PACIFIC GAS AND ELECTRIC COMPANY
STATION CONSTRUCTION DEPARTMENT
DIABLO CANYON PROJECT

UNIT 1

TEST PROCEDURE NO. 42.7

NATURAL CIRCULATION BORON MIXING TEST

1.0 TEST PURPOSE

This test will accomplish the following:

1) Verify that the Reactor Coolant System can be borated to the COLD SHUTDOWN concentration.

2) Confirm that adequate mixing of borated water added prior to cooldown can be achieved under natural circulation conditions.

3) Confirm cooldown and depressurization of the reactor from normal HOT STANDBY to COLD SHUTDOWN conditions can be accomplished using only safety related equipment.

4) Obtain reactor vessel head cooldown rates.

5) Verify adequate water volume available in the Condensate Storage Tank to cooldown the plant.

2.0 TEST DESCRIPTION

After the 100 hour Acceptance Test (Ref. T.P. 43.6), the main turbine and reactor will be tripped and the plant allowed to stabilize to HOT STANDBY Conditions (Ref. T.P. 43.4). With the Reactor Coolant System (RCS) at specified HOT STANDBY (MODE 3) conditions, all Reactor Coolant Pumps will be tripped, natural circulation conditions established and then 900 gallons of 12% Boric Acid injected into the RCS by aligning a centrifugal charging pump to the Boron Injection Tank.

The RCS will be maintained at HOT STANDBY conditions for at least four hours and sampled every twenty minutes to verify boron mixing. When the RCS boron concentration (C_B) is stable (± 20 ppm between loops) and at least 4 hours have elapsed since natural circulation had been established, cooldown of the RCS will commence using the 10% atmospheric steam dumps. RCS Coolant volume and RCP seal flow will be maintained by charging blended Boric Acid from the VCT.

When RCS temperature of less than 350 deg. F has been reached, depressurization of the RCS will commence. Once an RCS temperature and pressure of approximately 350 deg. F and 425 psig have been established, the RHR system will be aligned to the RCS and the plant brought to COLD SHUTDOWN conditions (MODE 5).

2.8 (Continued)

test will terminate when 1) the temperature in all RCS hot legs is less than 200 deg. F, 2) fluid temperature in the Upper Head region is less than 300 deg. F and 3) RCS decay heat is being removed by the RHR system.

Listed below is a general outline of the tests' sequence of events:

ACTIVITY

1) Trip Plant From 100% Power (T.P. 43.4)

2) Stabilize to HOT STANDBY Conditions (Section 5.0)

3) Establish Natural Circulation (Section 6.1)

4) Inject BIT, Verify Boron Mixing and Maintain HOT STANDBY for 4 Hrs. (Section 6.2)

5) Cooldown to RHR Initiation (Section 6.3)

6) Depressurize to RHR Initiation (Section 6.4)

7) Stabilize to COLD SHUTDOWN using RHR (Section 6.5)

3.0 REFERENCES

3.1 Piping Schematics:

Reactor Coolant System	102007-17
Chemical and Volume Control System	102008-25
Nuclear Steam Supply Sampling System	102011-19

3.2 DCPP Unit I Technical Specifications

3.3 Diablo Canyon FSAR

3.4 Precautions, Limitations and Setpoints 663229-47-11

3.5 Instrument Schematics:

Multivariable Instrument System	102036-18
Flow Instrument System	102032-21
Pressure Instrument System	102034-22

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3.6 Nuclear Plant Operations Department Emergency Operating Procedures

OP-0.1	Reactor Trip Response
OP-4	Loss of All AC Power
OP-0.2	Natural Circulation Cooldown

3.7 Nuclear Plant Operations Department Operating Procedures

L-5	Plant Cooldown from Minimum Load to COLD SHUTDOWN
K-1	Compressed Air System (Part 4)
B-2	Residual Heat Removal System
A4:V	Pressurizer Heaters - Emergency Operation
B-1C:I	12% Boric Acid System - Place in Service
AP-6	Emergency boration
AP-17	Loss of Charging
AP-18	Loss of Normal Letdown
AP-19	Malfunction of Reactor Makeup Control System

3.8 Startup Test Procedure 40.0 - Startup Program Master Document

3.9 1967 ASME Steam Tables

3.10 Diablo Canyon "Q" List

3.11 "Natural Circulation Pre-Test Report"

3.12 NRC Branch Technical Position RSB 5-1, "Design Requirements of the Residual Heat Removal System".

3.13 Diablo Canyon Site Units 1 and 2 Final Safety Analysis Report Appendix J, "Systems/Equipment for Achieving and Maintaining Hot Standby and Cold Shutdown of Diablo Canyon Unit Nos. 1 and 2 following SSE."

4.0 PREREQUISITES

4.1 Steam Dump System available as required (minimum 10% capacity).

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4.2 The Test Recorders listed on the attached Data Sheet entitled "Recorder Parameter Check List" have:

a) required calibration information recorded _____

b) been connected to test points for data acquisition _____

c) scaling adjusted per above Data Sheet _____

d) associated traces identified with parameter measured, recorder and test point number, chart speed, scaling and time and date _____

e) calibration information listed for the associated recorder and test points "TEST INSTRUMENT LIST" (Form S-50). _____

4.3 Condensate Storage Tank 1-1 contains sufficient water to complete this test. (90% level minimum). Record the level _____% _____

4.4 Verify that Aux. Boiler 0-1 or 0-2 are aligned to CST 2-1 and are available to supply gland steam to the condenser. _____

4.5 Minimum of 100 clean bottles available for boron samples. _____

4.6 Chem. lab set up to give boron concentration analysis. _____

4.7 RCS boron concentration has stabilized. Record the value: _____ppm. _____

4.8 Verify that magnetic thermocouples (T/C's) have been attached to the vessel head and that a temperature recording device is available. Indicate T/C locations on Figure 1. _____

NOTE: Record instrument data and verify calibration on the attached TEST INSTRUMENT LIST.

4.9 Verify that the P-250 has been reprogrammed so that T/C maps can be obtained without RCP's running. _____

4.10 Arrange to have incore thermocouple data (short form) printed on request. _____

NOTE: If the P-250 program is not operable, thermocouple maps can be obtained from PAM 3 and PAM 4 panels.

4.11 Verify Sub-Cooled Margin Monitor is in service. _____

4.12 Verify a minimum of 8,000 gallons of 12% boric acid is available. _____

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NOTE: This should satisfy the minimum Tech. Spec. Requirement of 5106 gallons and an estimated usage of approximately 2000 gallons during the performance of this test.

4.13 Verify incore thermocouple recorders on PAM I panel are in service. _____

NOTE: These recorders (2 pen recorders, TR65 A&B) record both the highest and next highest thermocouple temperatures for Trains A and B respectively.

