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ATTACHMENT (3)

BG&E Letter dated October 22, 1990

License Amendment Request

Low Temperature Overpressure Protection

PROPOSED TECHNICAL SPECIFICATION CHANGES

3/4.1.2 BORATION SYSTEMS

FLOW PATHS - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.2.1 As a minimum, one of the following boron injection flow paths and one associated heat tracing circuit shall be **OPERABLE**:

a. A flow path from the boric acid storage tank via either a boric acid pump or a gravity feed connection and charging pump to the Reactor Coolant System if only the boric acid storage tank in specification 3.1.2.7a is **OPERABLE**, or

b. The flow path from the refueling water tank via either a charging pump or a high pressure safety injection pump* to the Reactor Coolant system if only the refueling water tank in Specification 3.1.2.7b is **OPERABLE**.

APPLICABILITY: MODES 5 and 6.

ACTION:

With none of the above flow paths **OPERABLE**, suspend all operations involving **CORE ALTERATIONS** or positive reactivity changes until at least one injection path is restored to **OPERABLE** status.

SURVEILLANCE REQUIREMENTS

4.1.2.1 At least one of the above required flow paths shall be demonstrated **OPERABLE**:

a. At least once per 7 days by verifying that the temperature of the heat traced portion of the flow path is above the temperature limit line shown on Figure 3.1-1 when a flow path from the concentrated boric acid tanks is used.

b. At least once per 31 days be verifying that each valve (manual, power operated or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct position.

* At 305°F and less, the required **OPERABLE** HPSI pump shall be in pull-to-lock and will not start automatically. At 305°F and less, HPSI pump use will be conducted in accordance with Technical Specification 3.4.9.3

CHARGING PUMP - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.2.3 At least one charging pump or one high pressure safety injection pump* in the boron injection flow path required **OPERABLE** pursuant to Specification 3.1.2.1 shall be **OPERABLE** and capable of being powered from an **OPERABLE** emergency bus.

APPLICABILITY: **MODES** 5 and 6.

ACTION:

With no charging pump or high pressure safety injection pump **OPERABLE**, suspend all operations involving **CORE ALTERATIONS** or positive reactivity changes until at least one of the required pumps is restored to **OPERABLE** status.

SURVEILLANCE REQUIREMENTS

4.1.2.3 No additional Surveillance Requirements other than those required by Specification 4.0.5.

* At 305°F and less, the required **OPERABLE** HPSI pump shall be in pull-to-lock and will not start automatically. At 305°F and less , HPSI pump use will be conducted in accordance with Technical Specification 3.4.9.3

TABLE 3.3-3

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION

FUNCTIONAL UNIT	TOTAL NO. OF CHANNELS	MINIMUM CHANNELS TO TRIP	CHANNELS OPERABLE	APPLICABLE MODES	ACTION
1. **SAFETY INJECTION (SIAS)**@					
a. Manual (Trip Buttons)	2	1	2	1, 2, 3, 4	6
b. Containment Pressure-High	4	2	3	1, 2, 3	7*
c. Pressurizer Pressure - Low	4	2	3	1, 2, 3(a)	7*
2. **CONTAINMENT SPRAY (CSAS)**					
a. Manual (Trip Buttons)	2	1	2	1, 2, 3, 4	6
b. Containment Pressure -- High	4	2	3	1, 2, 3	11
3. **CONTAINMENT ISOLATION (CIS)**#					
a. Manual CIS (Trip Buttons)	2	1	2	1, 2, 3, 4	6
b. Containment Pressure - High	4	2	3	1, 2, 3	7*

\# Containment isolation of non-essential penetrations is also initiated by SIAS (functional units 1.a and 1.c).

@ When the RCS temperature is:

(a) Greater than 350°F, the required **OPERABLE** HPSI pumps must be able to start automatically upon receipt of a SIAS signal,

(b) Between 350°F and 305°F, a transition region exists where the **OPERABLE** HPSI pump will be placed in pull-to-lock on a cooldown and restored to automatic status on a heatup,

(c) At 305°F and less, the required **OPERABLE** HPSI pump shall be in pull-to-lock and will not start automatically.

COOLANT LOOPS AND COOLANT CIRCULATION

HOT STANDBY

LIMITING CONDITION FOR OPERATION

3.4.1.2 a. The reactor coolant loops listed below shall be OPERABLE:

1. Reactor Coolant Loop ~~#11~~ (#21) and at least one associated reactor coolant pump.

2. Reactor Coolant Loop ~~#12~~ (#22) and at least one associated reactor coolant pump.

b. At least one of the above Reactor Coolant Loops shall be in operation*.

APPLICABILITY: MODE 3**

ACTION:

a. With less than the above required reactor coolant loops OPERABLE, restore the required loops to OPERABLE status within 72 hours or be in HOT SHUTDOWN within the next 12 hours.

b. With no reactor coolant loop in operation, suspend all operations involving a reduction in boron concentration of the Reactor Coolant System and initiate corrective action to return the required loop to operation within one hour.

SURVEILLANCE REQUIREMENTS

4.4.1.2.1 At least the above required reactor coolant pumps, if not in operation, shall be determined to be OPERABLE once per 7 days by verifying correct breaker alignments and indicated power availability.

4.4.1.2.2 At least one cooling loop shall be verified to be in operation and circulating reactor coolant at least once per 12 hours.

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*All reactor coolant pumps may be de-energized for up to 1 hour (up to 2 hours for low flow test) provided (1) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (2) core outlet temperature is maintained at least 10°F below saturation temperature.

** A reactor coolant pump shall not be started with the RCS temperature less than or equal to 305°F unless (1) the pressurizer water level is less than or equal to 170 inches and (2) the secondary water temperature of each steam generator is less than or equal to 30°F above the RCS temperature, and (3) the pressurizer pressure is less than or equal to 320 psia.

SURVEILLANCE REQUIREMENTS

4.4.1.3.1 The required shutdown cooling loop(s), if not in operation, shall be determined **OPERABLE** once per 7 days by verifying correct breaker alignments and indicated power availability for pumps and shutdown cooling loop valves.

4.4.1.3.2 The required steam generator(s), if it is being used to meet 3.4.1.3.a, shall be determined **OPERABLE** by verifying the secondary side water level to be above -50 inches at least once per 12 hours.

4.4.1.3.3 At least one coolant loop shall be verified to be in operation and circulating reactor coolant at least once per 12 hours.

LIMITING CONDITION FOR OPERATION

3.4.1.3 a. At least two of the coolant loops listed below shall be **OPERABLE**:

1. Reactor Coolant Loop #21 and its associated steam generator and at least one associated reactor coolant pump,

2. Reactor Coolant Loop #22 and its associated steam generator and at least one associated reactor coolant pump,

3. Shutdown Cooling Loop #21*,

4. Shutdown Cooling Loop #22*.

b. At least one of the above coolant loops shall be in operation**.

APPLICABILITY: **MODES** 4***# and 5***#.

ACTION:

a. With less than the above required coolant loops **OPERABLE**, initiate corrective action to return the required coolant loops to **OPERABLE** status within one hour or be in **COLD SHUTDOWN** within 24 hours.

b. With no coolant loop in operation, suspend all operations involving a reduction in boron concentration of the Reactor Coolant System and initiate corrective action to return the required coolant loop to operation within one hour.

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* The normal or emergency power source may be inoperable in **MODE** 5.

** All reactor coolant pumps and shutdown cooling pumps may be de-energized for up to 1 hour provided (1) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (2) core outlet temperature is maintained at least 10°F below saturation temperature.

*** A reactor coolant pump shall not be started with the RCS temperature less than or equal to 305°F unless (1) the pressurizer water level is less than or equal to 170 inches, and (2) the secondary water temperature of each steam generator is less than or equal to 30°F above the RCS temperature, and (3) the pressurizer pressure is less than or equal to 320 psia.

\# See Special Test Exception 3.10.5.

