Murray Selman
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September 29, 1987

Re: Indian Point Unit No. 2
Docket No. 50-247

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Loss of Residual Heat Removal (RHR) While the Reactor Coolant System (RCS) is Partially Filled (Generic Letter 87-12)

The purpose of this letter is to respond to the subject generic letter received by Con Edison on July 27, 1987. The key issues raised by the generic letter are discussed below and in the attachment.

Upon receipt of the generic letter we initiated an in-depth review of our operating procedures and their technical bases to assure ourselves that:

1) during RCS draindown, the Residual Heat Removal (RHR) System complies with the licensing basis for Indian Point Unit 2 as expressed in the FSAR and the Technical Specifications, and

2) that no plant operational condition postulated during primary loop draindown constitutes an unanalyzed event or could result in an undue risk to the health and safety of the public.

In accommodating these two objectives, we have reviewed our upcoming refueling outage activities and determined that there is minimal impact on the planned activities and on our operating procedures as they pertain to operation of the RHR system during Reactor Coolant System (RCS) draindown operations. Our procedures were previously upgraded to address most of the abnormal operating issues raised in the generic letter based on in house analyses and the dissemination (via INPO and other sources) of the Industry's experience with RHR operation at mid-loop.

At the same time, recognizing the potential significance of the Containment integrity issues addressed in the generic letter, we have conservatively analyzed offsite radiological consequences of RCS fluid boiloff without Containment integrity. Based on this analysis we will prohibit draindown of the RCS to the water level where the potential for vortexing of RHR can occur unless the radioactivity level in the primary coolant is at an acceptable limit as defined in attached analyses. In proceeding in this manner the question of retaining Containment integrity or establishing Containment integrity become moot points. This approach is preferable since emphasis is placed upon preventing an accident (source term reduction) rather than on mitigating measures (Containment). Due to the many Outage activities that involve the periphery of the Containment boundary it

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1/1

becomes an impractical task to retain or restore Containment integrity. In addition, there will always be uncertainty as to the time period required to restore Containment integrity under varying outage conditions. Assuming a primary coolant radioactivity concentration corresponding to equilibrium values for the iodine radioisotopes in this cycle of operation, the thyroid dose at the site boundary is conservatively calculated to be less than 200 mrem. This calculation assumes one hour for operator action, no Containment integrity and adverse meteorological conditions.

Lastly, because of the possibility of departure from normal RHR operating conditions, our procedures address contingencies such as vortexing of the RHR pumps through throttling of the RHR pump flow and/or ceasing RCS draindown. By delaying draindown until only one RHR loop is required to remove decay heat, the second loop is available to handle unanticipated abnormal operating conditions. If, despite these measures, an unanticipated loss of all RHR event should occur which would disable both RHR pumps, our approach would be to restore an alternate cooling path via the Refueling Water Storage tank. Our studies conclude that more than two hours can elapse before this alternate cooling path must be established without core uncovery. Our operating procedures for the time period when the possibility of vortexing the RHR pumps exists have been modified to require one Safety Injection Pump to be operable for the alternate cooling path via the RWST. As a diverse backup, gravity flow from the RWST would suffice to accommodate boiloff and core cooling.

Our responses to the specific requests contained in the generic letter are contained in Attachments A and B.

Very truly yours,

Murray Selman

23.190.9.9.1
Attachment

cc: Ms. Marylee M. Slosson
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Subscribed to and sworn to before me this 29th day of September, 1987.

ANTHONY R. ARNONE
Notary Public, State of New York
No. 4883047
Qualified in Westchester County
Commission Expires January 26, 19 89

Anthony R. Arnone

Notary Public

50-247

LOSS OF RESIDUAL HEAT REMOVAL WHILE THE REACTOR COOLANT SYSTEM IS PARTIALLY FILLED

ATTACHMENT A

(1) A detailed description of the circumstances and conditions under which your plant would be entered into and brought through a draindown process and operated with the RCS partially filled, including any interlocks that could cause a disturbance to the system. Examples of the type of information required are the time between full-power operation and reaching a partially filled condition (used to determine decay heat loads); requirements for minimum steam generator (SG) levels; changes in the status of equipment for maintenance and testing and coordination of such operations while the RCS is partially filled; restrictions regarding testing, operations, and maintenance that could perturb the nuclear steam supply system (NSSS); ability of the RCS to withstand pressurization if the reactor vessel head and steam generator manway are in place; requirements pertaining to isolation of containment; the time required to replace the equipment hatch should replacement be necessary; and requirements pertinent to reestablishing the integrity of the RCS pressure boundary.

Response

a. Circumstances and conditions under which the plant would be entered into and brought through a draindown process and operated with the RCS partially filled are initially addressed in System Operating Procedure (SOP) 1.2 "Draining Reactor Coolant System"; Sections 1, "Precautions and Limitations", and Section 2, "Initial Conditions". The rest of SOP 1.2 addresses the draindown process in detail, including placing draindown level instrumentation in service and accounting and control of RCS inventory.

b. Preparations prior to drain down, including requirements for RCS boron concentration, requirements for an injection path to the core, required temperature indication and Steam Generator Level requirements are all addressed in Plant Operating Procedure 3.3 "Plant Cooldown".

c. Included in the cooldown procedure identified above is reference to the System Operating Procedure (SOP) 4.2.1 "Residual Heat Removal System Operation". SOP 4.2.1 clearly establishes necessary precautions when operating with the RCS at mid-loop draindown level. It also directs one to Abnormal Operating Instruction (A) 4.2.1 "Loss of Residual Heat Removal System", in order to establish alternate Decay Heat Removal capability as a result of failure or if planned testing or maintenance is to occur on normal RHR system. A 4.2.1 also reiterates the additional contingencies that could occur due to operation in the draindown, mid-loop configuration. In addition, it directs required remedial action, dependent upon the condition of the RCS, e.g., Head on, Head off, Steam Generator manways removed.

d. In the interest of clarification and to address additional concerns brought to our attention by Generic Letter 87-12, we have made revisions to A-4.2.1, SOP-4-1, and SOP 1.2.

POP 3.3 and drafts of SOP-4.2.1, A-4.2.1, SOP-1.2 new SOPs -1.2.1, -1.2.2, -1.2.3 and 1.2.4 provide the necessary detailed description and are contained in Attachment B.

(2) A detailed description of the instrumentation and alarms provided to the operators for controlling thermal and hydraulic aspects of the NSS during operation with the RCS partially filled. You should describe temporary connections, piping, and instrumentation used for this RCS condition and the quality control process to ensure proper functioning of such connections, piping, and instrumentation, including assurance that they do not contribute to loss of RCS inventory or otherwise lead to perturbation of the NSSS while the RCS is partially filled. You should also provide a description of your ability to monitor RCS pressure, temperature, and level after the RHR function may be lost.

Response

a) With the RCS in mid-loop draindown condition and the Reactor Head in place, RCS level is indicated locally in two places; 1) Tygon hose marked at 1 foot intervals on #21 RCP platform, accessible from 46' elevation, inside the ring-wall, and 2) outside the ring-wall on 46' elevation by means of a wide range level gauge. A remote read out is in the CCR on Panel SA and there is an associated RCS Low Level alarm set for 62 feet on panel SG. Both the local and remote transmitter receive their Δ P from the same point in the system. All three indicators; Local, Remote and Tygon Hose are vented to the pressurizer. All three indicators have a common variable leg which can be lined up either to #21 RCS hot leg at mid-loop or from 21 RCS intermediate leg, between the first and second loop drain valve.

System Operating Procedure 1.2 (Draining Reactor Coolant System) has several Precautions and Limitations regarding the use of the level instrumentation and also has a detailed procedure for placing the instrument in service as well as a requirement to calibrate it prior to use. SOP 1.2 also requires a drain down log which records all three indicators at hourly intervals during drain down from 20 percent in the pressurizer to 64 feet, and at 15 minute intervals using CCR indication from 64 feet to mid-loop level (62'). Precautions include limits on deviation of readings between instruments at each interval as well as changes in deviation from interval to interval to ensure that hydraulic effect of the draindown is not adversely affecting the level indication.

b) RCS pressure indication is not affected by loss of RHR as it is derived from separate pressure transmitters connected to the RCS loop.

c) RCS temperature indication with the Reactor head on and thermocouples connected will not be affected by loss of RHR. RCS temperature indication with the thermocouples disconnected is measured by the loop RTDs with an operating reactor coolant pump(s) and/or RHR loops(s). With uncovery of the RTDs, RCS temperature indication is via temperature sensor at the inlet to the RHR heat exchanger.

d) RCS level indication would not be affected by RHR loss.

