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May 28, 2003

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
License Amendment Request: Revision to Technical Specification P-T Curves

REFERENCES:

(a) Letter from Mr. C. H. Cruse (CCNPP) to Document Control Desk (NRC), dated September 14, 2000, License Amendment Request: Revision to Technical Specification P-T Curves

(b) Letter from Ms. D. M. Skay (NRC) to Mr. C. H. Cruse (CCNPP), dated March 15, 2001, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Amendment Re: Pressure-Temperature Curves (TAC Nos. MA9999 and MB0000)

(c) Letter from Ms. D. M. Skay (NRC) to Mr. C. H. Cruse (CCNPP), dated February 26, 2001, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Exemption from the Requirements of 10 CFR Part 50, Section 50.60(a) and Appendix G (TAC Nos. MB0001 and MB0002)

Pursuant to 10 CFR 50.90, Calvert Cliffs Nuclear Power Plant, Inc. hereby requests an amendment to Renewed Operating License Nos. DPR-53 and DPR-69 to incorporate the changes described below into the Technical Specifications for Calvert Cliffs Units 1 and 2.

DESCRIPTION

The proposed amendment revises the Unit 1 and Unit 2 cooldown curves [Technical Specification Figure 3.4.3-2 (2 pages)] to change the range of temperatures for which a cooldown rate of 100°F/hr is acceptable.

The existing pressure/temperature (P-T) limits are based on K_{IC} and were submitted by Reference (a) and approved by Reference (b). Evaluation of the stress build up during a cooldown from high temperature at high cooldown rate has shown that the analyzed transient should be continuous. An allowable pressure determined in this way will include the actual stresses determined from the thermal gradient resulting

A001
A047

from the history of the transient. This proposed amendment will further limit the allowable thermal stress intensity factor during cooldown to reflect the persistence of thermal stress from higher cooldown rates following transition to lower cooldown rates. Further limitations in allowable thermal stress intensity factor requires an increase in the changeover temperature from higher to lower cooldown rates.

BACKGROUND

Appendix G to 10 CFR Part 50 requires the establishment of P-T limits for material fracture toughness requirements of the reactor coolant pressure boundary materials. It requires an adequate margin to brittle failure during normal operation, anticipated operational occurrences, and system hydrostatic tests. It mandates the use of the methods of analysis and the required margins of safety of the applicable section of the American Society of Mechanical Engineers (ASME) Code. Accordingly, the Calvert Cliffs P-T limits for material fracture toughness requirements of reactor coolant pressure boundary materials were developed using the methods of linear elastic fracture mechanics and the guidance found in ASME Boiler and Pressure Vessel Code, Section III, Appendix G.

Calvert Cliffs Technical Specification Figures 3.4.3-1 and 3.4.3-2 (2 pages each) contain P-T limit curves for heatup, cooldown, and inservice leak and hydrostatic testing, and data for the maximum rate of change of reactor coolant temperature. Each P-T limit curve defines an acceptable region for normal operation. Technical Specification 3.4.3 provides allowable operational P-T combinations during cooldown, shutdown, and heatup to keep from violating the 10 CFR Part 50, Appendix G, requirements.

REQUESTED CHANGES

Revise Technical Specification Figures 3.4.3-2 (Unit 1) and 3.4.3-2 (Unit 2) as shown in the marked-up Technical Specification pages in Attachment (1). The final Technical Specification pages are provided in Attachment (2).

SAFETY ANALYSIS

The resistance to brittle fracture is determined by analyzing the stress (and stress intensity factors) applied to the vessel, and comparing them to the maximum stress intensity factors that can be applied to the material without inducing fracture. The maximum stress intensity factor that the vessel material can withstand without failing is known as the material reference toughness, and is a function of temperature. At low temperatures, fracture resistance is low; while at high temperatures, fracture resistance is higher. The relationship between toughness and temperature can be plotted and can also be described mathematically. The ASME Code provides two descriptions of the relationship between vessel fracture resistance and temperature. These two descriptions are for different types of fracture resistance, and are called K_{IC} and K_{IA}. K_{IC} is approved for use on Calvert Cliffs Units 1 and 2. The equation for K_{IC} is provided in ASME Section XI, Article A-4000:

$$K_{IC} = 33.2 + 20.734 \exp(0.02 (T - RT_{NDT}))$$

K_{IC} is the stress intensity factor that, applied to a material, will cause crack initiation or an existing crack to propagate. This fracture toughness parameter was determined by drawing a lower bound to static crack initiation toughness data. If applied loads are limited so that they do not create stress intensity factors that exceed K_{IC}, then cracks will not initiate.

