ATTACHMENT 1

Consumers Power Company
Palisades Plant
Docket 50-255

PROPOSED TECHNICAL SPECIFICATION PAGE CHANGES

September 12, 1989

19 Pages

3.1 PRIMARY COOLANT SYSTEM (Cont'd)

3.1.1 Operable Components (Cont'd)

h. During initial primary coolant pump starts (initiation of forced circulation) at PCS cold leg temperatures ≤ 430°F, the secondary system temperature in both steam generators must be ≤ the PCS cold leg temperature unless the Shutdown Cooling System is isolated from the PCS and one of the following conditions is met:

1. The steam generator temperature shall not exceed the PCS cold leg temperature by more than the ΔT limit below.

Cold Leg Temperature	ΔT Limit
1. ≥ 120°F and < 160°F	100°F
2. ≥ 160°F and ≤ 210°F	10°F
3. > 210°F and ≤ 350°F	100°F

2. Under transient conditions with only one of the steam generator's temperatures higher than the PCS temperature, and the PCS temperature > 350°F:

A. To start a PCP in the cold steam generator loop, ΔT in the hot steam generator loop shall be < 100°F; or

B. To start a PCP in the hot steam generator loop, ΔT shall be < 100°F and the PCS pressure shall be at least 100 psi less than the pressure limits of Figure 3-4.

i. The PCS shall not be heated or maintained above 325°F unless a minimum of 375 kW of pressurizer heater capacity is available from both buses 1D and 1E. Should heater capacity from either bus 1D and 1E fall below 375 kW, either restore the inoperable heaters to provide at least 375 kW of heater capacity from both buses 1D and 1E within 72 hours or be in hot shutdown within the next 12 hours.

Basis

When primary coolant boron concentration is being changed, the process must be uniform throughout the primary coolant system volume to prevent stratification of primary coolant at lower boron concentration which could result in a reactivity insertion. Sufficient mixing of the primary coolant is assured if one shutdown cooling or one primary coolant pump is in operation.(1) The shutdown cooling pump will circulate the primary system volume in less than 60 minutes when operated at rated capacity. By imposing a minimum shutdown cooling pump flow rate of 2810 gpm, sufficient time is provided for the operator to terminate the boron dilution under asymmetric flow conditions.(5) The pressurizer volume is relatively inactive, therefore will tend to have a boron concentration higher than rest of the primary coolant system during a dilution operation.

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3.1 PRIMARY COOLANT SYSTEM (Contd)

Basis (Contd)

Administrative procedures will provide for use of pressurizer sprays to maintain a nominal spread between the boron concentration in the pressurizer and the primary system during the addition of boron.[2]

The FSAR safety analysis was performed assuming four primary coolant pumps were operating for accidents that occur during reactor operation. Therefore, reactor startup above hot shutdown is not permitted unless all four primary coolant pumps are operating. Operation with three primary coolant pumps is permitted for a limited time to allow the restart of a stopped pump or for reactor internals vibration monitoring and testing.

Requiring the plant to be in hot shutdown with the reactor tripped from the C-06 panel, opening the 42-01 and 42-02 circuit breakers, assures an inadvertent rod bank withdrawal will not be initiated by the control room operator. Both steam generators are required to be operable whenever the temperature of the primary coolant is greater than the design temperature of the shutdown cooling system to assure a redundant heat removal system for the reactor.

Calculations have been performed to demonstrate that a pressure differential of 1380 psi[3] can be withstood by a tube uniformily thinned to 36% of its original nominal wall thickness (64% degradation), while maintaining:

(1) A factor of safety of three between the actual pressure differential and the pressure differential required to cause bursting.

(2) Stresses within the yield stress for Inconel 600 at operating temperature.

(3) Acceptable stresses during accident conditions.

Secondary side hydrostatic and leak testing requirements are consistent with ASME BPV Section XI (1971). The differential maintains stresses in the steam generator tube walls within code allowable stresses.

The minimum temperature of 100°F for pressurizing the steam generator secondary side is set by the NDTT of the manway cover of + 40°F.

The transient analyses were performed assuming a vessel flow at hot zero power (532°F) of 124.3 x 10^6 lb/hr minus 6% to account for flow measurement uncertainty and core flow bypass. A DNB analysis was performed in a parametric fashion to determine the core inlet temperature as a function of pressure and flow for which the minimum DNBR is equal to 1.17. This analysis includes the following uncertainties and allowances: 2% of rated power for power

Basis (Cont'd)

measurement; ±0.06 for ASI measurement; ±50 psi for pressurizer pressure; ±7°F for inlet temperature; and 3% measurement and 3% bypass for core flow. In addition, transient biases were included in the derivation of the following equation for limiting reactor inlet temperature:[4]

$$T_{inlet} \leq 543.3 + .0575(P-2060) + 0.00005(P-2060)^{**}2 + 1.173(W-120) - .0102(W-120)^{**}2$$

The limits of validity of this equation are:

$1800 \leq \text{Pressure} \leq 2200$ Psia

$100.0 \times 10^6 \leq \text{Vessel Flow} \leq 130 \times 10^6$ Lb/h

ASI as shown in Figure 3.0

With measured primary coolant system flow rates > 130 M lbm/hr, limiting the maximum allowed inlet temperature to the T_{Inlet} LCO at 130 M lbm/hr increases the margin to DNB for higher PCS flow rates.

The Axial Shape Index alarm channel is being used to monitor the ASI to ensure that the assumed axial power profiles used in the development of the inlet temperature LCO bound measured axial power profiles. The signal representing core power (Q) is the auctioneered higher of the neutron flux power and the Delta-T power. The measured ASI calculated from the excore detector signals and adjusted for shape annealing (Y_I) and the core power constitute an ordered pair (Q,Y_I). An alarm signal is activated before the ordered pair exceed the boundaries specified in Figure 3.0.

The requirement that the steam generator temperature be ≤ the PCS temperature when forced circulation is initiated in the PCS ensures that an energy addition caused by heat transferred from the secondary system to the PCS will not occur. This requirement applies only to the initiation of forced circulation (the start of the first primary coolant pump) when the PCS cold leg temperature is < 430°F. However, analysis (Reference 6) shows that under limited conditions when the Shutdown Cooling System is isolated from the PCS, forced circulation may be initiated when the steam generator temperature is higher than the PCS cold leg temperature.

References

(1) Updated FSAR, Section 14.3.2.
(2) Updated FSAR, Section 4.3.7.
(3) Palisades 1983/1984 Steam Generator Evaluation and Repair Program Report, Section 4, April 19, 1984
(4) ANF-87-150(NP), Volume 2, Section 15.0.7.1
(5) ANF-88-108
(6) Consumers Power Company Engineering Analysis EA-A-NL-89-14

3.1.2 Heatup and Cooldown Rates

The primary coolant pressure and the system heatup and cooldown rates shall be limited in accordance with Figure 3-1, Figure 3-2 and as follows.

a. Allowable combinations of pressure and temperature for any heatup or cooldown rate shall be below and to the right of the applicable limit line as shown on Figures 3-1 and 3-2. The average heatup or cooldown rate in any one hour time period shall not exceed the heatup or cooldown rate limit when one or more PCS cold leg is less than the corresponding "Cold Leg Temperature" below.

	*Cold Leg Temperature	Heatup/Cooldown Rate Limit
1	≤ 160°F	20°F/Hr
2.	> 160°F and ≤ 250°F	40°F/Hr
3.	> 250°F and ≤ 350°F	60°F/Hr
4.	≥ 350°F	100°F/Hr

Whenever the shutdown cooling isolation valves (MOV3015 and MOV3016) are open, the primary coolant system shall not be heated at a rate of more than 40°F/Hr. when the "Cold Leg Temperature" is >160°F.

b. Allowable combinations of pressure and temperature for inservice testing during heatup are as shown in Figure 3-3. The maximum heatup and cooldown rates required by Section a. above, are applicable. Interpolation between limit lines for other than the noted temperature change rates is permitted in 3.1.2a.

c. The average heatup or cooldown rates for the pressurizer shall not exceed 200°F/hr in any one hour time period. Whenever the Shutdown Cooling isolation valves (MOV3015 and MOV3016) are OPEN, the pressurizer shall not be heated at a rate of more than 60°F/Hr.

*Use shutdown cooling return temperature if the shutdown cooling system is in operation and all PCP's are off.

3.1.2 Heatup and Cooldown Rates (Continued)

d. Before the radiation exposure of the reactor vessel exceeds the exposure for which the figures apply, Figures 3-1, 3-2 and 3-3 shall be updated in accordance with the following criteria and procedure: /

1. US Nuclear Regulatory Commission Regulatory Guide 1.99 Revision 2 has been used to predict the increase in transition temperature based on integrated fast neutron flux and surveillance test data. If measurements on the irradiated specimens show increase above this curve, a new curve shall be constructed such that it is above and to the left of all applicable data points. /

2. Before the end of the integrated power period for which Figures 3-1, 3-2 and 3-3 apply, the limit lines on the figures shall be updated for a new integrated power period. The total integrated reactor thermal power from start-up to the end of the new power period shall be converted to an equivalent integrated fast neutron exposure ($E \geq 1$ MeV). Such a conversion shall be made consistent with the dosimetry evaluation of capsule W-290[12].

3. The limit lines in Figures 3-1, 3-2 and 3-3 are based on the requirements of Reference 9, Paragraphs IV.A.2 and IV.A.3. These lines reflect a preservice hydrostatic test pressure of 2400 psig and a vessel flange material reference temperature of 60°F[8].

Basis

All components in the primary coolant system are designed to withstand the effects of cyclic loads due to primary system temperature and pressure changes.[1] These cyclic loads are introduced by normal unit load transients, reactor trips and start-up and shutdown operation. During unit start-up and shutdown, the rates of temperature and pressure changes are limited. A maximum plant heatup and cooldown limit of 100°F per hour is consistent with the design number of cycles and satisfies stress limits for cyclic operation.[2]

The reactor vessel plate and material opposite the core has been purchased to a specified Charpy V-Notch test result of 30 ft-lb or greater at an NDTT of + 10°F or less. The vessel weld has the highest RT_{NDT} of plate, weld and HAZ materials at the fluence to which the Figures 3-1, 3-2 and 3-3 apply.[10] The unirradiated RT_{NDT} has been determined to be -56°F.[11] An RT_{NDT} of -56°F is used as an unirradiated value to which irradiation effects are added. In addition,

3.1.2 Heatup and Cooldown Rates (Continued)

the plate has been 100% volumetrically inspected by ultrasonic test using both longitudinal and shear wave methods. The remaining material in the reactor vessel, and other primary coolant system components, meets the appropriate design code requirements and specific component function and has a maximum NDTT of +40°F.[5]

As a result of fast neutron irradiation in this region of the core, there will be an increase in the RT with operation. The integrated fast neutron (E > 1 MeV) fluxes of the reactor vessel are calculated using Reference 13, utilitzing DOT III Code with the SAILOR set of cross-sections.

Since the neutron spectra and the flux measured at the samples and reactor vessel inside radius should be nearly identical, the measured transition shift from a sample can be applied to the adjacent section of the reactor vessel for later stages in plant life equivalent to the difference in calculated flux magnitude. The maximum exposure of the reactor vessel will be obtained from the measured sample exposure by application of the calculated azimuthal neutron flux variation. The predicted RT_{NDT} shift for the base metal has been predicted based upon surveillance data and the US NRC Regulatory Guide.[10] To compensate for any increase in the RT caused by irradiation, limits on the pressure-temperature relationship are periodically changed to stay within the stress limits during heatup and cooldown.

Reference 7 provides a procedure for obtaining the allowable loadings for ferritic pressure-retaining materials in Class 1 components. This procedure is based on the principles of linear elastic fracture mechanics and involves a stress intensity factor prediction which is a lower bound of static, dynamic and crack arrest critical values.[7] The stress intensity factor computed is a function of RT_{NDT}, operating temperature, and vessel wall temperature gradients.

Pressure-temperature limit calculational procedures for the reactor coolant pressure boundary are defined in Reference 8 based upon Reference 7. The limit lines of Figures 3-1 through 3-3 consider a 54 psi pressure allowance to account for the fact that pressure is measured in the pressurizer rather than at the vessel beltline and to account for PCP discharge pressure. In addition, for calculational purposes, 5°F was taken as measurement error allowance for calculation of criticality temperature. By Reference 7, reactor vessel wall locations at 1/4 and 3/4 thickness are limiting. It is at these locations that the crack propagation associated with the hypothetical flaw must be arrested. At these locations, fluence attenuation and thermal gradients have been

3.1.2 Heatup and Cooldown Rates (Continued)

Basis (Cont'd)

evaluated. During cooldown, the 1/4 thickness location is always more limiting in that the RT_{NDT} is higher than that at the 3/4 thickness location and thermal gradient stresses are tensile there. During heatup, either the 1/4 thickness or 3/4 thickness location may be limiting depending upon heatup rate.

Figures 3-1 through 3-3 define stress limitations only from a fracture mechanics point of view.

Other considerations may be more restrictive with respect to pressure-temperature limits. For normal operation, other inherent plant characteristics may limit the heatup and cooldown rates which can be achieved. Pump parameters and pressurizer heating capacity tends to restrict both normal heatup and cooldown rates to less than 60°F per hour.

The revised pressure-temperature limits are applicable to reactor vessel inner wall fluences of up to 1.8×10^{19}nvt. The application of appropriate fluence attenuation factors (Reference 10) at the 1/4 and 3/4 thickness locations results in RT_{NDT} shifts of 241°F and 177°F, respectively, for the limiting weld material. The criticality condition which defines a temperature below which the core cannot be made critical (strictly based upon fracture mechanics' considerations) is 371°F. The most limiting wall location is at 1/4 thickness. The minimum criticality temperature, 371°F is the minimum permissible temperature for the inservice system hydrostatic pressure test. That temperature is calculated based upon 2310 psig inservice hydrostatic test pressure.

The restriction of average heatup and cooldown rates to 100°F/h when all PCS cold legs are $\geq$ 350°F and the maintenance of a pressure-temperature relationship under the heatup, cooldown and inservice test curves of Figures 3-1, 3-2 and 3-3, respectively, ensures that the requirements of References 7, 8 and 9 are met. Calculation of average hourly cooldown rate after cooling to a temperature range requiring a lower cooldown rate shall be only from the time the lower cooldown rate is required. The core operational limit applies only when the reactor is critical.

3.1.2 Heatup and Cooldown Rates (Continued)

Basis (Continued)

The heatup and cooldown rate restrictions are consistent with the analyses performed for low temperature overpressure protection (LTOP) (References 13, 14 and 15). Below 430°F, the Power Operated Relief Valves (PORVs) provide overpressure protection; at 430°F or above, the PCS safety valves provide overpressure protection.

The criticality temperature is determined per Reference 8 and the core operational curves adhere to the requirements of Reference 9. The inservice test curves incorporate allowances for the thermal gradients associated with the heatup curve used to attain inservice test pressure. These curves differ from heatup curves only with respect to margin for primary membrane stress.[7] Due to the shifts in RT_{NDT}, NDTT requirements associated with nonreactor vessel materials are, for all practical purposes, no longer limiting.

