PALISADES PLANT TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS - APPENDIX A

Amendment No. 37, 48, 63, 67, 68, 83, 108, 128,

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. Deleted /

Amendment No 31, 83, 118, 119,

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.

Basis (Contd)

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 hear removal system for the reactor.

The transient analyses were performed assuming a vessel flow at hot zero power (532°F) of 124.3×10^6 lb/hr minus 6% of 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

3.1 PRIMARY COOLANT SYSTEM (Cont'd)

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[4] of the following equation for limiting reactor inlet temperature:

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

The limits of validity of this equation are:

$1800 \leq$ Pressure ≤ 2200 psia

$100.0 \times 10^6 \leq$ 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) Deleted
(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-89-14-1

The steam generator tube leakage limit ensures that the dosage contributed from the tube leakage will be limited to a small fraction of Part 100 limits in the event of a steam generator tube rupture or steam line break. The leakage limit also ensures that steam generator tube integrity is maintained in the event of a main steam line rupture or under LOCA conditions. /

Operation during short periods of time when the leakage measurement sensitivity is reduced is provided for by an added allowance to the leakage limit. Leakage limits are not required when the plant is not at power.

References

(1) FSAR, Amendment 15, Question 4.3.
(2) FSAR, Section 11, Table 11-6.

ATTACHMENT

Consumers Power Company
Palisades Plant
Docket 50-255

MARKED UP TECHNICAL SPECIFICATION PAGES

August 21, 1990

11 Pages

PALISADES PLANT TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS - APPENDIX A

Amendment No. 37, 48, 63, 67, 68, 83, 108, ~~128~~
~~September 5, 1989~~

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 x 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. Deleted ~~Maximum primary system pressure differentials shall not exceed the following:~~

~~(1) Deleted~~

Amendment No 31, 85, 118, 119
~~December 12, 1988~~

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)

h. Forced circulation (starting the first primary coolant pump) shall not be initiated unless one of the following conditions is met: /

(1) Primary coolant cold leg temperature is > 430°F. /
(2) PCS cold leg temperature is ≤ 430°F and S/G secondary temperature is less than PCS cold leg temperature. /
(3) Shutdown cooling is isolated from the PCS AND PCS cold leg temperature is > 210°F AND S/G secondary temperture is less than 100°F higher than PCS temperature. /
(4) Shutdown cooling is isolated from the PCS AND PCS cold leg temperature is ≥ 170°F and ≤ 210°f AND S/G secondary temperature is less than 20°F higher than PCS cold leg temperature. /
(5) Shutdown cooling is isolated from the PCS AND PCS cold leg temperature is ≥ 120°F and < 170°F AND S/G secondary temperature is less than 100°F higher than PCS cold leg temperature. /

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. 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)

Amendment No 67, 83, 117, 118, 131
April 26, 1990

No changes, for continuity

Basis (Contd)

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 hear 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% of 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 ≤ Pressure ≤ 2200 psia
100.0×10^6 ≤ Vessel Flow ≤ 130×10^6 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~~ Deleted
(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-89-14-1 +

3.1 PRIMARY COOLANT SYSTEM (Contd)

3.1.5 Primary Coolant System Leakage Limits

Specification

a. If the primary coolant system leakage exceeds 1 gpm and the source of the leakage is not identified, reduce unidentified primary coolant system leakage to less than 1 gpm within 6 hours, or place the reactor in hot shutdown condition within the following 6 hours and in cold shutdown condition within the following 24 hours.

b. If leakage from the primary coolant system exceeds 10 gpm, reduce primary coolant system leakage to less than 10 gpm within 6 hours, or place the reactor in hot shutdown condition within the following 6 hours and in cold shutdown condition within the following 24 hours.

c. If the specific activity of the secondary coolant in a steam generator exceeds 0.1 μCi/gram dose equivalent I-131, the reactor shall be placed in hot shutdown within 6 hours and in cold shutdown within the following 30 hours.

d. The primary to secondary leakage in a steam generator shall not exceed 0.3 gpm for any period of steady state operation greater than 24 consecutive hours.

During periods of start-up and major load changes, when the leakage measurement sensitivity is reduced, the calculated leakage shall not exceed 0.6 gpm for any period of greater than 24 consecutive hours.