The existing Low Temperature Overpressure Protection (LTOP) limits are based on the use of K_{IC} with the maximum pressure limit at 100% of ASME Section XI, Appendix G, P-T limits. With the approval provided in Reference (c) to use Code Case N-640, K_{IC} can be used for determining P-T limits.

Pressure-temperature curves are calculated using ASME Section XI, Appendix G, guidance. The governing equation is:

$$2K_{IM} + K_{IT} < K_{IC}.$$

Where: K_{IM} = Allowable pressure stress intensity factor, ksi$\sqrt{in}$;

K_{IT} = Allowable thermal stress intensity factor, ksi$\sqrt{in}$;

K_{IC} = Reference critical stress intensity factor for the material, ksi$\sqrt{in}$.

K_{IM} and K_{IT} are calculated according to ASME Section XI, Appendix G, G-2214, with K_{IM} derived principally from membrane stress due to vessel internal pressure, and K_{IT} derived from thermal stress due to vessel temperature transients.

To develop the P-T limits, a continuous cooldown transient is evaluated to determine the value of K_{IT} versus time. The K_{IT} is affected by a previous cooldown rate of 100°F/hr even when presently at 40°F/hr. At each time during the cooldown transient, the applied K_{IT} is subtracted from K_{IC} to determine the maximum permissible K_{IM} according to the following re-arrangement of the governing equation:

$$K_{IM} < 1/2(K_{IC} - K_{IT})$$

Knowing the maximum K_{IM} permits calculation of maximum allowable pressure.

In order to maintain current LTOP setpoints, it is necessary to define the new cooldown rate range (the temperature at which it is required to change the cooldown rate from 100°F/hr to 40°F/hr) such that the pressure necessary to create the maximum K_{IM} is equal to or greater than maximum allowable pressure for the existing LTOP limits. It is important to note that the new temperature range will not permit operation at higher pressures (K_{IM}) than permitted previously. Instead, pressure will be limited in the new curves to the same value it was limited to in the old curves.

As the cooldown rate breakpoint is increased, the thermal stress, K_{IT}, at later times and lower temperatures, will increase resulting in a greater allowable pressure. The breakpoint is selected so that the calculated K_{IT} satisfies:

$$K_{IT} < K_{IC} - 2\,K_{IM}$$

By constraining K_{IM} as described above, K_{IT} (and cooldown rates) can be adjusted while maintaining the existing P-T limits.

We have performed a calculation that re-evaluates the LTOP P-T limits using the actual continuous cooldown history and shutdown cooling (SDC) initiation transient within each analytical run rather than the previous method of evaluating each cooldown rate in isolation and without SDC initiation. In this way, the evaluation considers all stresses that are built up. The evaluation uses the new, higher cooldown rates and the new K_{IC} for stress intensity which results in higher temperature levels at which the cooldown rate must be reduced from 100°F/hr to 40°F/hr and also results in restrictions on initiation of SDC. The existing LTOP P-T limits and setpoints are preserved. It is important to note that none of the heatup or cooldown rates are greater than 100°F/hr. This means, there are no changes to the cooldown rates above 300°F, or to the cooldown rates assumed in the Updated Final Safety Analysis Report, Chapter 14, Safety Analyses.

The proposed changes to the cooldown rates are necessary to address P-T limit concerns encountered when entering plant outage periods and cooling down. The existing cooldown rate ranges are protected by the present fluence levels until the end of 2004 for both Units.