References

(1) FSAR, Section 4.2.2.
(2) ASME Boiler and Pressure Vessel Code, Section III, A-2000.
(3) Battelle Columbus Laboratories Report, "Palisades Pressure Vessel Irradiation Capsule Program: Unirradiated Mechanical Properties," August 25, 1977.
(4) Battelle Columbus Laboratories Report, "Palisades Nuclear Plant Reactor Vessel Surveillance Program: Capsule A-240," March 13, 1979, submitted to the NRC by Consumers Power Company letter dated July 2, 1979.
(5) FSAR, Section 4.2.4.
(6) (Deleted)
(7) ASME Boiler and Pressure Vessel Code, Section III, Appendix G, "Protection Against Non-Ductile Failure," 1974 Edition.
(8) US Atomic Energy Commission Standard Review Plan, Directorate of Licensing, Section 5.3.2, "Pressure-Temperature Limits."
(9) 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements," May 31, 1983 as amended November 6, 1986.
(10) US Nuclear Regulatory Commission, Regulatory Guide 1.99, Revision 2, May, 1988.
(11) Combustion Engineering Report CEN-189, December, 1981.
(12) "Analysis of Capsules T-330 and W-290 from the Consumers Power Company Palisades Reactor Vessel Radiation Surveillance Program," WCAP-10637, September, 1984.
(13) "Analysis of Fast Neutron Exposure of the Palisades Reactor Pressure Vessel" by Westinghouse Electric Corporation, March 1989.
(14) Consumers Power Company Engineering Analysis EA-FC-809-13 "Pressure Response Effect of VLTOP with Replacement PORVs."
(15) Consumers Power Company Engineering Analysis EA-A-PAL-89-98 "Palisades Pressure and Temperature Limits."

FIGURE 3-1

PALISADES PRESSURE AND TEMPERATURE LIMITS FOR HEATUP

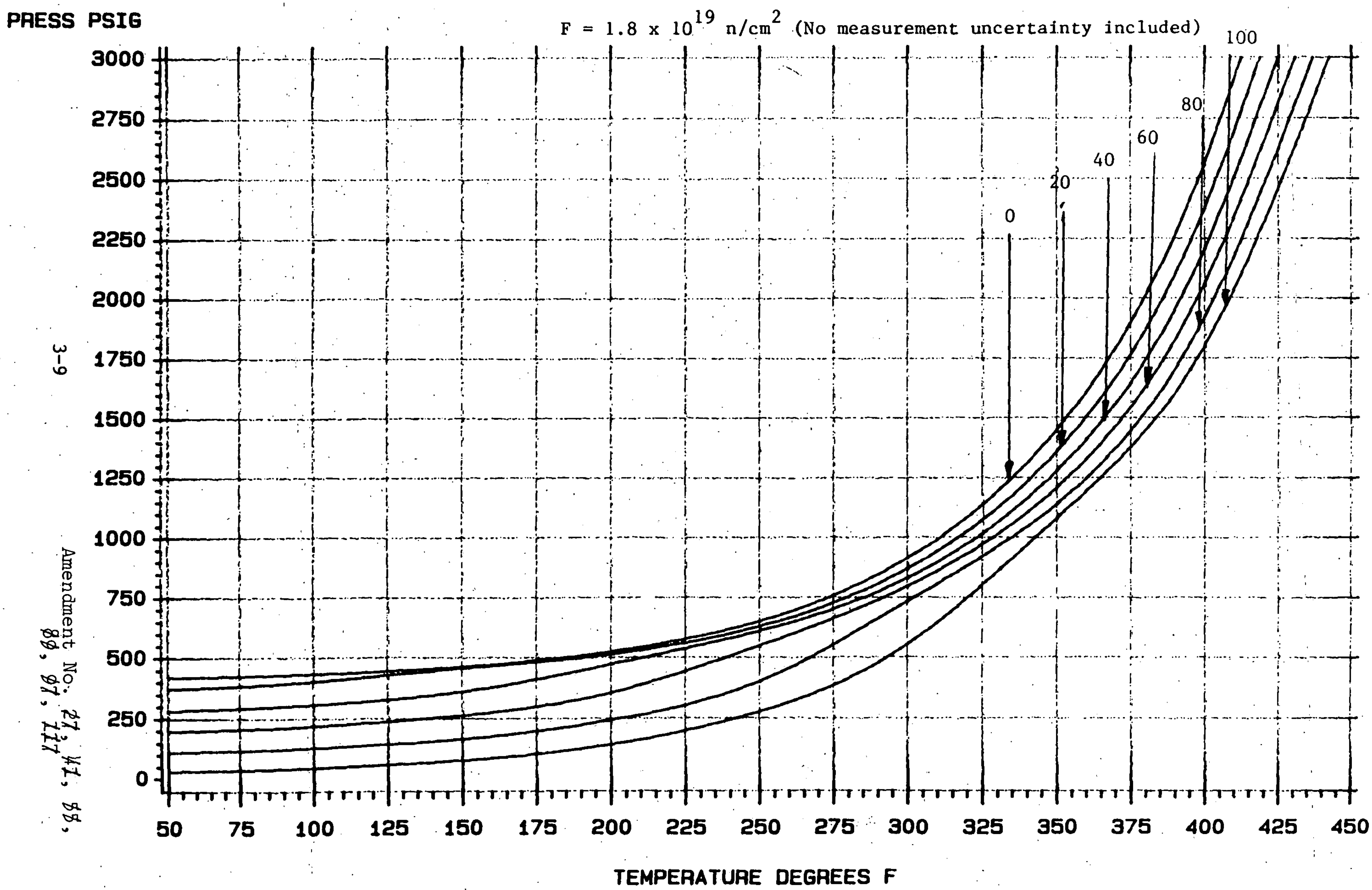

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FIGURE 3-2

PALISADES PRESSURE & TEMPERATURE LIMITS FOR COOLDOWN

$F = 1.8 \times 10^{19}$ n/cm^2 (No Measurement Uncertainty Included)

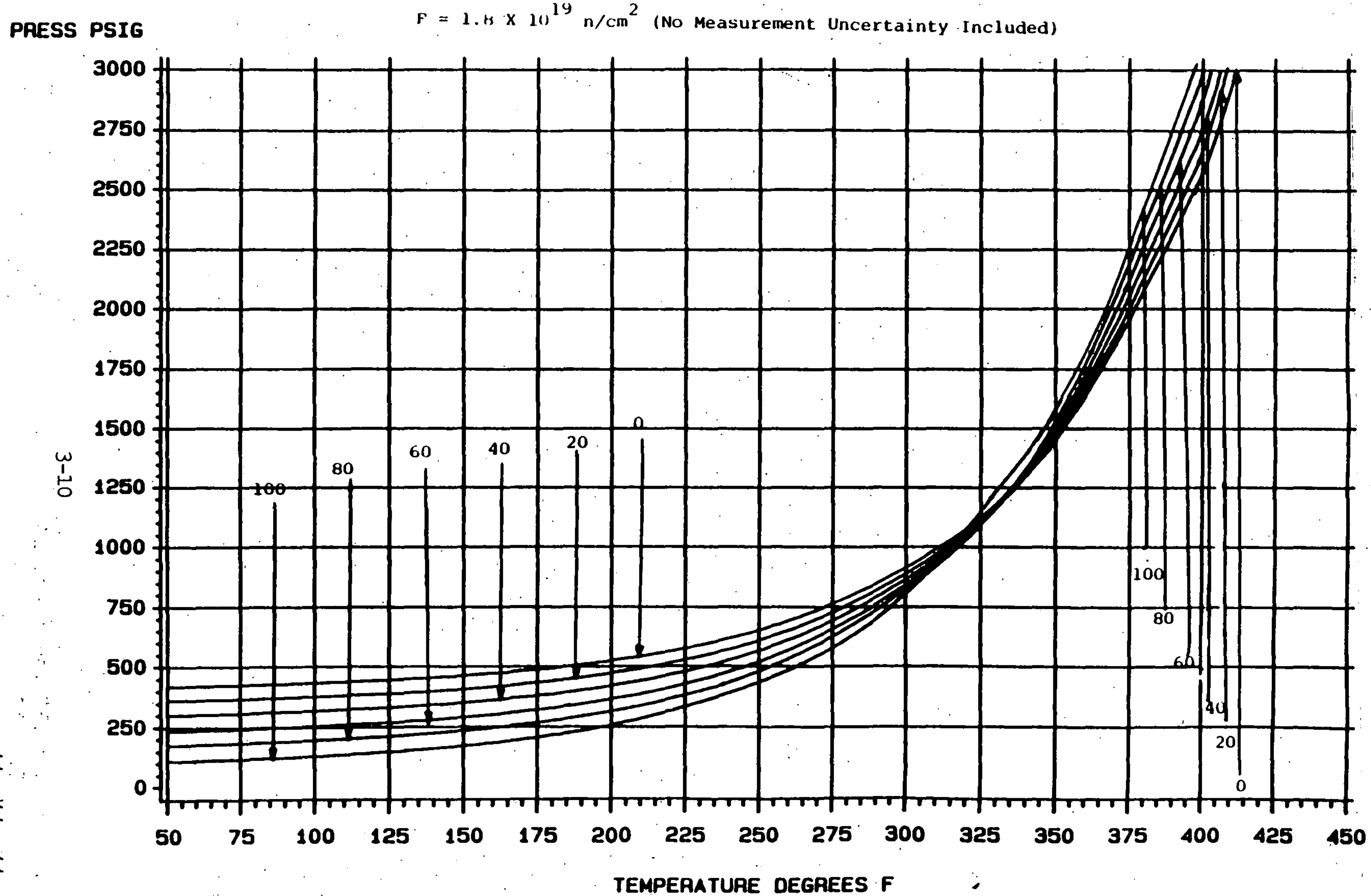

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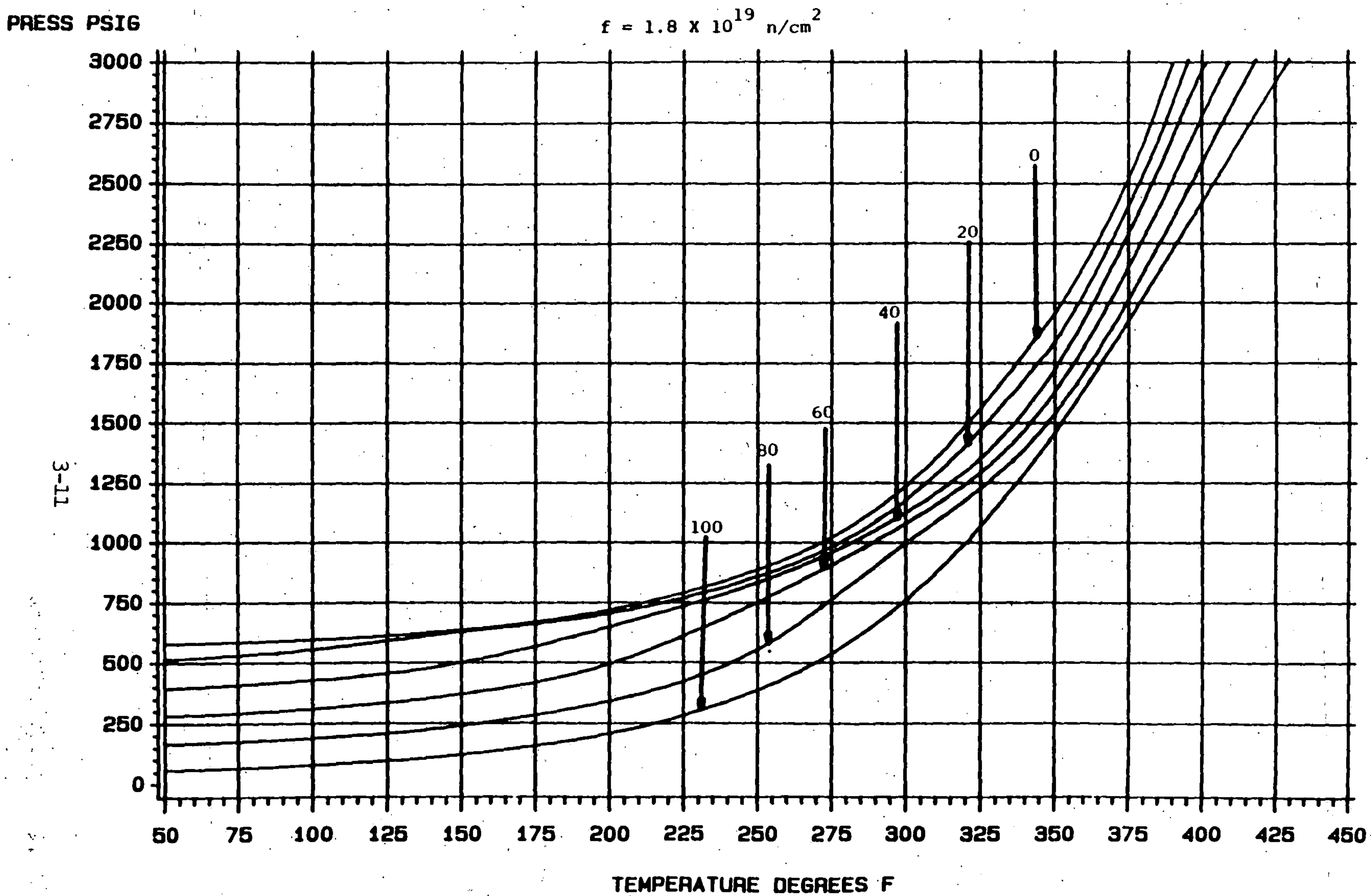
FIGURE 3-3

PALISADES PRESSURE AND TEMPERATURE LIMITS FOR HYDRO



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3.1.8 OVERPRESSURE PROTECTION SYSTEMS

LIMITING CONDITIONS FOR OPERATION

3.1.8.1 REQUIREMENTS

Two power operated relief valves (PORVs) with a lift setting below and/or to the right of the curve in Figure 3-4 shall be operable.

APPLICABILITY: When the temperature of one or more of the primary coolant system cold legs is less than 430°F.

ACTION:

a. With one PORV inoperable, either restore the inoperable PORV to operable status within 7 days or depressurize within the next 8 hours and either vent the PCS through a ≥ 1.3 square inch vent or open both PORV valves and both PORV block valves.

b. With both PORVs inoperable, depressurize within the next 8 hours and either vent the PCS through a ≥ 1.3 square inch vent or open both PORV valves and both PORV block valves.

c. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

Basis

There are three pressure transients which could cause the PCS pressure to exceed the pressure limits required by 10CFR50 Appendix G. They are: (1) a charging/letdown imbalance, (2) the start of high pressure safety injection (HPSI), and (3) initiation of forced circulation in the PCS when the steam generator temperature is higher than the PCS temperature.

Analysis (Reference 3) shows that when three charging pumps are operating and letdown is isolated and a spurious HPSI occurs between 230°F and 430°F, the PORV setpoints ensure that 10CFR50 Appendix G pressure limits will not be exceeded. Below 230°F, overpressure protection is still provided by the PORVs but HPSI operability is precluded by the limitations of Technical Specification 3.3.2 g. Above 430°F, the pressurizer safety valves prevent 10CFR50 Appendix G limits from being exceeded.

