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REACTOR COOLANT SYSTEM

3/4.4.8 PRESSURE/TEMPERATURE LIMITS

REACTOR COOLANT SYSTEM

LIMITING CONDITION FOR OPERATION

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

a. Maximum heatup and cooldown rates as specified in Table 3.4-3.

b. A maximum temperature change of 10°F in any 1-hour period during inservice hydrostatic testing operations.

APPLICABILITY: At all times*, except when the reactor vessel head is fully detensioned such that the Reactor Coolant System cannot be pressurized.

ACTION:

With any of the above limits exceeded, restore the temperature and/or pressure to within the limit within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the Reactor Coolant System; determine that the Reactor Coolant System remains acceptable for continued operations or be in at least HOT STANDBY within the next 6 hours and reduce the RCS T_{cold} and pressure to less than 210°F and 500 psia, respectively, within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.8.1.1 The Reactor Coolant System temperature and pressure shall be determined to be within the limits at least once per 30 minutes during system heatup, cooldown, and inservice leak and hydrostatic testing operations.

4.4.8.1.2 The reactor vessel material irradiation surveillance specimens shall be removed and examined, to determine changes in material properties, at the intervals required by 10 CFR Part 50 Appendix H in accordance with the schedule in Table 4.4-5. The results of these examinations shall be used to update Figure 3.4-2.

*See Special Test Exception 3.10.5.

FOR INFORMATION ONLY

TABLE 3.4-3

Maximum Allowable Heatup and Cooldown Rates

<8 Effective Full Power Years

Heatup

T_c^* (°F)	Rate (°F/HR)
< 128°F	20°F/HR
128° - 180°F	30°F/HR
181° - 230°F	50°F/HR
> 230°F	75°F/HR

Cooldown

T_c^* (°F)	Rate (°F/HR)
≤ 93°F	see Figure 3.4-2c ~~0°F/HR~~
94° - 114°F	10°F/HR
115° - 148°F	20°F/HR
> 148°F	100°F/HR

8-32 Effective Full Power Years

Heatup

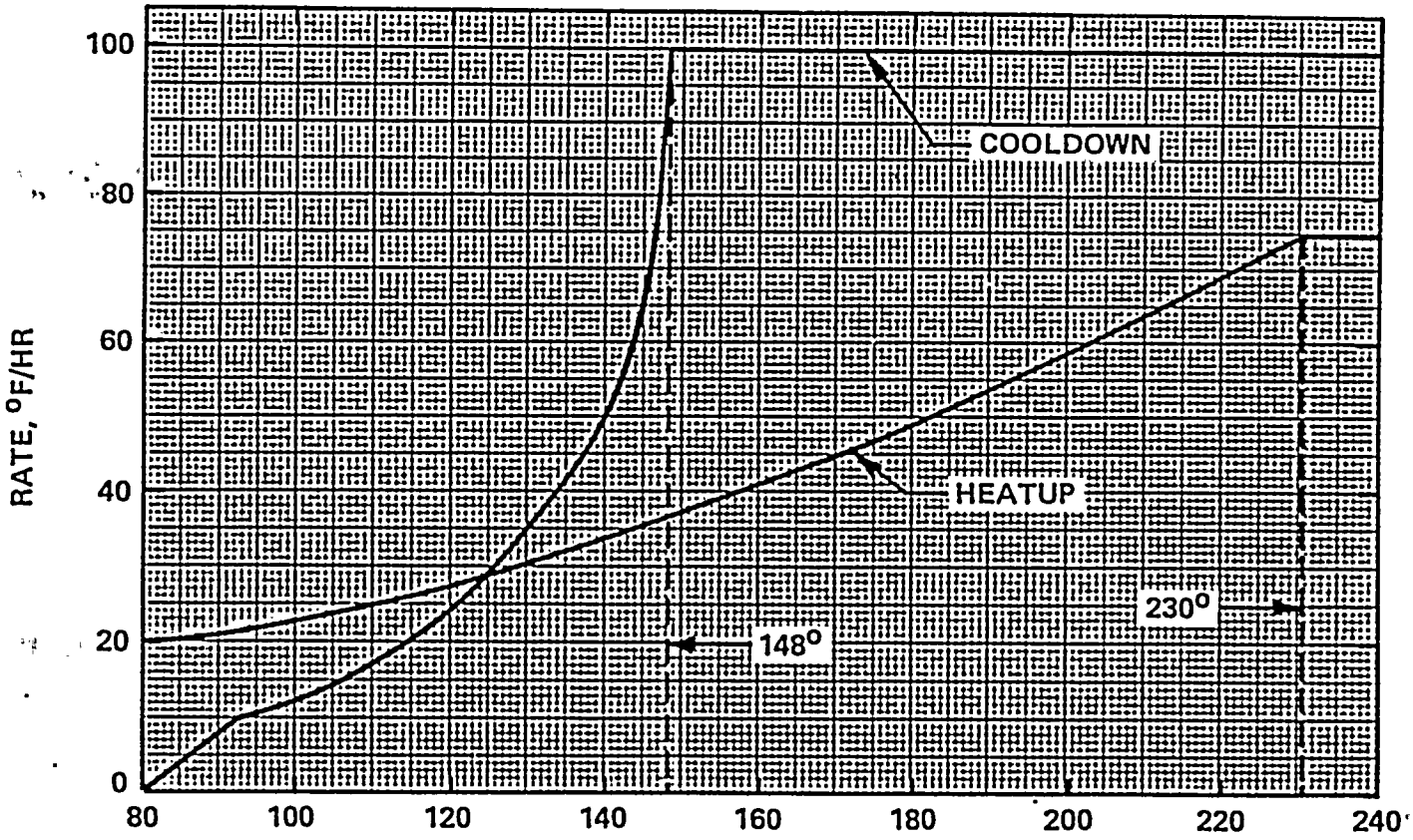
T_c^* (°F)	Rate (°F/HR)
< 116°F	10°F/HR
117° - 150°F	20°F/HR
151° - 199°F	30°F/HR
200° - 246°F	50°F/HR
> 246°F	75°F/HR