DETERMINATION OF SIGNIFICANT HAZARDS

This proposed amendment revises the Unit 1 and Unit 2 cooldown curves to change the range of temperatures for which a cooldown rate of 100°F/hr is acceptable. The change in range resulted from an evaluation of a cooldown in which residual stresses from the 100°F/hr rate affected the stress during the cooldown at the 40°F/hr rate.

The proposed change has been evaluated against the standards in 10 CFR 50.92 and has been determined to not involve a significant hazards consideration, in that operation of the facility in accordance with the proposed amendments:

1. *Would not involve a significant increase in the probability or consequences of an accident previously evaluated.*

   In accordance with 10 CFR Part 50, Appendix G, the Calvert Cliffs pressure/temperature (P-T) limits for material fracture toughness requirements of the reactor coolant pressure boundary materials were developed using the methods of linear elastic fracture mechanics and the guidance found in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Appendix G. The proposed cooldown rates for the Technical Specification P-T limits were made possible by ASME Code Case N-640 which permits use of K_{IC} for reference stress intensity factor. Low temperature overpressure protection enable temperatures are not affected.

   The proposed change only changes the temperature at which the cooldown transitions from 100°F/hr to 40°F/hr. It does not change the basic cooldown rates or methods of cooling down the Reactor Coolant System. This cooldown transition does not affect the probability of an accident previously evaluated because the cooldown rates have not changed. Additionally, since the cooldown rates are not changed above 300°F, the safety analyses and dose consequences in the Updated Final Safety Analysis Report are not affected.

   Therefore the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Would not create the possibility of a new or different type of accident from any accident previously evaluated.*

   The implementation of the proposed revision has no significant effect on either the configuration of the plant, or the manner in which it is operated.

   Therefore, this proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. *Would not involve a significant reduction in a margin of safety.*

   The margin of safety is defined by compliance with 10 CFR Part 50, Appendix G, requirements for adequate margin to prevent brittle failure of the reactor coolant pressure boundary materials. As discussed above, use of K_{IC} with continuous cooldown results in a conservative cooldown rate that will maintain plant safety. With the proposed change, the underlying intent of the 10 CFRPart 50, Appendix G, is maintained.

   Therefore, this proposed change does not significantly reduce the margin of safety.

ENVIRONMENTAL ASSESSMENT

We have determined that operation with the proposed amendment will not result in any significant change in the types or significant increases in the amounts of any effluents that may be released offsite, and no significant increases in individual or cumulative occupational radiation exposure. Therefore, the proposed amendment is eligible for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed amendment.

SAFETY COMMITTEE REVIEW

The Plant Operations and Safety Review Committee and the Offsite Safety Review Committee have reviewed this proposed amendment and concur that operation with the proposed amendment will not result in an undue risk to the health and safety of the public.

SCHEDULE

We plan to make use of the proposed cooldown rate break points for the upcoming spring 2004 Unit 1 refueling outage. In order to allow time to make the necessary preparation to use the new heatup and cooldown rates, we request that the Nuclear Regulatory Commission review and approve the proposed amendment on or before December 1, 2003.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

STATE OF MARYLAND :
: **TO WIT:**
COUNTY OF CALVERT :

I, Peter E. Katz, being duly sworn, state that I am Vice President - Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP), and that I am duly authorized to execute and file this License Amendment Request on behalf of CCNPP. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other CCNPP employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Peter E. Katz

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of St. Mary's, this 28th day of May, 2003.

WITNESS my Hand and Notarial Seal:

Notary Public

My Commission Expires: March 25 2007
Date

PEK/PSF/bjd

Attachments: (1) Technical Specification Marked-up Pages
(2) Final Technical Specification Pages

cc: J. Petro, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
G. S. Vissing, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