3.1.8. Basis (continued)

Assurance that the Appendix G limits for the reactor pressure vessel will not be violated while operating at low temperature is provided by the variable setpoint of the Low Temperature Overpressure Protection (LTOP) system. The LTOP system is programmed and calibrated to ensure opening of the pressurizer power operated relief valve (PORV) when the combination of primary coolant system (PCS) pressure and temperature is above or to the left of the limit displayed in Figure 3-4. That limit is developed from the more limiting of the heating or cooling limits for the specific temperature of the PCS while heating or cooling at the maximum permissible rate for that temperature. The limit in Figure 3-4 includes an allowance for pressure overshoot during the interval between the time pressurizer pressure reaches the limit, and the time a PORV opens enough to terminate the pressure rise. LTOP is provided by two independent channels of measurement, control, actuation, and valves, either one of which is capable of providing full protection. The actual setpoint of PORV actuation for LTOP will be lowered from the limit of Figure 3-4 to allow for potential instrument inaccuracies, measurement error, and instrument drift. This will ensure that at no time between calibration intervals will the combination of PCS temperature and pressure exceed the limits of Figure 3-4 without PORV actuation.

When the shutdown cooling system is not isolated (MO-3015 and MO-3016 open) from the PCS, assurance that the shutdown cooling system will not be pressurized above its design pressure is afforded by the relief valves on the shutdown cooling system, and the limitations of sections 3.1.1.h., 3.1.2.a & c, and 3.3.2.g.

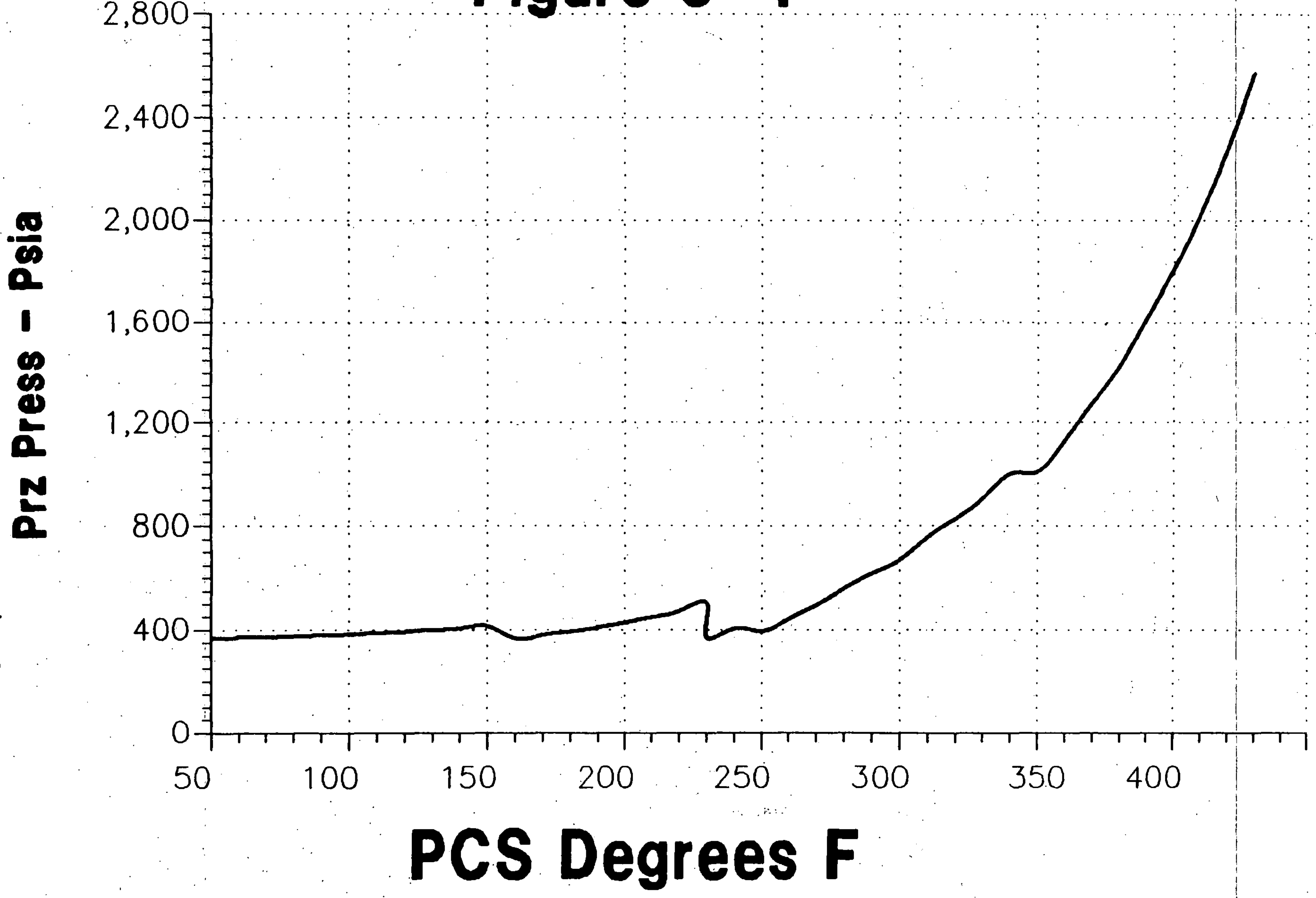
The requirement for the PCS to be depressurized and vented by an opening $\geq$ 1.3 square inches (Reference 4) or by opening both PORV valves and both PORV block valves when one or both PORVs are inoperable ensures that the 10CFR50 Appendix G pressure limits will not be exceeded when one of the PORVs is assumed to fail per the "single failure" criteria 10CFR50 Appendix A, Criterion 34. Since the PORV solenoid is strong enough to overcome spring pressure and valve disc weight, the PORVs may be held open by keeping the control switch in the open position.

References

1. Technical Specification 3.3.2
2. Technical Specification 3.1.2.
3. Consumers Power Company Engineering Analysis EA-FC-809-13
4. "Palisades Plant Overpressurization Analysis" June 1987 and "Palisades Plant Primary Coolant System Overpressurization Subsystem Description" October 1977.

LTOP T.S. LIMITS

Figure 3-4



g. HPSI pump operability shall be as follows:

1) If the reactor head is installed, both HPSI pumps shall be rendered inoperable when:

a. The PCS temperature is < 230°F, or

b. Shutdown cooling isolation valves MO-3015 and MO-3016 are open.

2) Two HPSI pumps shall be operable when the PCS temperature is > 325°F.

3) One HPSI pump may be made inoperable when the reactor is subcritial provided the requirements of Section 3.3.2.c are met.

4) HPSI pump testing may be performed when the PCS temperature is <430°F provided the HPSI pump manual discharge valve is closed.

3.3.3 Prior to returning to the Power Operation Condition after every time the plant has been placed in the Refueling Shutdown Condition, or the Cold Shutdown Condition for more than 72 hours and testing of Specification 4.3.h has not been accomplished in the previous 9 months, or prior to returning the check valves in Table 4.3.1 to service after maintenance, repair or replacement, the following conditions shall be met:

a. All pressure isolation valves listed in Table 4.3.1 shall be functional as a pressure isolation device, except as specified in b. Valve leakage shall not exceed the amounts indicated.

b. In the event that integrity of any pressure isolation valve specified in Table 4.3.1 cannot be demonstrated, at least two valves in each high pressure line having a non-functional valve must be in and remain in, the mode corresponding to the isolated condition.(1)

1 Motor-operated valves shall be placed in the closed position and power supplies deenergized.

Basis (continued)

demonstrate that the maximum fuel clad temperatures that could occur over the break size spectrum are well below the melting temperature of zirconium (3300°F).

Malfunction of the Low Pressure Safety Injection Flow control valve could defeat the Low Pressure Injection feature of the ECCS; therefore, it is disabled in the 'open' mode (by isolating the air supply) during plant operation. This action assures that it will not block flow during Safety Injection.

The inadvertent closing of any one of the Safety Injection bottle isolation valves in conjunction with a LOCA has not been analyzed. To provide assurance that this will not occur, these valves are electrically locked open by a key switch in the control room. In addition, prior to critical the valves are checked open, and then the 480 volt breakers are opened. Thus, a failure of a breaker and a switch are required for any of the valves to close.

Insuring both HPSI pumps are inoperable when the PCS temperature is < 230°F or the shutdown cooling isolation valves are open eliminates PCS mass additions due to inadvertent HPSI pump starts. Both HPSI pumps starting in conjunction with a charging/letdown imbalance may cause 10CFR50 Appendix G limits to be exceeded when the PCS temperature is < 230°F. When the PCS temperature is ≥ 430°F, the pressurizer safety valves ensure that the PCS pressure will not exceed 10CFR50 Appendix G.

The requirement to have both HPSI trains operable above 325°F provides added assurance that the effects of a LOCA occuring under LTOP conditions would be mitigated. If a LOCA occurs when the primary system temperature is less than or equal to 325°F, the pressure would drop to the level where low pressure safety injection can prevent core damage. Therefore, when the PCS temperature is ≥230°F and ≤325°F operation of the HPSI system would not cause the 10CFR50 Appendix G limits to be exceeded nor is HPSI system operation necessary for core cooling.

HPSI pump testing with the HPSI pump manual discharge valve closed is permitted since the closed valve eliminates the possibility of pump testing being the cause of a mass addition to the PCS.

References

(1) FSAR, Section 9.10.3;
(2) FSAR, Section 6.1,

b. The PCS vent(s) shall be verified to be open at least once per 12 hours when the vent(s) is being used for overpressure protection except when the vent pathway is provided with a valve which is locked, sealed, or otherwise secured in the open position, then verify these valves open at least once per 31 days.

c. When both open PORV valves are used as an alternative to venting the PCS, then verify both PORV valves and both PORV block valves are open at least once per 7 days.

Basis

Failures such as blown instrument fuses, defective indicators, and faulted amplifiers which result in "upscale" or "downscale" indication can be easily recognized by simple observation of the functioning of an instrument or system. Furthermore, such failures are, in many cases, revealed by alarm or annunciator action and a check supplements this type of built-in surveillance.

Based on experience in operation of both conventional and nuclear plant systems when the plant is in operation, a checking frequency of once-per-shift is deemed adequate for reactor and steam system instrumentation. Calibrations are performed to insure the presentation and acquisition of accurate information.

The power range safety channels and ΔT power channels are are calibrated daily against a heat balance standard to account for errors induced by changing rod patterns and core physics parameters.

Other channels are subject only to the "drift" errors induced within the instrumentation itself and, consequently, can tolerate longer intervals between calibration. Process system instrumentation errors induced by drift can be expected to remain within acceptable tolerances if recalibration is performed at each refueling shutdown interval.

Substantial calibration shifts within a channel (essentially a channel failure) will be revealed during routine checking and testing procedures. Thus, minimum calibration frequencies of one-per-day for the power range safety channels, and once each refueling shutdown for the process system channels, are considered adequate.

The minimum testing frequency for those instrument channels connected to the reactor protective system is based on an estimated average unsafe failure rate of 1.14×10^{-5} failure/hour per channel. This estimation is based on limited operating experience at conventional and nuclear plants. An "unsafe failure" is defined as one which negates channel operability and which, due to its nature, is revealed only when the channel is tested or attempts to respond to a bonafide signal.

4.6 SAFETY INJECTION AND CONTAINMENT SPRAY SYSTEMS TESTS

Applicability

Applies to the safety injection system, the containment spray system, chemical injection system and the containment cooling system tests.

Objective

To verify that the subject systems will respond promptly and perform their intended functions, if required.

Specifications

4.6.1 Safety Injection System

a. System tests shall be performed at each reactor refueling interval. A test safety injection signal will be applied to initiate operation of the system. The safety injection and shutdown cooling system pump motors may be de-energized for this test. The system will be considered satisfactory if control board indication and visual observations indicate that all components have received the safety injection signal in the proper sequence and timing (ie, the appropriate pump breakers shall have opened and closed, and all valves shall have completed their travel).

b Both high pressure safety injection pumps, P-66A and P-66B shall be demonstrated inoperable at least once per 12 hours whenever the temperature of one or more of the PCS cold legs is < 230°F or if shutdown cooling valves MO-3015 and MO-3016 are open unless the reactor head is removed.

4.6.2 Containment Spray System

a. System test shall be performed at each reactor refueling interval. The test shall be performed with the isolation valves in the spray supply lines at the containment blocked closed. Operation of the system is initiated by tripping the normal actuation instrumentation.

b. At least every five years the spray nozzles shall be verified to be open.

c. The test will be considered satisfactory if visual observations indicate all components have operated satisfactorily.

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TSP0889-0101-MD01-NL04

Basis (continued)

During reactor operation, the instrumentation which is depended on to initiate safety injection and containment spray is generally checked daily and the initiating circuits are tested monthly. In addition, the active components (pumps and valves) are to be tested every three months to check the operation of the starting circuits and to verify that the pumps are in satisfactory running order. The test interval of three months is based on the judgment that more frequent testing would not significantly increase the reliability (ie, the probability that the component would operate when required), yet more frequent test would result in increased wear over a long period of time. Verification that the spray piping and nozzles are open will be made initially by a smoke test or other suitably sensitive method, and at least every five years thereafter. Since the material is all stainless steel, normally in a dry condition, and with no plugging mechanism available, the retest every five years is considered to be more than adequate.

Other systems that are also important to the emergency cooling function are the SI tanks, the component cooling system, the service water system and the containment air coolers. The SI tanks are a passive safety feature. In accordance with the specifications, the water volume and pressure in the SI tanks are checked periodically. The other systems mentioned operate when the reactor is in operation and by these means are continuously monitored for satisfactory performance.

With the reactor vessel head installed when the PCS cold leg temperature is less than 230°F, or if the shutdown cooling system isolation valves MO-3015 and MO-3016 are open, the start of one HPSI pump could cause the Appendix G or the shutdown cooling system pressure limits to be exceeded; therefore, both pumps are rendered inoperable.

References

(1) FSAR, Section 6.1.3.
(2) FSAR, Section 6.2.3.

ATTACHMENT II

Consumers Power Company
Palisades Plant
Docket 50-255

EXISTING TECHNICAL SPECIFICATION PAGES
MARKED UP WITH PROPOSED CHANGES

September 12, 1989

31 Pages

TSP0889-0101-MD01-NL04

3.1 PRIMARY COOLANT SYSTEM

Applicability

Applies to the operable status of the primary coolant system.

Objective

To specify certain conditions of the primary coolant system which must be met to assure safe reactor operation.

Specifications

3.1.1 Operable Components

a. At least one primary coolant pump or one shutdown cooling pump with a flow rate greater than or equal to 2810 gpm shall be in operation whenever a change is being made in the boron concentration of the primary coolant and the plant is operating in cold shutdown or above, except during an emergency loss of coolant flow situation. Under these circumstances, the boron concentration may be increased with no primary coolant pumps or shutdown cooling pumps running.

b. Four primary coolant pumps shall be in operation whenever the reactor is operated above hot shutdown, with the following exception:

Before removing a pump from service, thermal power shall be reduced as specified in Table 2.3.1 and appropriate corrective action implemented. With one pump out of service, return the pump to service within 12 hours (return to four-pump operation) or be in hot shutdown (or below) with the reactor tripped (from the C-06 panel, opening the 42-01 and 42-02 circuit breakers) within the next 12 hours. Start-up (above hot shutdown) with less than four pumps is not permitted and power operation with less than three pumps is not permitted.

c. The measured four primary coolant pumps operating reactor vessel flow shall be 124.3×10^6 lb/hr or greater, when corrected to 532°F.

d. Both steam generators shall be capable of performing their heat transfer function whenever the average temperature of the primary coolant is above 325°F.

e. Maximum primary system pressure differentials shall not exceed the following:

(1) Deleted

3.1.1 Operable Components (Continued)

(2) Hydrostatic tests shall be conducted in accordance with applicable paragraphs of Section XI ASME Boiler & Pressure Vessel Code (1974). Such tests shall be conducted with sufficient pressure on the secondary side of the steam generators to restrict primary to secondary pressure differential to a maximum of 1380 psi. Maximum hydrostatic test pressure shall not exceed 1.1 Po plus 50 psi where Po is nominal operating pressure.