(3) Identification of all pumps that can be used to control NSSS inventory. Include: (a) pumps you require be operable or capable of operation (include information about such pumps that may be temporarily removed from service for testing or maintenance); (b) other pumps not included in item a (above); and (c) an evaluation of items a and b (above) with respect to applicable TS requirements.

Response

The pumps which can be used to control RCS inventory are as follows:

a) 3 Charging Pumps
b) 3 Safety Injection Pumps
c) 2 RHR pumps
d) 2 Boric Acid Transfer pumps in conjunction with 2 Primary Water pumps

To varying degrees the above pumps can be removed from service subject to the limitations stated in the Technical Specifications. Table 1-1 is reproduced from the Technical Specifications and stipulates the conditions under which pump removal is permitted with the exception of the safety injection (S.I.) pumps. With the modified procedures, one safety injection pump is required to be operable when primary draindown below elevation 63' is contemplated and spent fuel is in the reactor vessel. Elevation 63' represents the elevation below which vortexing is considered possible. With an operable S.I. pump, to prevent primary system overpressurization, either the Overpressurization System is required to be operable or venting to the containment atmosphere must be provided. These are the limitations contained in the Technical Specifications regarding primary system overpressurization.

Reactor Coolant (RC) Pumps/Residual Heat Removal (RHR) Pump(s) Operability/Operating Requirements for Decay Heat Removal and Core Mixing

(1) Reactor Condition	(2) Required No. of Pumps Operating	(3) Required No. of Pumps Operable (including operating pump)	(4) Action Required if Condition of Column (2) or (3) is not met
Hot shutdown Tavg $>$ 350°F (Excluding loss of offsite power)	Two RCPs	Two RCPs	With less than two reactor coolant pumps operating, maintain the reactor trip breakers open. With no reactor coolant pumps operating, Tavg may be maintained above 350°F for up to one hour provided: (1) no operations are permitted that would cause dilution of the reactor coolant system, and (2) RCS temperature. If a RCP has not been restored to operating status within the one hour permitted, take action as listed below for no operable pumps. With only one RCP operable, restore a second RCP to operable status within 72 hours or bring the RCS temperature to 350°F. Except for testing, with no RCPs operable, immediately initiate action to bring RCS temperature to 350°F.

Reactor Coolant (RC) Pumps/Residual Heat Removal (RHR) Pump(s) Operability/Operating Requirements for Decay Heat Removal and Core Mixing

(1) Reactor Condition	(2) Required No. of Pumps Operating	(3) Required No. of Pumps Operable (including operating pump)	(4) Action Required if Condition of Column (2) or (3) is not met
Hot shutdown Tavg $\leq$ 350°F	One RCP or one RHR pump	Two RCPs or Two RHR pumps or one RCP and one RHR pump	The requirement is to have at least one RCP or RHR pump in operation may be suspended for up to one hour provided: (1) no operations are permitted that would cause dilution of the reactor coolant system, and (2) RCS temperature is maintained at least 10°F below saturation temperature. If a pump has not been restored to operating status within the one hours permitted, take action as listed below for no operable pumps. With only one pump (RHR or RCP) operable, either restore a second pump to operable status or be in cold shutdown within 20 hours. With no pumps operable, suspend all operations involving a reduction in boron concentration and immediately initiate action to restore at least one pump to operable status.

Reactor Coolant (RC) Pumps/Residual Heat Removal (RHR) Pump(s) Operability/Operating Requirements for Decay Heat Removal and Core Mixing

(1) Reactor Condition	(2) Required No. of Pumps Operating	(3) Required No. of Pumps Operable (including operating pump)	(4) Action Required if Condition of Column (2) or (3) is not met
Cold Shut-down	One RCP or One RHR pump	Two RCPs or two RHR pumps or one RCP and one RHR pump	The requirement to have at least one reactor coolant pump or RHR pump in operation may be suspended for up to one hour provided: (1) no operations are permitted that would cause dilution of the reactor coolant system, and (2) RCS temperature is maintained at least 10°F below saturation temperature. With only one pump operable, stay in cold shutdown until a second pump is restored to operable status.

Reactor Coolant (RC) Pumps/Residual Heat Removal (RHR) Pump(s) Operability/Operating Requirements for Decay Heat Removal and Core Mixing

(1) Reactor Condition	(2) Required No. of Pumps Operating	(3) Required No. of Pumps Operable (including operating pump)	(4) Action Required if Condition of Column (2) or (3) is not met
Cold Shutdown (Cont'd)			The requirements of columns (2) and/or (3) may be suspended during maintenance, modifications, testing, inspection or repair. During operation under this provision, the following shall apply: (1) an alternate means of decay heat removal shall be available and return of the system within sufficient time to prevent exceeding cold shutdown requirements shall be assured. (2) RCS temperature and the source range detectors shall be monitored hourly. (3) no operations are permitted that would cause dilution of the reactor coolant system.
Refueling	See Specification 3.8	See Specification 3.8	See Specification 3.8

(4) A description of the containment closure condition you require for the conduct of operations while the RCS is partially filled. Examples of areas of consideration are the equipment hatch, personnel hatches, containment purge valves, SG secondary-side condition upstream of the isolation valves (including the valves), piping penetrations, and electrical penetrations.

Response

Recognizing the potential significance of the Containment integrity issues addressed in the generic letter, we have conservatively analyzed offsite radiological consequences of RCS fluid boiloff without Containment integrity. Based on this analysis we will prohibit draindown of the RCS to the water level where the potential for vortexing of RHR can occur unless the radioactivity level in the primary coolant is at an acceptable limit as defined in attached analyses. In proceeding in this manner the question of retaining Containment integrity or establishing Containment integrity become moot points. This approach is preferable since emphasis is placed upon preventing an accident (source term reduction) rather than on mitigating measures (Containment). Due to the many Outage activities that involve the periphery of the Containment boundary it becomes an impractical task to retain or restore Containment integrity. In addition, there will always be uncertainty as to the time period required to restore Containment integrity under varying outage conditions. Assuming a primary coolant radioactivity concentration corresponding to equilibrium values for the iodine radioisotopes in this cycle of operation, the thyroid dose at the site boundary is conservatively calculated to be less than 200 mrem. This calculation assumes one hour for operator action, no Containment integrity and adverse meteorological conditions.

Our forthcoming Refueling Outage is scheduled to commence October 5, 1987. There are activities where penetrations in the Containment boundary, such as the main steam isolation valves, will be opened for the purpose of maintenance. Controlling and/or restoration of Containment integrity within a meaningful time frame, has the potential for being an impractical objective. To restore the equipment hatch may be meaningless based on our analysis of radiological consequences and that it is not feasible to accomplish this task within a reasonable time frame. As a short term measure, we have chosen to restrict the radioactivity level of the RCS which has the same effect as retaining containment integrity during mid loop draindown.

Calculations have been conservatively performed to estimate the dose at the site boundary assuming total loss of residual heat removal capability for one hour. The decay heat corresponding to four days after achieving core sub-criticality was utilized in the calculations. We have administratively prohibited RCS drain down below elevation 63' until after four days have elapsed. After four days the decay heat load can be accommodated by one RHR loop operation. Based on engineering studies, elevation 63' is the demarcation point at which vortexing becomes a possible concern and is addressed by our operating procedures. By point of comparison the midloop elevation is 62'.

The calculations assume an initial RCS temperature of 140°F and an initial elevation of 63' at the time the RHR system is lost. 140°F is the minimum RCS temperature required prior to refueling. With the primary system vented to Containment, boiling would commence in approximately 9 minutes. The top of core would be uncovered in 2.6 hours. The average evaporation rate corresponds to 579 pounds/minute. With adverse meteorological conditions allowing one hour for operator action, calculations result in a site boundary dose to the thyroid of less than 200 mrems. Recognizing that 10 CFR 20 limits are expressed in terms of whole body limits, the mathematical sum of the thyroid and whole body dose is less than 0.5 rem. On this basis we conclude that a release of this magnitude does not represent an undue risk to the health and safety of the public.