Basis

Industry experience has shown that while a limited amount of leakage is expected from the primary coolant system, the unidentified portion of this leakage can be reduced to a threshold value of less than 1 gpm. This threshold value is sufficiently low to ensure early detection of additional leakage. When the source of the leakage can be identified, the condition shall be evaluated to determine if operation can safety continue. Justification for continued operation with identified leakage in excess of 1 gpm shall be documented in writing and approved by the Plant General Manager or his representative.

A maximum allowable primary coolant system leak rate of 10 gpm has been established. This limitation does not include the primary coolant pump seal leak-off which is directed to the volume control tank. The 10 gpm limitation provides allowances for a limited amount of leakage from known sources whose presence will not interfere with the detection of unidentified leakage. A primary coolant system leak rate in excess of 10 gpm is indicative of a failure of sufficient magnitude to warrant shutdown for repair.

no change, for continuity

Basis (Contd)

The 10 gpm limitation is well within the 40 gpm capacity of one charging pump which would be available even under a loss of off-site power condition.

The initial 6 hour period following indication of unidentified primary coolant system leakage in excess of 1 gpm, or total primary coolant system leakage in excess of 10 gpm, provides sufficient time to facilitate identification and confirmation of the leakage source with the Plant being maintained in a stable condition. When the source of the leakage cannot be identified or reduced, the following 6 hour period is sufficient to bring the Plant to hot shutdown condition in an orderly manner. The 24 hour period which follows provides adequate time to bring the Plant to cold shutdown condition in an orderly fashion and to correct minor deficiencies. If major repairs are necessary, a cold shutdown condition would be in order.

The limitations on secondary system specific activity ensure that the resultant off-site radiation dose will be limited to a small fraction of 10 CFR Part 100 limits in the event of a steam line rupture. This dose also includes the effects of a coincident 1.0 gpm primary to secondary tube leak in the steam generator of the affected steam line and a concurrent loss of offsite electrical power.

no change, for continuity

The steam generator tube leakage limit ensures that the dosage contributed from the tube leakage will be limited to a small fraction of Part 100 limits in the event of a steam generator tube rupture or steam line break. The leakage limit also ensures that steam generator tube integrity is maintained in the event of a main steam line rupture or under LOCA conditions.

~~Tests and analysis have been performed showing that the effect, on the structural integrity of a tube, with a one-quarter inch through-wall crack superimposed on a 64% wasted area, is acceptable. The 0.3 gpm leakage limit is set to provide detection of crack leakage which would result from a crack length of less than one-quarter inch.~~

Operation during short periods of time when the leakage measurement sensitivity is reduced is provided for by an added allowance to the leakage limit. Leakage limits are not required when the plant is not at power.

References

(1) FSAR, Amendment 15, Question 4.3.

(2) FSAR, Section 11, Table 11-6.

Deleted

4.4 PRIMARY COOLANT SYSTEM INTEGRITY TESTING

Applicability

Applies to test requirements for primary coolant system integrity.

Objective

To specify test for primary coolant system integrity after the system is closed following normal opening, modification or repair.

Specifications

a. Whenever the primary coolant system is closed after it has been opened, the system shall be leak tested at not less than 2135 psig prior to the reactor being made critical. A test temperature shall be selected such that secondary (saturation) pressure will limit the differential pressure across the steam generator tubes to not greater than 1380 psi.

b. Whenever modifications or repairs are made in the primary coolant system that involve new strength welds on components greater than 2-inch diameter, the new welds shall receive both a surface and 100% volumetric examination and shall meet all applicable code requirements.

c. Whenever modifications or repairs are made in the primary coolant system that involve new strength welds on components 2-inch diameter or smaller, the new welds shall receive a surface examination.

Basis

For normal opening, the integrity of the primary coolant system, in terms of strength, is unchanged. If the system does not leak at 2135 psig (operating pressure + 50 psi; ± 50 psi is normal system pressure fluctuation)[1], it will be leak tight during normal operation. If the pressure goes above 2135 psig, the worst consequence is a leak.

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

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

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

c) Acceptable stresses during accident conditions.

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Amendment No 25
March 11, 1977

4.4 PRIMARY COOLANT SYSTEM INTEGRITY TESTING (Contd)

For repairs on components greater than 2-inch diameter, the thorough nondestructive testing gives a very high degree of confidence in the integrity of the primary coolant system and will detect any significant defects in and near the new welds.

Repairs on components 2-inch diameter or smaller are relatively minor in comparison and the surface examination assures a similar standard of integrity. In all cases, the leak test will insure leak tightness during normal operation.

References

(1) FSAR, Section 4.2.