REACTOR COOLANT SYSTEM

3/4.4.9 PRESSURE/TEMPERATURE LIMITS

REACTOR COOLANT SYSTEM

LIMITING CONDITION FOR OPERATION

3.4.9.1 The Reactor Coolant System (except the pressurizer) temperature and pressure shall be limited in accordance with the limit lines shown on Figure 3.4-2 during heatup, cooldown, criticality, and inservice leak and hydrostatic testing with:

a. A maximum heatup of ~~100~~ 75°F in any one hour period,

b. ~~A maximum cooldown of 100°F in any one hour period with T_{avg} above 250°F and a maximum cooldown of 20°F in any one hour period with T_{avg} below 250°F.~~

c. A maximum temperature change of 5°F in any one hour period, during hydrostatic testing operations above system design pressure.

APPLICABILITY: At all times.

ACTION:

With any of the above limits exceeded, restore the temperature and/or pressure to within the limit within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the fracture toughness properties of the Reactor Coolant System; determine that the Reactor Coolant System remains acceptable for continued operations or be in at least HOT STANDBY within the next 6 hours and reduce the RCS T_{avg} and pressure to less than 200°F and ~~500~~ 300 psia, respectively, within the following 30 hours.

b. a maximum cooldown of:

Maximum Allowable Cooldown Rate	RCS Temperat
100°F in any one hour period	>180°F
40°F in any one hour period	180°F to 140°F
15°F in any one hour period	<140°F

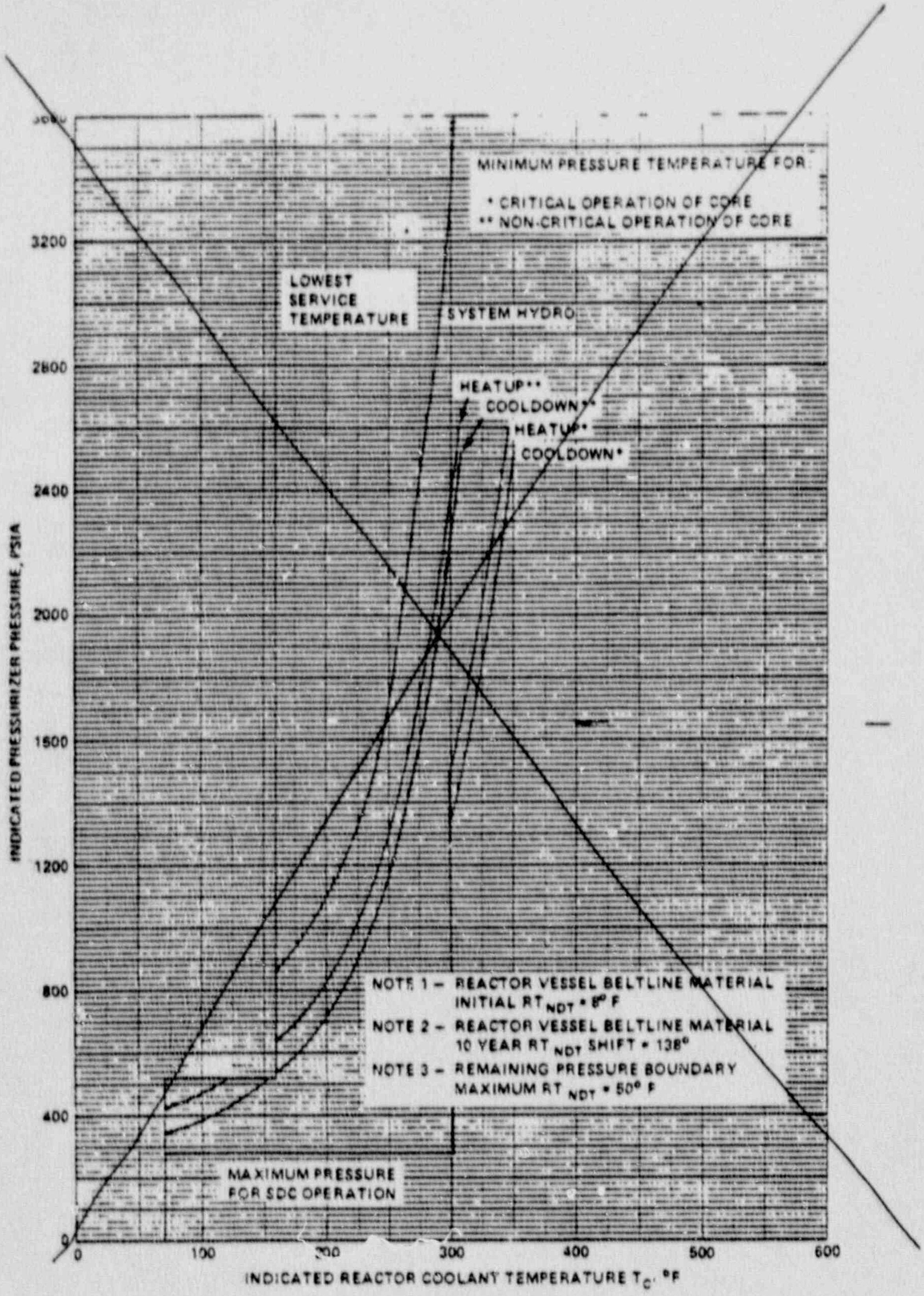


FIGURE 3.4-2b

Reactor Coolant System Pressure Temperature Limitations for 2 to 10 Years of Full Operation

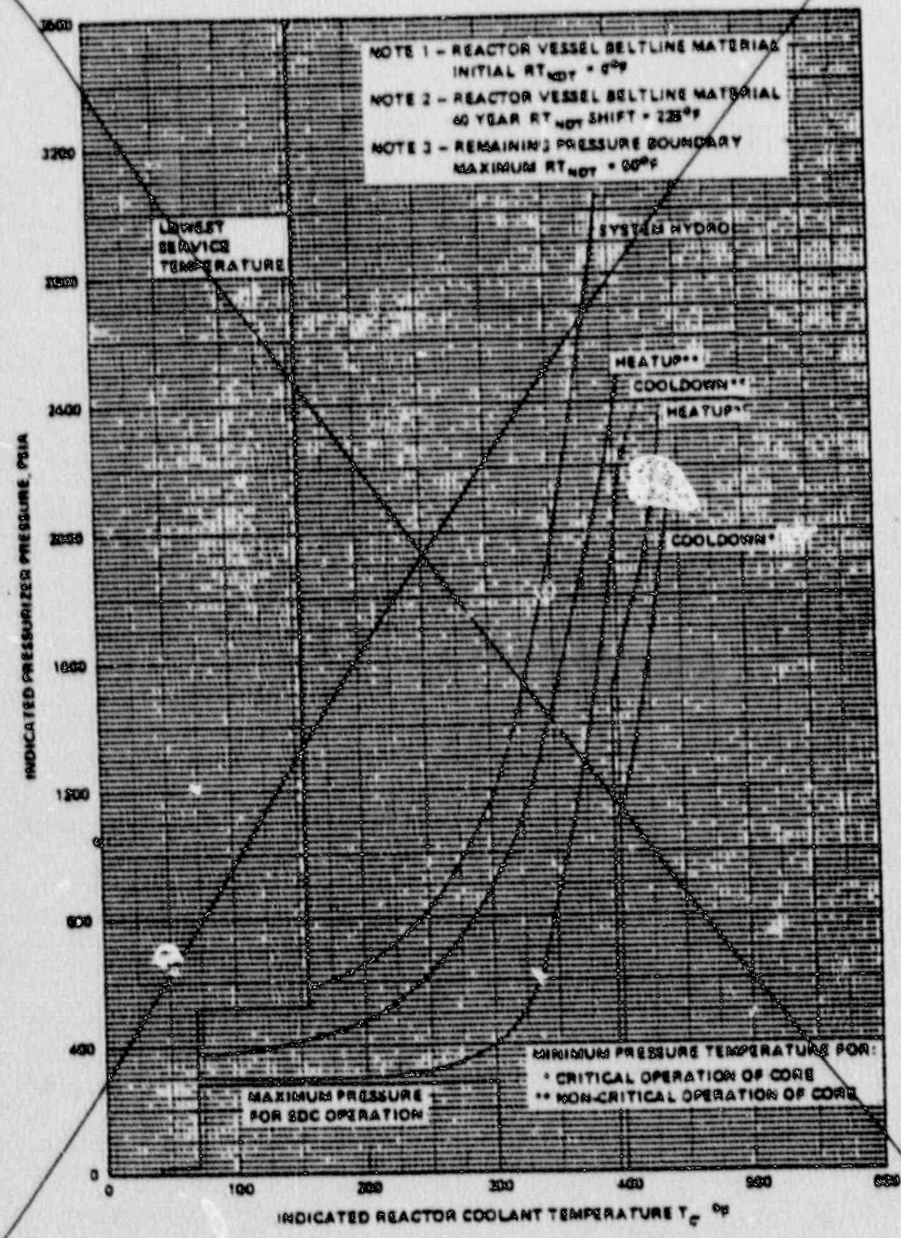


FIGURE 3.4-2c

Reactor Coolant System Pressure Temperature Limitations for 10 to 40 Years of Full Power Operation

AUG 1 3 197?