Cooldown

T_c^* (°F)	Rate (°F/HR)
≤ 108°F	see Figure 3.4-2d ~~0°F/HR~~
109° - 126°F	10°F/HR
127° - 147°F	20°F/HR
148° - 162°F	40°F/HR
> 162°F	100°F/HR

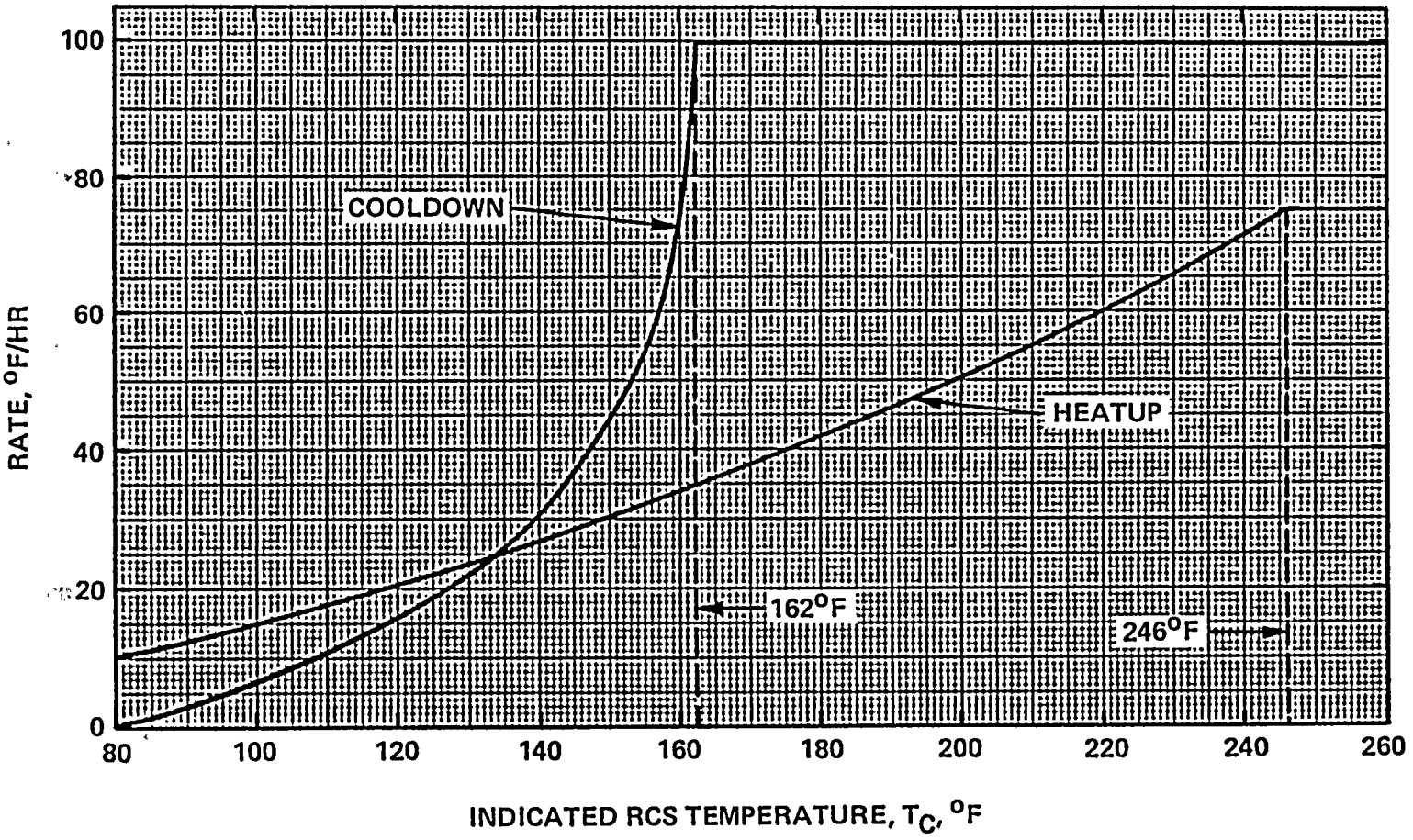
* Indicated Cold Leg Temperature

FIGURE 3.4-2c
MAXIMUM ALLOWABLE HEATUP AND
COOLDOWN RATES < 8 EFPY



NOTE: A Maximum Heatup Rate of 75°F/Hr
is Allowed at any temperature above 230°F.
A Maximum Cooldown Rate of 100°F/Hr
is Allowed at any temperature above 148°F