We believe that one hour represents an overly conservative time period for operator action for restoration of cooling which can be accomplished in 30 minutes or less. This is especially true since the appropriate procedural actions are in place with the operators fully aware of these potential contingencies.

With respect to evacuation of personnel from Containment, our prior experience with spurious containment evacuation alarms induced by welding equipment has demonstrated that this is easily accomplished within 10 minutes; 5 minutes is more the norm. Evacuation is therefore expected to be complete before boiling begins.

5) Reference to and a summary description of procedures in the control room of your plant which describe operation while the RCS is partially filled. Your response should include the analytic basis you used for procedures development. We are particularly interested in your treatment of draindown to the condition where the RCS is partially filled, treatment of minor variations from expected behavior such as caused by air entrainment and de-entrainment, treatment of boiling in the core with and without RCS pressure boundary integrity, calculations of approximate time from loss of RHR to core damage, level differences in the RCS and the effect upon instrumentation indications, treatment of air in the RCS/RHR system, including the impact of air upon NSSS and instrumentation response, and treatment of vortexing at the connection of the RHR suction line(s) to the RCS.

Explain how your analytic basis supports the following as pertaining to your facility: (a) procedural guidance pertinent to timing of operations, required instrumentation, cautions, and critical parameters; (b) operations control and communications requirements regarding operations that may perturb the NSSS, including restrictions upon testing, maintenance, and coordination of operations that could upset the condition of the NSSS; and (c) response to loss of RHR, including regaining control of RCS heat removal, operations involving the NSSS if RHR cannot be restored, control of effluent from the containment if containment was not in an isolated condition at the time of loss of RHR, and operations to provide containment isolation if containment was not isolated at the time of loss of RHR (guidance pertinent to timing of operations, cautions and warnings, critical parameters, and notifications is to be clearly described).

Response

Some of the information requested in this question has been provided in the responses to questions (1) through (4) above and is not repeated here.

We have attached our procedures in their entirety (Attachment B) rather than summarize them. These procedures have evolved over a period of time since plant startup in 1973 and reflect actual experience rather than analytical projection. The enclosed procedures contain cautions and limitations to be employed during midloop operation such as increased frequency of RCS level monitoring. Analytical evaluations have been used to establish limits for safe operation such as the restriction on the draindown elevation of 63' until the decay heat load has decreased to the capacity of one RHR loop, i.e. 4 days after initiation of hot shutdown.

Enclosed are eight curves which depict the time to reach 212°F, as well as the time for the core to be uncovered, as a function of time after hot shutdown initiation, assuming no residual heat removal capability. These curves reflect an initial RCS temperatures of 140°F or 180°F. 140°F represents the RCS temperature which must be achieved prior to refueling. 180°F is the maximum temperature that is permitted for the RCS to perform maintenance. Actual RCS temperature will vary between these two limits. Figures 1, 2, 3 and 4 illustrate the time to reach boiling as a function of time after initiation of hot shutdown for the two elevations assuming an initial temperature of 140°F or 180°F. In addition, figures 5, 6, 7 and 8 illustrate for the same initial temperatures and elevation, the time for core uncovery with no decay heat removal as a function of time after hot shutdown initiation. Figure 9 is the decay heat curve used in developing these curves.

Elevations of 61' 6" and 63' have been analyzed. Elevation 61' 6" corresponds to uncovery of the top of the RHR suction line at the point of intersection with the RCS hot leg. As a point of information, the elevation of the filled hot leg corresponds to 63' 2."

We have analyzed the susceptibility of the RHR/RCS piping connection to vortexing and possible air entrainment in the RHR system. Inhouse evaluations indicate that below elevation 63', vortexing should be considered. An independent study concluded that the RCS level can be as low as 62' 3" with a flow of 3,000 gpm without vortexing. We are in the process of confirming this claim. It should be noted that this flowrate can accommodate the decay heat three days after initiation of hot shutdown. Thus, we are confident that our procedural/administrative controls are conservative with respect to vortexing and decay heat removal capabilities.

The Generic Letter and NUREG-1269 (Diablo Canyon event) both address primary system pressurization as a potential phenomenon to be evaluated. This would follow as a consequence of reactor vessel heatup, and loss of heat transfer via the steam generator. It also would be highly dependent upon the time required for restoration of an alternate coolant path and the ability of the RCS vent paths (PORVs and reactor vessel head vent) to vent steam formed in the core. In the case of IP-2, the vent paths are not interconnected as in the case of Diablo Canyon. Neither the pressurizer nor the reactor vessel head vent is utilized as a source of air for steam generator draining. Draindown of steam generator tubes is accomplished with the assist of nitrogen cover gas injection. Draindown of the Steam Generators does not require lowering the RCS level below elevation the where vortexing is a concern. Whereas 63' is addressed procedurally for employing cautions and limitations with respect to vortexing it is recognized that this level is conservative. Draindown of the Steam Generator below 62' 6" is not possible due to the physical arrangement of the RCS piping. At this elevation vortexing can be avoided by limiting RHR suction flow and still accommodate decay heat removal.

Thus, in the case of IP-2, Steam Generator draindown, which represents the bounding case for the presence of gas in the Steam Generators, does not present the potential for RHR vortexing. Hypothetically, if boiloff did occur it is not believed that significant, if any, primary pressurization would occur due to the capacity of the PORVs to vent steam. Use of the S.I. pump, which we will maintain available, would counteract any primary pressurization during establishment of an alternate cooling path.

The RCS loop level indicating system has been under evaluation for the past several years and modifications have been implemented to improve its performance. Tygon tubing continues to be in use, however it has been augmented by level monitoring instrumentation with direct readout in the

Control Room. The use of both devices, including precautions and limitations, are described in the Operating procedures. Level differences within the RCS obviously influence readings and changes have been made to reduce the effect. For the most part the instrumentation system suffers from "lag" (slow response time). However, since the phenomenon has been identified, it is compensated for.

The current RCS level monitoring instrumentation sensing line arrangement differs from the routing described in NUREG-1269. IP-2 connects via the hot-leg as well as the intermediate leg since the reactor coolant pump was previously determined to introduce a level difference in readings during draindown.

Introduction of air into the RCS can cause transient effects on both instrumentation and equipment. In addition to the monitoring of the RCS level the RHR pumps are monitored to determine the onset of pump cavitation via audible indications. Should cavitation be apparent, RHR flow would be reduced. If necessary, draindown would be terminated and RCS level increased until cavitation was no longer evident at the pumps. Again the four-day limit restricting draindown below the critical elevation in this upcoming outage assures full system design redundancy in the RHR system. Should the necessity arise to decrease RHR flow rates, there exists added conservatism on the component cooling water side of the RHR heat exchanger to compensate for flow reduction and maintain adequate heat removal.

Additional modifications are under evaluation for improving the accuracy of RCS level indications and for the monitoring of RHR pump performance under conditions conducive to vortexing and pump cavitation.

Responses to previous questions have addressed the issues of Containment integrity, restrictions on component availability (Tech. Specs.) and the restoration of decay heat removal should the RHR system be lost.