(3) Primary side leak tests shall be conducted at normal operating pressure. The temperature shall be consistent with applicable fracture toughness criteria for ferritic materials and shall be selected such that the differential pressure across the steam generator tubes is not greater than 1380 psi.

(4) Maximum secondary hydrostatic test pressure shall not exceed 1250 psia. A minimum temperature of 100°F is required. Only ten cycles are permitted.

(5) Maximum secondary leak test pressure shall not exceed 1000 psia. A minimum temperature of 100°F is required.

(6) In performing the tests identified in 3.1.1.e(4) and 3.1.1.e(5), above, the secondary pressure shall not exceed the primary pressure by more than 350 psi.

f. Nominal primary system operation pressure shall not exceed 2100 psia.

g. The reactor inlet temperature (indicated) shall not exceed the value given by the following equation at steady state power operation: /

$$T_{inlet} \leq 543.3 + .0575(P-2060) + 0.00005(P-2060)**2 + 1.173(W-120) - .0102(W-120)**2$$ /

Where: T_{inlet} = reactor inlet temperature in F°
P = nominal operating pressure in psia
W = total recirculating mass flow in 10^6 lb/h corrected to the operating temperature conditions.

When the ASI exceeds the limits specified in Figure 3.0, within 15 minutes, initiate corrective actions to restore the ASI to the acceptable region. Restore the ASI to acceptable values within one hour or be at less than 70% of rated power within the following two hours. /

If the measured primary coolant system flow rate is greater than 130 M lbm/hr, the maximum inlet temperature shall be less than or equal to the T_{Inlet} LCO at 130 M lbm/hr. /

3.1.1 Operable Components (Cont'd)

Insert (A)

h. ~~During initial primary coolant pump starts (i.e., initiation of forced circulation), secondary system temperature in the steam generators shall be ≤ the PCS cold leg temperature unless the PCS cold leg temperature is ≥ 450°F.~~

i. The PCS shall not be heated or maintained above 325°F unless a minimum of 375 kW of pressurizer heater capacity is available from both buses 1D and 1E. Should heater capacity from either bus 1D and 1E fall below 375 kW, either restore the inoperable heaters to provide at least 375 kW of heater capacity from both buses 1D and 1E within 72 hours or be in hot shutdown within the next 12 hours.

Basis

When primary coolant boron concentration is being changed, the process must be uniform throughout the primary coolant system volume to prevent stratification of primary coolant at lower boron concentration which could result in a reactivity insertion. Sufficient mixing of the primary coolant is assured if one shutdown cooling or one primary coolant pump is in operation.(1) The shutdown cooling pump will circulate the primary system volume in less than 60 minutes when operated at rated capacity. By imposing a minimum shutdown cooling pump flow rate of 2810 gpm, sufficient time is provided for the operator to terminate the boron dilution under asymmetric flow conditions.(6) The pressurizer volume is relatively inactive, therefore will tend to have a boron concentration higher than rest of the primary coolant system during a dilution operation. Administrative procedures will provide for use of pressurizer sprays to maintain a nominal spread between the boron concentration in the pressurizer and the primary system during the addition of boron.(2)

The FSAR safety analysis was performed assuming four primary coolant pumps were operating for accidents that occur during reactor operation. Therefore, reactor startup above hot shutdown is not permitted unless all four primary coolant pumps are operating. Operation with three primary coolant pumps is permitted for a limited time to allow the restart of a stopped pump or for reactor internals vibration monitoring and testing.

Requiring the plant to be in hot shutdown with the reactor tripped from the C-06 panel, opening the 42-01 and 42-02 circuit breakers, assures an inadvertent rod bank withdrawal will not be initiated by the control room operator. Both steam generators are required to be operable whenever the temperature of the primary coolant is greater than the design temperature of the shutdown cooling system to assure a redundant heat removal system for the reactor.

Amendment No ~~67~~, ~~85~~, ~~117~~, 118
November 15, 1988

A

h. During initial primary coolant pump starts (initiation of forced circulation) at PCS cold leg temperatures $\leq$ 430°F, the secondary system temperature in both steam generators must be $\leq$ the PCS cold leg temperature unless the Shutdown Cooling System is isolated from the PCS and one of the following conditions is met:

1. The steam generator temperature shall not exceed the PCS cold leg temperature by more than the ΔT limit below.

Cold Leg Temperature	ΔT Limit
1. $\geq$ 120°F and < 160°F	100°F
2. $\geq$ 160°F and $\leq$ 210°F	10°F
3. > 210°F and $\leq$ 350°F	100°F

2. Under transient conditions with only one of the steam generator's temperatures higher than the PCS temperature, and the PCS temperature > 350°F:

A. To start a PCP in the cold steam generator loop, ΔT in the hot steam generator loop shall be shall be < 100°F; or

B. To start a PCP in the hot steam generator loop, ΔT shall be < 100°F and the PCS pressure shall be at least 100 psi less than the pressure limits of Figure 3-4.

i. The PCS shall not be heated or maintained above 325°F unless a minimum of 375 kW of pressurizer heater capacity is available from both buses 1D and 1E. Should heater capacity from either bus 1D and 1E fall below 375 kW, either restore the inoperable heaters to provide at least 375 kW of heater capacity from both buses 1D and 1E within 72 hours or be in hot shutdown within the next 12 hours.

Basis

When primary coolant boron concentration is being changed, the process must be uniform throughout the primary coolant system volume to prevent stratification of primary coolant at lower boron concentration which could result in a reactivity insertion. Sufficient mixing of the primary coolant is assured if one shutdown cooling or one primary coolant pump is in operation.(1) The shutdown cooling pump will circulate the primary system volume in less than 60 minutes when operated at rated capacity. By imposing a minimum shutdown cooling pump flow rate of 2810 gpm, sufficient time is provided for the operator to terminate the boron dilution under asymmetric flow conditions.(5) The pressurizer volume is relatively inactive, therefore will tend to have a boron concentration higher than rest of the primary coolant system during a dilution operation.

3.1 PRIMARY COOLANT SYSTEM (Contd)

Basis (Contd)

Administrative procedures will provide for use of pressurizer sprays to maintain a nominal spread between the boron concentration in the pressurizer and the primary system during the addition of boron.[2]

The FSAR safety analysis was performed assuming four primary coolant pumps were operating for accidents that occur during reactor operation. Therefore, reactor startup above hot shutdown is not permitted unless all four primary coolant pumps are operating. Operation with three primary coolant pumps is permitted for a limited time to allow the restart of a stopped pump or for reactor internals vibration monitoring and testing.

Requiring the plant to be in hot shutdown with the reactor tripped from the C-06 panel, opening the 42-01 and 42-02 circuit breakers, assures an inadvertent rod bank withdrawal will not be initiated by the control room operator. Both steam generators are required to be operable whenever the temperature of the primary coolant is greater than the design temperature of the shutdown cooling system to assure a redundant heat removal system for the reactor.

Calculations have been performed to demonstrate that a pressure differential of 1380 psi[3] can be withstood by a tube uniformily thinned to 36% of its original nominal wall thickness (64% degradation), while maintaining:

(1) A factor of safety of three between the actual pressure differential and the pressure differential required to cause bursting.
(2) Stresses within the yield stress for Inconel 600 at operating temperature.
(3) Acceptable stresses during accident conditions.

Secondary side hydrostatic and leak testing requirements are consistent with ASME BPV Section XI (1971). The differential maintains stresses in the steam generator tube walls within code allowable stresses.

The minimum temperature of 100°F for pressurizing the steam generator secondary side is set by the NDTT of the ~~mayway~~ manway cover of + 40°F.

The transient analyses were performed assuming a vessel flow at hot zero power (532°F) of 124.3 x 10 lb/hr minus 6% to account for flow measurement uncertainty and core flow bypass. A DNB analysis was performed in a parametric fashion to determine the core inlet temperature as a function of pressure and flow for which the minimum DNBR is equal to 1.17. This analysis includes the following uncertainties and allowances: 2% of rated power for power

Basis (Cont'd)

The Axial Shape Index alarm channel is being used to monitor the ASI to ensure that the assumed axial power profiles used in the development of the inlet temperature LCO bound measured axial power profiles. The signal representing core power (Q) is the auctioneered higher of the neutron flux power and the Delta-T power. The measured ASI calculated from the excore detector signals and adjusted for shape annealing (Y_I) and the core power constitute an ordered pair (Q, Y_I). An alarm signal is activated before the ordered pair exceed the boundaries specified in Figure 3.0. /

The requirement that the steam generator temperature be $\leq$ the PCS temperature when forced circulation is initiated in the PCS ensures that an energy addition caused by heat transferred from the secondary system to the PCS will not occur. This requirement applies only to the initiation of forced circulation (the start of the first primary coolant pump) when the PCS cold leg temperature is < ~~450°F~~ 430 F. ~~At or above 450°F, the PCS safety valves prevent the PCS pressure from exceeding 10CFR50 Appendix G limits.~~

However, Analysis (Reference 6) shows that under limited conditions when the Shutdown Cooling System is isolated from the PCS, forced circulation may be initiated when the steam generator temperature is higher than the PCS cold leg temperature.

References

(1) Updated FSAR, Section 14.3.2. /
(2) Updated FSAR, Section 4.3.7. /
(3) Palisades 1983/1984 Steam Generator Evaluation and Repair Program Report, Section 4, April 19, 1984 /
(4) ANF-87-150(NP), Volume 2, Section 15.0.7.1 /
~~(5) (Deleted)~~
(5) ~~(6)~~ ANF-88-108 /
(6) CPCo Engineering Analysis EA-A-NL-89-14

Amendment No 31, 51, 117, 118
November 15, 1988

3.1 PRIMARY COOLANT SYSTEM (

3.1.2 Heatup and Cooldown Rates

The primary coolant pressure and the system heatup and cooldown rates shall be limited in accordance with Figure 3-1, Figure 3-2 and as follows.

and 3-2. or cooldown

a. Allowable combinations of pressure and temperature for any heatup or Cooldown rate shall be below and to the right of the applicable limit line as shown on Figures 3-1. The average heatup or cooldown rate in any one hour time period shall not exceed the heatup rate limit when one or more PCS cold leg is less than the corresponding "Cold Leg Temperature" below.

	*Cold Leg Temperature	Heatup Rate Limit
1	≤ ~~100°F~~ 160°F	20°F/Hr
2.	≥ ~~100°F~~ 160° and ≤ ~~310°F~~ 250°F	40°F/Hr
3.	≥ ~~310°F~~ 250° and ≤ ~~450°F~~ 350°F	60°F/Hr
4.	≥ ~~450°F~~ 350°F	100°F/Hr

b. Allowable combinations of pressure and temperature for any cooldown rate shall be below and to the right of the applicable limit lines as shown on Figure 3-2. The average cooldown rate shall not exceed the Cooldown Rate Limit when one or more PCS cold legs is less than the corresponding "Cold Leg Temperature" below:

	*Cold Leg Temperature	Cooldown Rate Limit
1.	≥ 450°F	100°F/Hr
2.	≥ 300°F and < 450°F	60°F/Hr
3.	≤ 300°F and ≥ 180°F	40°F/Hr
4.	≤ 180°F	20°F/Hr

~~c.~~ b. Allowable combinations of pressure and temperature for inservice testing during heatup are as shown in Figure 3-3. The maximum heatup and cooldown rates required by Sections a and b, above, are applicable. Interpolation between limit lines for other than the noted temperature change rates is permitted in 3.1.2a, b or c.

~~d.~~ c. 1. The average heatup or cooldown rates for the pressurizer shall not exceed ~~100°F~~ 200 °F/hr in any one hour time period ~~when the PCS cold leg temperature is less than 450°F.~~

~~2. The average cooldown rate for the pressurizer shall not exceed 200°F/hr for any one hour time period.~~

Whenever the Shutdown Cooling isolation valves (MO 3015 and MO 3016) are open, the pressurizer shall not be heated at a rate of more than 60°F/Hr.

*Use shutdown cooling return temperature if the shutdown cooling system is in operation and all PCP's are off.

Whenever the Shutdown cooling isolation valves (MO3015 and MO3016) are OPEN, the primary coolant system shall not be heated at a rate of more than 40°F/Hr. when the "Cold Leg Temperature" is > 160°F.

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3.1.2 Heatup and Cooldown Rates (Continued)

d. Before the radiation exposure of the reactor vessel exceeds the exposure for which the figures apply, Figures 3-1, 3-2 and 3-3 shall be updated in accordance with the following criteria and procedure:

Revision 2

1. US Nuclear Regulatory Commission Regulatory Guide 1.99 has been used to predict the increase in transition temperature based on integrated fast neutron flux and surveillance test data. If measurements on the irradiated specimens show increase above this curve, a new curve shall be constructed such that it is above and to the left of all applicable data points.

2. Before the end of the integrated power period for which Figures 3-1, 3-2 and 3-3 apply, the limit lines on the figures shall be updated for a new integrated power period. The total integrated reactor thermal power from start-up to the end of the new power period shall be converted to an equivalent integrated fast neutron exposure ($E \geq 1$ MeV). Such a conversion shall be made consistent with the dosimetry evaluation of capsule W-290[12].

3. The limit lines in Figures 3-1, 3-2 and 3-3 are based on the requirements of Reference 9, Paragraphs IV.A.2 and IV.A.3. These lines reflect a preservice hydrostatic test pressure of 2400 psig and a vessel flange material reference temperature of 60°F[8].

Basis

All components in the primary coolant system are designed to withstand the effects of cyclic loads due to primary system temperature and pressure changes.[1] These cyclic loads are introduced by normal unit load transients, reactor trips and start-up and shutdown operation. During unit start-up and shutdown, the rates of temperature and pressure changes are limited. A maximum plant heatup and cooldown limit of 100°F per hour is consistent with the design number of cycles and satisfies stress limits for cyclic operation.[2]

The reactor vessel plate and material opposite the core has been purchased to a specified Charpy V-Notch test result of 30 ft-lb or greater at an NDTT of + 10°F or less. The vessel weld has the highest RT_{NDT} of plate, weld and HAZ materials at the fluence to which the Figures 3-1, 3-2 and 3-3 apply.[10] The unirradiated RT_{NDT} has been determined to be -56°F.[11] An RT_{NDT} of -56°F is used as an unirradiated value to which irradiation effects are added. In addition, The integrated fast neutron (E > 1 MeV) fluxes of the reactor vessel are calculated using Reference 13, utilizing DOT III code with the SAILOR set of cross-sections.