FIGURE 3.4-2d
MAXIMUM ALLOWABLE HEATUP AND
COOLDOWN RATES , 8-32 EFPY



NOTE: A Maximum Heatup Rate of 75°F/Hr
is Allowed at any temperature above 246°F
A Maximum Cooldown Rate of 100°F/Hr
is Allowed at any temperature above 162°F

SPECIFIC ACTIVITY (Continued)

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

3/4.4.8 PRESSURE/TEMPERATURE LIMITS

The various categories of load cycles used for design purposes are provided in Chapters 3 and 5 of the FSAR. During startup and shutdown, the rates of temperature and pressure changes are limited so as not to exceed the limit lines of Figures 3.4-2a and 3.4-2b. This ensures that the maximum specified heatup and cooldown rates are consistent with the design assumptions and satisfy the stress limits for cyclic operation.

insert A →

Reactor vessel pressure-temperature limitations and Low Temperature Overpressure Protection requirements for the Palo Verde Nuclear Generating Station are calculated to meet the regulations of 10 CFR Part 50 Appendix A, Design Criterion 14 and Design Criteria 31. These design criteria require that the reactor coolant pressure boundary be designed, fabricated, erected, and tested in order to have an extremely low probability of abnormal leakage, of rapid failure, and of gross rupture. The criteria also require that the reactor coolant pressure boundary be designed with sufficient margin to assure that when stressed under operation, maintenance, and testing the boundary; behaves in a non-brittle manner and the probability of a rapidly propagating fracture is minimized.

The pressure-temperature limits are developed using the requirements of 10 CFR 50 Appendix G. This appendix describes the requirements for developing the pressure-temperature limits and provides the general basis for these limitations. The margins of safety against fracture provided by the pressure-temperature limits using the requirements of 10 CFR Part 50 Appendix G are equivalent to those recommended in the ASME Boiler and Pressure Vessel Code Section III, Appendix G, "Protection Against Nonductile Failure." The general guidance provided in those procedures has been utilized to develop the Palo Verde pressure-temperature limits with the requisite margins of safety for heatup and cooldown conditions.

The pressure-temperature limits account for the temperature differential between the reactor vessel base metal and the reactor coolant bulk fluid temperature. Correction for elevation and RCS flow induced pressure differences between the reactor vessel beltline and pressurizer, are included in the development of the pressure-temperature limits as are instrumentation

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The purpose of the maximum cooldown rates specified in Table 3.4-3 (and supplemented graphically by Figures 3.4-2c and 3.4-2d) is to prevent the RCS pressure from exceeding the corresponding normal operation P-T limit, assuming a concurrent overpressurization due to the limiting low temperature overpressurization transient. Consequently, the cooldown rate limits are only valid if the RCS is capable of being pressurized. Therefore, with the vessel head fully detensioned, the Technical Specification cooldown limits are not applicable. This specification does not apply only for the period of time the vessel head is fully detensioned and thus the RCS cannot be pressurized above the static head of water over the vessel in the refueling pit which is negligible compared to the ASME Code Appendix G, P-T limit.

3/4.4.8 PRESSURE/TEMPERATURE LIMITS

REACTOR COOLANT SYSTEM

LIMITING CONDITION FOR OPERATION

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

a. Maximum heatup and cooldown rates as specified in Table 3.4-3.

b. A maximum temperature change of 10°F in any 1-hour period during inservice hydrostatic testing operations.

APPLICABILITY: At all times*, except when the reactor vessel head is fully detensioned such that the Reactor Coolant System cannot be pressurized.

ACTION:

With any of the above limits exceeded, restore the temperature and/or pressure to within the limit within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the Reactor Coolant System; determine that the Reactor Coolant System remains acceptable for continued operations or be in at least HOT STANDBY within the next 6 hours and reduce the RCS T_{cold} and pressure to less than 210°F and 500 psia, respectively, within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.8.1.1 The Reactor Coolant System temperature and pressure shall be determined to be within the limits at least once per 30 minutes during system heatup, cooldown, and inservice leak and hydrostatic testing operations.

4.4.8.1.2 The reactor vessel material irradiation surveillance specimens shall be removed and examined, to determine changes in material properties, at the intervals required by 10 CFR Part 50 Appendix H in accordance with the schedule in Table 4.4-5. The results of these examinations shall be used to update Figure 3.4-2.

*See Special Test Exception 3.10.5.