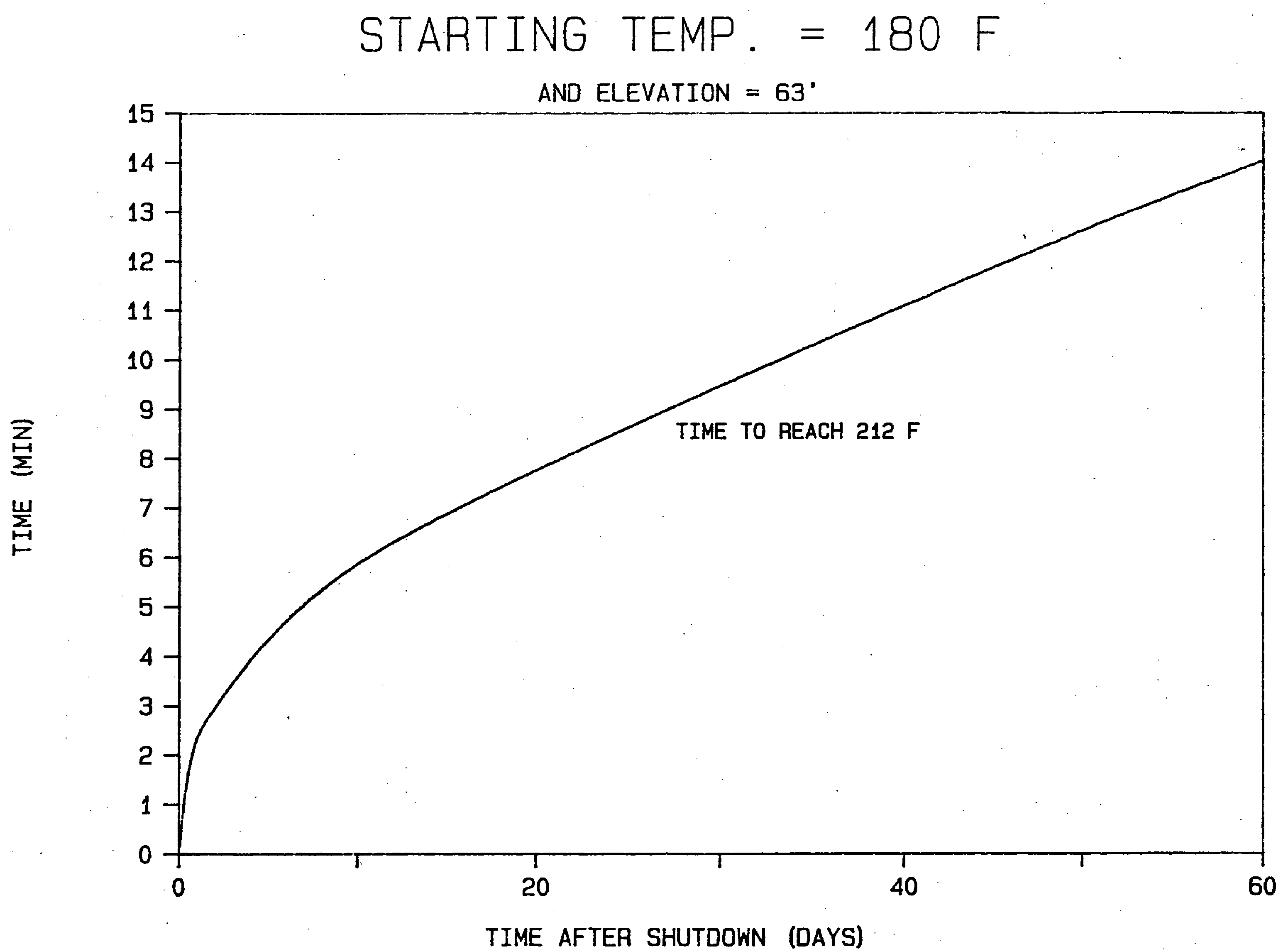

STARTING TEMP. = 180 F
AND ELEVATION = 63'
TIME (MIN)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
TIME TO REACH 212 F
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 1

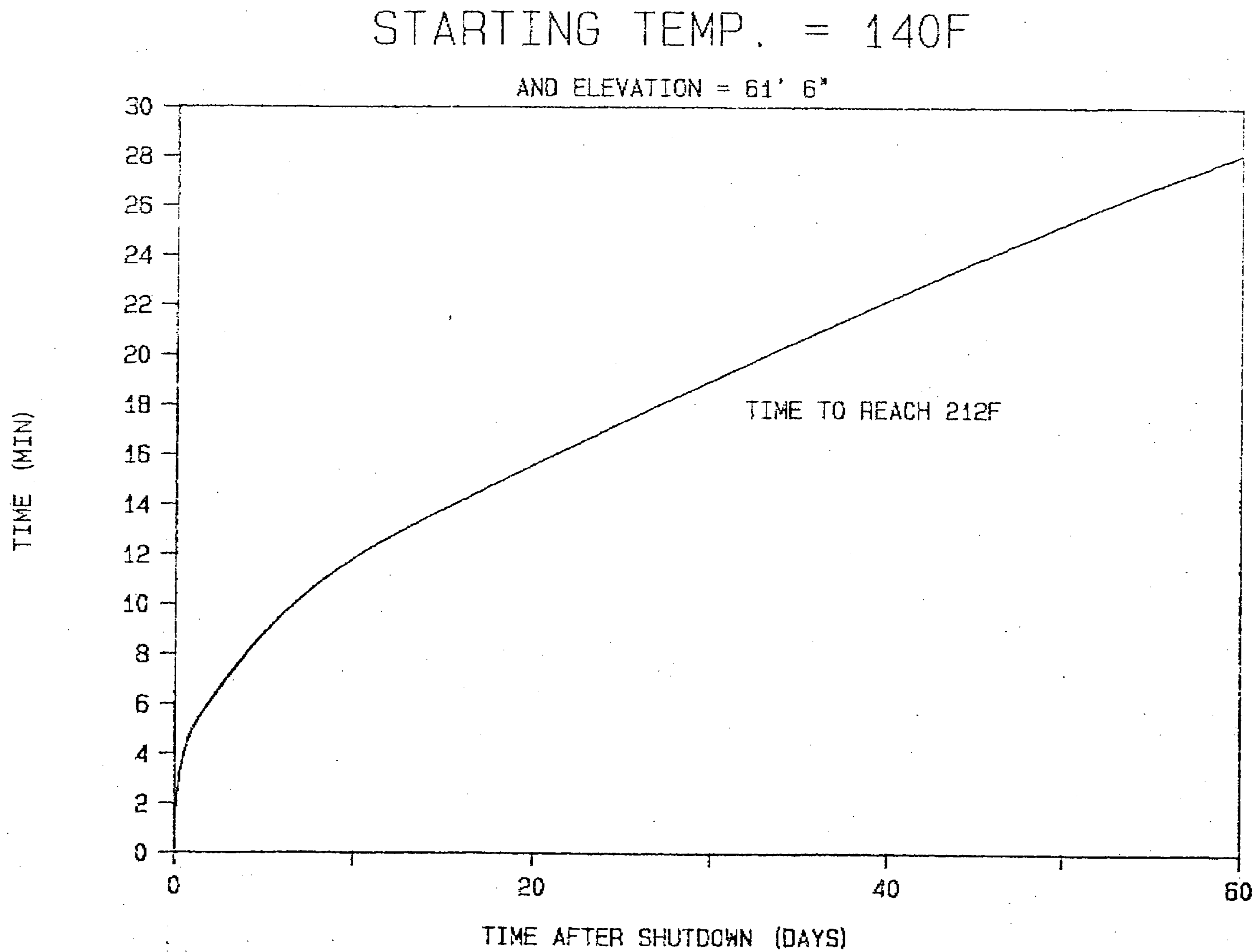
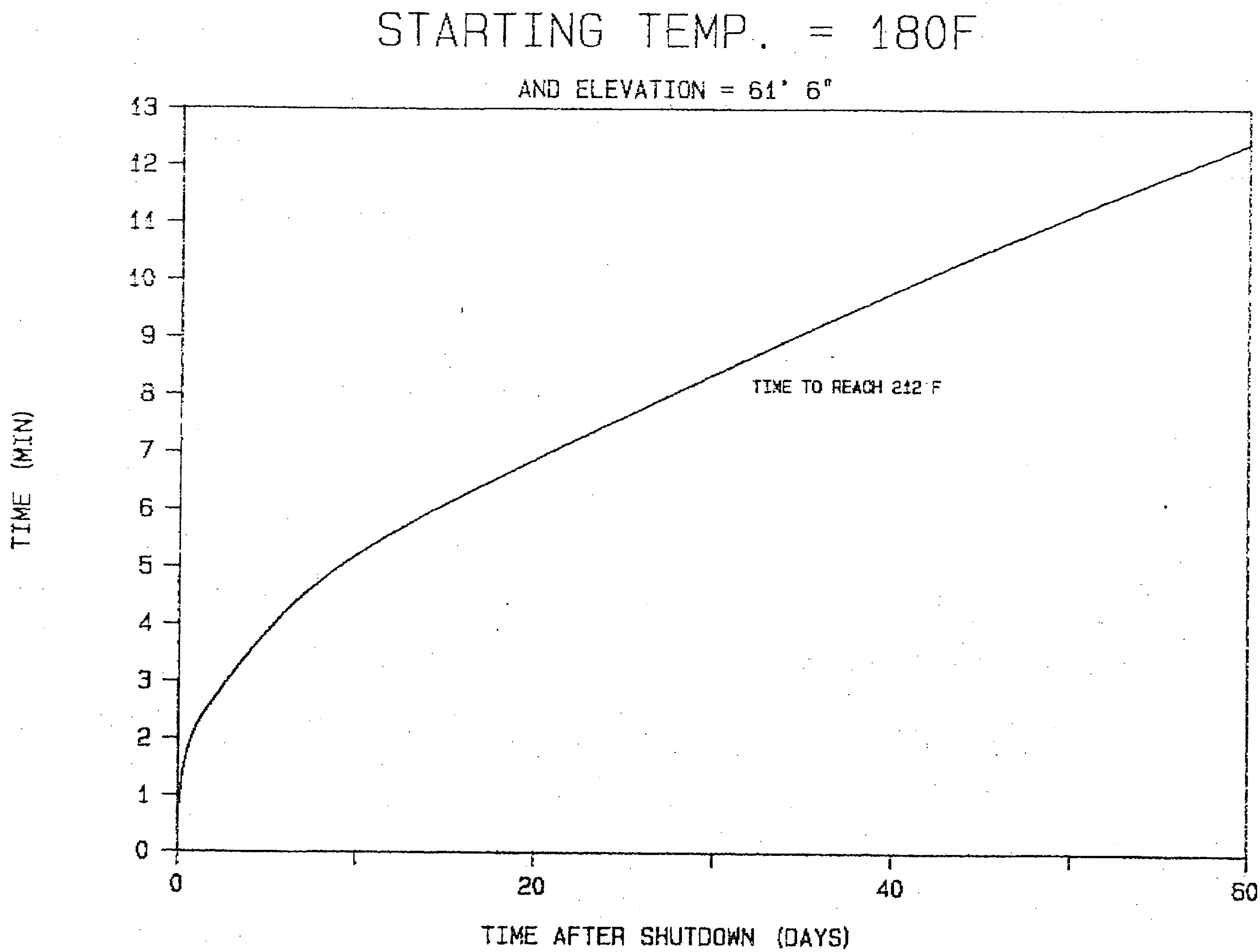