FIGURE 3.4-2b
CALVERT CLIFFS UNIT 2 HEATUP CURVE, 12 EFPY
REACTOR COOLANT SYSTEM PRESSURE TEMPERATURE LIMITS

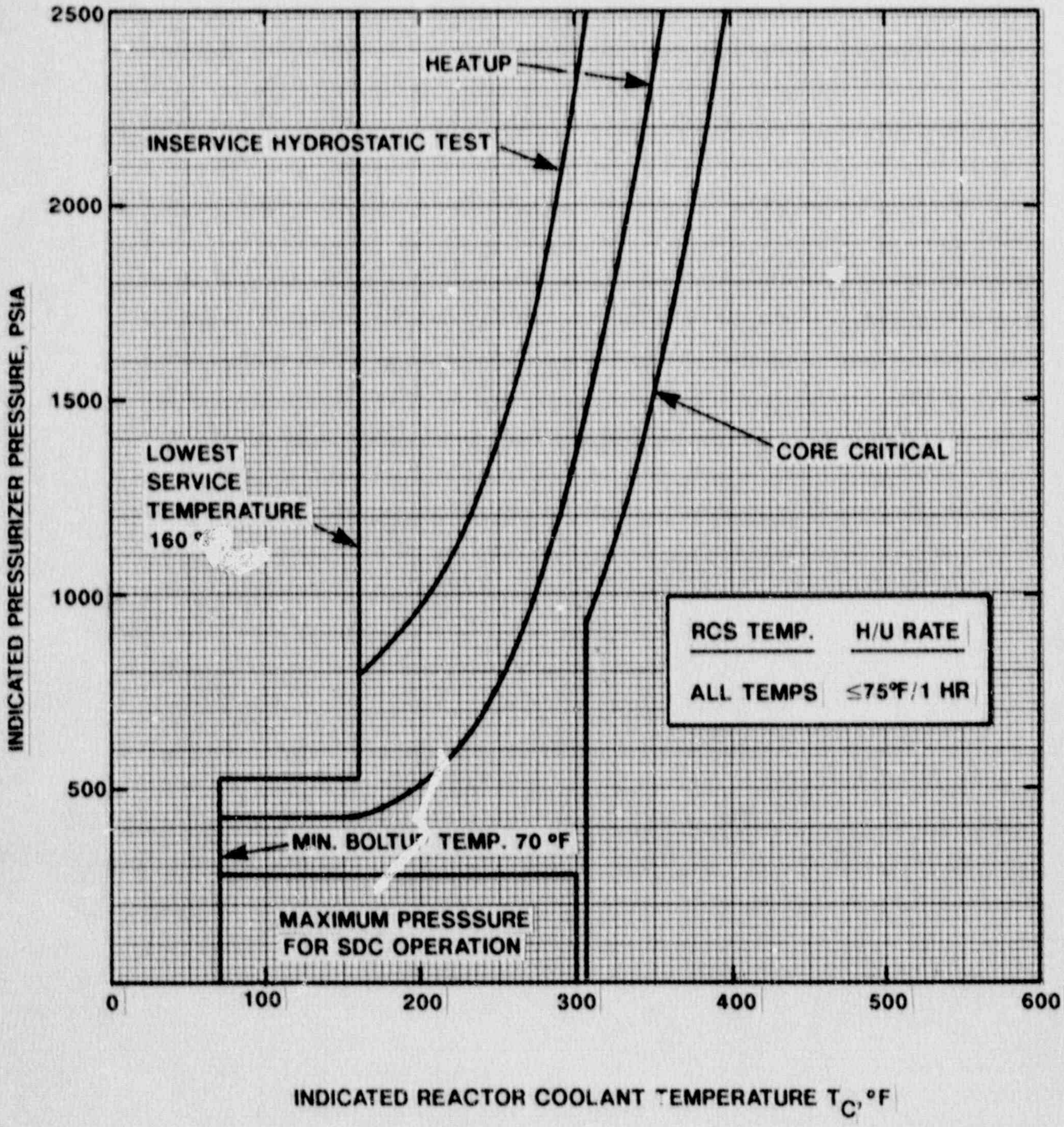
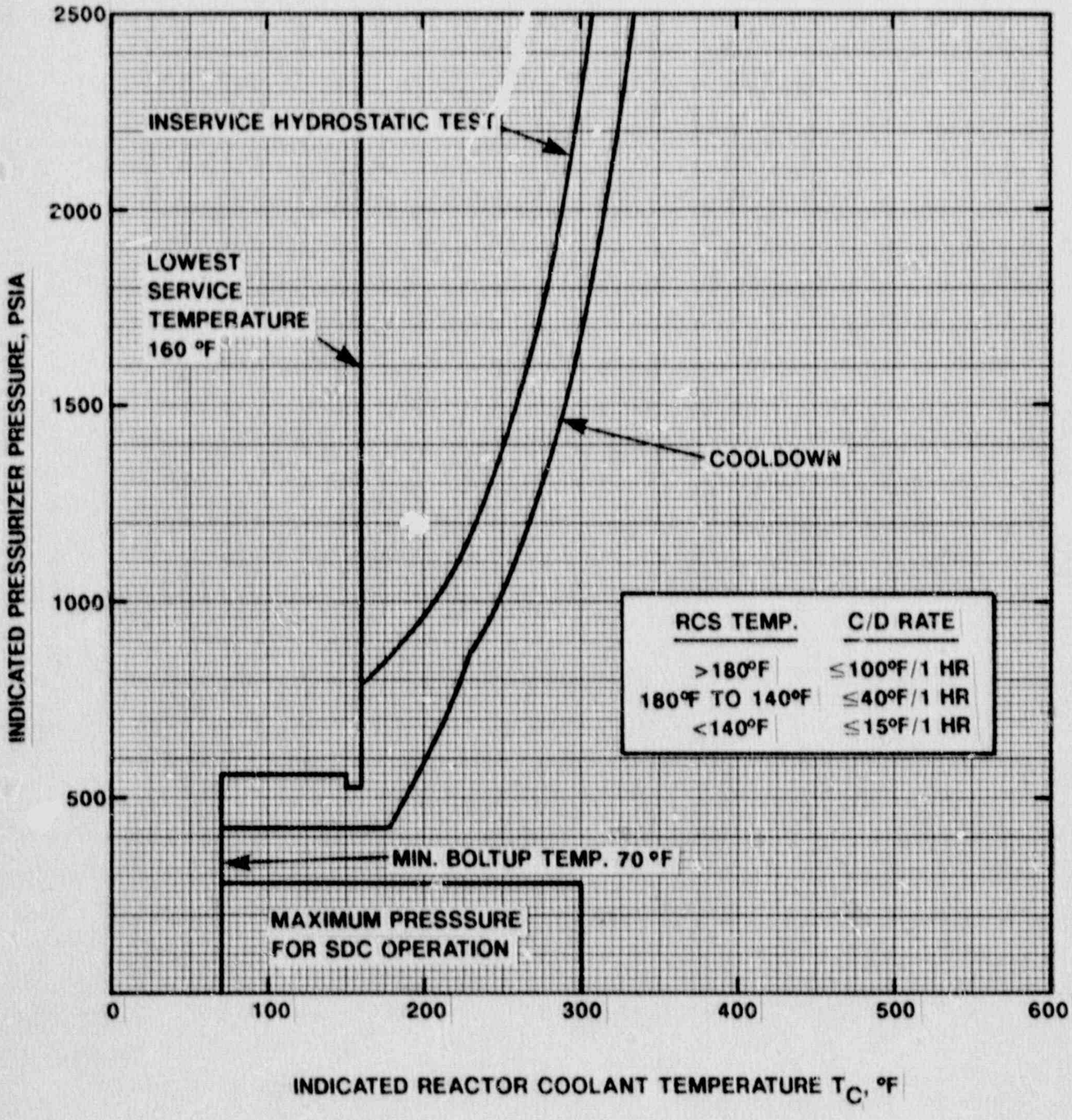


FIGURE 3.4-2c
CALVERT CLIFFS UNIT 2 COOLDOWN CURVE, 12 EFPY
REACTOR COOLANT SYSTEM PRESSURE TEMPERATURE LIMITS



LIMITING CONDITION FOR OPERATION

3.4.9.2 The pressurizer temperature shall be limited to:

a. A maximum heatup of 100°F in any one hour period,

b. A maximum cooldown of 200°F in any one hour period, and

c. A maximum spray water temperature differential of 400°F.