4.14 Verify that instrumentation to record accumulator pressures have been installed on the following back-up air accumulators:

4.14.1 Back-up accumulator for valves 8145, 8146, and 8147 _____

4.14.2 Back-up accumulator for valve 8148 _____

4.14.3 Back-up accumulator for PCV-455C _____

4.14.4 Back-up accumulator for PCV-456 _____

4.14.5 Back-up accumulator for HCV-142 _____

4.14.6 FCV-364 RHR Hx 1-1 CCW Supply Valve _____

4.14.7 FCV-365 RHR Hx 1-2 CCW Supply Valve _____

4.14.8 FCV-602 ASW Supply to CCW Hx 1-1 _____

4.14.9 FCV-603 ASW Supply to CCW Hx 1-2 _____

NOTE: The compressed air bottles for the 100% steam dumps have test gauges installed already. Record instrument ranges and accuracies on the attached S-50 Test Instrument List.

4.15 All test instruments and permanent plant instruments necessary for data acquisition are available, calibrated and listed with the appropriate information on the attached Test Instrument List (S-50 Form). _____

5.0 INITIAL CONDITIONS

In the conduct of this test, some equipment will be employed which may not be available during actual emergency Natural Circulation conditions. Such equipment and the justification for using it are specified below:

a) Reactor Makeup Control System is employed to retain the VCT as the charging pump suction supply rather than transferring suction to the RWST, due to potentially high dissolved oxygen levels in RWST.

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5.0 (Continued)

b) The Control Rod Drive Mechanism (CRDM) lift, stationary and holding coils are designed to operate at temperatures between 68 deg. F and 392 deg. F. Therefore, the CRDM fans will be operated to protect the CRDM coils. Once the reactor vessel head temperature approaches 350 deg. F the CRDM fans will be tripped so that vessel head cooldown rate can be determined without the CRDM fans operating.

c) If steam dump usage exceeds the available capacity of the Condensate Storage Tank, CST makeup will be initiated by aligning the Hotwell Reject to the CST. Note any CST makeup requirements in the attached "Remarks" section.

NOTE: Steps 5.1 through 5.8 shall be performed prior to the plant trip.

NOTE: The following trend data is taken for information only. Therefore, if a trend point is not available, enter N/A in the checkoff space and continue with the test.

5.1 Place the following points on a computer trend block:

a) Wide range temperatures

	Loop 1	Loop 2	Loop 3	Loop 4
Thot	T0419A_____	T0439A_____	T0459A_____	T0479A_____
Tcold	T0406A_____	T0426A_____	T0446A_____	T0466A_____

b) RCL 1.4 Hot Leg Pressure

P0499A _____

c) Pressurizer Pressure - Choose one channel, enter N/A for those channels not monitored

Channel 1	Channel 2	Channel 3	Channel 4
P0480A _____	P0481A _____	P0482A _____	P0483A _____

d) Pressurizer Level Channels - Choose one channel, enter N/A for those channels not monitored

L0480A _____ L0481A _____ L0482A _____

e) Pressurizer Vapor Temperature

T0481A _____

f) Pressurizer Liquid Temperature

T0480A _____

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5.1 (Continued)

g) Steam Generator Level (Narrow Range)

SG 1	SG 2	SG 3	SG 4
L0400A _____	L0420A _____	L0440A _____	L0460A _____

h) Steam Generator Pressure - Choose one channel per steam generator; enter N/A for those channels not monitored.

S/G 1-1	S/G 1-2	S/G 1-3	S/G 1-4
P0400A _____	P0420A _____	P0440A _____	P0460A _____
P0401A _____	P0421A _____	P0441A _____	P0461A _____
P0402A _____	P0422A _____	P0442A _____	P0462A _____

i) Regeneration Heat Exchanger Charging Flow Temperature

T0126A _____

j) Charging Flow

F0128A _____

k) Condensate Storage Tank level

L2200A _____

l) NIS Source Range

N0031A _____ N0032A _____

m) Control Rod Drive Mechanism Fan Suction Temperatures

CRDM 1-1	CRDM 1-2	CRDM 1-3	CRDM 1-4
T1034A _____	T1039A _____	T1044A _____	T1061A _____

n) Vessel Shield Wall Temperature

Southeast	Southwest	Northwest	Northeast
T0720A _____	T0721A _____	T0722A _____	T0723A _____

5.2 Place the following incore T/C's on a computer trend block:

TT 16	TT 21	TT 25	TT 49
T0016A _____	T0021A _____	T0025A _____	T0049A _____

NOTE: These T/C's have been modified to monitor the upper head fluid temperature.

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5.3 Isolation valves for Pressurizer power operated relief valves open and operable.

8000A _____
8000B _____
8000C _____

5.4 Pressurizer liquid sample space on recirculation to VCT. _____

5.5 CRDM fans ON. (Three fans minimum.) _____

5.6 Verify centrifugal charging pumps' recirculation paths are properly aligned.

1-1 _____
1-2 _____

5.7 Primary Water makeup Pumps 1-1 and 1-2 are available. _____

5.8 A Shutdown Margin Calculation, STP R-19, has been performed to verify adequate shutdown margin for Mode 3 Hot Standby conditions. _____

5.9 Reactor has been tripped from 100% power (Ref. T.P. 43.4). Record date and time of the trip:

Date _____ Time _____ _____

5.10 Plant is stabilizing to HOT STANDBY Conditions per T.P. 43.4. _____

5.11 Source Range Nuclear Instruments are in operation (i.e. P-6 is cleared). _____

5.12 All Reactor Coolant Pumps running. _____

5.13 Steam pressure maintained at approximately 1005 psig by using steam dump to condenser (Steam Header Pressure Control). _____

5.14 Charging and letdown lines in service with one centrifugal charging pump on line. _____

5.15 Start the Vessel Head Magnetic T/C recorder. _____

5.16 Isolate these lines to/from U-1 CST:

a) CST to Unit 2 CST _____
b) CST to package boiler _____
c) CST to transfer pumps _____
d) Evaporator Distillate to CST _____

5.17 Communication established between the Control Room and test personnel at Reactor Vessel Head Temperature Recorder. _____

5.18 Obtain coolant samples from Loop 1 or Loop 4 (not both) and Pressurizer liquid space at twenty (20) minute intervals. Label each sample with source of sample and date and time taken. Continue sampling until termination of test. Record results on Data Sheet No. 1.

Initially Selected Loop Sample Point _____ _____

NOTE: The interval for taking core maps and boron samples may be changed during the conduct of the test at the direction of the Test Director.

DATA ACQUISITION:

Good engineering practice is to be used when compiling data (i.e. adequate scaling of recorders, indication of events that affect the measured parameter, etc.).

In addition, it is imperative that all data obtained for this test procedure be properly labeled so that later identification and evaluation will be possible. This requires that each piece of trend data, recorder output, etc. be labeled with T.P. number, date, time, parameter, input source, scaling, chart speed, etc.

When applicable, data recorded in this procedure will be obtained from the P-250 printout. the S-50 Form for trend points used.