STARTING TEMP. = 140F
AND ELEVATION = 61' 6"
TIME (MIN)
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
TIME TO REACH 212F
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 3


STARTING TEMP. = 180F
AND ELEVATION = 61' 6"
TIME (MIN)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
TIME TO REACH 212 F
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure

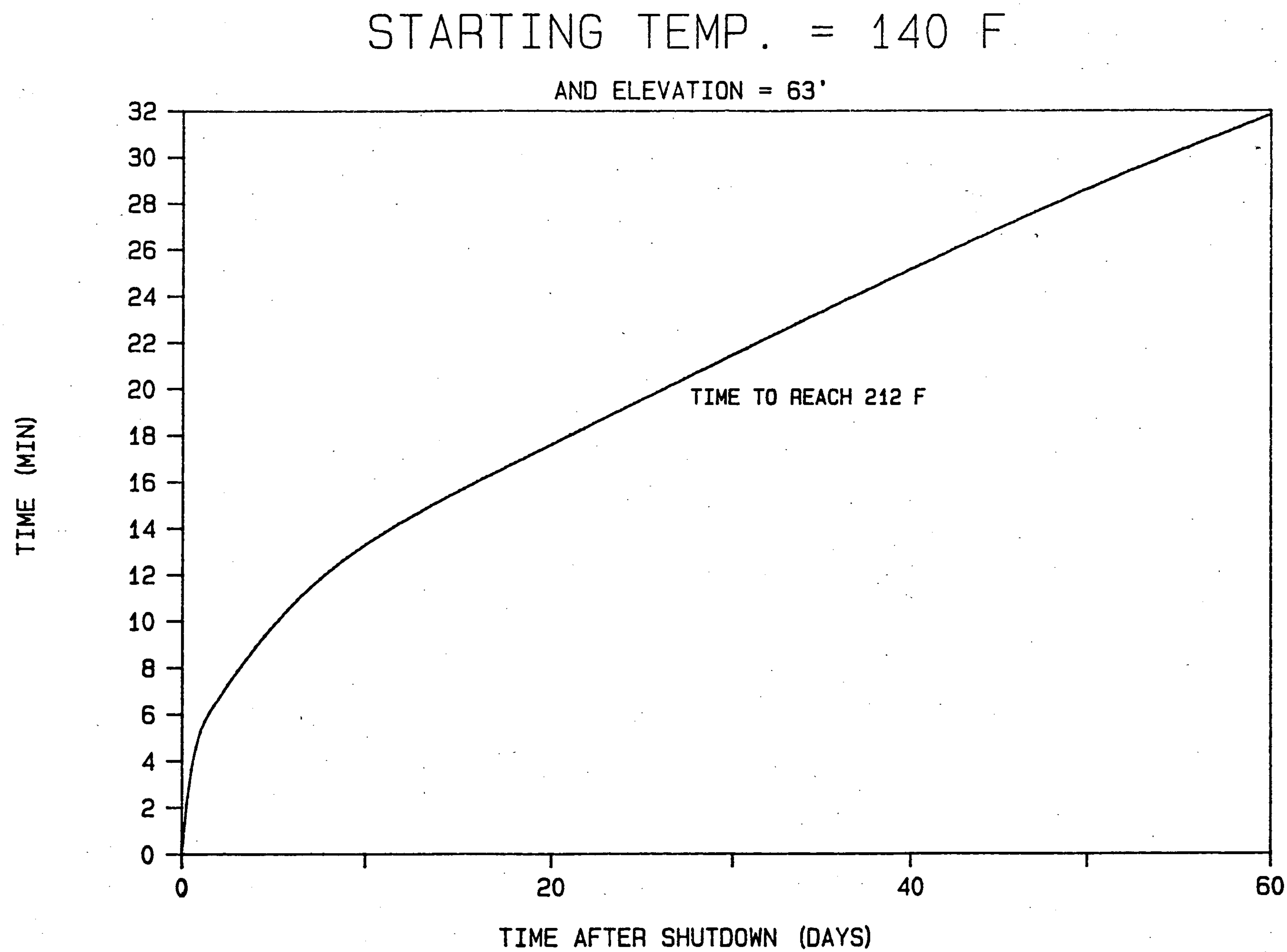

STARTING TEMP. = 140 F
AND ELEVATION = 63'
TIME (MIN)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
TIME TO REACH 212 F
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 4