APPLICABILITY: At all times.

ACTION:

With the pressurizer temperature limits in excess of any of the above limits, restore the temperature to within the limits within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the fracture toughness properties of the pressurizer; determine that the pressurizer remains acceptable for continued operation or be in at least HOT STANDBY within the next 6 hours and reduce the pressurizer pressure to less than ~~500 psig~~ 300 psia within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.9.2 The pressurizer temperatures shall be determined to be within the limits at least once per 30 minutes during system heatup or cooldown. The spray water temperature differential shall be determined to be within the limit at least once per 12 hours during auxiliary spray operation.

REACTOR COOLANT SYSTEM

OVERPRESSURE PROTECTION SYSTEMS

LIMITING CONDITION FOR OPERATION

3.4.9.3 At least one of the following overpressure protection systems shall be OPERABLE:

a. Two power operated relief valves (PORVs) with a lift setting of ≤ 450 psig, or

b. A reactor coolant system vent of ≥ 1.3 square inches.

APPLICABILITY: When the temperature of one or more of the RCS cold legs is ≤ 275°F.

ACTION:

a. With one PORV inoperable, either restore the inoperable PORV to OPERABLE status within 7 days or depressurize and vent the RCS through a ≥ 1.3 square inch vent(s) within the next 8 hours; maintain the RCS in a vented condition until both PORVs have been restored to OPERABLE status.

b. With both PORVs inoperable, depressurize and vent the RCS through a ≥ 1.3 square inch vent(s) within 8 hours; maintain the RCS in a vented condition until both PORVs have been restored to OPERABLE status.

c. In the event either the PORVs or the RCS vent(s) are used to mitigate a RCS pressure transient, a Special Report shall be prepared and submitted to the Commission pursuant to Specification 6.9.2 within 30 days. The report shall describe the circumstances initiating the transient, the effect of the PORVs or vent(s) on the transient and any corrective action necessary to prevent recurrence.

d. The provisions of Specification 3.0.4 are not applicable.

LIMITING CONDITION FOR OPERATION

3.4.9.3 The following overpressure protection requirements shall be met:

a. One of the following three overpressure protection systems shall be in place:

1. Two power-operated relief valves (PORVs) with a lift setting of ≤ 430 psia, or

2. A single PORV with a lift setting of ≤ 430 psia and a Reactor Coolant System vent of ≥ 1.3 square inches, or

3. A Reactor Coolant System (RCS) vent ≥ 2.6 square inches.

b. Two high pressure safety injection (HPSI) pumps # shall be disabled by either removing (racking out) their motor circuit breakers from the electrical power supply circuit, or by locking shut their discharge valves.

c. The HPSI loop motor operated valves (MOVs)# shall be prevented from automatically aligning HPSI pump flow to the RCS by placing their handswitches in pull-to-override.

d. No more than one **OPERABLE** high pressure safety injection pump with suction aligned to the Refueling Water Tank may be used to inject flow into the RCS and when used, it must be under manual control and one of the following restrictions shall apply:

1. The total high pressure safety injection flow shall be limited to ≤ 210 gpm **OR**

2. A reactor coolant system vent of ≥ 2.6 square inches shall exist.

APPLICABILITY: When the RCS temperature is ≤ 305°F and the RCS is vented to < 8 square inches.

ACTION:

a. With one PORV inoperable, either restore the inoperable PORV to **OPERABLE** status within 5 days or depressurize and vent the RCS through a ≥ 1.3 square inch vent(s) within the next 48 hours; maintain the RCS in a vented condition until both PORVs have been restored to **OPERABLE** status.

b. With both PORVs inoperable, depressurize and vent the RCS through a ≥ 2.6 square inch vent(s) within 48 hours; maintain the RCS in a vented condition until either one **OPERABLE** PORV and a vent of ≥ 1.3 square inches has been established or both PORVs have been restored to **OPERABLE** status.

EXCEPT when required for testing.

c. In the event either the PORVs or the RCS vent(s) are used to mitigate a RCS pressure transient, a Special Report shall be prepared and submitted to the Commission pursuant to Specification 6.9.2 within 30 days. The report shall describe the circumstances initiating the transient, the effect of the PORVs or vent(s) on the transient and any corrective action necessary to prevent recurrence.

d. With less than two HPSI pumps# disabled, place at least two HPSI pump handswitches in pull-to-lock within fifteen minutes and disable two HPSI pumps within the next four hours.

e. With one or more HPSI loop MOVs# not prevented from automatically aligning a HPSI pump to the RCS, immediately place the MOV handswitch in pull-to-override, or shut and disable the affected MOV or isolate the affected HPSI header flowpath within four hours, and implement the action requirements of Specifications 3.1.2.1, 3.1.2.3, and 3.5.3, as applicable.

f. With HPSI flow exceeding 210 gpm while suction is aligned to the RWT and an RCS vent of < 2.6 square inches exists,

   1. Immediately take action to reduce flow to less than or equal to 210 gpm.
   2. Verify the excessive flow condition did not raise pressure above the maximum allowable pressure for the given RCS temperature on Figure 3.4-2b or Figure 3.4-2c.
   3. If a pressure limit was exceeded, take action in accordance with Specification 3.4.9.1.

g. The provisions of Specification 3.0.4 are not applicable.

\# EXCEPT when required for testing.

SURVEILLANCE REQUIREMENTS

4.4.9.3.1 Each PORV shall be demonstrated **OPERABLE** by:

a. Performance of a **CHANNEL FUNCTIONAL TEST** on the PORV actuation channel, but excluding valve operation, within 31 days prior to entering a condition in which the PORV is required **OPERABLE** and at least once per 31 days thereafter when the PORV is required **OPERABLE**.

b. Performance of a **CHANNEL CALIBRATION** on the PORV actuation channel at least once per 18 months.

c. Verifying the PORV isolation valve is open at least once per 72 hours when the PORV is being used for overpressure protection.

d. Testing in accordance with the inservice test requirements for ASME Category C valves pursuant to Specification 4.0.5

4.4.9.3.2 The RCS vent(s) shall be verified to be open at least once per 12 hours* when the vent(s) is being used for overpressure protection.

4.4.9.3.3 All high pressure safety injection pumps, except the above **OPERABLE** pump, shall be demonstrated inoperable at least once per 12 hours by verifying that the motor circuit breakers have been removed from their electrical power supply circuits or by verifying their discharge valves are locked shut. The automatic opening feature of the high pressure safety injection loop MOVs shall be verified disabled at least once per 12 hours.

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* Except when the vent pathway is locked, sealed, or otherwise secured in the open position, then verify these vent pathways open at least once per 31 days.

SURVEILLANCE REQUIREMENTS

4.5.2 Each ECCS subsystem shall be demonstrated **OPERABLE***:

a. At least once per 12 hours by verifying that the following valves are in the indicated positions with power to the valve operators removed:

Valve Number	Valve Function	Valve Position
1. MOV-659	Mini-flow Isolation	Open
2. MOV-660	Mini-flow Isolation	Open
3. CV-306	Low Pressure SI Flow Control	Open

b. At least once per 31 days by:

1. Verifying that upon a Recirculation Actuation Test Signal, the containment sump isolation valves open.

2. Verifying that each valve (manual, power operated or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct position.

c. By a visual inspection which verifies that no loose debris (rags, trash, clothing, etc.) is present in the containment which could be transported to the containment sump and cause restriction of the pump suctions during LOCA conditions. This visual inspection shall be performed:

1. For all accessible areas of the containment prior to establishing **CONTAINMENT INTEGRITY**, and

2. Of the areas affected within containment at the completion of containment entry when **CONTAINMENT INTEGRITY** is established.

d. Within 4 hours prior to increasing the RCS pressure above 1750 psia by verifying, via local indication at the valve, that CV-306 is open.

