prevent overcooling the RCS causing loss of RC pressure control or pressurizer level. The final action prior to tripping the RC pumps is to stablize pressurizer level. After the pumps are tripped, T_h will increase with T_c remaining essentially constant, resulting in a pressurizer level increase.

4.2.2 Securing the RC pumps

With steam generator pressure being automatically controlled, T_c can be expected to remain essentially constant after the RC pumps are secured. With the decrease in RC flow, core T_h will increase. As a point of reference, a typical increase of 25-35^{o}F in T_h is expected. Figure 1 is intended to provide adequate subcooling before the RC pumps are secured, so that the hot legs will be at least 20^{o}F subcooled after the pumps are off.

Stopping the last RCP causes the OTSG level control to shift to the emergency feedwater system.

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4.2.3 Verifying natural circulation

Natural Circulation may be verified by:

1. Monitoring that T_c stays essentially constant with T_h increasing and then leveling out. The hot leg should remain subcooled.
2. Monitoring the heat removal from the OTSG's signifying that primary flow is available to remove core heat production.
3. Monitoring incore thermocouples. The temperatures should rise and then level off and stablize. The final temperature will be a function of many variables including decay heat removal.

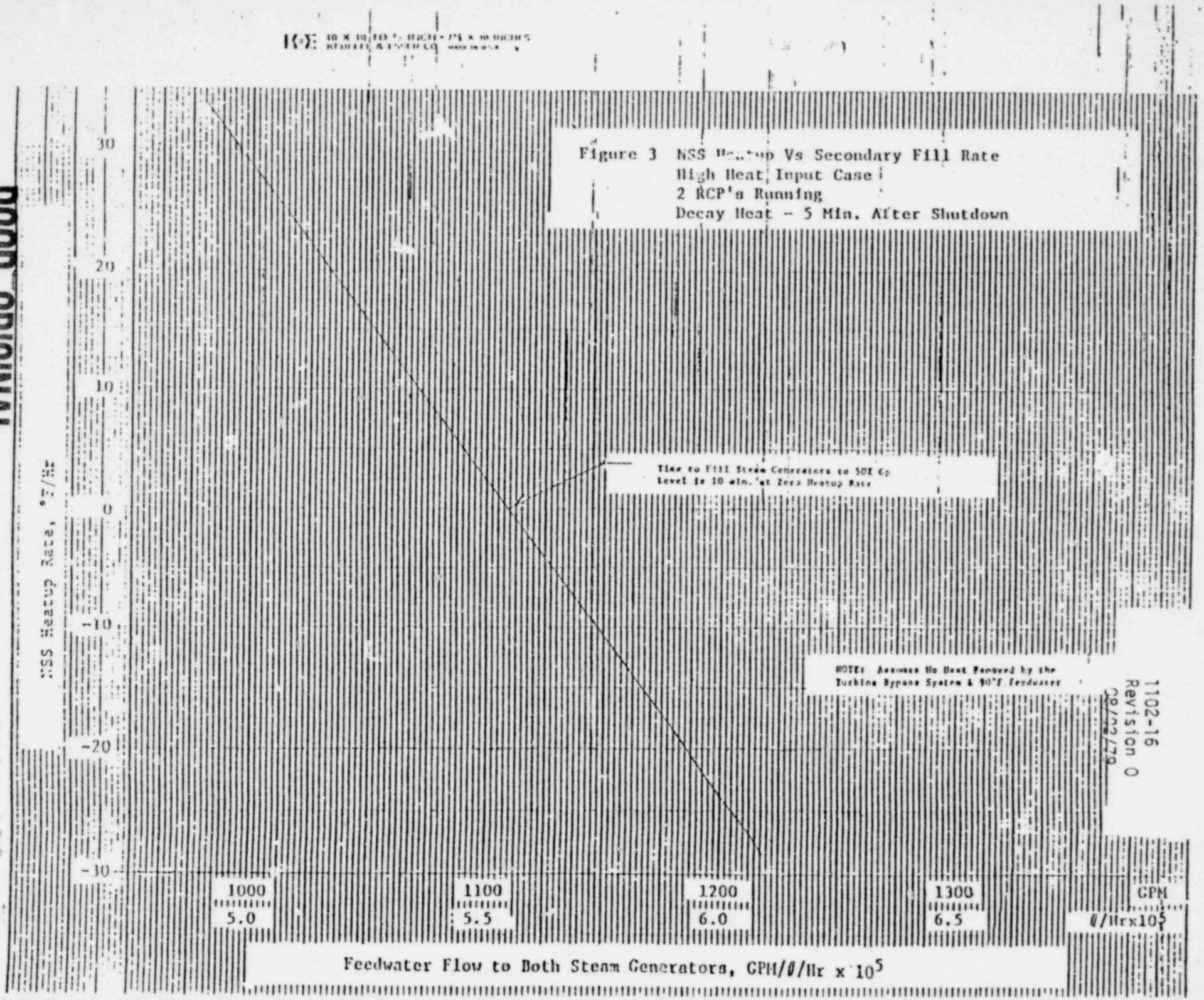
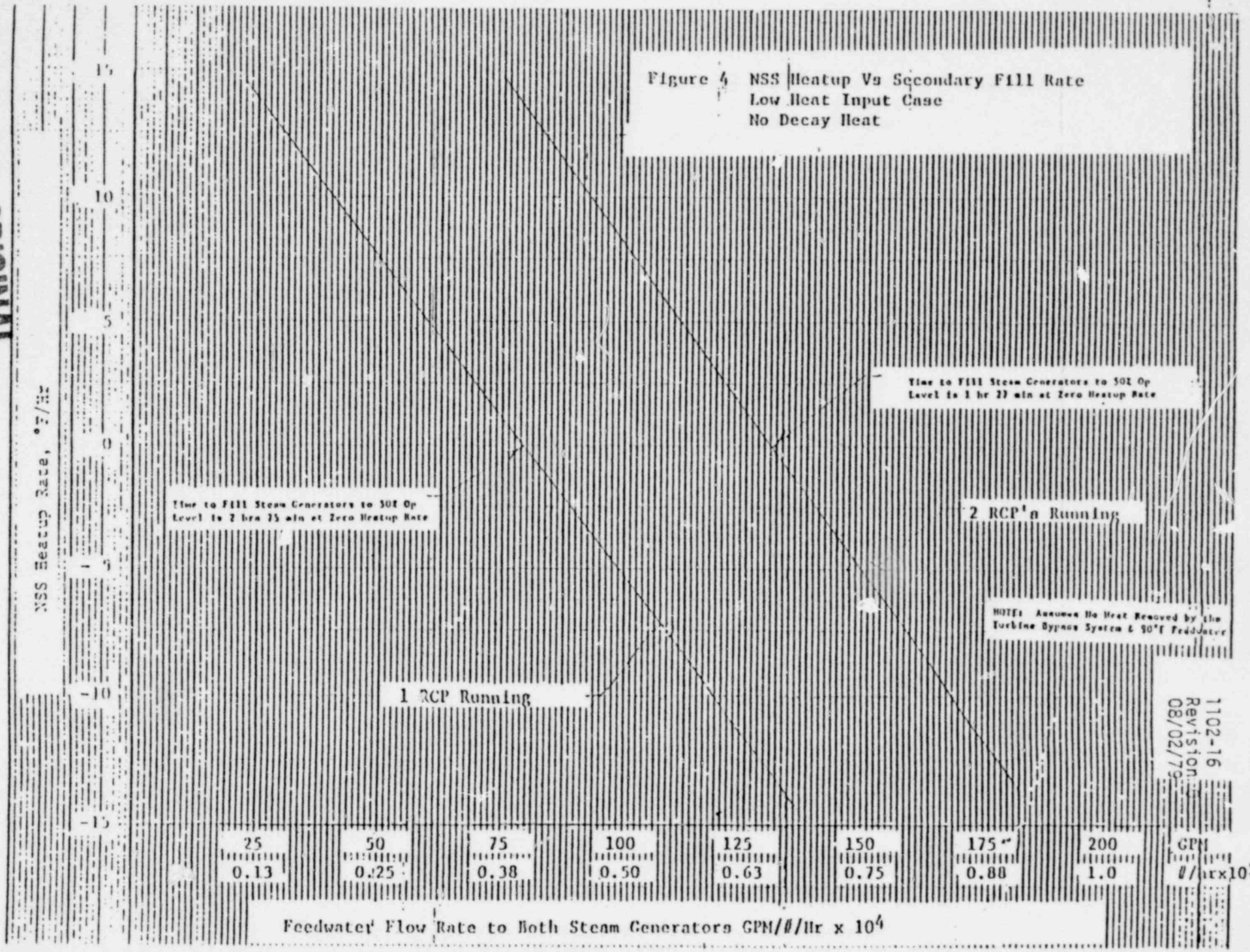


Figure 3 NSS Heatup Vs Secondary Fill Rate
High Heat Input Case
2 RCP's Running
Decay Heat - 5 Min. After Shutdown

Figure 4 NSS Heatup Vs Secondary Fill Rate
Low Heat Input Case
No Decay Heat



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