TECHNICAL SPECIFICATION MARKED-UP PAGES

3.4.3-4

3.4.3-6

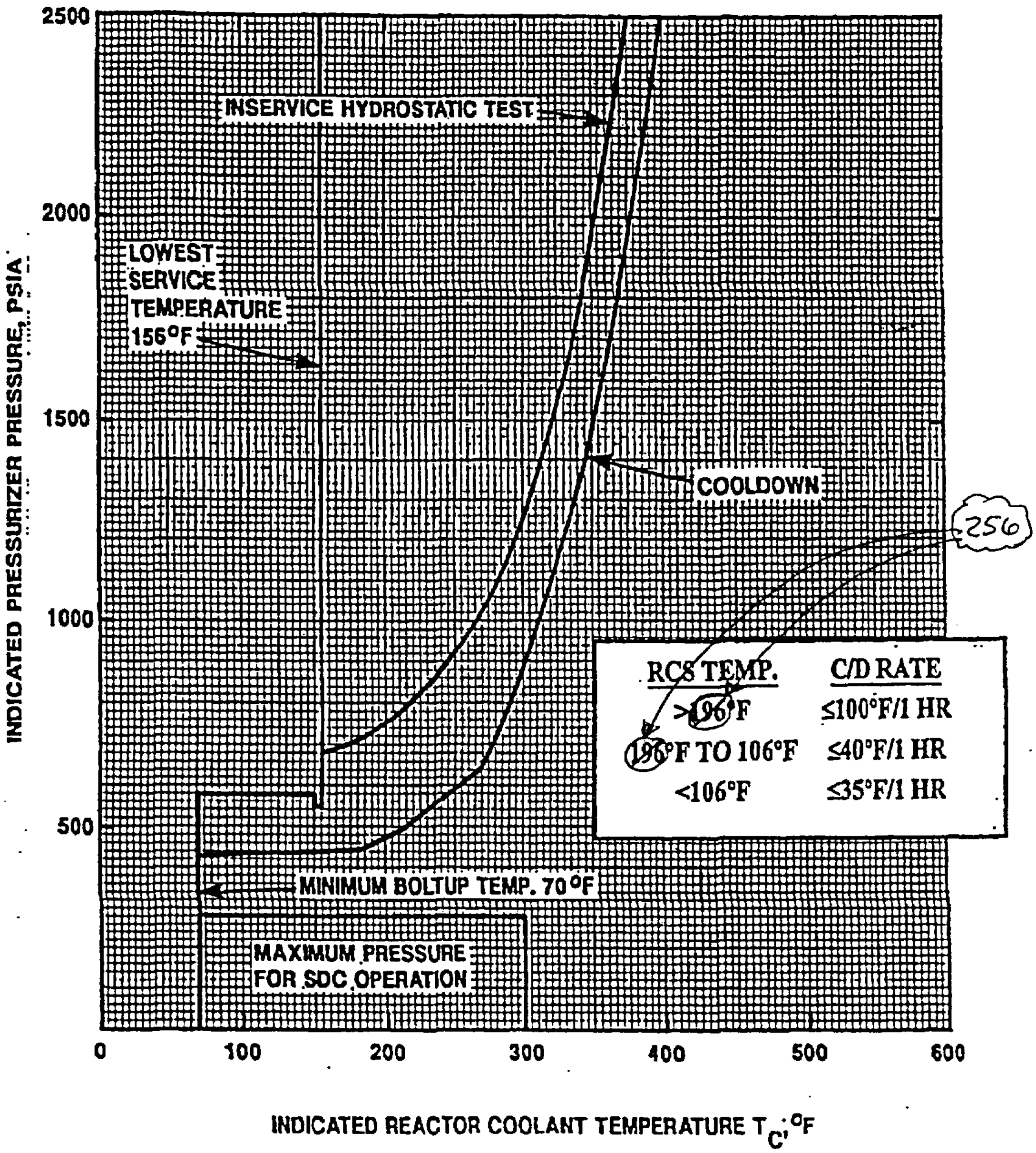


Figure 3.4.3-2
Calvert Cliffs Unit 1 Cooldown Curve, for Fluence ≤ 4.49×10^{19} n/cm^2
Reactor Coolant System Pressure Temperature Limits