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* Whenever flow testing into the RCS is required at RCS temperatures of 305°F and less, the high pressure safety injection pump shall recirculate RCS water (suction from RWT isolated) or the controls of Technical Specification 3.4.9.3 shall apply.

ECCS SUBSYSTEMS - T_{avg} < 300°F

LIMITING CONDITION FOR OPERATION

3.5.3 As a minimum, one ECCS subsystem comprised of the following shall be **OPERABLE**:

a. One# **OPERABLE** high-pressure safety injection pump, and

b. An **OPERABLE** flow path capable of taking suction from the refueling water tank on a Safety Injection Actuation Signal and automatically transferring suction to the containment sump on a Recirculation Actuation Signal.

APPLICABILITY: **MODES** 3* and 4.

ACTION:

a. With no ECCS subsystem **OPERABLE**, restore at least one ECCS subsystem to **OPERABLE** status within 1 hour or be in **COLD SHUTDOWN** within the next 20 hours.

b. In the event the ECCS is actuated and injects water into the Reactor Coolant System, a Special Report shall be prepared and submitted to the Commission pursuant to Specification 6.9.2 within 90 days describing the circumstances of the actuation and the total accumulated actuation cycles to date.

SURVEILLANCE REQUIREMENTS

4.5.3.1 The ECCS subsystem shall be demonstrated **OPERABLE** per the applicable Surveillance Requirements of 4.5.2.

* With pressurizer pressure < 1750 psia.

\# Between 350°F and 305°F, a transition region exists where the **OPERABLE** HPSI pump will be placed in pull-to-lock on a cooldown and restored to automatic status on a heatup. At 305°F and less, the required **OPERABLE** HPSI pump shall be in pull-to-lock and will not start automatically. At 305°F and less, HPSI pump use will be conducted in accordance with Technical Specification 3.4.9.3.

3/4.4.1 COOLANT CODES AND COOLANT CIRCULATION

The plant is designed to operate with both reactor coolant loops and associated reactor coolant pumps in operation, and maintain DNBR above 1.195 during all normal operations and anticipated transients.

A single reactor coolant loop with its steam generator filled above the low level trip setpoint provides sufficient heat removal capability for core cooling while in **MODES** 2 and 3; however, single failure considerations require plant shutdown if component repairs and/or corrective actions cannot be made within the allowable out-of-service time.

In **MODES** 4 and 5, a single reactor coolant loop or shutdown cooling loop provides sufficient heat removal capability for removing decay heat; but single failure considerations require that at least two loops be **OPERABLE**. Thus, if the reactor coolant loops are not **OPERABLE**, this specification requires two shutdown cooling loops to be **OPERABLE**.

The operation of one Reactor Coolant Pump or one shutdown cooling pump provides adequate flow to ensure mixing, prevent stratification and produce gradual reactivity changes during boron concentration reductions in the Reactor Coolant System. The reactivity change rate associated with boron reductions will, therefore, be within the capability of operator recognition and control.

The restrictions on starting a Reactor Coolant Pump during **MODES** 3, 4 and 5 with the RCS temperature $\leq 305^{o}F$ are provided to prevent RCS pressure transients, caused by energy additions from the secondary system, which could exceed the limits of Appendix G to 10 CFR Part 50 (see Bases 3/4.4.9). For operation of the reactor coolant pumps, the following criteria apply: (1) restrict the water volume in the pressurizer (170 inches) and thereby providing a volume for the primary coolant to expand into and (2) restrict starting of the RCPs to when the indicated secondary water temperature of each steam generator is less than or equal to $30^{o}F$ above Reactor Coolant System temperature, and (3) limit the initial indicated pressure of the pressurizer to less than or equal to 320 psia.

3/4.4.2 SAFETY VALVES

The pressurizer code safety valves operate to prevent the RCS from being pressurized above its Safety Limit of 2750 psia. Each safety valve is designed to relieve approximately 3×10^5 lbs per hour of saturated steam at the valve setpoint. The relief capacity of a single safety valve is adequate to relieve any overpressure condition which could occur during shutdown. In the event that no safety valves are **OPERABLE**, an operating shutdown cooling loop, connected to the RCS, provides overpressure relief capability and will prevent RCS overpressurization.

During operation, all pressurizer code safety valves must be **OPERABLE** to prevent the RCS from being pressurized above its safety limit of 2750 psia. The combined relief capacity of these valves is sufficient to

steam generator tube rupture accident in conjunction with an assumed steady state primary-to-secondary steam generator leakage rate of 1.0 GPM and a concurrent loss of offsite electrical power. The values for the limits on specific activity represent interim limits based upon a parametric evaluation by the NRC of typical site locations. These values are conservative in that specific site parameters of the Calvert Cliffs site, such as site boundary location and meteorological conditions, were not considered in this evaluation. The NRC is finalizing site specific criteria which will be used as the basis for the reevaluation of the specific activity limits of this site. This reevaluation may result in higher limits.

The ACTION statement permitting POWER OPERATION to continue for limited time periods with the primary coolant's specific activity > 1.0 μCi/gram DOSE EQUIVALENT I-131, but within the allowable limit shown on Figure 3.4-1, accommodates possible iodine spiking phenomenon which may occur following changes in THERMAL POWER. Operation with specific activity levels exceeding 1.0 μCi/gram DOSE EQUIVALENT I-131 but within the limits shown on Figure 3.4-1 must be restricted to no more than 10 percent of the unit's yearly operating time since the activity levels allowed by Figure 3.4-1 increase the 2 hour thyroid dose at the site boundary by a factor of up to 20 following a postulated steam generator tube rupture.

Reducing T_{avg} to < 500°F prevents the release of activity should a steam generator tube rupture since the saturation pressure of the primary coolant is below the lift pressure of the atmospheric steam relief valves. The surveillance requirements provide adequate assurance that excessive specific activity levels in the primary coolant will be detected in sufficient time to take corrective action. Information obtained on iodine spiking will be used to assess the parameters associated with spiking phenomena. A reduction in frequency of isotopic analyses following power changes may be permissible if justified by the data obtained.

3/4.4.9 PRESSURE/TEMPERATURE LIMITS

All components in the Reactor Coolant System are designed to withstand the effects of cyclic loads due to system temperature and pressure changes. These cyclic loads are introduced by normal load transients, reactor trips, and startup and shutdown operations. The various categories

of load cycles used for design purposes are provided in Section 4.2.1 of the FSAR. During startup and shutdown, the rates of temperature and pressure changes are limited so that the maximum specified heatup and cooldown rates are consistent with the design assumptions and satisfy the stress limits for cyclic operation.

During heatup, the thermal gradients in the reactor vessel wall produce thermal stresses which vary from compressive at the inner wall to tensile at the outer wall. These thermal induced compressive stresses tend to alleviate the tensile stresses induced by the internal pressure. Therefore, a pressure-temperature curve based on steady state conditions (i.e., no thermal stresses) represents a lower bound of all similar curves for finite heatup rates when the inner wall of the vessel is treated as the governing location.

The heatup analysis also covers the determination of pressure-temperature limitations for the case in which the outer wall of the vessel becomes the controlling location. The thermal gradients established during heatup produce tensile stresses at the outer wall of the vessel. These stresses are additive to the pressure induced tensile stresses which are already present. The thermal induced stresses at the outer wall of the vessel are tensile and are dependent on both the rate of heatup and the time along the heatup ramp; therefore, a lower bound curve similar to that described for the heatup of the inner wall cannot be defined. Consequently, for the cases in which the outer wall of the vessel becomes the stress controlling location, each heatup rate of interest must be analyzed on an individual basis.