3.1.2 Heatup and Cooldown Rates (Continued)

the plate has been 100% volumetrically inspected by ultrasonic test using both longitudinal and shear wave methods. The remaining material in the reactor vessel, and other primary coolant system components, meets the appropriate design code requirements and specific component function and has a maximum NDTT of +40°F.(5)

As a result of fast neutron irradiation in this region of the core, there will be an increase in the RT with operation. ~~The techniques used to predict the integrated fast neutron (E > 1 MeV) fluxes of the reactor vessel are described in Section 3.3.2.6 of the FSAR and also in Amendment 13, Section II, to the FSAR.~~

Since the neutron spectra and the flux measured at the samples and reactor vessel inside radius should be nearly identical, the measured transition shift from a sample can be applied to the adjacent section of the reactor vessel for later stages in plant life equivalent to the difference in calculated flux magnitude. The maximum exposure of the reactor vessel will be obtained from the measured sample exposure by application of the calculated azimuthal neutron flux variation. The predicted RT_{NDT} shift for the base metal has been predicted based upon surveillance data and the US NRC Regulatory Guide.(10) To compensate for any increase in the RT caused by irradiation, limits on the pressure-temperature relationship are periodically changed to stay within the stress limits during heatup and cooldown.

Reference 7 provides a procedure for obtaining the allowable loadings for ferritic pressure-retaining materials in Class 1 components. This procedure is based on the principles of linear elastic fracture mechanics and involves a stress intensity factor prediction which is a lower bound of static, dynamic and crack arrest critical values. The stress intensity factor computed(7) is a function of RT_{NDT}, operating temperature, and vessel wall temperature gradients.

Pressure-temperature limit calculational procedures for the reactor coolant pressure boundary are defined in Reference 8 based upon Reference 7. The limit lines of Figures 3-1 through 3-3 consider a 54 psi pressure allowance to account for the fact that pressure is measured in the pressurizer rather than at the vessel beltline. In addition, for calculational purposes, 5°F ~~and 30 psi~~ was ~~were~~ taken as measurement error allowance ~~s~~ for temperature ~~and pressure, respectively~~. By Reference 7, reactor vessel wall locations at 1/4 and 3/4 thickness are limiting. It is at these locations that the crack propagation associated with the hypothetical flaw must be arrested. At these locations, fluence attenuation and thermal gradients have been

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Calculation of criticality

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3.1.2 Heatup and Cooldown Rates (Continued)

Basis (Cont'd)

evaluated. During cooldown, the 1/4 thickness location is always more limiting in that the RT_{NDT} is higher than that at the 3/4 thickness location and thermal gradient stresses are tensile there. During heatup, either the 1/4 thickness or 3/4 thickness location may be limiting depending upon heatup rate.

Figures 3-1 through 3-3 define stress limitations only from a fracture mechanics point of view.

Other considerations may be more restrictive with respect to pressure-temperature limits. For normal operation, other inherent plant characteristics may limit the heatup and cooldown rates which can be achieved. Pump parameters and pressurizer heating capacity tends to restrict both normal heatup and cooldown rates to less than 60°F per hour.

The revised pressure-temperature limits are applicable to reactor vessel inner wall fluences of up to 1.8×10^{19}nvt. The application of appropriate fluence attenuation factors (Reference 10) at the 1/4 and 3/4 thickness locations results in RT_{NDT} shifts of 241°F and ~~185~~ 177°F, respectively, for the limiting weld material. The criticality condition which defines a temperature below which the core cannot be made critical (strictly based upon fracture mechanics' considerations) is 371°F. The most limiting wall location is at 1/4 thickness. The minimum criticality temperature, 371°F is the minimum permissible temperature for the inservice system hydrostatic pressure test. That temperature is calculated based upon 2310 psig inservice hydrostatic test pressure.

The restriction of average heatup and cooldown rates to 100°F/h when all PCS cold legs are ≥ ~~450~~ 350°F and the maintenance of a pressure-temperature relationship under the heatup, cooldown and inservice test curves of Figures 3-1, 3-2 and 3-3, respectively, ensures that the requirements of References 6, 7, 8 and 9 are met. Calculation of average hourly cooldown rate after cooling to temperature range requiring a lower cooldown rate shall be only from the time the lower cooldown rate is required. The core operational limit applies only when the reactor is critical.

The heatup and cooldown rate restrictions ~~applicable when the temperature of one or more of the PCS cold legs is less than 450°F~~ are consistent with the analyses performed for low temperature overpressure protection (LTOP) (References 13, 14, 15, 16 & 17). Below 430°F, the Power Operated Relief Valves (PORVs) provide overpressure protection; ~~At 450~~ at 430°F or above, the PCS safety valves provide overpressure protection for heatup or cooldown rates ≤ 100°F/hr.

Basis (Continued)

The criticality temperature is determined per Reference 8 and the core operational curves adhere to the requirements of Reference 9. The inservice test curves incorporate allowances for the thermal gradients associated with the heatup curve used to attain inservice test pressure. These curves differ from heatup curves only with respect to margin for primary membrane stress.[7] Due to the shifts in RT_{NDT}, NDTT requirements associated with nonreactor vessel materials are, for all practical purposes, no longer limiting.

References

(1) FSAR, Section 4.2.2.
(2) ASME Boiler and Pressure Vessel Code, Section III, A-2000.
(3) Battelle Columbus Laboratories Report, "Palisades Pressure Vessel Irradiation Capsule Program: Unirradiated Mechanical Properties," August 25, 1977.
(4) Battelle Columbus Laboratories Report, "Palisades Nuclear Plant Reactor Vessel Surveillance Program: Capsule A-240," March 13, 1979, submitted to the NRC by Consumers Power Company letter dated July 2, 1979.
(5) FSAR, Section 4.2.4.
(6) ~~US Nuclear Regulatory Commission, Regulator Guide 1.99, "Effects of Residual Elements on Predicted Radiation Damage to Reactor Vessel Materials," July, 1975.~~ (Deleted)
(7) ASME Boiler and Pressure Vessel Code, Section III, Appendix G, "Protection Against Non-Ductile Failure," 1974 Edition.
(8) US Atomic Energy Commission Standard Review Plan, Directorate of Licensing, Section 5.3.2, "Pressure-Temperature Limits."
(9) 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements," May 31, 1983 as amended November 6, 1986.
(10) US Nuclear Regulatory Commission, Regulatory Guide 1.99, ~~Draft~~ Revision 2, ~~April, 1984~~ May, 1988
(11) Combustion Engineering Report CEN-189, December, 1981.
(12) "Analysis of Capsules T-330 and W-290 from the Consumers Power Company Palisades Reactor Vessel Radiation Surveillance Program," WCAP-10637, September, 1984.
~~(13) EA-PAL-85-101 "Calculation of RCS Pressure Increase from Adding 133 gpm (3 charging pumps) Before the PORVs Open," November 4, 1987.~~
~~(14) EA-PAL-LTOP-880119 - "Calculation of Required PORV Capacity to Maintain the RCS Below Appendix G," January 19, 1988.~~
~~(15) EA-PAL-LTOP-880120 Rev. A - PORV Flow Capacity at Expected LTOP Conditions" February 15, 1988.~~
~~(16) EA-PAL-LTOP-880121 - "Calculation of Time for Operator to Act for HPSI and Bubble" - January 20, 1988.~~
~~(17) EA-ESSR-88727-G/S-01 "Palisades Plant Primary Coolant System Pressure Temperature Limits Per Appendix G of the ASME Boiler and Pressure Vessel Code" Revision 0.~~

(13) Analysis ... ation Exposure of the Palisades Reactor Pressure Vessel by Westinghouse Electric Corporation, March 1989.
(14) Consumers Power Company Engineering Analysis EA-FC-809-13 "Pressure Response Effect of VLTOP with Replacement PORVs".
(15) Consumers Power Company Engineering Analysis EA-A-PAL-89-98 "Palisades Pressure and Temperature Limits".

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PALISADES PLANT PRESSURE AND TEMPERATURE LIMITS FOR HEATUP

For Fluence to 1.8 X 10^{19} nvt

Figure 3-1

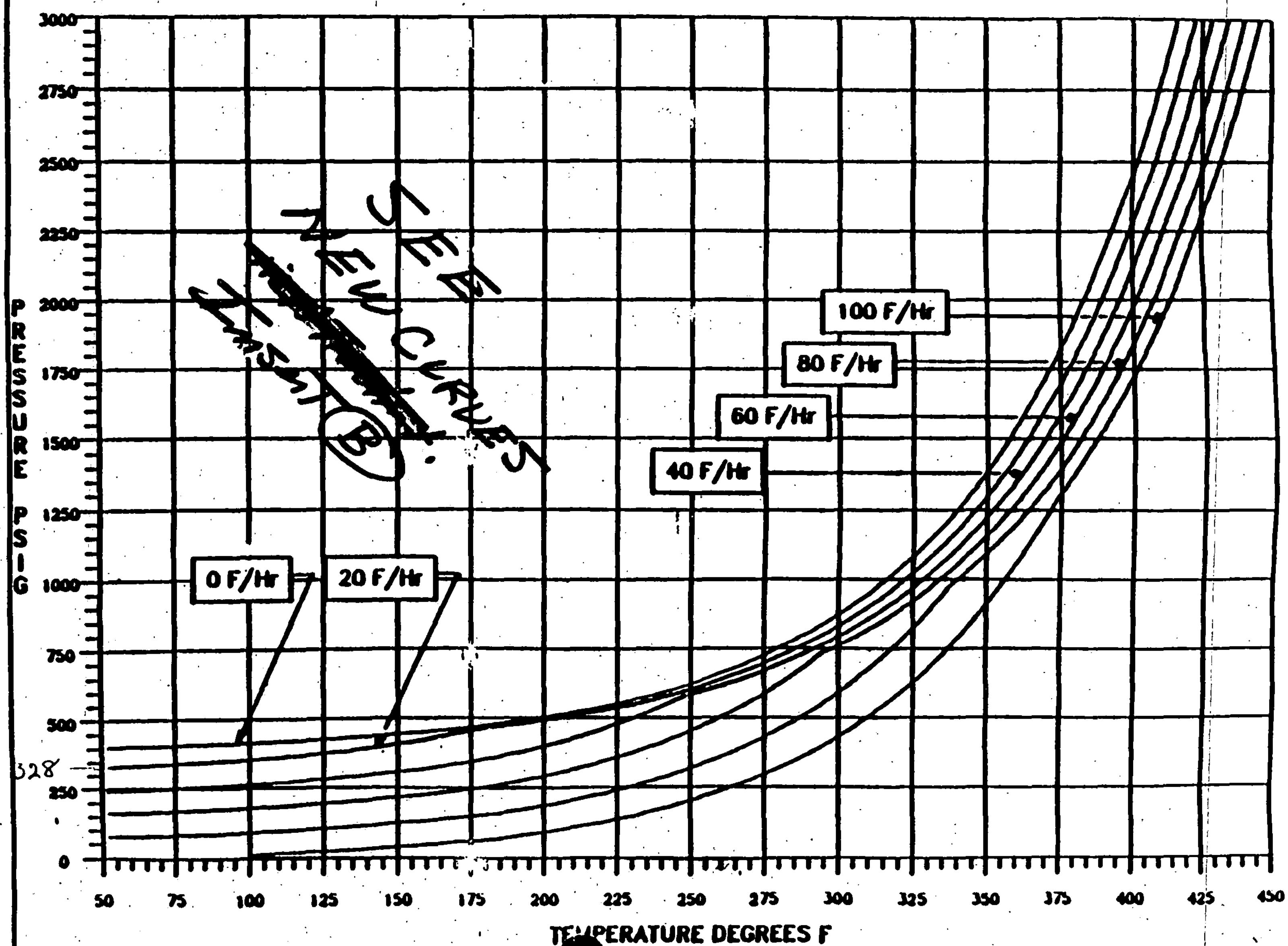

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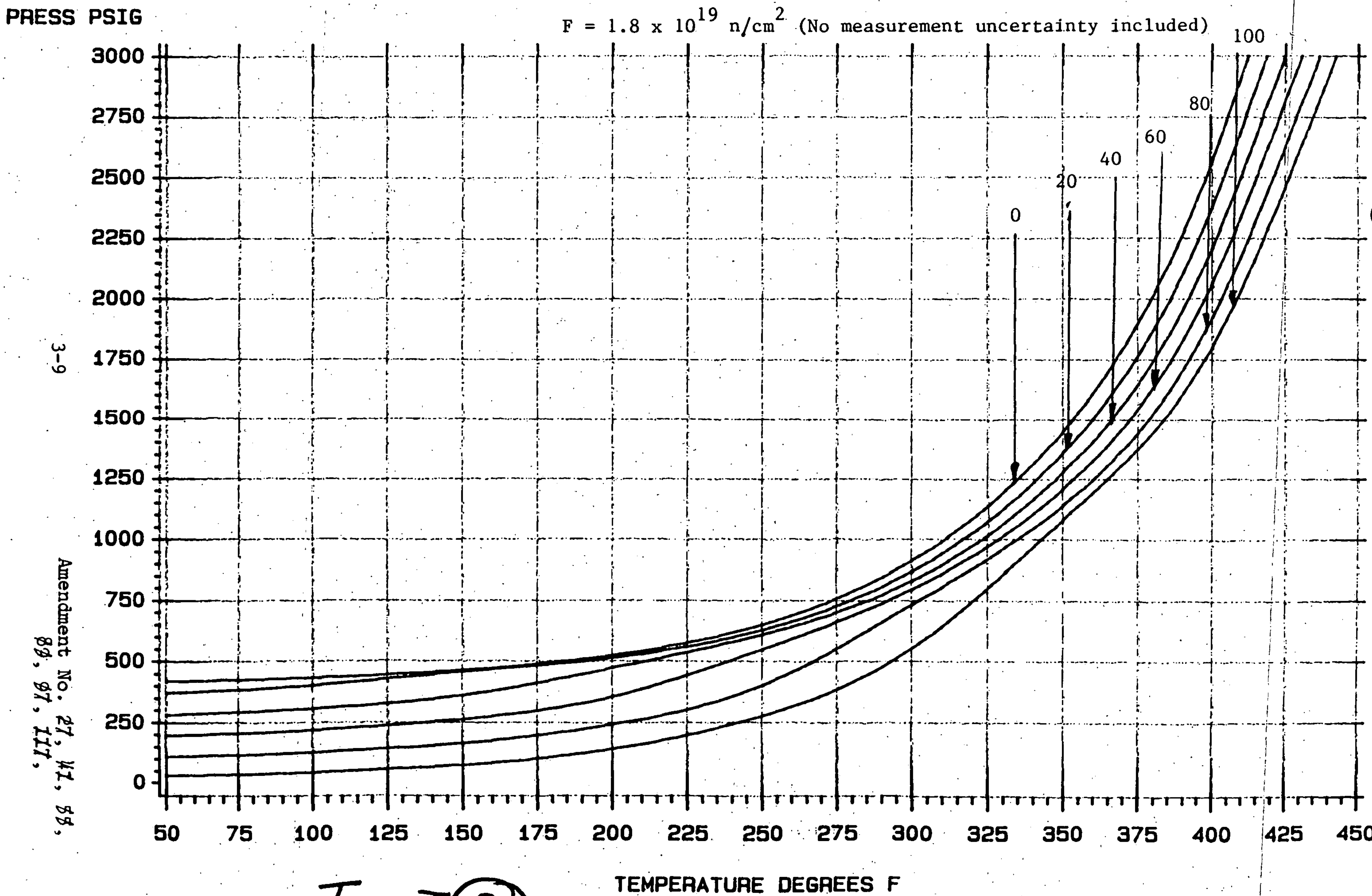
FIGURE 3-1