6.0 TEST INSTRUCTIONS

6.1 SIMULATION OF LOSS OF OFF-SITE POWER - ESTABLISHING NATURAL CIRCULATION

PRECAUTIONS

a) Avoid sudden changes in steam pressure.

b) Maintain differential pressure between the RCS and the steam generators' secondary side to less than 1600 psid.

c) Avoid sudden changes in auxiliary feedwater flow or in steam generator water level.

d) Avoid overpressurization of the Pressurizer Relief Tank through excessive use of the Pressurizer power operated relief valves.

e) To minimize temperature transients to the pressurizer during the plant shutdown operation, the following precautions should be observed:

If used, the auxiliary spray flow from the charging pumps should be initiated cautiously.

6.1 (Continued)

In accordance with Technical Specification 3.4.9.2, auxiliary spray flow into the pressurizer shall not be initiated if the temperature difference between the pressurizer and the spray fluid exceeds 560 deg. F. If the temperature difference exceeds 320 deg. F, (320 deg. F is an administration limit) refer to the cyclic limits (12) of Table 5.7-1 of the Technical Specifications. When applicable, perform STP M-55.

The maximum cooldown rate for the pressurizer averaged over 30 minute periods must not exceed 200 deg. F/hr.

f) Do not remove the CRDM ventilation system from operation whenever Reactor Vessel Head temperature is >350 deg. F or when the control rod drive mechanisms are energized.

g) Though CVCS letdown is not safety grade, it will be used, as required, to maintain pressurizer level within operating range during the period at hot standby. However, during Boration Phase, it will be isolated until the acceptance criteria for boron mixing is verified.

h) Do not exceed any Tech. Spec. limits regarding RCS temperatures and pressures while in the process of cooling down from HOT STANDBY conditions to COLD SHUTDOWN conditions. (Reference attached Figure 2.)

i) Once Natural Circulation conditions have been established, Test Termination must occur if any of the following conditions are met:

a)	Primary System sub-cooling (Tsat margin)	≤15 deg. F
b)	Steam Generator Water level	< 5% Narrow Range Span
c)	Pressurizer Water Level	17% > span > 92%
d)	Any loop ΔT	> 65 deg. F
e)	Tavg	> 577 deg. F
f)	Core Exit Temperature (highest)	> 610 deg. F
g)	Source Range NIS	Unexplained increase in count rates
h)	Pressurizer Pressure	> 2350 psig

NOTE: Maximum cooldown rate must not exceed 25 deg. F/hr averaged over a 20 minute period. Rate of temperature change will be determined from average incore thermocouples (T/C) readings.

6.1.1 Verify that the plant is at stable HOT STANDBY Conditions following the trip from 100% RTP. Record the time: _____ hours. _____

6.1.2 Verify/Record the following:

6.1.2.1 RCS parameters at nominal HOT STANDBY values (547 deg. F and 2235 psig).

Temperature _____ Pressure _____ _____

6.1.2.2 Steam pressure maintained at approximately 1005 psig by using steam dump to condenser (Steam Header Pressure control). Record steam lead pressures.

Lead 1_____psig Lead 3_____psig
Lead 2_____psig Lead 4_____psig _____

6.1.2.3 Pressurizer level and pressure being maintained at nominal HOT STANDBY values (22% and 2235 psig respectively).

Level_____ Pressure_____ _____

6.1.2.4 Steam Generator level being maintained at nominal HOT STANDBY value (33%).

SG 1_____ SG 3_____
SG 2_____ SG 4_____ _____

6.1.3 Start the chart recorder(s). Verify all channels are recording (chart speed approximately 2 cm/min). _____

NOTE: Operation of the chart recorder(s) during the test shall be at the direction of the Test Director. Data should be recorded at a speed commensurate with the conditions/transient expected - relatively fast (approximately 2 cm/min.) for RCS flows and Pressurizer pressure during RCP trips, initial establishment of natural circulation conditions, etc.; and slow (approximately 5 cm/hour) for other parameters and once conditions no longer require a fast speed. Always note chart speed changes on the trace.

1.4 Start P-250 computer trend of points listed in Steps 5.1 and 5.2. Trend data at two (2) minute intervals. _____

NOTE: The trend interval may be changed during the conduct of the test at the direction of the Test Director.

6.1.5 Take first core thermocouple map. Continue taking core maps at twenty (20) minute intervals. _____

6.1.6 Verify CVCS is in MANUAL and set to make up to the VCT with approximately 1200 ppm boric acid. Let VCT level rise to 60%. _____

NOTE: VCT is providing suction for the charging pumps. Monitor VCT level and Chg. Pp. suction pressure continually. Also, set Boric Acid and Primary Water Flow integrators, YIC-110 and YIC-111, high enough to prevent their perturbing the blended flow.

6.1.7 Record Condensate Storage Tank level. Continue recording CST levels on Data Sheet No. 1 at 20 minute intervals until the test terminates.

_____% Start time_____ _____

6.1.8 Start/verify started Special Test Exception 3.10.4 Surveillance Requirements by performing the following:

1.8.1 Verify once per 4 hours that at least three reactor coolant loops are operable. _____

6.1.8.2 Verify once per 4 hours that the fire-water tank and its path to the auxiliary feedwater pump are operable. _____

NOTE: Data Sheet S-1 will be used to log verification of Tech. Spec. Surveillance Requirements.

NOTE: The following equipment alignment has been selected to minimize the use of non-safety related equipment. If safety concerns arise which necessitates the use of non-safety related equipment, the action shall be noted in the Remarks Section of this procedure and the test performance shall continue.

6.1.9 Verify that Pressurizer Heater Groups 1-2 and 1-3 are aligned to their vital power supplies.

1-2 _____ 1-3 _____ _____

6.1.10 Verify that the following valves have been aligned to their Class I air sources (i.e., Non-Class I Air Sources Isolated):

a)	PCV-19	(10% Atmospheric Steam Dump)	_____
b)	PCV-20	(10% Atmospheric Steam Dump)	_____
c)	PCV-21	(10% Atmospheric Steam Dump)	_____
d)	PCV-22	(10% Atmospheric Steam Dump)	_____
e)	8145	Auxiliary Pressurizer Spray Valve	_____
f)	8146	Charging to Loop 4 Cold Leg	_____
g)	8147	Charging to Loop 3 Cold Leg	_____
h)	8148	Auxiliary Pressurizer Spray Bypass	_____
i)	HCV-142	Charging Pumps Discharge to Regen. Hx	_____
j)	PCV-455C	Pressurizer Power Operated Relief Valve	_____
k)	PCV-456	Pressurizer Power Operated Relief Valve	_____
l)	FCV-364	RHR Hx 1-1 CCW Supply Valve	_____
m)	FCV-365	RHR Hx 1-2 CCW Supply Valve	_____
n)	FCV-602	ASW Supply to CCW Hx 1-1	_____
o)	FCV-603	ASW Supply to CCW Hx 1-2	_____

NOTE: Once the Class I Air has been aligned, record time and initial accumulator pressures on Data Sheets III and IV. Continue taking accumulator pressure readings on an hourly frequency or at the discretion of the Test Director.