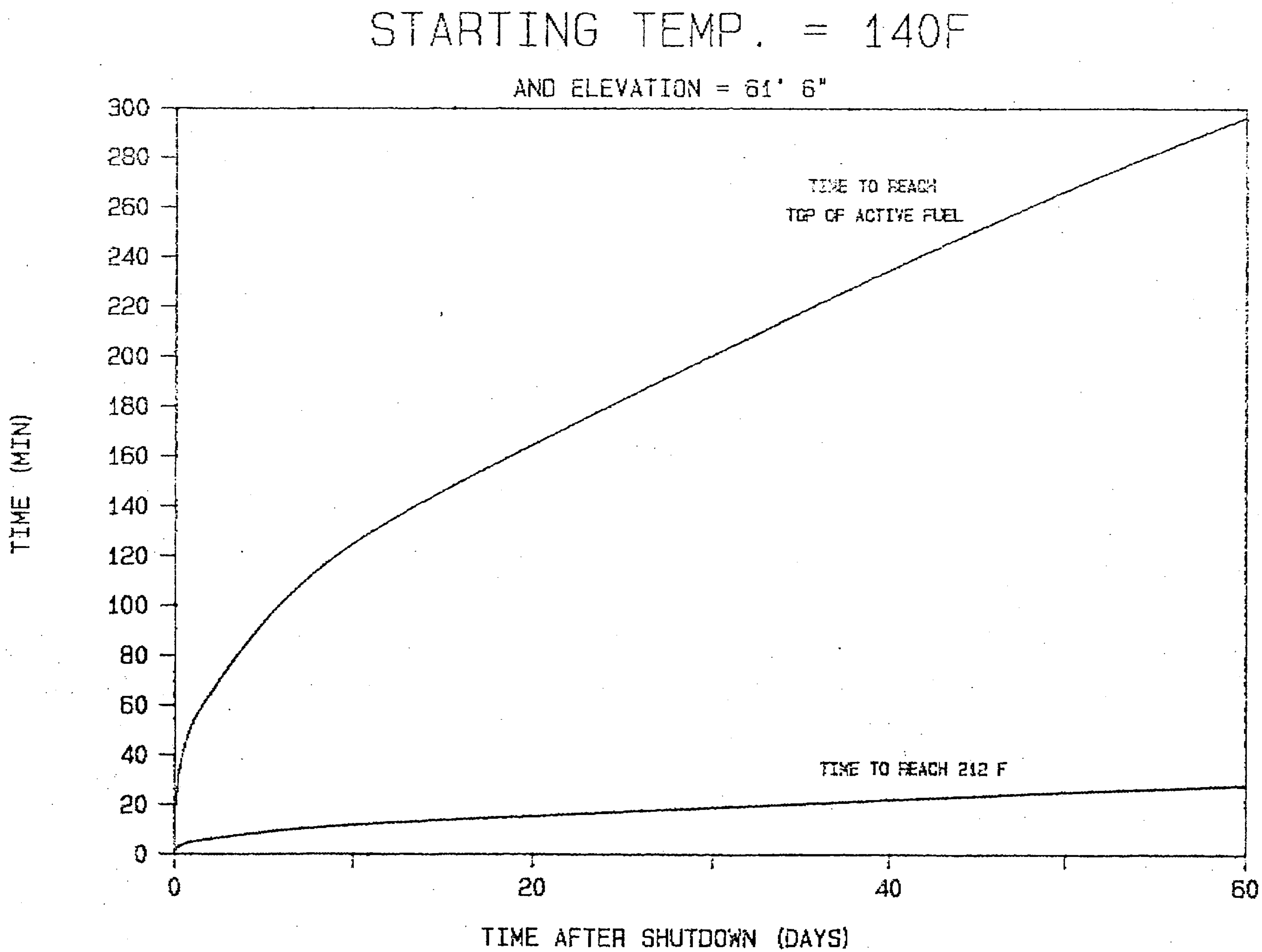

STARTING TEMP. = 140F
AND ELEVATION = 61' 6"
TIME (MIN)
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
TIME TO REACH
TOP OF ACTIVE FUEL
TIME TO REACH 212 F
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 5

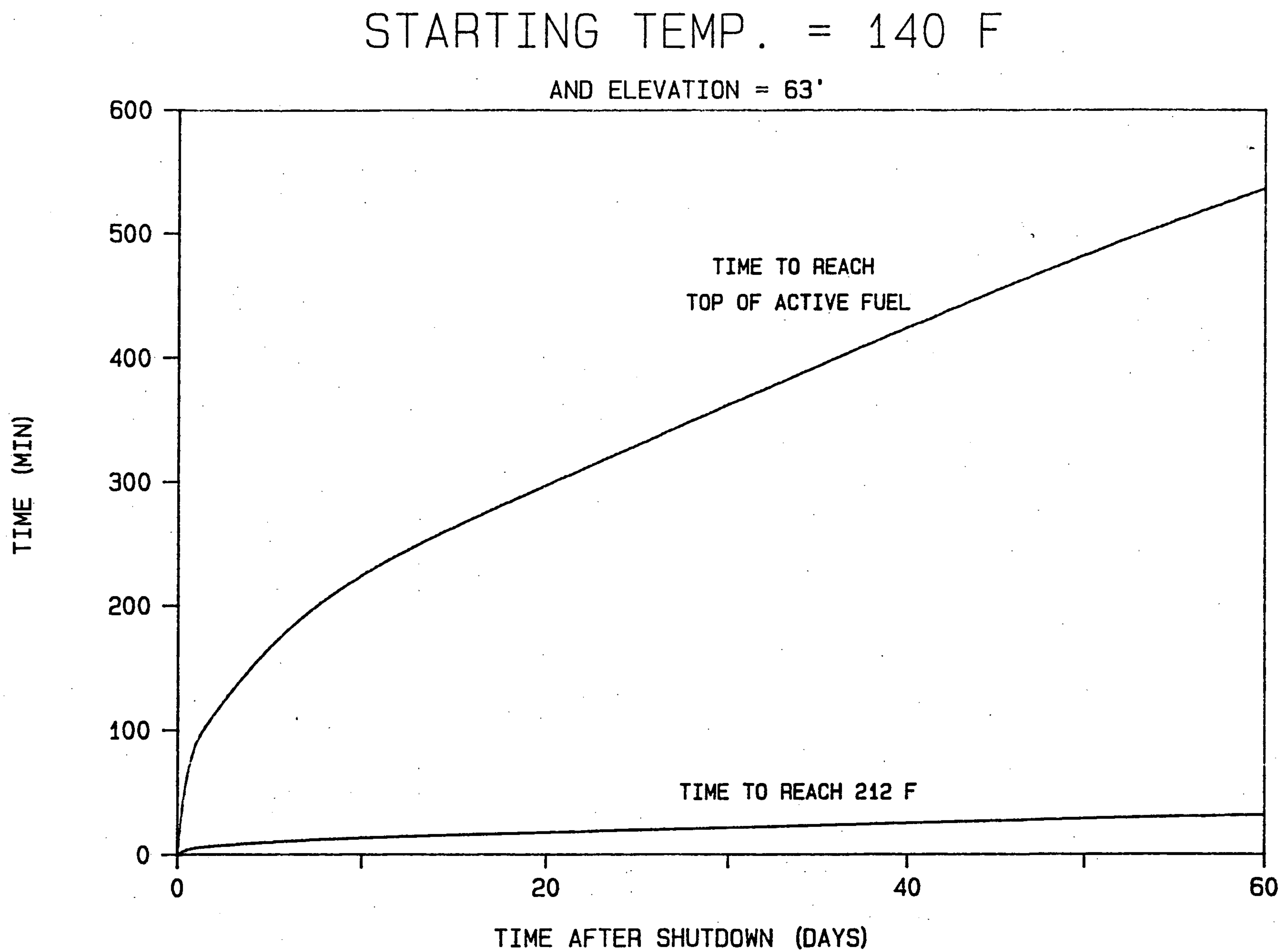

STARTING TEMP. = 140 F
AND ELEVATION = 63'
TIME (MIN)
600
500
400
300
200
100
0
TIME TO REACH
TOP OF ACTIVE FUEL
TIME TO REACH 212 F
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 6