TABLE 3.4-3

Maximum Allowable Heatup and Cooldown Rates

<8 Effective Full Power Years

Heatup

T_c^* (°F)	Rate (°F/HR)
< 128°F	20°F/HR
128° - 180°F	30°F/HR
181° - 230°F	50°F/HR
> 230°F	75°F/HR

Cooldown

T_c^* (°F)	Rate (°F/HR)
≤ 93°F	see Figure 3.4-2c ~~0°F/HR~~
94° - 114°F	10°F/HR
115° - 148°F	20°F/HR
> 148°F	100°F/HR

8-32 Effective Full Power Years

Heatup

T_c^* (°F)	Rate (°F/HR)
< 116°F	10°F/HR
117° - 150°F	20°F/HR
151° - 199°F	30°F/HR
200° - 246°F	50°F/HR
> 246°F	75°F/HR

Cooldown

T_c^* (°F)	Rate (°F/HR)
≤ 108°F	see Figure 3.4-2d ~~0°F/HR~~
109° - 126°F	10°F/HR
127° - 147°F	20°F/HR
148° - 162°F	40°F/HR
> 162°F	100°F/HR

* Indicated Cold Leg Temperature

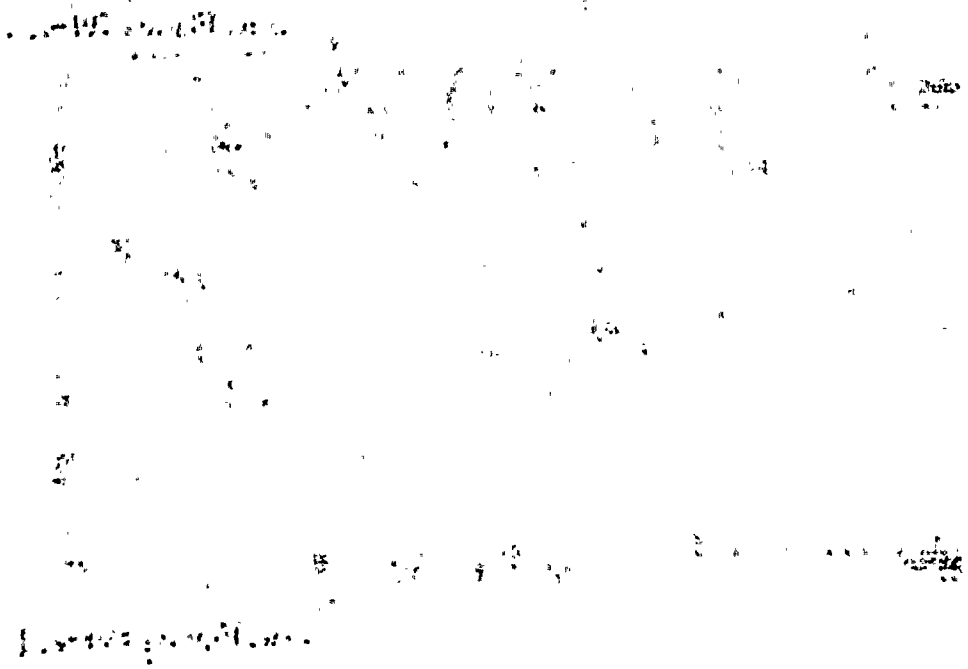
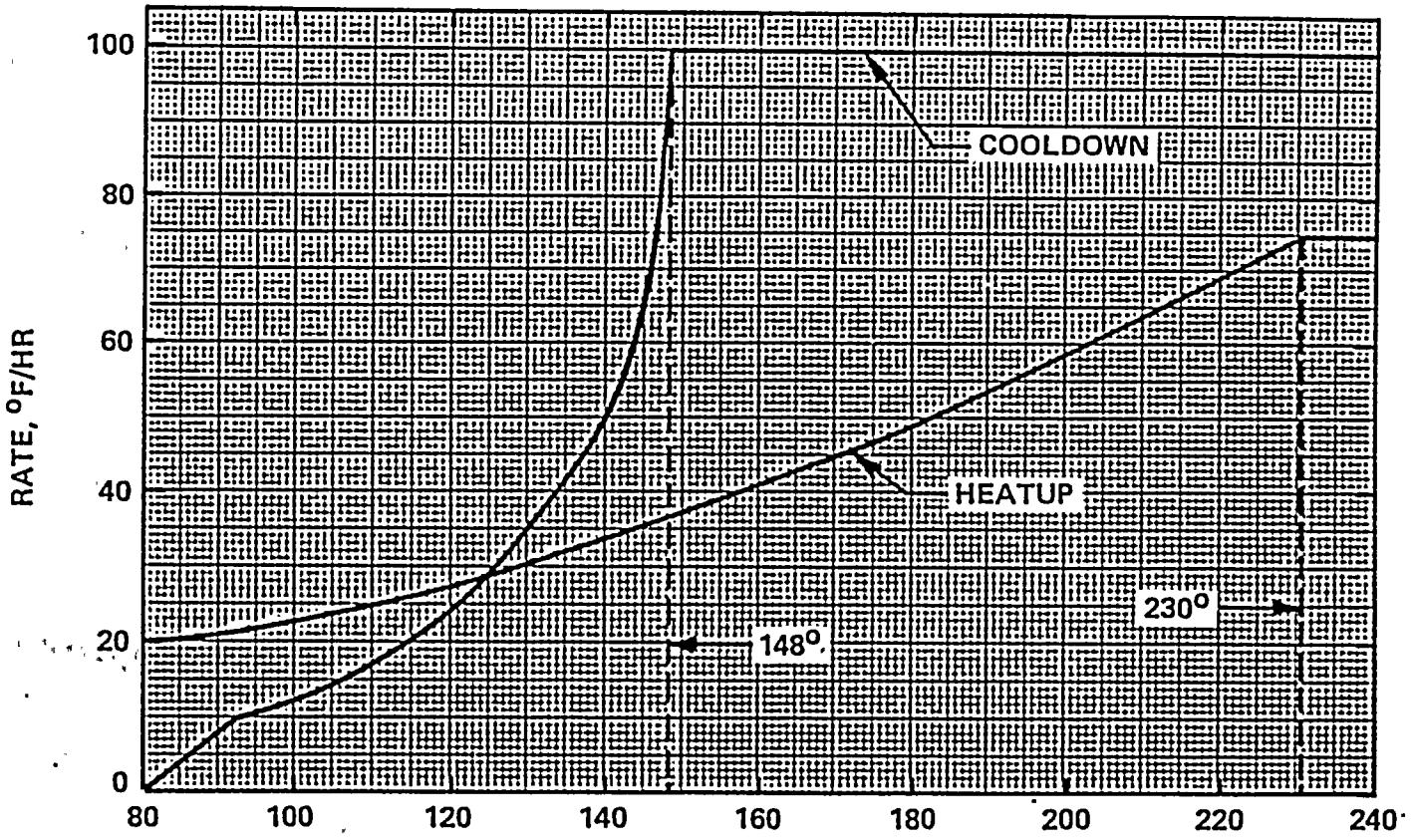
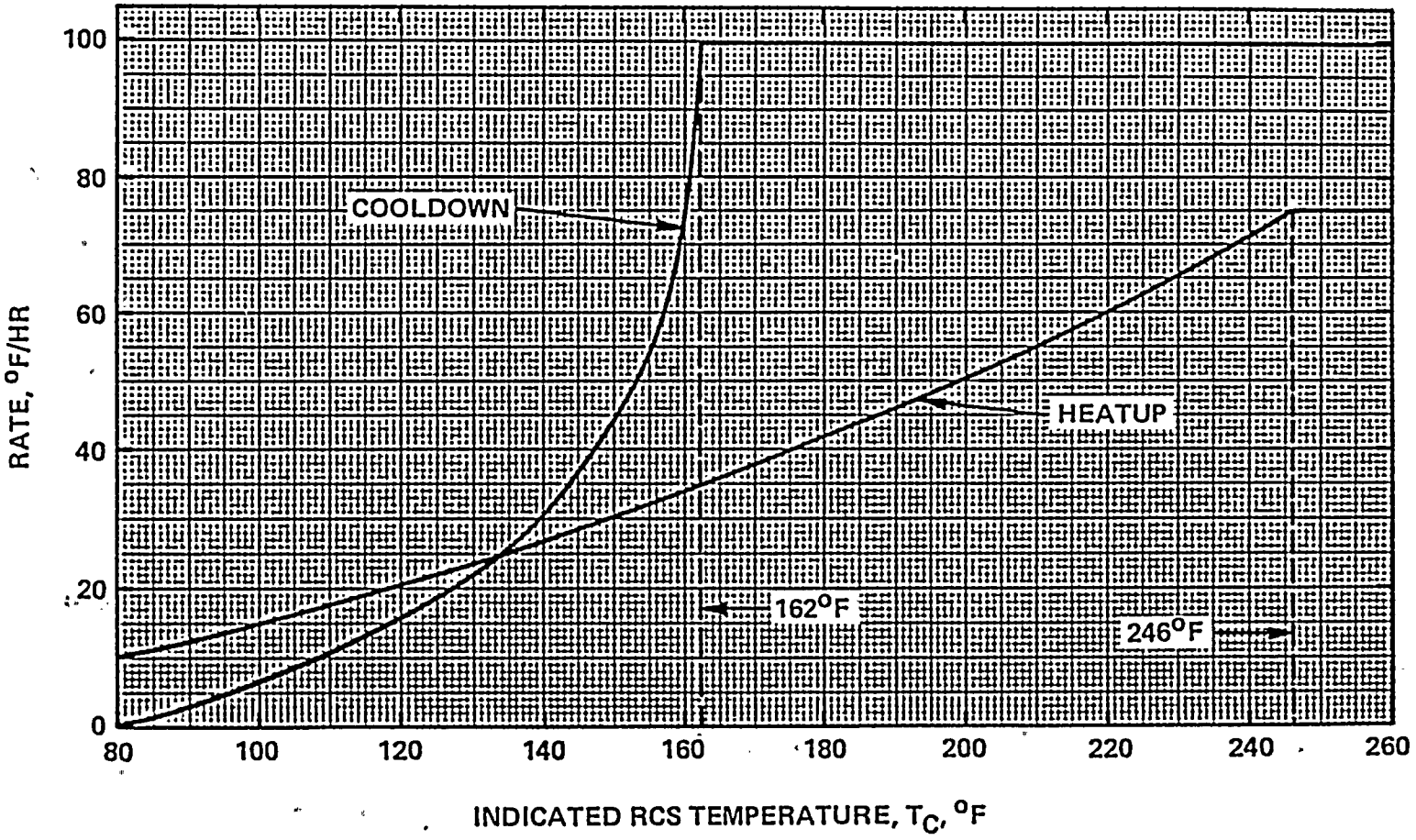