6.1.11 Verify containment supply and exhaust fans are shutdown.

S-3 _____ E-3 _____ _____

6.1.12 Transfer steam dump control from the condenser steam dumps to the 10% atmospheric steam dumps. _____

NOTE: The 10% steam dumps are aligned to their Class I air bottles. Therefore, their operation is limited to their ON/OFF toggle switches on VB-3.

CAUTION: Maintain steam pressure at zero load steam pressure (1005 psig) until cooldown commences.

If the MSIV's are closed, balance the use of the 10% steam dumps to avoid 100 psid among the steam generators. Otherwise Safety Injection will be actuated.

6.1.13 Place the following valves in the CLOSED position:

6.1.13.1 LCV-8 CST makeup to hotwell. _____

6.1.13.2 LCV-12 Hotwell rejection to CST. _____

6.1.14 Place control switch for PCV-474 in the CLOSED position. Comply with the appropriate action statement of Tech. Spec. 3.4.4. _____

6.1.15 Turn off the Pressurizer Proportional Heater Group 1-1 and Backup Heater Group 1-4. _____

NOTE: Maintain RCS pressure within Tech. Spec. limits at all times during the test. During boration and cooldown phases, use PORV's and heater groups 1-2 and 1-3 for this purpose. Record on Data Sheet II all operating times of PORV's and heaters. Per Tech. Spec 3.4.9.3, a special report shall be prepared if the PORV's are used to mitigate a pressure transient.

NOTE: There is no regenerative heat exchanger with letdown terminated. Normal and alternate charging lines have thermal sleeves; pressurizer auxiliary spray line does not.

6.1.16 Terminate letdown by closing the letdown orifice stop valves.

8149A _____
8149B _____
8149C _____

6.1.17 Close off charging flow to the RCS.

NOTE: Maintain RCP seal flows.

8146 CLOSED _____
8147 CLOSED _____

NOTE: At the initiation of natural circulation from RCP trip the following instrumentation responses are expected.

a) Wide range Thot - increase
b) Wide range Tcold - slight decrease or constant
c) Core exit T/C's - increase
d) Tavg and Δ T indications - unreliable
e) Pressurizer level and pressure - increase
f) Steam Generator levels - slight variation in response to steam usage
g) Steam Generator Pressure - decrease slightly
h) NIS indications - constant or slight variation with Tcold
i) Auxiliary Feedwater Flows - increase in response to item f)
j) Steam Generator Steam Flows - constant or slight variation in response to item g)
k) RCS Flows - nearly full scale decrease (100% to less than 10%)

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NOTE: The following step allows restart of the RCP's after natural circulation is established, if safety concerns necessitate re-establishment of forced circulation. However, RCP's should not be restarted for 30 minutes after a pump trip.

6.1.18 Start all four RCP Thrust Bearing Oil Lift pumps not more than 50 seconds prior to tripping the RCP's in the next step. _____

6.1.19 Close the Pressurizer Spray valves.

PCV 455A CLOSED _____
PCV 455B CLOSED _____ _____

6.1.20 Simutaneously trip all four RCP's. Record time on Data Sheet S-1. _____

NOTE: Verify by using Data Sheet S-1 that all Special Test Exception Prerequisites have been met.

NOTE: If PORV's open but fail to close, immediately close the PORV block isolation valve (8000 A, B, or C).

6.1.21 HOT STANDBY conditions have to be maintained for at least four hours. Therefore, if necessary, use Pressurizer Heaters 1-2 and 1-3 to maintain HOT STANDBY conditions. Record on Data Sheet II whenever the Pressurizer Heaters are used. _____

6.1.22 Carefully control Auxiliary Feedwater flow to the steam generators to maintain levels at approximately 33% narrow range (N.R.). _____

6.1.23 Verify the establishment and effectiveness of Natural Circulation by checking the following conditions. (Refer to OP-0.2, Natural Circulation Cooldown). Record approximate values of the parameters listed below on the attached "Natural Circulation Data Sheet" at intervals shown.

NOTE: Stable Natural Circulation flows may be attained prior to the end of the 15 minute interval. If this occurs, enter N/A in those spaces where data is no longer required.

NOTE: Monitor sub-cooled margin monitor throughout the establishment of Natural Circulation and during the cooldown phase of the test. The recorder (YR31) data from this monitor on PAM I panel will be attached to this procedure at the completion of the test.

a) Core exit temperature is at least 50 deg. F cooler than pressurizer temperature and exhibits stable or decreasing values.

b) Cold leg temperatures are approximately equal to S.G. saturation temperature.

c) Hot leg temperatures are stabilizing and hot to cold leg ΔT should be less than 65 deg. F.

6.1.24 Natural circulation flow will be stable when:

a) ΔT between wide range Thot and Tcold is approximately constant.

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b) Δ T between wide range Tcold and core exit T/C average temperature is approximately constant.

c) Wide range Thot is approximately equal to core exit T/C average temperature.

Record time when Natural Circulation was declared established.

Time _____ hrs. _____

6.1.25 Re-establish letdown, and bring down and maintain Pressurizer level at about 22%. _____

6.1.26 Isolate letdown prior to Boration Phase. _____

6.2 BORATION PHASE

COMMENTS: Boric Acid will be added to the RCS by discharging the Boron Injection Tank into all four cold legs and by charging into the RCP seals. Boron mixing will occur at 547 deg. F (Tcold) and nominal RCS pressures.

6.2.1 Close BIT Boric Acid recirc. to Boric Acid Storage Tank valves.

8870A and 8870B _____
8911 _____

6.2.2 Record Pressurizer level. _____% _____

RCS Boron Concentration _____ ppm _____

6.2.3 Align charging pump to BIT.

8803A and 8803B OPEN _____
8801A and 8801B OPEN _____

Allow pump to run in this configuration for approximately 30 minutes. Record injection start time (Use Control Room clock).

_____hrs. _____

CAUTION: VCT makeup is in MANUAL. Maintain VCT levels around 60%. This should assure adequate NPSH for charging pump. When discharging to BIT, blend 1200 ppm Boric Acid to VCT.

VCT: 1% = 19.25 gallons

NOTE: Injection of the BIT will cool the RCS. Pressurizer Heaters 1-2 and 1-3 may have to be used to maintain HOT STANDBY conditions (Ref. Step 6.1.21).

With letdown isolated and the Pressurizer level at approximately 22% prior to the Boration Phase, the Pressurizer level is expected to stabilize at about 70% after the injection of the BIT is complete (Pressurizer high level alarm will occur at ≈70%).

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6.2.4 After the injection phase, terminate charging flow through BIT and record time. Record total injection time.