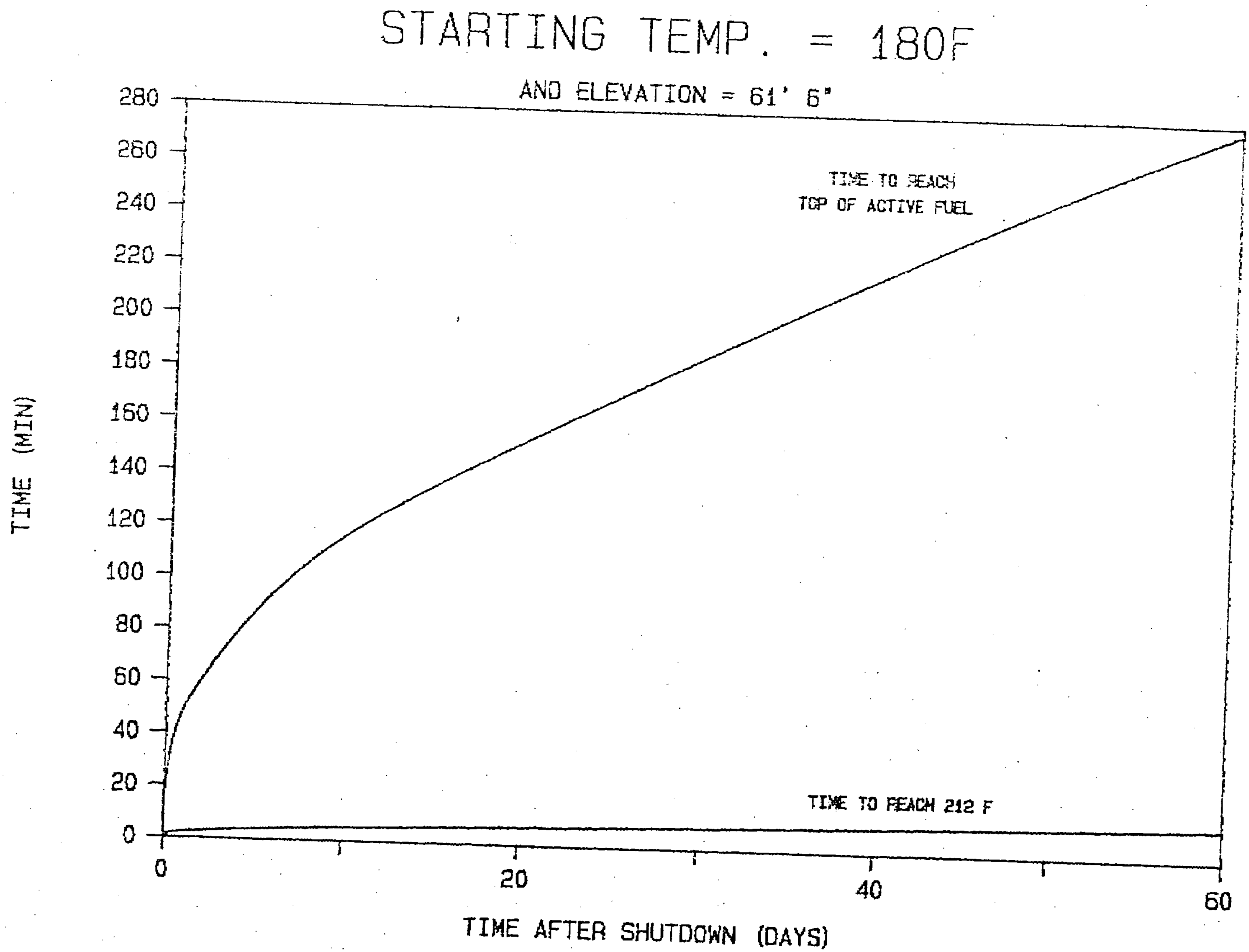

STARTING TEMP. = 180F
AND ELEVATION = 61' 6"
TIME TO REACH
TOP OF ACTIVE FUEL
TIME TO REACH 212 F
TIME (MIN)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 7

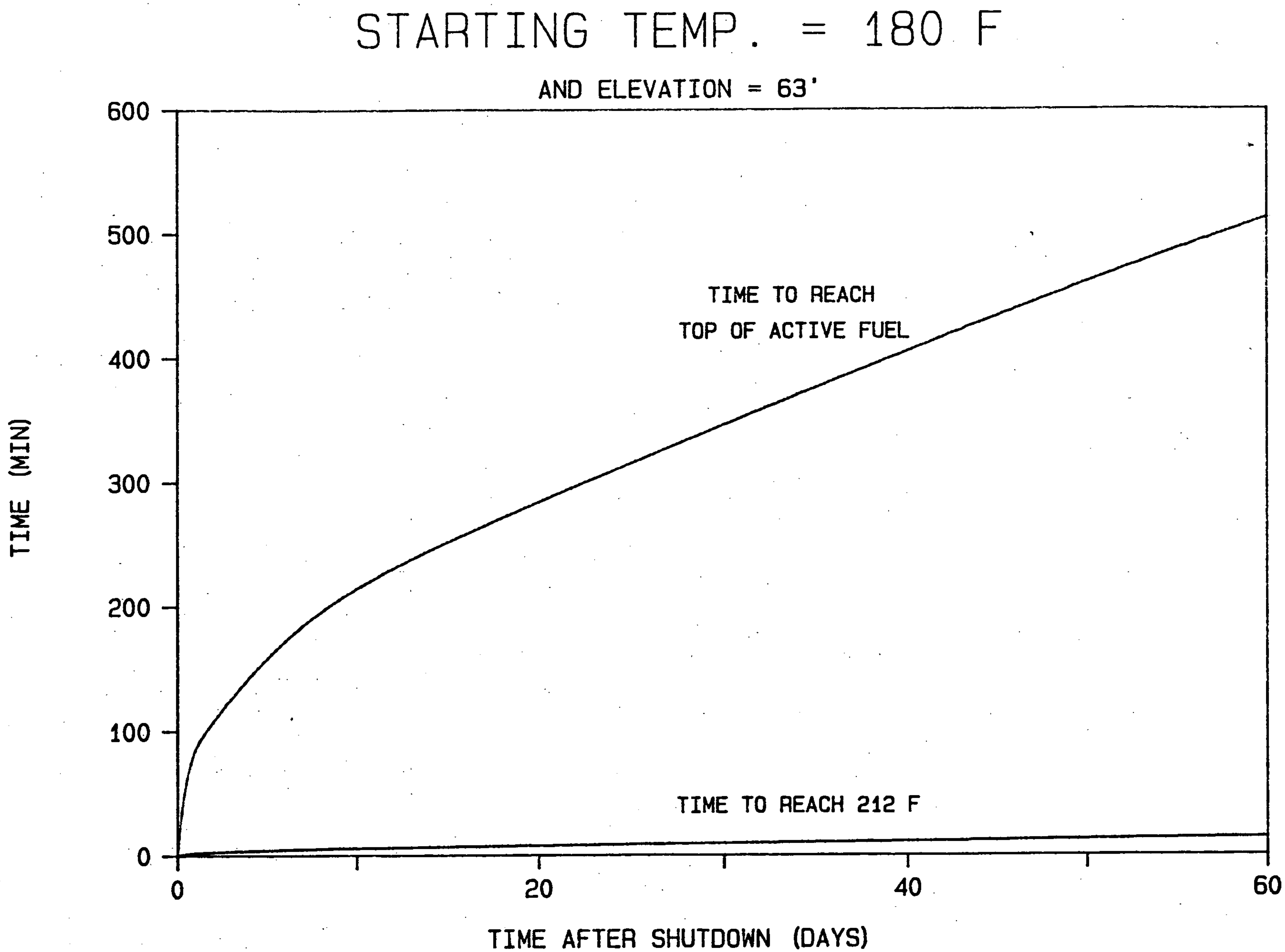

STARTING TEMP. = 180 F
AND ELEVATION = 63'
TIME TO REACH
TOP OF ACTIVE FUEL
TIME TO REACH 212 F
TIME (MIN)
0
100
200
300
400
500
600
0
20
40
60
TIME AFTER SHUTDOWN (DAYS)