FIGURE 3.4-2c
MAXIMUM ALLOWABLE HEATUP AND
COOLDOWN RATES < 8 EFPY



NOTE: A Maximum Heatup Rate of 75°F/Hr
is Allowed at any temperature above 230°F.
A Maximum Cooldown Rate of 100°F/Hr
is Allowed at any temperature above 148°F

FIGURE 3.4-2d
MAXIMUM ALLOWABLE HEATUP AND
COOLDOWN RATES , 8-32 EFPY



NOTE: A Maximum Heatup Rate of 75°F/Hr
is Allowed at any temperature above 246°F
A Maximum Cooldown Rate of 100°F/Hr
is Allowed at any temperature above 162°F

SPECIFIC ACTIVITY (Continued)

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

3/4.4.8 PRESSURE/TEMPERATURE LIMITS

The various categories of load cycles used for design purposes are provided in Chapters 3 and 5 of the FSAR. During startup and shutdown, the rates of temperature and pressure changes are limited so as not to exceed the limit lines of Figures 3.4-2a and 3.4-2b. This ensures that the maximum specified heatup and cooldown rates are consistent with the design assumptions and satisfy the stress limits for cyclic operation.

insert A

Reactor vessel pressure-temperature limitations and Low Temperature Overpressure Protection requirements for the Palo Verde Nuclear Generating Station are calculated to meet the regulations of 10 CFR Part 50 Appendix A, Design Criterion 14 and Design Criteria 31. These design criteria require that the reactor coolant pressure boundary be designed, fabricated, erected, and tested in order to have an extremely low probability of abnormal leakage, of rapid failure, and of gross rupture. The criteria also require that the reactor coolant pressure boundary be designed with sufficient margin to assure that when stressed under operation, maintenance, and testing the boundary; behaves in a non-brittle manner and the probability of a rapidly propagating fracture is minimized.

The pressure-temperature limits are developed using the requirements of 10 CFR 50 Appendix G. This appendix describes the requirements for developing the pressure-temperature limits and provides the general basis for these limitations. The margins of safety against fracture provided by the pressure-temperature limits using the requirements of 10 CFR Part 50 Appendix G are equivalent to those recommended in the ASME Boiler and Pressure Vessel Code Section III, Appendix G, "Protection Against Nonductile Failure." The general guidance provided in those procedures has been utilized to develop the Palo Verde pressure-temperature limits with the requisite margins of safety for heatup and cooldown conditions.

The pressure-temperature limits account for the temperature differential between the reactor vessel base metal and the reactor coolant bulk fluid temperature. Correction for elevation and RCS flow induced pressure differences between the reactor vessel beltline and pressurizer, are included in the development of the pressure-temperature limits as are instrumentation uncertainties for pressure and temperature measurement. Consequently the P-T

INSERT A

The purpose of the maximum cooldown rates specified in Table 3.4-3 (and supplemented graphically by Figures 3.4-2c and 3.4-2d) is to prevent the RCS pressure from exceeding the corresponding normal operation P-T limit, assuming a concurrent overpressurization due to the limiting low temperature overpressurization transient. Consequently, the cooldown rate limits are only valid if the RCS is capable of being pressurized. Therefore, with the vessel head fully detensioned, the Technical Specification cooldown limits are not applicable. This specification does not apply only for the period of time the vessel head is fully detensioned and thus the RCS cannot be pressurized above the static head of water over the vessel in the refueling pit which is negligible compared to the ASME Code Appendix G, P-T limit.

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3/4.4.8 PRESSURE/TEMPERATURE LIMITS

REACTOR COOLANT SYSTEM

LIMITING CONDITION FOR OPERATION

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

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ACTION:

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Cooldown

T_c^* (°F)	Rate (°F/HR)
≤ 93°F	see Figure 3.4-2c ~~0°F/HR~~
94° - 114°F	10°F/HR
115° - 148°F	20°F/HR
> 148°F	100°F/HR