_____hrs. Total injection time _____min. _____

6.2.5 Record Pressurizer level.

_____% _____

6.2.6 Continue to sample the selected RCS hot leg. When three (3) consecutive boron concentration measurements are within ±20 ppm of each other, record values and change sampling point to the alternate hot leg.

Selected sample point loop _____

Sample No.	_____	_____	_____	
Boron Conc.	_____	_____	_____	
Time of Sample	_____	_____	_____	_____

NOTE: Purge sample line adequately before taking alternate leg sample.

NOTE: As loop concentrations stabilize, it is permissible to allow VCT levels to decrease to normal levels. This anticipates change of blend concentration to 2000 ppm in cooldown phase.

6.2.7 Verify alternate leg sample boron concentration is within ±20 ppm of the final selected loop value. Record Loop 4 and Loop 1 boron concentration.

Loop 1 _____ppm Loop 4 _____ppm _____

NOTE: If Loops 4 and 1 are not within ±20 ppm of each other, repeat Steps 6.2.6 and 6.2.7 as necessary and record the Loop being sampled in Step 6.2.7 as the selected Loop.

6.2.8 Verify boron concentration has increased from initial boron concentration (6.2.2) by at least 250 ppm. _____

Loop 1 _____ppm Loop 4 _____ppm

6.2.9 Once the boron samples for Loop 1 and Loop 4 meet the acceptance criteria, (initial RCS boron concentration +250 ppm) letdown can be reestablished to maintain pressurizer level. _____

6.3 COOLDOWN PHASE

COMMENTS: Cooldown will reduce the RCS hot leg temperatures to below 350 deg. F and upper vessel head fluid temperature to below 450 deg. F. RCS pressure is expected to continue drifting down but, in all cases, will be maintained within Tech. Spec. limit and the shaded area in Fig. 2. Depressurization will be initiated, if necessary, by using the indication on the subcooled margin monitor. This is to ensure no steam formation

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will occur in the upper head region. Further depressurization will follow cooldown. (Reference attached Figure 2.)

CAUTION: Block both trains of safety injection when RCS pressure decreases below P-11 setpoint (1915 psig).

6.3.1 A Shutdown Margin Calculation, STP R-19, has been performed to verify adequate shutdown margin for Mode 5, Cold Shutdown, conditions. _____

6.3.2 Verify CVCS makeup control is providing 2000 ppm boric acid in VCT. Sample Loop 1 and Loop 4 hot legs alternately at the discretion of the Test Director. Continue sampling until COLD SHUTDOWN Conditions are established. _____

6.3.3 Verify that the plant has been in natural circulation and HOT STANDBY conditions for at least four (4) hours. _____

6.3.4 Re-establish charging flow as required to maintain pressurizer level at or above 22% during the Cooldown Phase and isolate letdown. _____

NOTE: During the Cooldown Phase, RCS volume is expected to decrease approximately 1800 ft.^{3} (100% of Pressurizer volume). Charging during cooldown will be necessary to maintain saturation margins and pressurizer levels.

6.3.5 Using only the 10% steam dump valves, start the cooldown. (Use RCS wide range temperature as trended on P-250). Record the cooldown start time and RCS temperature and pressure.

RCS temperature _____deg. F RCS pressure _____psig _____hrs. _____

6.3.6 Using RCS wide range temperature as trended on P-250, as a guide maintain as high a cooldown rate as possible commensurate with the following conditions:

1) Maximum cooldown rate is 25 deg. F/hr. averaged over 20 minute intervals. Maintain a minimum subcooled margin of 50 deg. F as indicated by the sub cooled margin monitor.

2) Upper head and RCS loops fluid ΔT must be less than 100 deg. F. If 100 deg. F ΔT is approached, decrease cooldown rate to allow loop temperature to increase.

3) Maintain Tcold, Thot and Pressurizer pressure within the shaded area of Figure 2. Step 6.4.2 may be repeated as required and a log of this will be maintained in Data Sheet II.

6.3.7 Cooldown to RHR initiation is complete when:

1) All 4 hot legs are less than 350 deg. F

and

2) Upper head fluid temperature is less than 450 deg. F (highest reading T/C).

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NOTE: Highest T/C can be obtained from PAM 3 and 4 panels.

Verify cooldown complete by recording the following:
Four hot leg temperatures:

RCL 1-1 _____deg. F RCL 1-2 _____deg. F

RCL 1-3 _____deg. F RCL 1-4 _____deg. F

Highest upper head fluid T/C TT - _____ _____deg. F

Record time: _____hrs. _____

6.3.8 Record final RCS and Pressurizer boron concentrations after cooldown phase.

Pressurizer _____ppm Loop 1 _____ppm Loop 4 _____ppm _____

6.4 DEPRESSURIZATION

CAUTION: To prevent flashing in the primary system, RCS pressure must be maintained above the saturation pressure of the hottest part of the RCS. It is anticipated that the upper head fluid will be the hottest section. (Reference attached Figure 2 for saturation curve.)

6.4.1 Record RCS pressure _____psig _____

NOTE: Differential temperature between Pressurizer and Auxiliary spray fluid should be less than 320 deg. F before using Auxiliary spray. If auxiliary spray can not be used, PORV's should be used to depressurize RCS.

6.4.2 Use PORV's if required, or Pressurizer Auxiliary Spray to depressurize RCS so as to maintain Tcold, Thot, and Pressurizer pressure in the shaded area in Figure 2. _____

NOTE: The following steps will verify the effects of a potential charging valve failure to the function of the auxiliary pressurizer spray system during RCS depressurization.

6.4.3 Verify that RCS depressurization/cooldown rate is constant. _____

6.4.4 Verify that auxiliary spray is in service. Record valve status.

8145 OPEN/CLOSED
8148 OPEN/CLOSED _____

6.4.5 Open charging valve 8146. _____

6.4.6 Mark the valve opening time on the recorder traces and keep the valve open until a marked change in the depressurization rate can be observed. _____

6.4.7 Close valve 8146. Continue with the depressurization of the RCS. _____

6.4.8 Verify that RCS pressure is below the Loop 4 to RHR recirc. valves (8701 and 8702) interlock setpoint (390 psig). Record pressure _____psig. _____

6.5 RHR SYSTEM INITIATION

6.5.1 Using Nuclear Plant Operations (NPO) Department Operating Procedure B-2, place the RHR system into operation to remove decay heat. _____

6.5.2 Declare Special Test Exception 3.10.4 no longer in effect. Record time _____hrs. _____

6.5.3 Once the vessel head metal temperature is less than 350 deg. F, secure the CRDM fans. Record time _____hrs. _____

6.5.4 Continue cooldown to COLD SHUTDOWN in accordance with NPO Emergency Operating Procedure EP OP-0.2, Natural Circulation Cooldown. _____

6.5.5 Once COLD SHUTDOWN conditions have been established, record time, RCS temperature and RCS pressure.

NOTE: Record highest Thot value for RCS temperature.