The heatup and cooldown limit curves (Figure 3.4-2) are composite curves which were prepared by determining the most conservative case, with either the inside or outside wall controlling, for any heatup or cooldown rates of up to 100°F per hour. The heatup and cooldown curves were prepared based upon the most limiting value of the predicted adjusted reference temperature at the end of the service period indicated on Figure 3.4-2.

The reactor vessel materials have been tested to determine their initial RT_{NDT}; the results of these test are shown in Table B 3/4.4-1. Reactor operation and resultant fast neutron (E>1 Mev) irradiation will cause an increase in the RT_{NDT}. Therefore, an adjusted reference temperature, based upon the fluence can be predicted using Figure B 3/4.4-1. The heatup and cooldown limit curves shown on Figure 3.4-2 include predicted adjustments for this shift in RT_{NDT} at the end of the applicable service period, as well as adjustments for possible errors in the pressure and temperature sensing instruments.

TABLE B 3/4.4-1

REACTOR VESSEL TOUGHNESS

PC. No.	Code No.	Heat No.	Vessel Location	Drop Weight	CHARPY V-NOTCH @30 ft-lb	CHARPY V-NOTCH @50 ft-lb	Minimum upper Shelf Cv energy for Longitudina Direction - ft-
Reference Dwg.	E 233-761-2						
203-02	D-8903	5B3063 4P2710-4210-VI	Vessel Flange	+30°	-48°	-25°	158
204-02	D-8912	C5505-5	Bottom Head Dome	-30°	-43°	-12°	125
204-03 A	D-8911-3	C5176-3	Bottom Head Peel	-20°	-42°	-08°	123
B	D-8911-2	C5505-4		-20°	-40°	-11°	130
C	D-8911-2	C5505-4		-20°	-40°	-11°	130
D	D-8911-1	C5505-3		-20°	-34°	-10°	131
E	D-8911-3	C5176-3		-20°	-42°	-08°	123
F	D-8911-1	C5505-3		-20°	-34°	-10°	131
205-02 A	D-7203-7	AV3280-9A-9133	Inlet Nozzles	-30°	-62°	-32°	130
B	D-7203-6	AV3288-9A-9254		-10°	-85°	-65°	132
C	D-7203-5	AV3283-9A-9134		+20°	-62°	-52°	135
D	D-7203-8	AV3285-9A-9253		-10°	-50°	+65°	126
205-03 A	D-8920-3	AV3176-8L2138	Inlet Nozzle Extensions	0°	-10°	+12°	150
B	D-8920-2	AV3176-8L2137		0°	-10°	+12°	150
C	D-8920-1	AV3176-8L2136		0°	-10°	+12°	150
D	D-8920-4	AV3176-8L2139		0°	-10°	+12°	150

TABLE B 3/4.4-1 (Cont'd)

REACTOR VESSEL TOUGHNESS

PC. No.		Code No.	Heat No.	Vessel Location	Drop Weight	CHARPY V-NOTCH @30 ft-lb	CHARPY V-NOTCH @50 ft-lb	Minimum upper Shelf Cv energy for Longitudina Direction - ft-
205-06	A	D-7204-3	9-6449-001	Outlet Nozzles	-20°	-50°	-24°	132
	B	D-7204-4	9-6512-002		0°	-34°	+06°	108
205-07	A	D-8921-1	AV3282-8L2127	Outlet Nozzle Extensions	+10°	-16°	+15°	128
	B	D-8921-2	AV3282-8L2128		+10°	-16°	+15°	128
215-01	A	D-8905-2	C5312-2	Upper Shell	-20°	-46°	+05°	133
	B	D-8905-3	C5286-2		-20°	-06°	+16°	125
	C	D-8905-1	C5312-1		-20°	-40°	+20°	125
215-02	A	D-8906-1	A4463-1	Intermediate Shell	-10°	-39°	+32°	118
	B	D-8906-3	A4463-2		-10°	+04°	+35°	116
	C	D-8906-2	B9427-2		+10°	-23°	+04°	126
215-03	A	D-8907-1	C5804-1	Lower Shell	-10°	0°	+28°	140
	B	D-8907-2	C5286-1		+10°	-20°	+14°	145
	C	D-8907-3	C5803-3		-20°	-18°	+07°	130

TABLE B 3/4.4-1 (Cont'd)

REACTOR VESSEL TOUGHNESS

PC. No.	Code No.	Heat No.	Vessel Location	Drop Weight	CHARPY V-NOTCH @30 ft-lb	CHARPY V-NOTCH @50 ft-lb	Minimum upper Shelf Cv energ for Longitudin Direction - ft-
Reference Dwg.	E 233-762-1						
209-02	D-8904-1	3P2339-AZU-174	Closure Head Flange	+10°	-68°	-55°	185
209-03 A	D-8909-3	C5389-3	Closure Head Peels	-10°	-20°	-02°	147
B	D-8909-1	C5524-4		0°	+14°	+48°	135
C	D-8909-2	A4700-2		-10°	-5°	+30°	130
D	D-8909-1	C5524-4		0°	+14°	+48°	135
E	D-8909-2	A4700-2		-10°	-5°	+30°	130
F	D-8909-3	C5389-3		-10°	-20°	-02°	147
209-04	D8910-1	A4700-1	Closure Head Dome	0°	0°	+24°	123

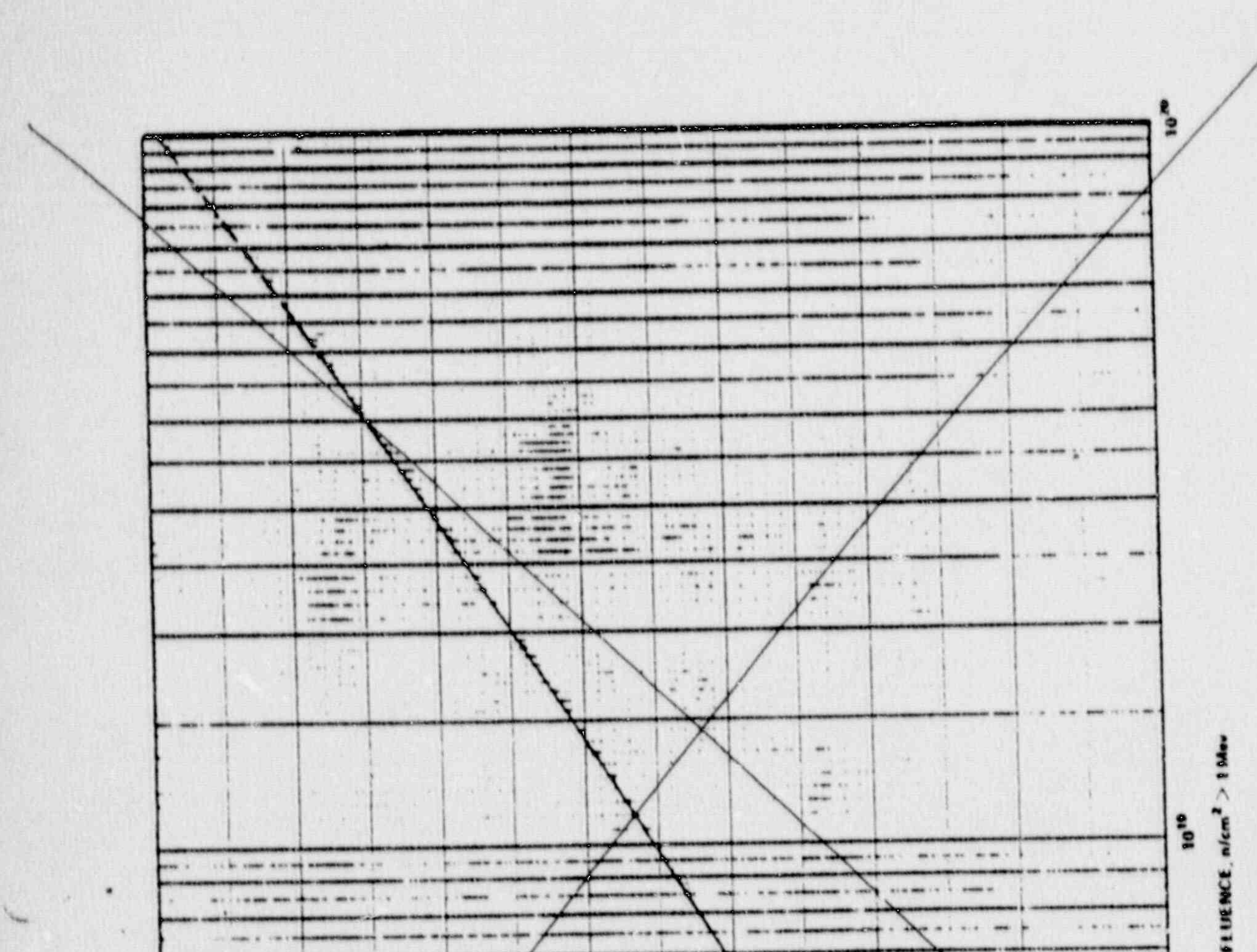

FIGURE B 3/4.4-1

Nil Ductility Temperature Increase as a Function of Fast Neutron Fluence (E > 1mev)