8-32 Effective Full Power Years

Heatup

T_c^* (°F)	Rate (°F/HR)
< 116°F	10°F/HR
117° - 150°F	20°F/HR
151° - 199°F	30°F/HR
200° - 246°F	50°F/HR
> 246°F	75°F/HR

Cooldown

T_c^* (°F)	Rate (°F/HR)
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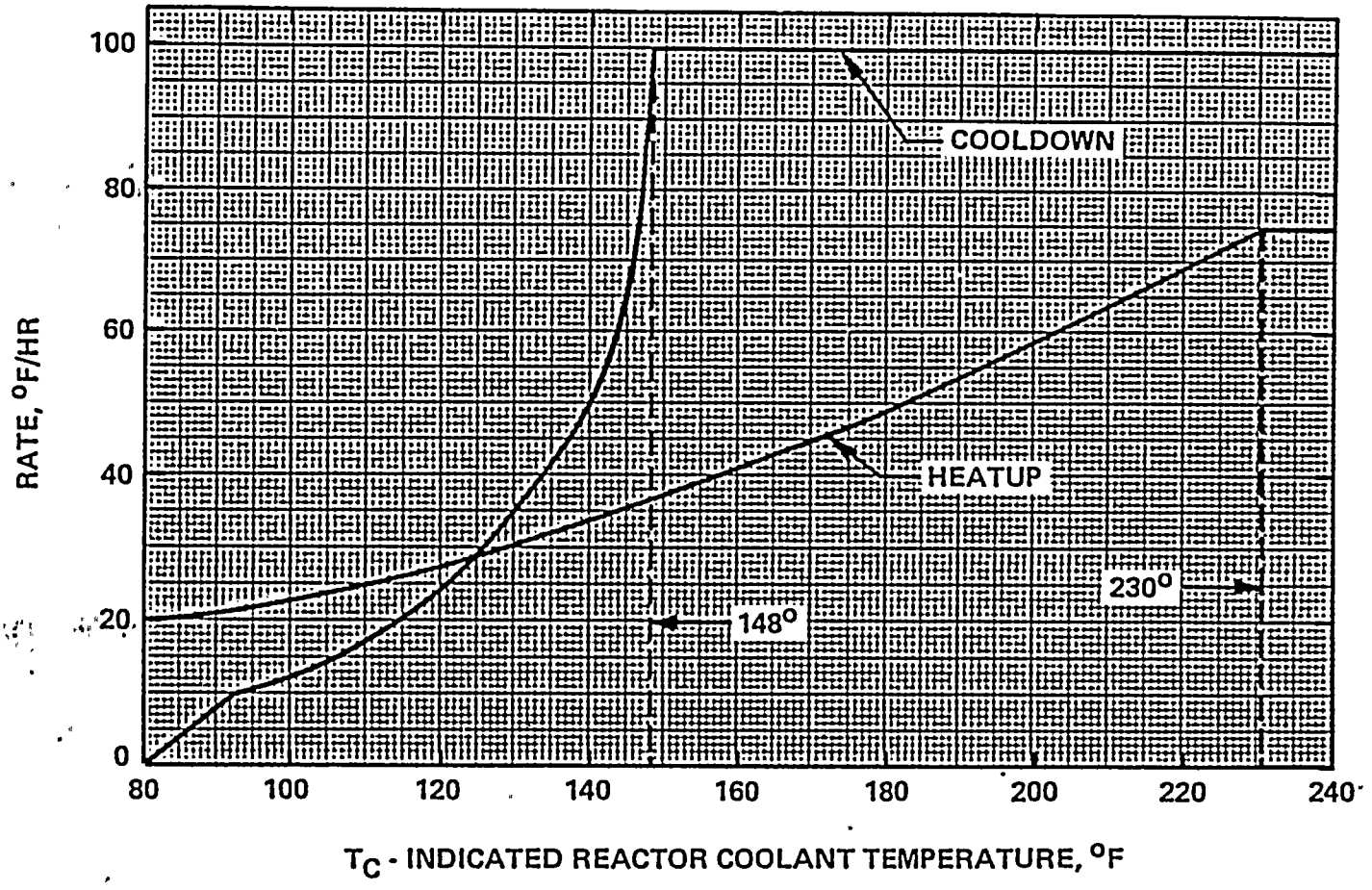
109° - 126°F	10°F/HR
127° - 147°F	20°F/HR
148° - 162°F	40°F/HR
> 162°F	100°F/HR