RCS upper head fluid temperature _____deg. F
RCS pressure _____psig
RCS temperature _____deg. F
Time _____hrs. _____

6.5.6 Discontinue trending on the P-250 Computer (Reference Steps 5.1 and 5.2). _____

6.5.7 Discontinue taking boron samples started in Step 5.18. _____

6.5.8 Record CST final level and change in volume (gallons).

Final level _____%
Δ Volume _____gals.

1% of CST = 4,207 gallons _____

6.5.9 Discontinue recording CST level on Data Sheet I. _____

6.5.10 Stop the chart recorder(s). _____

6.5.11 Discontinue taking core T/C maps. _____

6.6 RESTORATION

6.6.1 Restore parameters monitored by chart recorders to normal (Reference Step 4.2). _____

6.6.2 Collect all recorders charts, trend data and sub cooled margin monitor records data from PAM I panel and attach to the test procedure. _____

6.6.3 Disconnect the vessel head magnetic T/C recording device and secure the T/C extension wires. _____

NOTE: The vessel head magnetic T/C's and the modified incore T/C's will be dispositioned by NPO at the first refueling.

6.6.4 Restore the normal air supplies to the valves listed in Step 6.1.10. _____

6.6.5 Align Pressurizer Heater Groups 1-2 and 1-3 to their normal power supplies (Ref. Step 6.1.9). _____

7.0 ACCEPTANCE CRITERIA

Acceptable performance of Systems, Equipment or Components tested by this procedure is based only on two concerns;

a) That all steps have been successfully completed as prescribed, and

b) That data recorded specifically for Acceptance Criteria purposes falls within prescribed limits.

Verification in Steps 7.1 and 7.2 establish that acceptable performance has been demonstrated.

	VERIFIED
7.1 Verify that all Steps in this procedure have been successfully completed as prescribed.	_____
7.2 Verify that all data recorded for acceptability (Form S-54) falls within the Acceptable Data Limits.	_____

7.2 Data Limits

The steps appearing in the table below are keyed to steps within this procedure. The Acceptable Data Limits under the Acceptance Criteria column are the Operational Limits adjusted for Test Instrument Accuracy in the conservative direction. Verify the Actual Data Obtained falls within the Acceptable Data Limits.

STEP NO.	ITEM (Description)	TEST INSTRUMENT USED	OPERATIONAL LIMITS	TEST INSTRUMENT ACCURACY	ACCEPTANCE CRITERIA		
					ACCEPTABLE DATA LIMITS	ACTUAL DATA OBTAINED	ACCEPTANCE CRITERIA VERIFIED
6.2.8	Loop 1 Δ C_B		>250 ppm	±4 ppm			
	Loop 4 Δ C_B		>250 ppm	±4 ppm			
6.2.7	RCS Hot Leg Temp. RCL 1-1 RCL 1-2 RCL 1-3 RCL 1-4		<350°F <350°F <350°F <350°F				
	Upper Head Fluid Temp.		<450°F				
6.2.5	Verify cold shutdown conditions have been established: RCS Pressure RCS Temperature Upper Head Fluid Temp.		<350 psig <200°F <300°F				
6.5.9	Verify that the condensate storage tank had sufficient water volume to perform the cooldown (i.e. Makeup to CST 1-1 was not necessary.).	N/A	N/A	N/A	N/A	N/A	

TEST RECORDER PARAMETER CHECKLIST

Sheet 1 of 5

Recorder Mod. _____ I.D. No. _____

Startup T.P. 42.7

Accuracy Information _____

Calibtation Verified by _____ Date _____

TRACE NUMBER	PARAMETER	INPUT SOURCE	PROCESS SCALING	ELECTRONIC SCALING	COMMENTS	TRACE CONNECTED	TRACE RECEIVED
1	S.G. 1-1 Pressure	TP-514-2 (RK 33)	0 →1200 psig	1 →5 VDC			
2	Aux F.W. Flow S.G. 1-1	ERFDS 7/5/* (VB4)	0 →300 gpm				
3	Tcold RCL 1-1	TP-413B-2 (RK 34)	100 → 600°F	1.571 →4.429 V			
4	Thot RCL 1-1	TP-413A-2 (RK 33)	100 → 600°F	1.571 →4.429 V			
5	8145 Position	ERFDS 3/20/1	Open/Closed	1 →5 VDC			
6	8148 Position		Open/Closed				
7							
8							

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NOTE: Refer to Test Instrument List for parameter accuracy information.

TEST RECORDER PARAMETER CHECKLIST

Recorder Mod. _____ I.D. No. _____

Accuracy Information _____

Calibtation Verified by _____ Date _____

Startup T.P. 427

TEST SEQUENCE	PARAMETER	INPUT SOURCE	PROCESS SCALING	ELECTRONIC SCALING	COMMENTS	-TEST-	-TEST-
1	S.G. 1-2 Pressure	TP-524-2 (RK 33)	0 →1200 psig	1-5 VDC			
2	Aux. F.W. Flow to S.G. 1-2	ERFDS 7/6/* (VB4)	0 →300 gpm				
3	Tcold RCL 1-2	TP-423B-2 (RK 34)	100 → 600°F	1.571 → 4.429 V			
4	Thot RCL 1-2	TP-423A-2 (RK 33)	100 → 600°F	1.571 → 4.429 V			
5	Regenerative Heat Exchanger Charging Flow Temperature	TP- (RK 33)	100 → 600°F	1-5 VDC			
6	Pressurizer Liquid Space Temperature		200 → 700°F				
7							
8							

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Note: Refer to Test Instrument List for parameter accuracy information.

TEST RECORDER PARAMETER CHECKLIST

Recorder Mod. _____ I.D. No. _____

Accuracy Information _____

Startup T.P. 427

Calibtation Verified by _____ Date _____

TRACE NUMBER	PARAMETER	INPUT SOURCE	PROCESS SCALING	ELECTRONIC SCALING	COMMENTS	RECORDER SELECT	RECORDER SELECT
1	S.G. Pressure 1-3	TP-534-2 (RK 33)	0 →1200 psig	1-5 VDC			
2	Aux. F.W. Flow to S.G. 1-3	ERFDS 5/7/* (VB 4)	0 →300 gpm				
3	Tcold RCL 1-3	TP-433B-2 (RK 34)	100→ 600°F	1.571→ 4.429 V			
4	Thot RCL 1-3	TP-433A-2 (RK 33)	100 → 600°F	1.571 →4.429 V			
5	PORV Position (PCV-474)	ERFDS 1/23/4 (VBI)	Open/Closed	0 →125 VDC			
6	RCL 1-4 Hot Leg Pressure	TP-403-2 (RK 33)	0 →3000 psig	1 →5 VDC			
7						061332	
8							

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NOTE: Refer to Test Instrument List for parameter accuracy information.