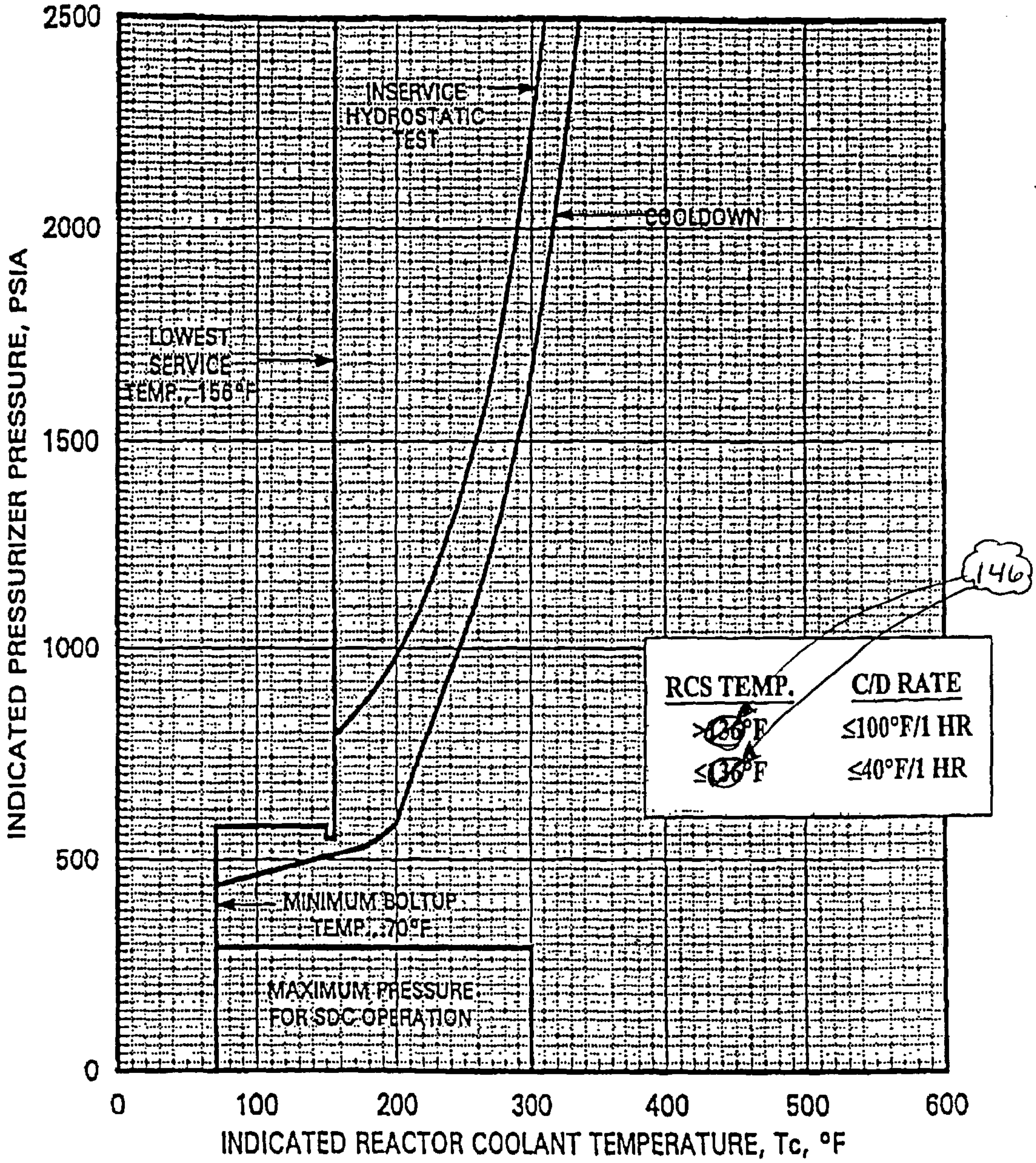


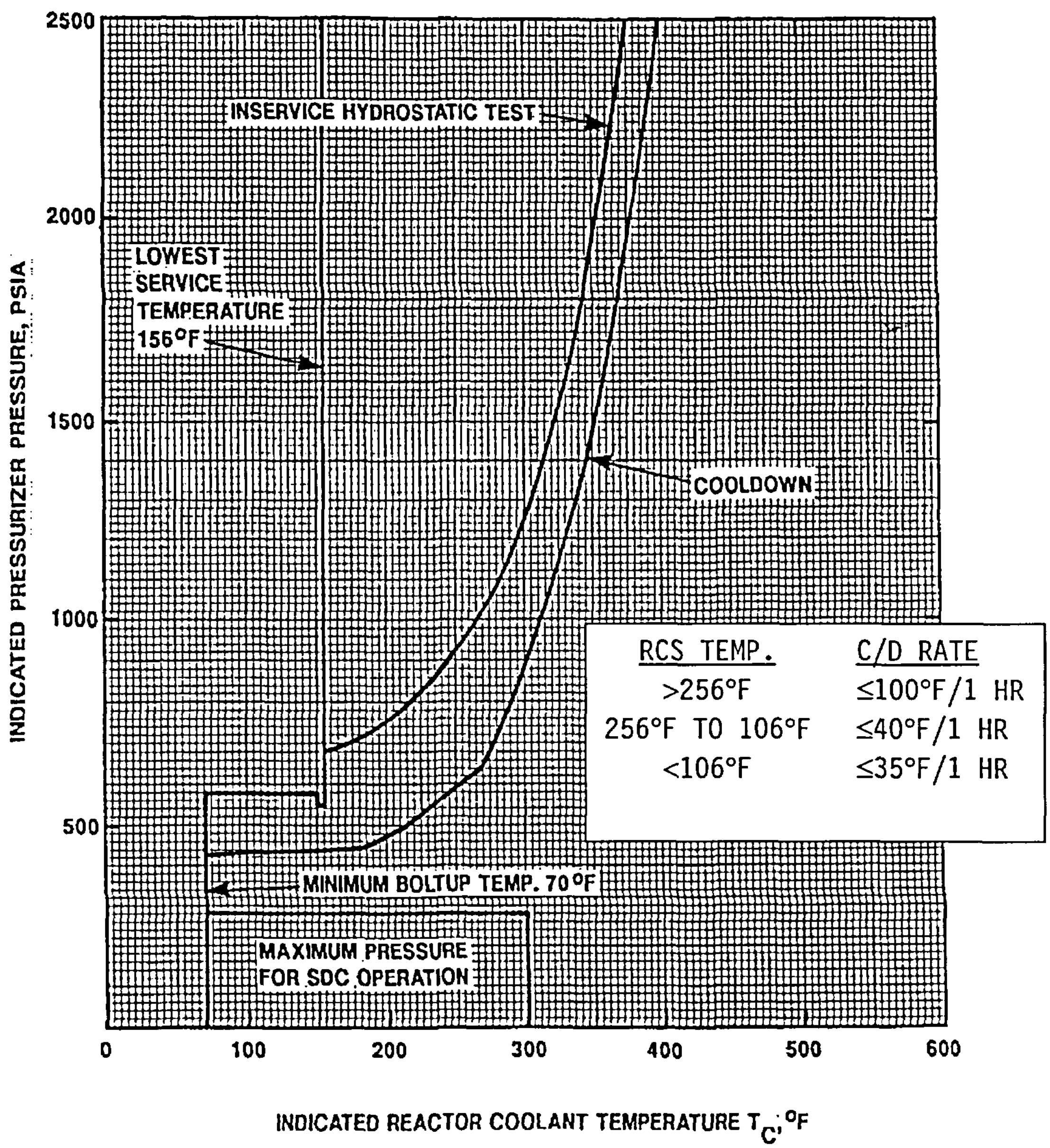
Figure 3.4.3-2
Calvert Cliffs Unit 2 Cooldown Curve, for Fluence ≤ 4.0×10^{19} n/cm^2
Reactor Coolant System Pressure Temperature Limits

ATTACHMENT (2)