BASES

The actual shift in RT_{NDT} of the vessel material will be established periodically during operation by removing and evaluating, in accordance with ASTM E185-73, reactor vessel material irradiation surveillance specimens installed near the inside wall of the reactor vessel in the core area. Since the neutron spectra at the irradiation samples and vessel inside radius are essentially identical, the measured transition shift for a sample can be applied with confidence to the adjacent section of the reactor vessel. The heatup and cooldown curves must be recalculated when the ΔRT_{NDT} determined from the surveillance capsule is different from the calculated ΔRT_{NDT} for the equivalent capsule radiation exposure.

The pressure-temperature limit lines shown on Figure 3.4-2 for reactor criticality and for inservice leak and hydrostatic testing have been provided to assure compliance with the minimum temperature requirements of Appendix G to 10 CFR 50.

The maximum RT_{NDT} for all reactor coolant system pressure-retaining materials, with the exception of the reactor pressure vessel, has been determined to be 50°F. The Lowest Service Temperature limit line shown on Figure 3.4-2 is based upon this RT_{NDT} since Article NB-2332 (Summer Addenda of 1972) of Section III of the ASME Boiler and Pressure Vessel Code requires the Lowest Service Temperature to be RT_{NDT} + 100°F for piping, pumps and valves. Below this temperature, the system pressure must be limited to a maximum of 20% of the system's hydrostatic test pressure of 3125 psia.

The number of reactor vessel irradiation surveillance specimens and the frequencies for removing and testing these specimens are provided in Table 4.4-5 to assure compliance with the requirements of Appendix H to 10 CFR Part 50.

The limitations imposed on the pressurizer heatup and cooldown rates and spray water temperature differential are provided to assure that the pressurizer is operated within the design criteria assumed for the fatigue analysis performed in accordance with the ASME Code requirements.

The OPERABILITY of two PORVs or an RCS vent opening of greater than 1.3 square inches ensures that the RCS will be protected from pressure transients which could exceed the limits of Appendix G to 10 CFR Part 50 when one or more of the RCS cold legs are ≤ 275°F. Either PORV has adequate relieving capability to protect the RCS from overpressurization when the transient is limited to either (1) the start of an idle RCP with the secondary water temperature of the steam generator ≤ 46°F (34°F when measured by a surface contact instrument) above the coolant temperature in the reactor vessel or (2) the start of a HPSI pump and its injection into a water solid RCS.

steam generator tube rupture accident in conjunction with an assumed steady state primary-to-secondary steam generator leakage rate of 1.0 gpm and a concurrent loss of offsite electrical power. The values for the limits on specific activity represent interim limits based upon a parametric evaluation by the NRC of typical site locations. These values are conservative in that specific site parameters of the Calvert Cliffs site, such as site boundary location and meteorological conditions, were not considered in this evaluation. The NRC is finalizing site specific criteria which will be used as the basis for the reevaluation of the specific activity limits of this site. This reevaluation may result in higher limits.

The **ACTION** statement permitting **POWER OPERATION** to continue for limited time periods with the primary coolant's specific activity >1.0 uCi/gram **DOSE EQUIVALENT** I-131, but within the allowable limit shown on Figure 3.4-1, accommodates possible iodine spiking phenomenon which may occur following changes in **THERMAL POWER**. Operation with specific activity levels exceeding 1.0 uCi/gram **DOSE EQUIVALENT** I-131 but within the limits shown on Figure 3.4-1 must be restricted to no more than 10 percent of the unit's yearly operating time since the activity levels allowed by Figure 3.4-1 increase the 2 hour thyroid dose at the site boundary by a factor of up to 20 following a postulated steam generator tube rupture.

Reducing T_{avg} to < 500°F prevents the release of activity should a steam generator tube rupture since the saturation pressure of the primary coolant is below the lift pressure of the atmospheric steam relief valves. The surveillance requirements provide adequate assurance that excessive specific activity levels in the primary coolant will be detected in sufficient time to take corrective action. Information obtained on iodine spiking will be used to assess the parameters associated with spiking phenomena. A reduction in frequency of isotopic analyses following power changes may be permissible if justified by the data obtained.

3/4.4.9 PRESSURE/TEMPERATURE LIMITS

Operation within the appropriate heatup and cooldown curves assures the integrity of the reactor vessel against fracture induced by combinative thermal and pressure stresses. As the vessel is subjected to increasing fluence, the toughness of the limiting material continues to decline, and even more restrictive Pressure/Temperature limits must be observed. The current limits, Figures 3.4-2b and 3.4-2c, are for up to and including 12 Effective Full Power Years (EFPY) of operation.

The shift in the material fracture toughness, as represented by RT_{NDT}, is calculated using Regulatory Guide 1.99, Revision 2. For 12 EFPY, at the 1/4 T position, the adjusted reference temperature (ART)

value is 171°F. At the 3/4 T position the ART value is 125°F. These values are used with procedures developed in the ASME Boiler and Pressure Vessel Code, Section III, Appendix G to calculate heatup and cooldown limits in accordance with the requirements of 10 CFR Part 50, Appendix G.

To develop composite pressure-temperature limits for the heatup transient, the isothermal, 1/4 T heatup, and 3/4 T heatup pressure-temperature limits are compared for a given thermal rate. Then the most restrictive pressure-temperature limits are combined over the complete temperature interval resulting in a composite limit curve for the reactor vessel beltline for the heatup event.

To develop a composite pressure-temperature limit for the cooldown event, the isothermal pressure-temperature limit must be calculated. The isothermal pressure-temperature limit is then compared to the pressure-temperature limit associated with a cooling rate and the more restrictive allowable pressure-temperature limit is chosen resulting in a composite limit curve for the reactor vessel beltline.

Both 10 CFR Part 50 Appendix G and ASME, Code Appendix G require the development of pressure-temperature limits which are applicable to inservice hydrostatic tests. The minimum temperature for the inservice hydrostatic test pressure can be determined by entering the curve at the test pressure (1.1 times normal operating pressure) and locating the corresponding temperature. This curve is shown for 12 EFPY on Figures 3.4-2b and 3.4-2c.

Similarly, 10 CFR Part 50 specifies that core critical limits be established based on material considerations. This limit is shown on the heatup curve, Figure 3.4-2b. Note that this limit does not consider the core reactivity safety analyses that actually control the temperature at which the core can be brought critical.

The Lowest Service Temperature is the minimum allowable temperature at pressures above 20% of the pre-operational system hydrostatic test pressure (625 psia). This temperature is defined as equal to the most limiting RT_{NDT} for the balance of the Reactor Coolant System components plus 100°F, per Article NB 2332 of Section III of the ASME Boiler and Pressure Vessel Code.

The horizontal line between the minimum boltup temperature and the Lowest Service Temperature is defined by the ASME Boiler and Pressure Vessel Code as 20% of the pre-operational hydrostatic test pressure. The change in the line at 150°F on the cooldown curve is due to a cessation of RCP flow induced pressure deviation, since no RCPs are permitted to operate during a cooldown below 150°F.