PALISADES PRESSURE AND TEMPERATURE LIMITS FOR HEATUP



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Insert (B)

PALISADES PLANT PRESSURE AND TEMPERATURE LIMITS FOR COOLDOWN

for Fluence to 1.8 X 10^{19} nvt

Figure 3-2

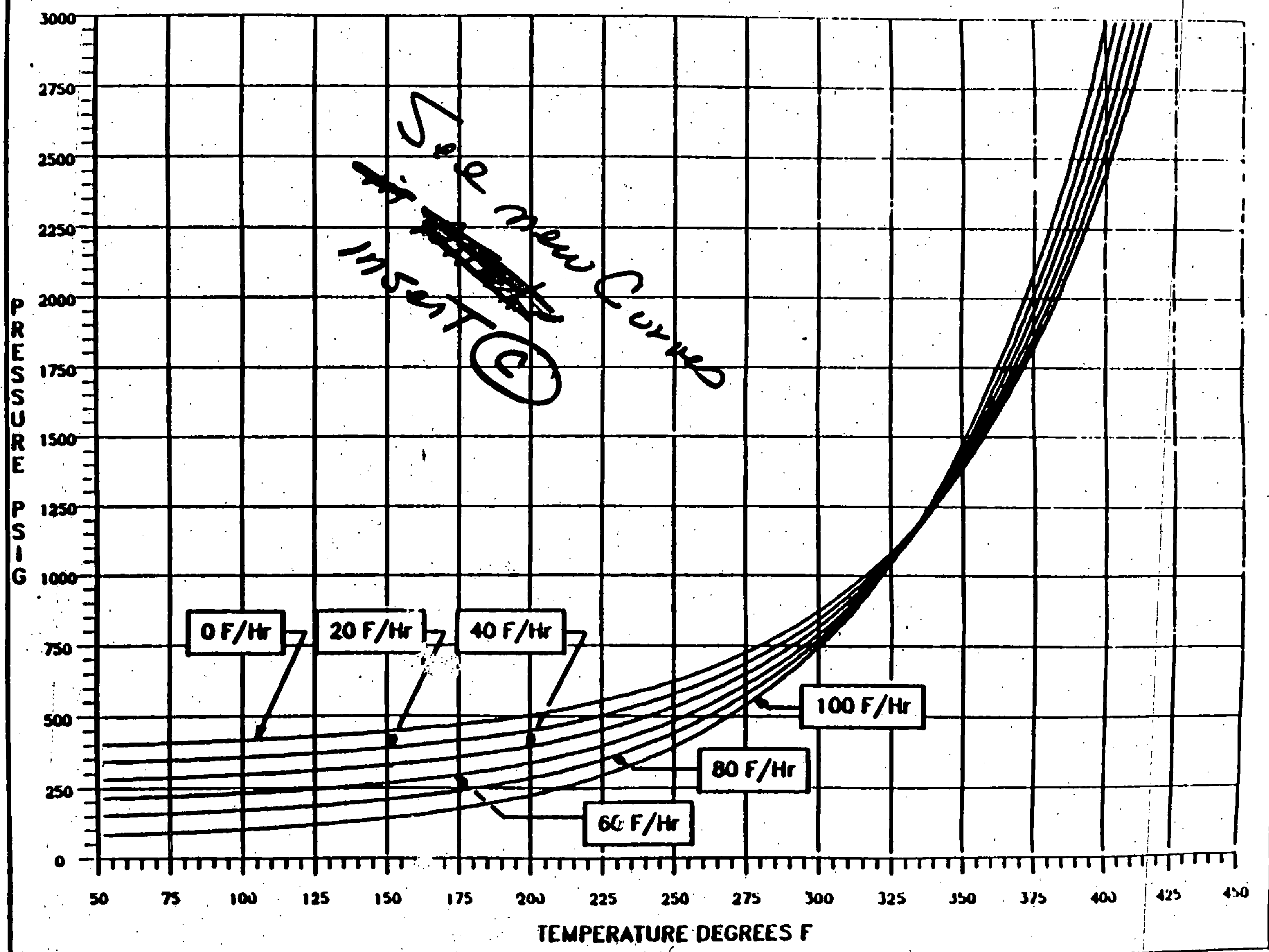

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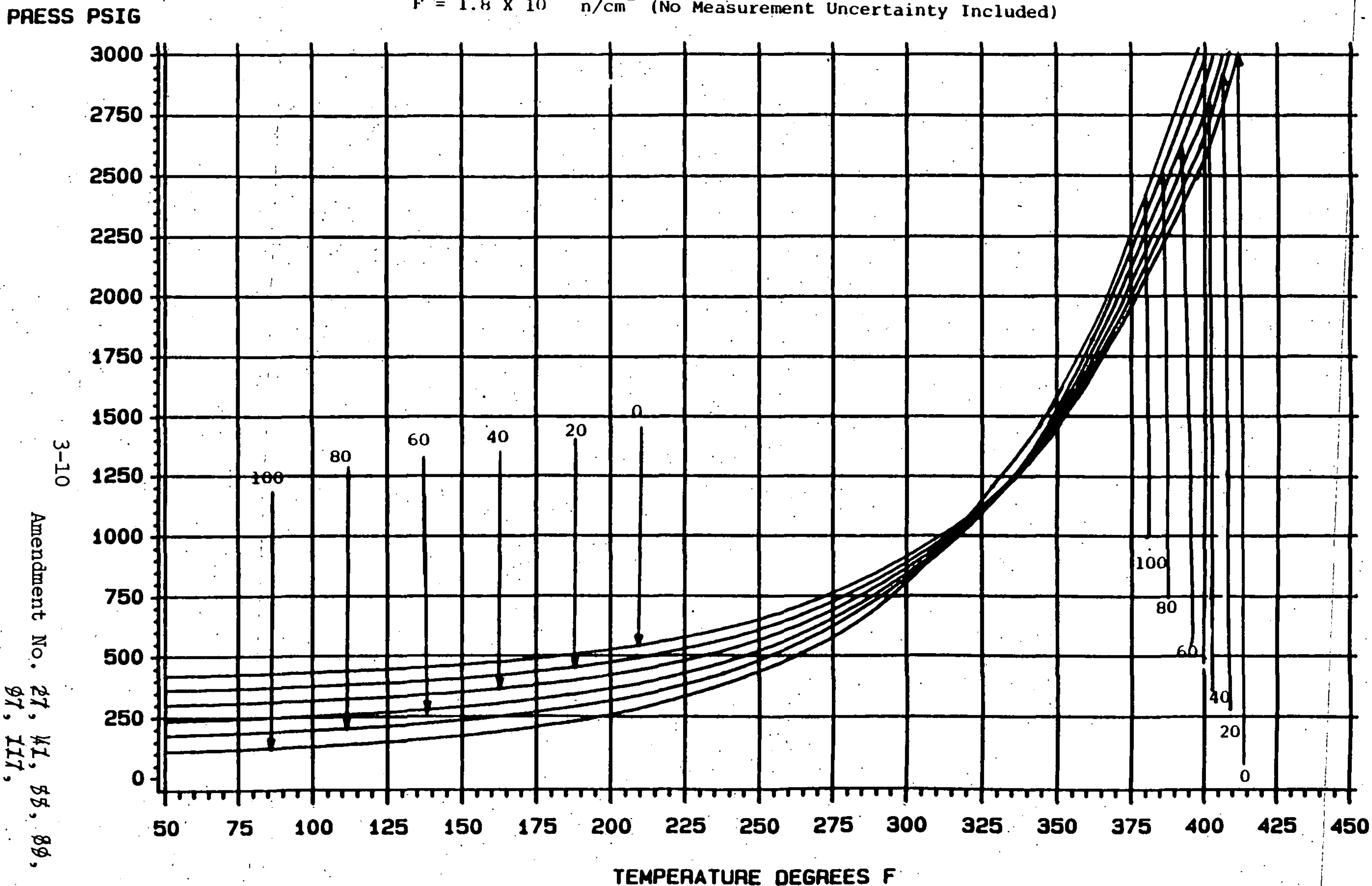
FIGURE 3-2

PALISADES PRESSURE & TEMPERATURE LIMITS FOR COOLDOWN

$F = 1.8 \times 10^{19}$ n/cm^2 (No Measurement Uncertainty Included)



3-10

Amendment No. 27, 41, 55, 89, 97, 117,

Insert C

PALISADES PLANT PRESSURE AND TEMPERATURE LIMITS FOR HYDROSTATIC TESTING

for Fluence TO 1.8 X 10[19] nvt

Figure 3-3

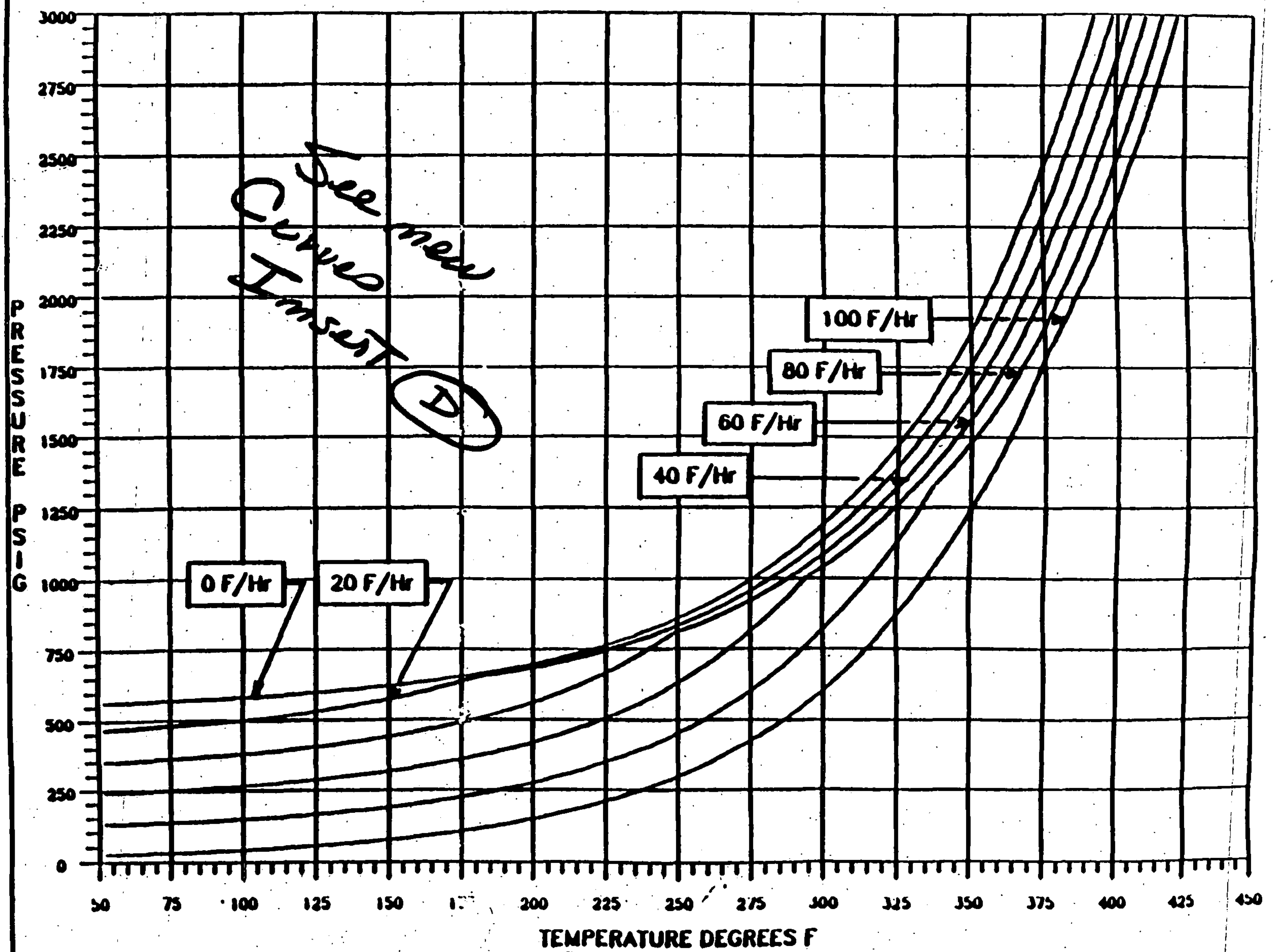


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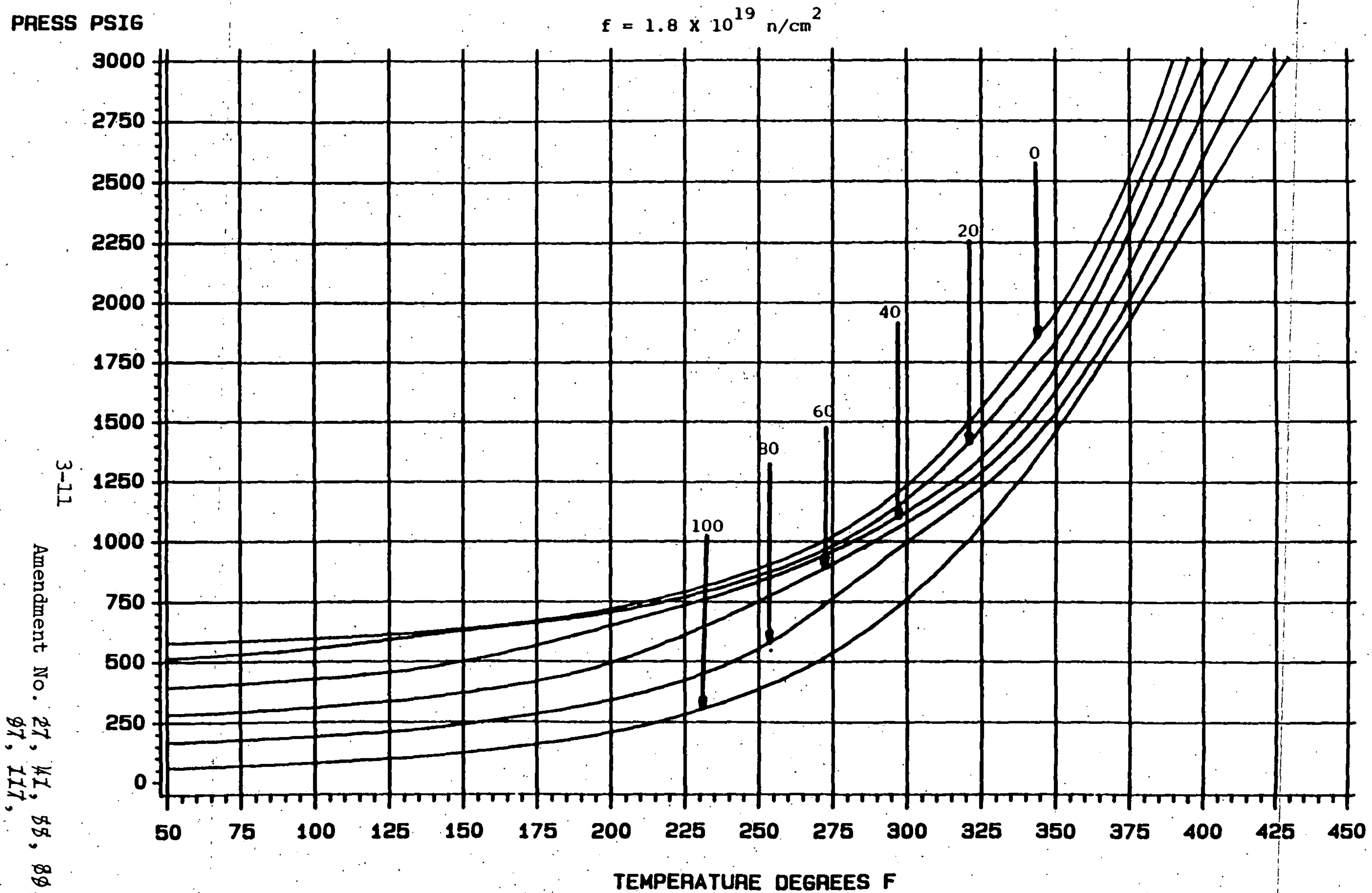
FIGURE 3-3

PALISADES PRESSURE AND TEMPERATURE LIMITS FOR HYDRO



Amendment No. 27, 41, 55, 80, 97, 117,

Insert (D)

3.1.8 OVERPRESSURE PROTECTION SYSTEMS

LIMITING CONDITIONS FOR OPERATION

3.1.8.1 REQUIREMENTS

~~a. When the temperature of one or more of the primary coolant system cold legs is < 300°F, or whenever the shutdown cooling isolation valves (MOV-3015 and MOV-3016) are open, two power operated relief valves (PORVs) with a lift setting of ≤ 310 psia shall be operable, or a reactor coolant system vent of ≥ 1.3 square inches shall be open, or both PORV pilot valves and both PORV block valves shall be open.~~

~~b. When the temperature of one or more of the primary system cold legs is < 430°F,~~ Two power operated relief valves (PORVs) with a lift setting ~~of ≤ 575 psia shall be operable except as specified in section c. below.~~

below and/or to the right of the curve in Figure 3-4 shall be operable.

c. ~~When a bubble is formed in the pressurizer and the actual pressurizer level is < 60 percent and the temperature of all the primary coolant system cold legs is > 385°F, PORV operability is not required.~~

APPLICABILITY: When the temperature of one or more of the primary coolant system cold legs is less than 430°F.