FINAL TECHNICAL SPECIFICATION PAGES

3.4.3-4

3.4.3-6



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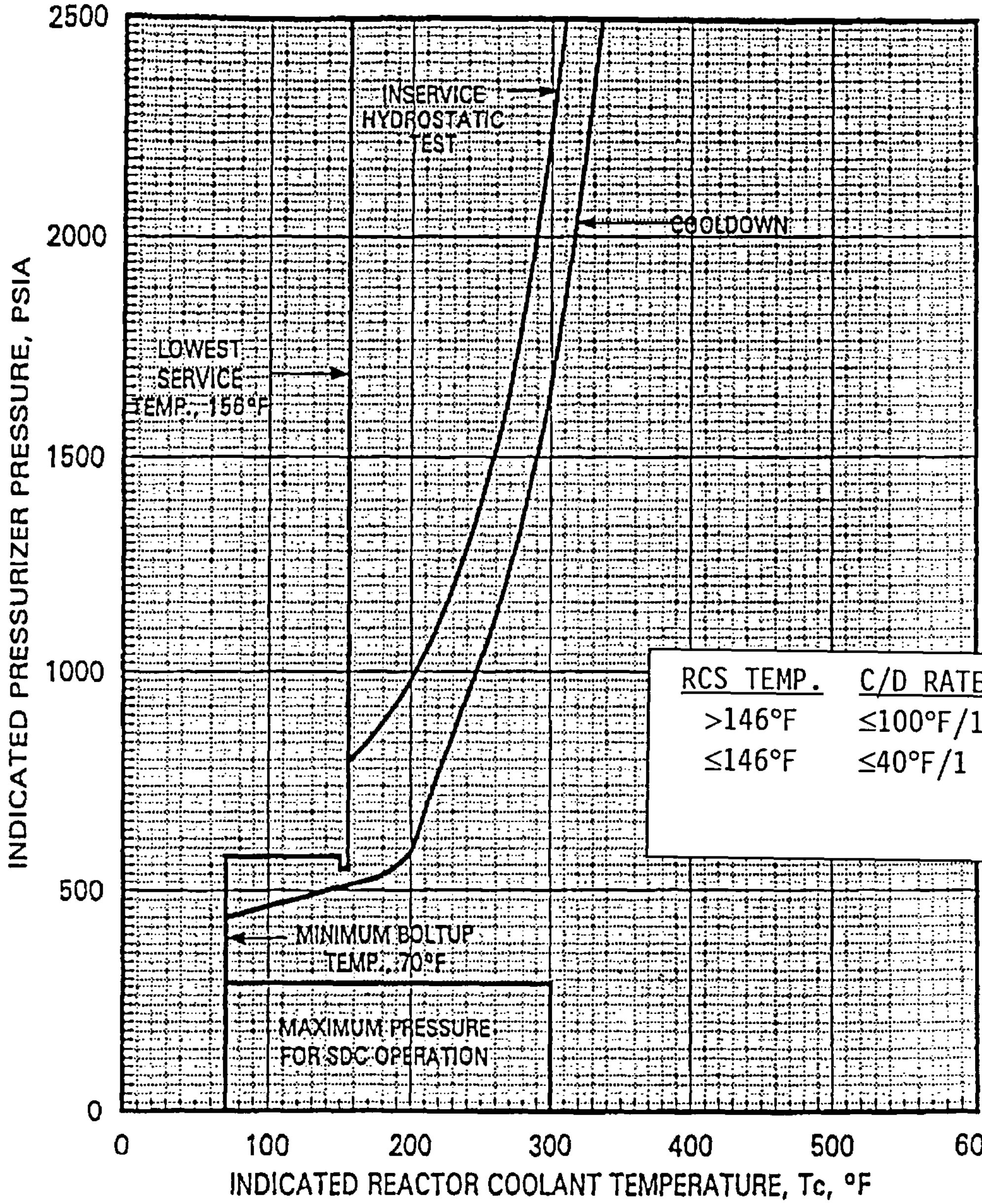
Reactor Coolant System Pressure Temperature Limits



RCS TEMP.	C/D RATE
>146°F	≤100°F/1 HR
≤146°F	≤40°F/1 HR

Figure 3.4.3-2
Calvert Cliffs Unit 2 Cooldown Curve, for Fluence ≤ 4.0×10^{19} n/cm^2
Reactor Coolant System Pressure Temperature Limits