The minimum boltup temperature is the minimum allowable temperature at pressures below 20% of the pre-operational system hydrostatic test pressure. The minimum is defined as the initial RT_{NDT} for the material of the higher stressed region of the reactor vessel plus any effects for irradiation per Article G-2222 of Section III of the ASME Boiler and Pressure Vessel Code. The initial reference temperature of the reactor vessel and closure head flanges was determined using the certified material test reports and Branch Technical Position MTEB 5-2. The maximum initial RT_{NDT} associated with the stressed region of the closure head flange is $30^{o}F$. The minimum boltup temperature including temperature instrument uncertainty in $30^{o}F + 10^{o}F = 40^{o}F$. However, for conservatism, a minimum boltup temperature of $70^{o}F$ is utilized in the analysis to establish the low temperature PORV lift setpoint.

The design basis events in the low temperature region assuming a water solid system are:

- A RCP start with hot steam generators; and,
- An inadvertent HPSI actuation with concurrent charging.

Any measures which will prevent or mitigate the design basis events are sufficient for any less severe incidents. Therefore, this section will discuss the results of the RCP start and mass addition transient analyses. Also discussed is the effectiveness of a pressurizer steam bubble and a single PORV relative to mitigating the design basis events.

The RCP start transient is a severe LTOP challenge for a water solid RCS. Therefore, during water solid operations all four RCPs are tagged out of service. Analysis indicates the transient is adequately controlled by placing restrictions on three parameters: initial pressurizer pressure and level, and the secondary-to-primary temperature difference. With these restrictions in place, the transient is adequately controlled without the assistance of the PORVs.

The inadvertent actuation of one HPSI pump in conjunction with one charging pump is the most severe mass addition overpressurization event. Analyses were performed for a single HPSI pump and one charging pump assuming one PORV available with the existing orifice area of 1.29 in^2. For the limiting case, only a single PORV is considered available due to single failure criteria. A figure was developed which shows the calculated RCS pressures versus time that will occur assuming HPSI and charging pump mass inputs, and the expansion of the RCS following loss of decay heat removal. Sufficient overpressure protection results when the

equilibrium pressure does not exceed the limiting Appendix G curve pressure. Because the equilibrium pressure exceeds the minimum Appendix G limit for full HPSI flow, HPSI flow is throttled to no more than 210 gpm indicated when the HPSI pump is used for mass addition. The HPSI flow limit includes allowances for instrumentation uncertainty, charging pump flow addition and RCS expansion following loss of decay heat removal. The HPSI flow is injected through only one HPSI loop MOV to limit instrumentation uncertainty. No more than one charging pump (44 gpm) is allowed to operate during the HPSI mass addition.

Comparison of the PORV discharge curve with the critical pressurizer pressure of 471.2 psia indicates that adequate protection is provided by a single PORV for RCS temperatures of 70°F or above when all mass input is limited to 380 gpm. HPSI discharge is limited to 210 gpm to allow for one charging pump and system expansion due to loss of decay heat removal. The low temperature PORV pressure lift setpoint is set to protect the most restrictive Appendix G pressure limit (471.2 psia). A PORV setpoint of 430 psia, which includes instrumentation uncertainties and sufficient margins for PORV response time requirements necessary for the protection of 471.2 psia, was selected.

To provide single failure protection against a HPSI pump mass addition transient, the HPSI loop MOV handswitches must be placed in pull-to-override so the valves do not automatically actuate upon receipt of a SIAS signal. Alternative actions, described in the ACTION STATEMENT, are to disable the affected MOV (by racking out its motor circuit breaker or equivalent), or to isolate the affected HPSI header. Examples of HPSI header isolation actions include; (1) de-energizing and tagging shut the HPSI header isolation valves; (2) locking shut and tagging all three HPSI pump discharge MOVs; and (3) disabling all three HPSI pumps.

Three 100% capacity HPSI pumps are installed at Calvert Cliffs. Procedures will require that two of the three HPSI pumps be disabled (breakers racked out) at RCS temperatures less than or equal to 305°F and that the remaining HPSI pump handswitch be placed in pull-to-lock. Additionally, the HPSI pump normally in pull-to-lock shall be throttled to less than or equal to 210 gpm when used to add mass to the RCS. Exceptions are provided for ECCS testing and for response to LOCAs.

A pressurizer steam volume and a single PORV will provide satisfactory control of all mass addition transients with the exception of a spurious actuation of full flow from a HPSI pump. Overpressurization due to this transient will be precluded for temperatures 305°F and less by disabling two HPSI pumps, placing the third in pull-to-lock, and by throttling the third pump to less than or equal to 210 gpm flow when it is used to add mass to the RCS.

Note that only the design bases events are discussed in detail since the less severe transients are bounded by the RCP start and inadvertent HPSI actuation analysis.

RCS temperature, as used in the applicability statement, is determined as follows: (1) with the RCPs running, the RCS cold leg temperature is the appropriate indication, (2) with the shutdown cooling system in operation, the shutdown cooling temperature indication is appropriate, (3) if neither the RCPs or shutdown cooling is in operation, the core exit thermocouples are the appropriate indicators of RCS temperature.

DELETED

DELETED

The trisodium phosphate dodecahydrate (TSP) store in dissolving baskets located in the containment basement is provided to minimize the possibility of corrosion cracking of certain metal components during operation of the ECCS following a LOCA. The TSP provides this protection by dissolving in the sump water and causing its final pH to be raised to $\geq$ 7.0. The requirement to dissolve a representative sample of TSP in a sample of RWT water provides assurance that the stored TSP will dissolve in borated water at the postulated post LOCA temperatures.

The Surveillance Requirements provided to ensure OPERABILITY of each component ensure that a minimum, the assumptions used in the safety analyses are met and the subsystem OPERABILITY is maintained. The surveillance requirement for flow balance testing provides assurance that proper ECCS flows will be maintained in the event of a LOCA. Maintenance of proper flow resistance and pressure drop in the piping system to each injection point is necessary to: (1) prevent total pump flow from exceeding runout conditions when the system is in its minimum resistance configuration, (2) provide the proper flow split between injection points in accordance with the assumptions used in the ECCS-LOCA analyses, and (3) provide an acceptable level of total ECCS flow to all injection points equal to or above that assumed in the ECCS-LOCA analyses. Minimum HPSI flow requirements for temperatures above 305°F are based upon small break LOCA calculations which credit charging pump flow following an SIAS. Surveillance testing includes allowances for instrumentation and system leakage uncertainties. The 470 gpm requirement for minimum HPSI flow from the three lowest flow legs includes instrument uncertainties but not system check valve leakage. The OPERABILITY of the charging pumps and the associated flow paths is assured by the Boration System Specification 3/4.1.2. Specification of safety injection pump total developed head ensures pump performance is consistent with safety analysis assumptions.

At temperatures of 305°F and less, HPSI injection flow is limited to less than or equal to 210 gpm except in response to excessive reactor coolant leakage. With excessive RCS leakage (LOCA), make-up requirements could exceed a HPSI flow of 210 gpm. Overpressurization is prevented by controlling other parameters, such as RCS pressure and subcooling. This provides overpressure protection in the low temperature region. An analysis has been performed which shows this flow rate is more than adequate to meet core cooling safety analysis assumptions. HPSI pumps are not required to auto-start when the RCS is in the MPT enable condition. The Safety Injection Tanks provide immediate injection of borated water into the core in the event of an accident, allowing adequate time for an operator to take action to start a HPSI pump.

Surveillance testing of HPSI pumps is required to ensure pump operability. Some surveillance testing requires that the HPSI pumps deliver flow to the RCS. To allow this testing to be done without increasing the potential for overpressurization of the RCS, either the RWT must be isolated or the HPSI pump flow must be limited to less than or equal to 210 gpm or an RCS vent greater than or equal to 2.6 square inches must be provided.

3/4.5.4 REFUELING WATER TANK (RWT)

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The OPERABILITY of the RWT as part of the ECCS ensures that a sufficient supply of borated water is available for injection by the ECCS in the vent of a LOCA. The limits on RWT minimum volume and boron concentration ensure that 1) sufficient water is available within containment to permit recirculation cooling flow to the core, and 2) the reactor will remain subcritical in the cold condition following mixing of the RWT and the RCS water volumes with all control rods inserted except for the most reactive control assembly. These assumptions are consistent with the LOCA analyses.

The contained water volume limit includes an allowance for water not usable because of tank discharge line location or other physical characteristics.