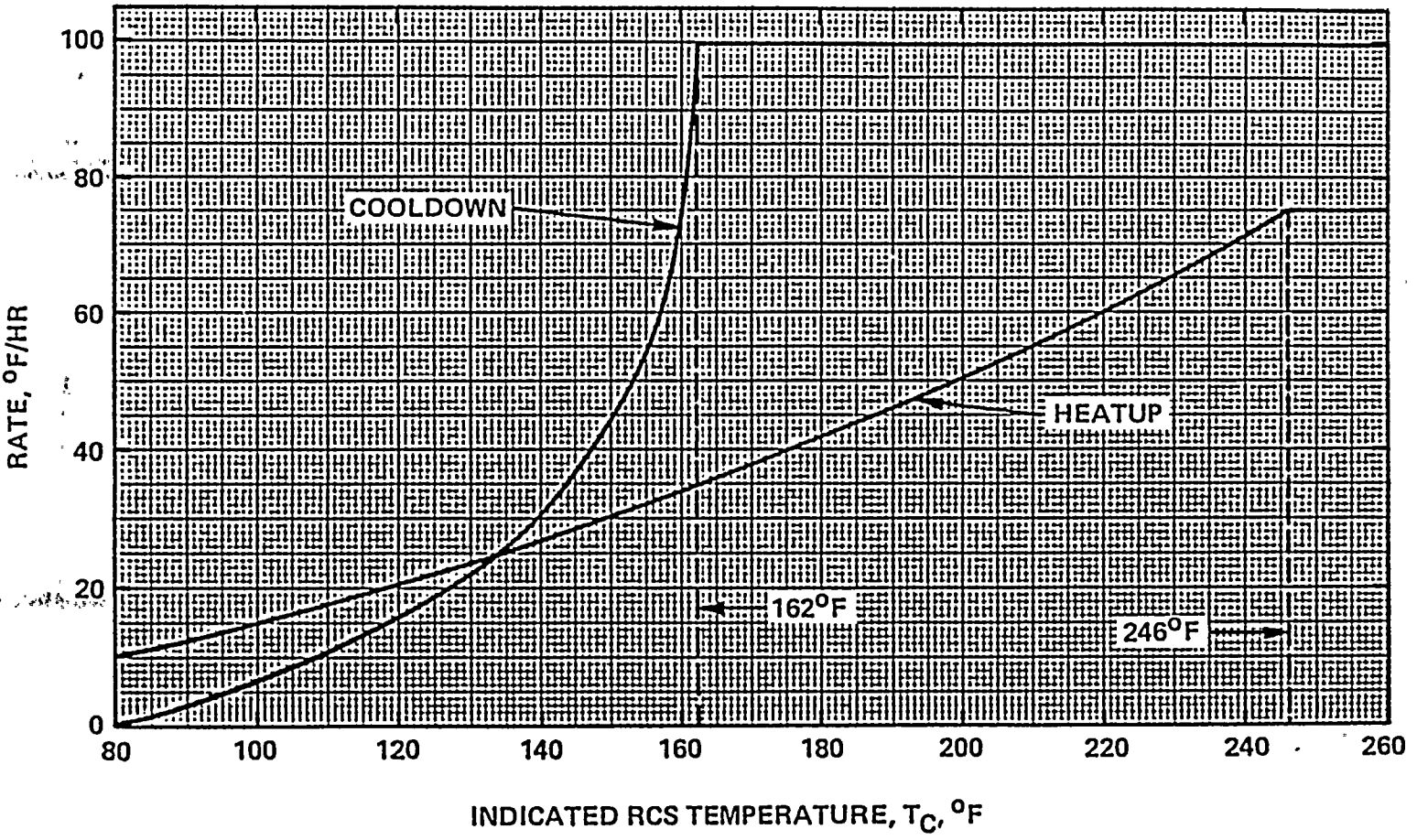
* Indicated Cold Leg Temperature

FIGURE 3.4-2c
MAXIMUM ALLOWABLE HEATUP AND
COOLDOWN RATES < 8 EFPY



NOTE: A Maximum Heatup Rate of 75°F/Hr
is Allowed at any temperature above 230°F.
A Maximum Cooldown Rate of 100°F/Hr
is Allowed at any temperature above 148°F

FIGURE 3.4-2d
MAXIMUM ALLOWABLE HEATUP AND
COOLDOWN RATES , 8-32 EFPY



NOTE: A Maximum Heatup Rate of 75°F/Hr
is Allowed at any temperature above 246°F
A Maximum Cooldown Rate of 100°F/Hr
is Allowed at any temperature above 162°F

SPECIFIC ACTIVITY (Continued)

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

3/4.4.8 PRESSURE/TEMPERATURE LIMITS

The various categories of load cycles used for design purposes are provided in Chapters 3 and 5 of the FSAR. During startup and shutdown, the rates of temperature and pressure changes are limited so as not to exceed the limit lines of Figures 3.4-2a and 3.4-2b. This ensures that the maximum specified heatup and cooldown rates are consistent with the design assumptions and satisfy the stress limits for cyclic operation.

insert A →

Reactor vessel pressure-temperature limitations and Low Temperature Overpressure Protection requirements for the Palo Verde Nuclear Generating Station are calculated to meet the regulations of 10 CFR Part 50 Appendix A, Design Criterion 14 and Design Criteria 31. These design criteria require that the reactor coolant pressure boundary be designed, fabricated, erected, and tested in order to have an extremely low probability of abnormal leakage, of rapid failure, and of gross rupture. The criteria also require that the reactor coolant pressure boundary be designed with sufficient margin to assure that when stressed under operation, maintenance, and testing the boundary; behaves in a non-brittle manner and the probability of a rapidly propagating fracture is minimized.

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The pressure-temperature limits account for the temperature differential between the reactor vessel base metal and the reactor coolant bulk fluid temperature. Correction for elevation and RCS flow induced pressure differences between the reactor vessel beltline and pressurizer, are included

INSERT A

The purpose of the maximum cooldown rates specified in Table 3.4-3 (and supplemented graphically by Figures 3.4-2c and 3.4-2d) is to prevent the RCS pressure from exceeding the corresponding normal operation P-T limit, assuming a concurrent overpressurization due to the limiting low temperature overpressurization transient. Consequently, the cooldown rate limits are only valid if the RCS is capable of being pressurized. Therefore, with the vessel head fully detensioned, the Technical Specification cooldown limits are not applicable. This specification does not apply only for the period of time the vessel head is fully detensioned and thus the RCS cannot be pressurized above the static head of water over the vessel in the refueling pit which is negligible compared to the ASME Code Appendix G, P-T limit.