ACTION:

a. With one PORV inoperable, either restore the inoperable PORV to operable status within 7 days or depressurize and within the next 8 hours either vent the PCS through a ≥ 1.3 square inch vent or open both PORV ~~pilot~~ valves and both PORV block valves.

b. With both PORVs inoperable, depressurize and within the next 8 hours either vent the PCS through a ≥ 1.3 square inch vent or open both PORV ~~pilot~~ valves and both PORV block valves.

c. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

Basis

There are three pressure transients which could cause the PCS pressure to exceed the pressure limits required by 10CFR50 Appendix G. They are: (1) a charging/letdown imbalance, (2) the start of a high pressure safety injection (HPSI) pump, and (3) initiation of forced circulation in the PCS when the steam generator temperature is higher than the PCS temperature.

3.1.8. **Basis** (continued)

Analysis (Reference 3 ~~1, 4 & 5~~) shows that when three charging pumps are operating and letdown is isolated and a spurious HPSI occurs, the PORV setpoints ensure that 10CFR50 Appendix G pressure limits will not be exceeded. Above 430°F, the pressurizer safety valves prevent 10CFR Appendix G limits from being exceeded. ~~by a charging/letdown imbalance (Reference 2).~~

~~The requirement that steam generator temperature be ≤ the PCS temperature when forced circulation is initiated in the PCS ensures that an energy addition caused by heat transferred from the secondary system to the PCS will not occur. This requirement applies only to the initiation of forced circulation (the start of the first primary coolant pump) with one or more of the PCS cold leg temperatures ≤ 450°F.~~

INSERT E

~~Requiring the PORVs to be operable when the shutdown cooling system is not isolated (MO-3015 and MO-3016 open) from the PCS ensures that the shutdown cooling system will not be pressurized above its design pressure.~~

The requirement for the PCS to be depressurized and vented by an opening ≥ 1.3 square inches (Reference 3), or by opening both PORV pilot valves and both PORV block valves when one or both PORVs are inoperable ensures that the 10CFR50 Appendix G pressure limits will not be exceeded when one of the PORVs is assumed to fail per the "single failure" criteria 10CFR50 Appendix A, Criterion 34. Since the PORV solenoid is strong enough to overcome spring pressure and valve disc weight, the PORVs may be held open ~~Section 3.3.2.g(6) requires a dedicated operator when the PORVs are inoperable as allowed in Section 3.1.8.1.c. Analysis justifying this condition is referenced in the Basis for Section 3.3.~~ by keeping the control switch in the open position.

References

1. Technical Specification 3.3.2 ~~EA-PAL-85-101 "Calculation of PCS Pressure Increase From Adding 133 gpm (3 charging pumps) Before the PORVs open," November 4, 1987.~~

2. Technical Specification 3.1.2.

4. ~~3.~~ "Palisades Plant Overpressurization Analysis," June 1977 and "Palisades Plant Primary Coolant System Overpressurization Subsystem Description," October, 1977.

~~4. EA-PAL-LTOP-880119 - "Calculation of Required PORV Capacity to Maintain the PCS Below Appendix G Curves," January 19, 1988.~~

~~5. EA-PAL-LTOP-880120 - "Palisades LTOP PORV Flowrate Capacity When PCS Temperature is 300°F or Greater." January 20, 1988.~~

3. CPC Engineering Analysis EA-FC-809-13

3.1.8. Basis (continued)

E

Assurance that the Appendix G limits for the reactor pressure vessel will not be violated while operating at low temperature is provided by the variable setpoint of the Low Temperature Overpressure Protection (LTOP) system. The LTOP system is programmed and calibrated to ensure opening of the pressurizer power operated relief valve (PORV) when the combination of primary coolant system (PCS) pressure and temperature is above or to the left of the limit displayed in Figure 3-4. That limit is developed from the more limiting of the heating or cooling limits for the specific temperature of the PCS while heating or cooling at the maximum permissible rate for that temperature. The limit in Figure 3-4 includes an allowance for pressure overshoot during the interval between the time pressurizer pressure reaches the limit, and the time a PORV opens enough to terminate the pressure rise. LTOP is provided by two independent channels of measurement, control, actuation, and valves, either one of which is capable of providing full protection. The actual setpoint of PORV actuation for LTOP will be lowered from the limit of Figure 3-4 to allow for potential instrument inaccuracies, measurement error, and instrument drift. This will ensure that at no time between calibration intervals will the combination of PCS temperature and pressure exceed the limits of Figure 3-4 without PORV actuation.

When the shutdown cooling system is not isolated (MO-3015 and MO-3016 open) from the PCS, assurance that the shutdown cooling system will not be pressurized above its design pressure is afforded by the relief valves on the shutdown cooling system, and the limitations of sections 3.1.1 h., 3.1.2 a & c, and 3.3 2 g.

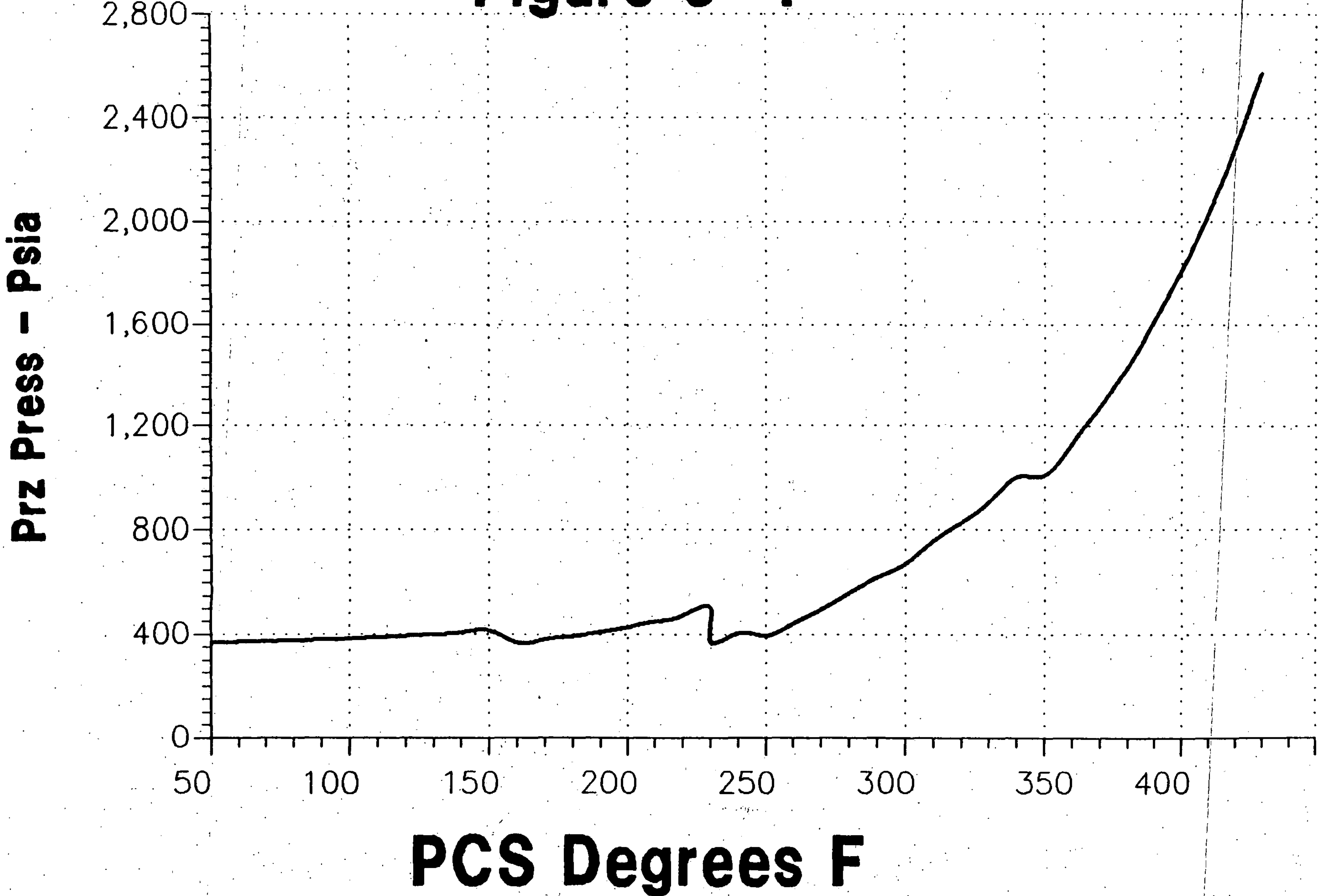
The requirement for the PCS to be depressurized and vented by an opening $\geq$ 1.3 square inches (Reference 4) or by opening both PORV valves and both PORV block valves when one or both PORVs are inoperable ensures that the 10CFR50 Appendix G pressure limits will not be exceeded when one of the PORVs is assumed to fail per the "single failure" criteria 10CFR50 Appendix A, Criterion 34. Since the PORV solenoid is strong enough to overcome spring pressure and valve disc weight, the PORVs may be held open by keeping the control switch in the open position.

References

1. Technical Specification 3.3.2
2. Technical Specification 3.1.2.
3. Consumers Power Company Engineering Analysis EA-FC-809-13
4. "Palisades Plant Overpressurization Analysis" June 1987 and "Palisades Plant Primary Coolant System Overpressurization Subsystem Description" October 1977.

LTOP T.S. LIMITS

Figure 3-4



3.3 EMERGENCY CORE COOLING SYSTEM

Applicability

Applies to the operating status of the emergency core cooling system.

Objective

To assure operability of equipment required to remove decay heat from the core in either emergency or normal shutdown situations.

Specifications

Safety Injection and Shutdown Cooling Systems

3.3.1 The reactor shall not be made critical, except for low-temperature physics tests, unless all of the following conditions are met:

a. The SIRW tank contains not less than 250,000 gallons of water with a boron concentration of at least 1720 ppm but not more than 2000 ppm at a temperature not less than 40°F.

b. All four Safety Injection tanks are operable and pressurized to at least 200 psig with a tank liquid level of at least 186 inches (55.5%) and a maximum level of 198 inches (59%) with a boron concentration of at least 1720 ppm but not more than 2000 ppm.

c. One low-pressure Safety Injection pump is operable on each bus.

d. One high-pressure Safety Injection pump is operable on each bus.

e. Both shutdown heat exchangers and both component cooling heat exchangers are operable.

f. Piping and valves shall be operable to provide two flow paths from the SIRW tank to the primary cooling system.

g. All valves, piping and interlocks associated with the above components and required to function during accident conditions are operable.

h. The Low-Pressure Safety Injection Flow Control Valve CV-3006 shall be opened and disabled (by isolating the air supply) to prevent spurious closure.

i. The Safety Injection bottle motor-operated isolation valves shall be opened with the electric power supply to the valve motor disconnected.

j. The Safety Injection miniflow valves CV-3027 and 3056 shall be opened with HS-3027 and 3056 positions to maintain them open.

3.3 EMERGENCY CORE COOLING SYSTEM (Contd)

3.3.2 During power operation, the requirements of 3.3.1 may be modified to allow one of the following conditions to be true at any one time. If the system is not restored to meet the requirements of 3.3.1 within the time period specified below, the reactor shall be placed in a hot shutdown condition within 12 hours. If the requirements of 3.3.1 are not met within an additional 48 hours, the reactor shall be placed in a cold shutdown condition within 24 hours.

a. One safety injection tank may be inoperable for a period of no more than one hour.

b. One low-pressure safety injection pump may be inoperable provided the pump is restored to operable status within 24 hours. The other low-pressure safety injection pump shall be tested to demonstrate operability prior to initiating repair of the inoperable pump.

c. One high-pressure safety injection pump may be inoperable provided the pump is restored to operable status within 24 hours. The other high-pressure safety injection pump shall be tested to demonstrate operability prior to initiating repair of the inoperable pump.

d. One shutdown heat exchanger and one component cooling water heat exchanger may be inoperable for a period of no more than 24 hours.

e. Any valves, interlocks or piping directly associated with one of the above components and required to function during accident conditions shall be deemed to be part of that component and shall meet the same requirements as listed for that component.

f. Any valve, interlock or pipe associated with the safety injection and shutdown cooling system and which is not covered under 3.3.2e above but, which is required to function during accident conditions, may be inoperable for a period of no more than 24 hours. Prior to initiating repairs, all valves and interlocks in the system that provide the duplicate function shall be tested to demonstrate operability.

g. HPSI Pump operability shall be as follows:

Insert F

1) Both HPSI Pumps shall be rendered inoperable whenever PCS temperature is < 300°F unless the reactor vessel head is removed.

2) A maximum of 1 HPSI pump may be operable whenever PCS Temperature is ≥ 300°F but < 350°F.

3) One, and only one, HPSI Pump shall be operable whenever PCS temperature is ≥ 350°F but < 430°F.

4) At least one HPSI Pump shall be operable whenever PCS temperature is ≥ 430°F but <460°F.

5) Both HPSI Pumps shall be operable whenever the PCS temperature is ≥ 460°F.

6) One HPSI pump may be made inoperable when the reactor is subcritical and the PCS temperature is ≥ 460°F, provided the requirements of Section 3.3.2.c are met.

7) Whenever PCS temperature is between 385°F to 430°F and LTOP system is not armed, then a dedicated licensed operator shall be stationed in the control room to terminate an inadvertent HPSI Pump start and stop Charging Pumps as necessary to limit PCS pressure.