TEST RECORDER PARAMETER CHECKLIST

Recorder Mod. _____ I.D. No. _____

Accuracy Information _____

Startup T.P. 42.7

Calibtation Verified by _____ Date _____

RECORDER CHANNEL	PARAMETER	INPUT SOURCE	PROCESS SCALING	ELECTRONIC SCALING	COMMENTS	[illegible] CORRECT	[illegible] CHECKED
1	S.G. Pressure 1-4	TP-544-2 (RK 33)	0 →1200 psig	1-5 VDC			
2	Aux. F.W. Flow to S.G. 1-4	ERFDS 5/8/* (VB4)	0 →300 gpm				
3	Tcold RCL 1-4	TP-443B-2 (RK 34)	100 → 600°F	1.571 →4.429 V			
4	Thot RCL 1-4	TP-443A-2 (RK 33)	100 → 600°F	1.571 →4.429 V			
5	Pressurizer Level	TP-459-2 (RK 33)	0 →100%	1-5 VDC			
6	PORV Position (PCV-455C)	ERFDS 2/24/4 (VB1)	Open/Closed	0 →125 VDC			
7							
8							

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[illegible] document list for parameter accuracy information.

order Mod. _____ I.D. No. _____ Sheet _____

curacy Information _____ Startup P. 42.7

Libtation Verified by _____ Date _____

INCREMENT TRACK	PARAMETER	INPUT SOURCE	PROCESS SCALING	ELECTRONIC SCALING	COMMENTS	CONTROL ROOM INDICATION	RECEIVED
1	Charging Flow	ERFDS 6/6/* (VB4)	0 →200 gpm	1-5 VDC			
2	Charging Flow to BIT	ERFDS 1/11/* (VB1)	0 →200 gpm	1-5 VDC			
3	Emergency Borate Flow to Charging Pumps Suction	ERFDS 11/11/*	0 →50 gpm	1-5 VDC			
4	Primary Water to Boric Acid Blender	FC 111 Input #1 (RK 19)	0 →200 gpm	1-5 VDC			
5	Boric Acid Flow to Boric Acid Blender	FC 110 Input (RK 19)	0 →10 gpm	1-5 VDC			
6	PORV Position (PCV 456)	ERFDS 3/12/4 (VB1)	Open/Closed	0 →125 VDC			
7							
8							

NOTE: Refer to Test Instrument List for parameter accuracy information.

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TEST INSTRUMENT LIST

SHEET _____ OF _____

STARTUP T.P. _____

UNIT _____

PARAMETER OR INSTRUMENT	INSTR. I.D. No.	RANGE	ACCURACY	INSTR. CAL. VERIFIED		CAL. DUE DATE	STEPS USED IN	COMMENTS	DISCREPANCY
				DATE	BY				

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(0512B2)

S-50 (2-28-84)

DATA SHEET I

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SHEET ____ OF ____

DATE: ________

	RCS C_B (ppm)			RCS		CST		
Initial	Loop 1	Loop 4	PZR	Pressure (psig)	Thot (°F)	Level (%)		

DATA SHEET 11

061332 SHEET____ OF____

DATE:____

Initial	PZR PORV Operations Time Open/Closed			Aux. Spray On/Off		PZR HTRS		Aux. Spray PZR >560° Y/N	ΔT >320° Y/N
	455 C	456	474	8145	8148	HTR 1-2	HTR 1-3		

DATA SHEET III

BACKUP ACCUMULATORS PRESSURE READINGS

061332 SHEET____ OF____

DATE:________

TM	Initials	8145 8146 8147	8148	PCV-455C	PCV-456	PCV-21	PCV-22	HCV-142	

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DATA SHEET IV

061332 SHEET____ OF____

BACKUP ACCUMULATORS PRESSURE READINGS

DATE:________

TIME	Initials	FCV-364	FCV-365	FCV-602	FCV-603	PCV-19	PCV-20		

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NATURAL CIRCULATION DATA SHEET

	RCP trip	+10 min	+20 min	+30 min
a) CORE EXIT TEMPERATURES				
1) P-250 average T/C temp. (deg. F)				
2) Pressurizer liquid temp. (deg. F)				
3) (2) - (1) (deg. F)				
b) COLD LEG TEMPERATURE/STEAM GENERATOR SATURATION TEMPERATURE				
Loop 1				
1) Tcold - (deg. F)				
2) S.G. Pressure (psig)				
3) S.G. Tsat * (deg. F)				
Loop 2				
4) Tcold - (deg. F)				
5) S.G. Pressure (psig)				
6) S.G. Tsat * (deg. F)				
Loop 3				
7) Tcold - (deg. F)				
8) S.G. Pressure (psig)				
S.G. Tsat * (deg. F)				
Loop 4				
10) Tcold - (deg. F)				
11) S.G. Pressure (psig)				
12) S.G. Tsat * (deg. F)				
c) HOT LEG-TEMPERATURES/HOT LEG AND COLD LEG ΔT				
Loop 1				
1) Thot (deg. F)				
2) ΔT (deg. F)				
Loop 2				
3) Thot (deg. F)				
4) ΔT (deg. F)				
Loop 3				
5) Thot (deg. F)				
6) ΔT (deg. F)				
Loop 4				
7) Thot (deg. F)				
8) ΔT (deg. F)				

*Steam Generator pressure will determine saturation temperature (use ASME steam tables.)

DATA SHEET S-1

061332

SURVEILLANCE DATA

TIME	OPERABLE LOOPS Y/N				3 Loops Operable	Firewater Tank to AFWPP Operable		Initial	RCP TRIP
	LOOP 1	LOOP 2	LOOP 3	LOOP 4	Y/N[1]	Y/N[1]			TIME (1)

REMARKS: 1 Per Special Test Exception 3.10.4, 3 RCPs and the flowpath from the firewater tank to the AFWPP must be verified operable within 4 Hrs. of initiating natural circulation testing.