Figure 8

DECAY HEAT RATE vs. TIME AFTER SHUTDOWN

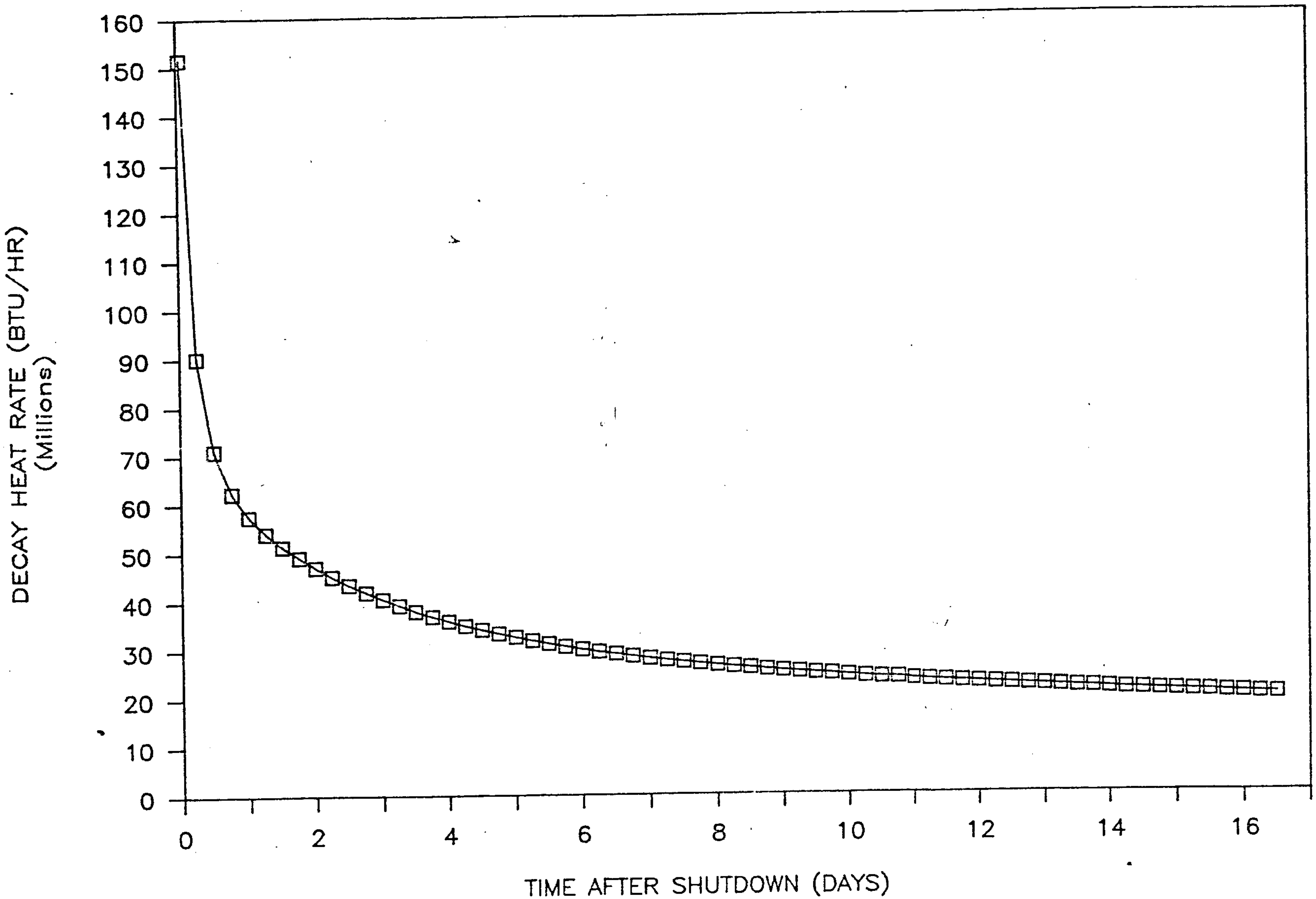


Figure 9

6) A brief description of training provided to operators and other affected personnel that is specific to the issue of operation while the RCS is partially filled. We are particularly interested in such areas as maintenance personnel training regarding avoidance of perturbing the NSSS and response to loss of decay heat removal while the RCS is partially filled.

Response

Lesson plans for Reactor Coolant and Residual Heat Removal Systems address:

- o the minimum levels for draindown/mid-loop operation to prevent vortexing/air-entrainment which can lead to pump cavitation
- o the necessity for frequent monitoring of RCS level and RHR pump operation
- o the elevation at which suction line uncovery and the potential for vortexing exists.

Historical RHR problems and their root causes are incorporated into training. Loss of RHR capabilities as emphasized in Training require immediate actions for its restoration, including alternate core cooling methods, and are addressed by referencing the appropriate procedure.

Causes and affects of inaccurate level indications due to uncommon vent paths, sensing line blockage, instrument venting/calibration/isolation, density differences, leaks/evaporation and draindown lag have been addressed.

We are presently incorporating appropriate lessons learned as a result of the Diablo Canyon Event into training.

7) Identification of additional resources provided to the operators while the RCS is partially filled, such as assignment of additional personnel with specialized knowledge involving the phenomena and instrumentation.

Response

We have reviewed our experience in this area and conclude that no additional resources are required beyond those normally available. During the forthcoming outage, personnel are assigned on an extended around the clock basis. Personnel who may have special knowledge are available around the clock via telephone for consultation and/or call in.

8) Comparison of the requirements implemented while the RCS is partially filled and requirements used in other Mode 5 operations. Some requirements and procedures followed while the RCS is partially filled may not appear in the other modes. An example of such differences is operation with a reduced RHR flow rate to minimize the likelihood of vortexing and air ingestion.

Response

The precautions, limitations and restrictions have been identified in the responses to the above questions as well as the attached procedures, for operation at mid-loop. Where differences exist between this mode of operation and others encountered during operation at cold shutdown, they have been identified.

9) As a result of your consideration of these items, you may have made changes to your current program related to these issues. If such changes have strengthened your ability to operate safely during a partially filled situation, describe those changes and tell when they were made or are scheduled to be made.

Response

1) RHR flow is to be minimized to maintain temperature.

2) Draindown is to cease if excessive deviation between level instruments is noted until stabilization is achieved.

3) Draindown below Elevation 63':

   a) Is prohibited unless RCS I-131 concentration is less than 9.0E-3 microcuries/cc

   b) Is prohibited until 96 hours (4 days) after initiation of hot shutdown.

   c) One safety injection pump is operable.

4) Added requirement to vent reactor head to Containment if vacuum or excessive level variation is noted.

5) Draindown is only permitted if one RHR pump is sufficient to accommodate decay heat removal.

6) A separate procedure is being developed to address draindown below El. 63'.

ATTACHMENT B

CHANGES TO EXISTING PROCEDURES AS RESULT OF GENERIC LETTER 87-12

1. SOP 1.2 - RCS DRAINDOWN

   a) Split SOP 1.2 into five procedures:

      1. SOP 1.2 - Preparation for draindown including placing RCS level instrumentation in service.

      2. SOP 1.2.1 - Draindown from level in Pressurizer to 63' 10 inches using RHR letdown to CVCS.

      3. SOP 1.2.2 - Draindown from level in Pressurizer to 62' 10 inches using RHR to RWST.

      4. SOP 1.2.3 - Draindown from level in Pressurizer to 62' 10 inches using Loops drains via RCDT to CVCS or WHOT.

      5. SOP 1.2.4 - Draindown from 62' 10 inches using letdown flow integrator to CVCS.

   b) Added requirement to minimize RHR flow by maintaining temperature with one pump and two heat exchangers with Component Cooling Water Flow.

   c) Added additional note in draindown log to stop draindown and allow system to stabilize if excessive deviation between level instruments.

   d) Added requirement to vent Rx head as necessary if vacuum is indicated per draindown level log.

   e) Added time to Boil RCS on loss of RHR.

   f) Added prerequisite for draindown below 63 ft. el.

      a) One SIS pump available.
      b) RCS Iodine Activity less than 9.0E-3 microcuries/cc

2. SOP 4.2.1 - RHR OPERATION

   a) Changed P&L to frequently monitor RCS level at 63 ft. vice 62 ft. to be consistent with SOP 1.2.

   b) Added time to Boil RCS on loss of RHR.

   c) Added one SIS pump available when RCS less than 63 ft. el.

3. A-4.2.1 - LOSS OF RHR

   a) Added time to Boil RCS on loss of RHR.

   b) Added caution to determine cause of RHR pump loss prior to pump restart or staring other pump.

4. ARP SGF - Auxiliary Coolant

   RCS Low Level

   a) Added caution of RCS heat-up to boiling on loss of RHR.

   b) Changed procedure reference from SOP 1.1 to A 4.2.1 in order to improve response time.

5. LOG SHEET CHANGES

   DSR-17 - CCR COLD S/D TURNOVER CHECKLIST

   a) Added status of Rx head and S/G Manways.

   b) Developed new SWS Cold S/D Turnover Checklist to include equipment in DSR-17 (new Checklist designated DCR-21).