8) Safety Injection Actuation System (SIAS) testing shall not be performed while the PCS is between 300°F and 430°F. HPSI pump testing may be performed below 430°F provided the HPSI pump manual discharge valve is closed.

3.3.3 Prior to returning to the Power Operation Condition after every time the plant has been placed in the Refueling Shutdown Condition, or the Cold Shutdown Condition for more than 72 hours and testing of Specification 4.3.h has not been accomplished in the previous 9 months, or prior to returning the check valves in Table 4.3.1 to service after maintenance, repair or replacement, the following conditions shall be met:

a. All pressure isolation valves listed in Table 4.3.1 shall be functional as a pressure isolation device, except as specified in b. Valve leakage shall not exceed the amounts indicated.

b. In the event that integrity of any pressure isolation valve specified in Table 4.3.1 cannot be demonstrated, at least two valves in each high pressure line having a non-functional valve must be in and remain in, the mode corresponding to the isolated condition.[1]

[1] Motor-operated valves shall be placed in the closed position and power supplies deenergized.

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g. HPSI pump operability shall be as follows:

F

1) If the reactor head is installed, both HPSI pumps shall be rendered inoperable when: /

a. The PCS temperature is < 230°F, or /

b. Shutdown cooling isolation valves MO-3015 and MO-3016 are open. /

2) Two HPSI pumps shall be operable when the PCS temperature is > 325°F. /

3) One HPSI pump may be made inoperable when the reactor is subcritical provided the requirements of Section 3.3.2.c are met. /

4) HPSI pump testing may be performed when the PCS temperature is <430°F provided the HPSI pump manual discharge valve is closed. /

3.3.3 Prior to returning to the Power Operation Condition after every time the plant has been placed in the Refueling Shutdown Condition, or the Cold Shutdown Condition for more than 72 hours and testing of Specification 4.3.h has not been accomplished in the previous 9 months, or prior to returning the check valves in Table 4.3.1 to service after maintenance, repair or replacement, the following conditions shall be met:

a. All pressure isolation valves listed in Table 4.3.1 shall be functional as a pressure isolation device, except as specified in b. Valve leakage shall not exceed the amounts indicated.

b. In the event that integrity of any pressure isolation valve specified in Table 4.3.1 cannot be demonstrated, at least two valves in each high pressure line having a non-functional valve must be in and remain in, the mode corresponding to the isolated condition.[1]

[1]Motor-operated valves shall be placed in the closed position and power supplies deenergized.

Basis (continued)

demonstrate that the maximum fuel clad temperatures that could occur over the break size spectrum are well below the melting temperature of zirconium (3300°F).

Malfunction of the Low Pressure Safety Injection Flow control valve could defeat the Low Pressure Injection feature of the ECCS; therefore, it is disabled in the 'open' mode (by isolating the air supply) during plant operation. This action assures that it will not block flow during Safety Injection.

The inadvertent closing of any one of the Safety Injection bottle isolation valves in conjunction with a LOCA has not been analyzed. To provide assurance that this will not occur, these valves are electrically locked open by a key switch in the control room. In addition, prior to critical the valves are checked open, and then the 480 volt breakers are opened. Thus, a failure of a breaker and a switch are required for any of the valves to close.

Insert G

~~Insuring one HPSI pump is inoperable eliminates unanalyzed PCS mass additions due to inadvertent two pump starts. Both HPSI pumps starting in conjunction with a charging/letdown imbalance may cause 10CFR50 Appendix G limits to be exceeded when the PCS temperature is < 430°F. When the PCS temperature is > 430°F, the pressurizer safety valves ensure that the PCS pressure will not exceed 10CFR50 Appendix G limits when one or both HPSI pumps are started.~~

The requirement to have ~~one~~ both HPSI trains operable above ~~350~~ 325°F provides added assurance that the effects of a LOCA occuring under LTOP conditions would be mitigated. If a LOCA occurs when the primary system temperature is less than or equal to ~~350°F~~ 325, the pressure would drop to the level where low pressure safety injection can prevent core damage.

~~Analysis (Reference 3) further shows that if the PCS temperature is ≥ 385°F and there is a bubble in the pressurizer and the actual pressurizer liquid level is < 60%, and LTOP is not armed, operator action, within 2.9 minutes of the time letdown is isolated concurrent with HPSI, can prevent the PCS pressure from exceeding 10CFR50 Appendix G pressure limits. A dedicated operator is required under these conditions to ensure that mitigatory action is initiated with 2.9 minutes.~~

HPSI pump testing with the HPSI pump manual discharge valve closed is permitted since the closed valve eliminates the possibility of pump testing being the cause of a mass addition to the PCS.

References

(1) FSAR, Section 9.10.3;
(2) FSAR, Section 6.1,
(3) EA-PAL-LTOP-880121 "Calculation of Time for Operation to Act for HPSI and Bubble", January 20, 1988.

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Therefore when the PCS Temperature is ≥ 230°F and ≤ 325°F, operation of the HPSI system would not cause the 10CFR50 Appendix G limits to be exceeded nor is HPSI system operation necessary for core cooling.

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Basis (continued)

demonstrate that the maximum fuel clad temperatures that could occur over the break size spectrum are well below the melting temperature of zirconium (3300°F).

Malfunction of the Low Pressure Safety Injection Flow control valve could defeat the Low Pressure Injection feature of the ECCS; therefore, it is disabled in the 'open' mode (by isolating the air supply) during plant operation. This action assures that it will not block flow during Safety Injection.

The inadvertent closing of any one of the Safety Injection bottle isolation valves in conjunction with a LOCA has not been analyzed. To provide assurance that this will not occur, these valves are electrically locked open by a key switch in the control room. In addition, prior to critical the valves are checked open, and then the 480 volt breakers are opened. Thus, a failure of a breaker and a switch are required for any of the valves to close.

G

Insuring both HPSI pumps are inoperable when the PCS temperature < 230°F or the shutdown cooling isolation valves are open eliminates PCS mass additions due to inadvertent HPSI pump starts. Both HPSI pumps starting in conjunction with a charging/letdown imbalance may cause 10CFR50 Appendix G limits to be exceeded when the PCS temperature is < 230°F. When the PCS temperature is ≥ 430°F, the pressurizer safety valves ensure that the PCS pressure will not exceed 10CFR50 Appendix G. ~~limits, when one or both HPSI pumps are started.~~ /

The requirement to have both HPSI trains operable above 325°F provides added assurance that the effects of a LOCA occuring under LTOP conditions would be mitigated. If a LOCA occurs when the primary system temperature is less than or equal to 325°F, the pressure would drop to the level where low pressure safety injection can prevent core damage. /

/

HPSI pump testing with the HPSI pump manual discharge valve closed is permitted since the closed valve eliminates the possibility of pump testing being the cause of a mass addition to the PCS.

References

(1) FSAR, Section 9.10.3;
(2) FSAR, Section 6.1,

4.0 SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance requirements shall be applicable during the reactor operating conditions associated with individual Limiting Conditions for Operation unless otherwise stated in an individual surveillance requirement.

4.0.2 Unless otherwise specified, each surveillance requirement shall be performed within the specified time interval with:

a. A maximum allowable extension not to exceed 25% of the surveillance interval, and

b. A total maximum combined interval time for any three consecutive surveillance intervals not to exceed 3.25 times the specified surveillance interval.

4.1 INSTRUMENTATION AND CONTROL

Applicability

Applies to the reactor protective system and other critical instrumentation and controls.

Objective

To specify the minimum frequency and type of surveillance to be applied to critical plant instrumentation and controls.

Specifications

Calibration, testing, and checking of instrument channels, reactor protective system and engineered safeguards system logic channels and miscellaneous instrument systems and controls shall be performed as specified in 4.1.1 and in Tables 4.1.1 to 4.1.3.

4.1.1 Overpressure Protection Systems

a. Each PORV shall be demonstrated operable by:

1. 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.

2. Performance of a channel calibration on the PORV actuation channel at least once per 18 months.

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

4. Testing in accordance with the inservice inspection requirements for ASME Section XI, Section IWV Category C valves.

b. The PCS vent(s) shall be verified to be open at least once per 12 hours when the vent(s) is being used for overpressure protection except when the vent pathway is provided with a valve which is locked, sealed, or otherwise secured in the open position, then verify these valves open at least once per 31 days.

c. When both open PORV ~~pilot~~ valves are used as an alternative to venting the PCS, then verify both PORV ~~pilot~~ valves and both PORV block valves are open at least once per 7 days.

Basis

Failures such as blown instrument fuses, defective indicators, and faulted amplifiers which result in "upscale" or "downscale" indication can be easily recognized by simple observation of the functioning of an instrument or system. Furthermore, such failures are, in many cases, revealed by alarm or annunciator action and a check supplements this type of built-in surveillance.

Based on experience in operation of both conventional and nuclear plant systems when the plant is in operation, a checking frequency of once-per-shift is deemed adequate for reactor and steam system instrumentation. Calibrations are performed to insure the presentation and acquisition of accurate information.

The power range safety channels and ΔT power channels are are calibrated daily against a heat balance standard to account for errors induced by changing rod patterns and core physics parameters.

Other channels are subject only to the "drift" errors induced within the instrumentation itself and, consequently, can tolerate longer intervals between calibration. Process system instrumentation errors induced by drift can be expected to remain within acceptable tolerances if recalibration is performed at each refueling shutdown interval.

Substantial calibration shifts within a channel (essentially a channel failure) will be revealed during routine checking and testing procedures. Thus, minimum calibration frequencies of one-per-day for the power range safety channels, and once each refueling shutdown for the process system channels, are considered adequate.

The minimum testing frequency for those instrument channels connected to the reactor protective system is based on an estimated average unsafe failure rate of 1.14×10^{-5} failure/hour per channel. This estimation is based on limited operating experience at conventional and nuclear plants. An "unsafe failure" is defined as one which negates channel operability and which, due to its nature, is revealed only when the channel is tested or attempts to respond to a bonafide signal.

4.6 SAFETY INJECTION AND CONTAINMENT SPRAY SYSTEMS TESTS

Applicability

Applies to the safety injection system, the containment spray system, chemical injection system and the containment cooling system tests.

Objective

To verify that the subject systems will respond promptly and perform their intended functions, if required.

Specifications

4.6.1 Safety Injection System

a. System tests shall be performed at each reactor refueling interval. A test safety injection signal will be applied to initiate operation of the system. The safety injection and shutdown cooling system pump motors may be de-energized for this test. The system will be considered satisfactory if control board indication and visual observations indicate that all components have received the safety injection signal in the proper sequence and timing (ie, the appropriate pump breakers shall have opened and closed, and all valves shall have completed their travel).

b. Both high pressure safety injection pumps, P-66A and P-66B shall be demonstrated inoperable at least once per 12 hours whenever the temperature of one or more of the PCS cold legs is < ~~300~~ 230°F unless the reactor head is removed.

4.6.2 Containment Spray System

a. System test shall be performed at each reactor refueling interval. The test shall be performed with the isolation valves in the spray supply lines at the containment blocked closed. Operation of the system is initiated by tripping the normal actuation instrumentation.

b. At least every five years the spray nozzles shall be verified to be open.

c. The test will be considered satisfactory if visual observations indicate all components have operated satisfactorily.

or if shutdown cooling valves MO-3015 and MO-3016 are open

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4.6 SAFETY INJECTION AND CONTAINMENT SPRAY

4.6.3 Pumps

a. The safety injection pumps, shutdown cooling pumps, and containment spray pumps shall be started at intervals not to exceed three months. Alternate manual starting between control room console and the local breaker shall be practiced in the test program.

b. Acceptable levels of performance shall be that the pumps start, reach their rated shutoff heads at minimum recirculation flow, and operate for at least fifteen minutes.

4.6.4 Valves

Deleted

4.6.5 Containment Air Cooling System

a. Emergency mode automatic valve and fan operation will be checked for operability during each refueling shutdown.

b. Each fan and valve required to function during accident conditions will be exercised at intervals not to exceed three months.

Basis

The safety injection system and the containment spray system are principal plant safety features that are normally inoperative during reactor operation.

Complete systems tests cannot be performed when the reactor is operating because a safety injection signal causes containment isolation and a containment spray system test requires the system to be temporarily disabled. The method of assuring operability of these systems is therefore to combine systems tests to be performed during annual plant shutdowns, with more frequent component tests, which can be performed during reactor operation.

The annual systems tests demonstrate proper automatic operation of the safety injection and containment spray systems. A test signal is applied to initiate automatic action and verification made that the components receive the safety injection in the proper sequence. The test demonstrates the operation of the valves, pump circuit breakers, and automatic circuitry. (1, 2)

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Basis

During reactor operation, the instrumentation which is depended on to initiate safety injection and containment spray is generally checked daily and the initiating circuits are tested monthly. In addition, the active components (pumps and valves) are to be tested every three months to check the operation of the starting circuits and to verify that the pumps are in satisfactory running order. The test interval of three months is based on the judgment that more frequent testing would not significantly increase the reliability (ie, the probability that the component would operate when required), yet more frequent test would result in increased wear over a long period of time. Verification that the spray piping and nozzles are open will be made initially by a smoke test or other suitably sensitive method, and at least every five years thereafter. Since the material is all stainless steel, normally in a dry condition, and with no plugging mechanism available, the retest every five years is considered to be more than adequate.

Other systems that are also important to the emergency cooling function are the SI tanks, the component cooling system, the service water system and the containment air coolers. The SI tanks are a passive safety feature. In accordance with the specifications, the water volume and pressure in the SI tanks are checked periodically. The other systems mentioned operate when the reactor is in operation and by these means are continuously monitored for satisfactory performance.

INSERT H

~~When the PCS cold leg temperature is less than 300°F, the start of one HPSI pump could cause the Appendix G limits to be to be exceeded; therefore, both pumps are rendered inoperable.~~

References

(1) FSAR, Section 6.1.3.
(2) FSAR, Section 6.2.3.

Basis (continued)

During reactor operation, the instrumentation which is depended on to initiate safety injection and containment spray is generally checked daily and the initiating circuits are tested monthly. In addition, the active components (pumps and valves) are to be tested every three months to check the operation of the starting circuits and to verify that the pumps are in satisfactory running order. The test interval of three months is based on the judgment that more frequent testing would not significantly increase the reliability (ie, the probability that the component would operate when required), yet more frequent test would result in increased wear over a long period of time. Verification that the spray piping and nozzles are open will be made initially by a smoke test or other suitably sensitive method, and at least every five years thereafter. Since the material is all stainless steel, normally in a dry condition, and with no plugging mechanism available, the retest every five years is considered to be more than adequate.

Other systems that are also important to the emergency cooling function are the SI tanks, the component cooling system, the service water system and the containment air coolers. The SI tanks are a passive safety feature. In accordance with the specifications, the water volume and pressure in the SI tanks are checked periodically. The other systems mentioned operate when the reactor is in operation and by these means are continuously monitored for satisfactory performance.

H

With the reactor vessel head installed when the PCS cold leg temperature is less than 230°F, or if the shutdown cooling system isolation valves MO-3015 and MO-3016 are open, the start of one HPSI pump could cause the Appendix G or the shutdown cooling system pressure limits to be exceeded; therefore, both pumps are rendered inoperable.

References

(1) FSAR, Section 6.1.3.
(2) FSAR, Section 6.2.3.