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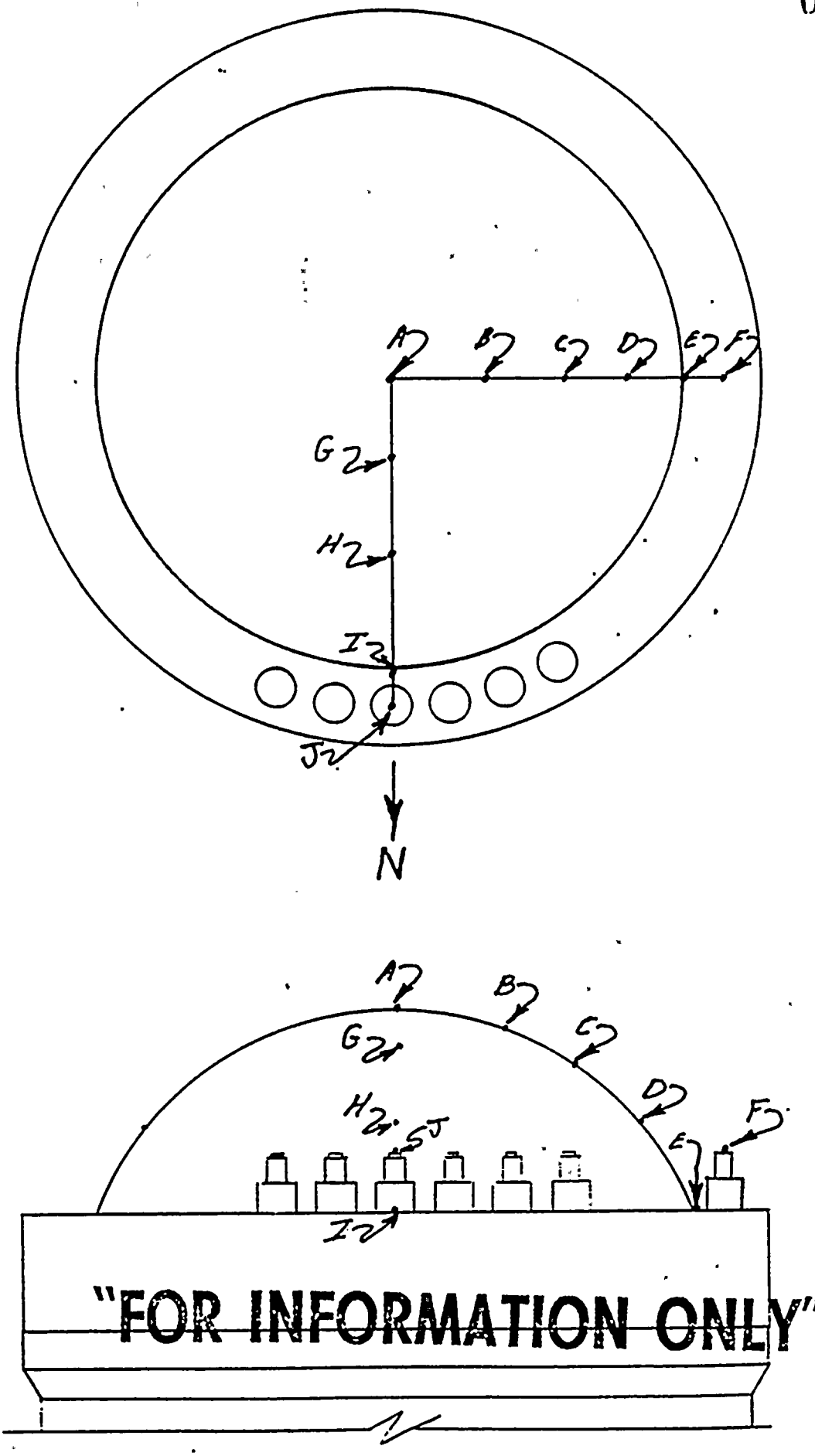

FIG. 1

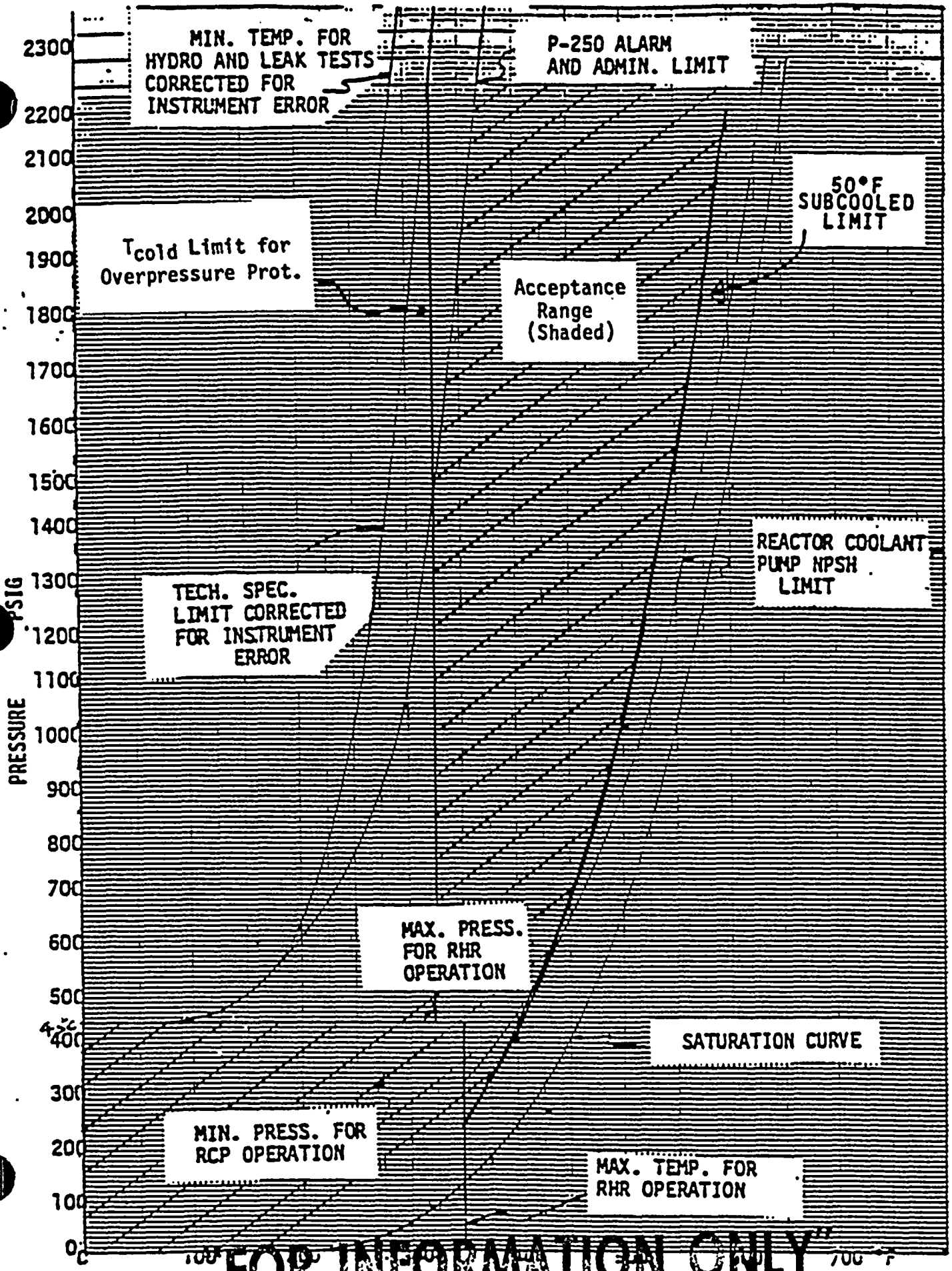

FIGURE 2

TEST PROCEDURE NO. 42.7

REMARKS

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