P.O. Box 63
Lycoming, New York 13093

Constellation Energy Group

Nine Mile Point
Nuclear Station

November 15, 2002
NMP1L 1697

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Nine Mile Point Unit 1
Docket No. 50-220
License Amendment Request Pursuant to 10 CFR 50.90: Revision of Reactor Pressure Vessel Pressure-Temperature Limits and Request for Exemption from Requirements of 10 CFR 50.60
TAC Nos. MB6687 and MB6703

Gentlemen:

Pursuant to 10 CFR 50.90, Nine Mile Point Nuclear Station, LLC, (NMPNS) hereby requests an amendment to Nine Mile Point Unit 1 (NMP1) Operating License DPR-63. The proposed changes to the Technical Specifications (TSs) contained herein would revise the Reactor Coolant System (RCS) Pressure-Temperature (P-T) limit curves and associated limit tables specified in Section 3/4.2.2, "Minimum Reactor Vessel Temperature for Pressurization " Specifically, the proposed changes replace TS Figures 3.2.2.a through 3.2.2.e with new figures, deleting Figures 3.2.2.f and 3.2.2.g, and replace associated Tables 3.2.2.a through 3.2.2.e with new Tables, deleting Tables 3.2.2.f and 3.2.2.g. Specification 3.2.2.c is updated to eliminate the references to the deleted figures. The Bases for TS 3/4.2.2 have been revised to reflect the proposed changes to the TSs

The P-T limit curves and tabular listing of P-T limit values contained in the new figures and tables are based, in part, on an alternative methodology and will be valid for 28 Effective Full Power Years (EFPY). The estimated EFPY at the end of the current operating cycle is 21.63 EFPY.

The alternative methodology used to develop the new P-T limit curves and tables has been endorsed by the American Society of Mechanical Engineers (ASME), but has not yet received formal approval by the NRC for generic application. The alternative methodology uses the ASME Boiler and Pressure Vessel (B&PV) Code Case N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves Section XI, Division 1," in calculating the new RCS P-T limits. The use of this alternative methodology requires an exemption from the current requirements of 10 CFR

A001

50.60, "Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation," pursuant to 10 CFR 50.60(b) and 10 CFR 50.12, "Specific exemptions." The exemption request is provided in Attachment 4. The NRC has granted similar exemptions and approved the associated TS changes for a number of other Boiling Water Reactor (BWR) plants, including: Pilgrim (ADAMS Accession Numbers ML010720448 and ML010790519), Brunswick Units 1 and 2 (ADAMS Accession Numbers ML012760157 and ML012780286), and Susquehanna Units 1 and 2 (ADAMS Accession Numbers ML013520568 and ML013520605).

The procedures and methodology that were previously used to calculate the RCS P-T limit curves and tables for NMP1 were revised to recalculate the curves based, in part, on the ASME N-640 Code Case. The neutron fluence values for the Reactor Pressure Vessel (RPV) are unchanged from those calculated for the current P-T limit curves and tables. Therefore, the new P-T limit curves and tables were developed using the ASME N-640 Code Case in conjunction with the current neutron fluence values.

The proposed changes have been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c) and it has been determined that the changes involve no significant hazards considerations. In addition, the proposed exemption to 10 CFR 50.60 has been evaluated and determined to be acceptable pursuant to the provisions of 10 CFR 50.12.

NMPNS requests approval of this application and issuance of the TS amendment by March 15, 2003 with 60 days allowed for implementation. The amendment is needed for the Spring 2003 refueling outage (RFO17) in anticipation of commencing hydrostatic testing on March 27, 2003. This letter contains one (1) new commitment as defined in Section 5.3 of Attachment 1.

Pursuant to 10CFR50.91(b)(1), NMPNS has provided a copy of this license amendment request and the associated analyses regarding no significant hazards considerations to the appropriate state representative.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 15, 2002.

Sincerely,

John T. Conway

John T. Conway
Vice President Nine Mile Point

JTC/CDM/jm

Attachments:
1. Evaluation of Proposed Technical Specification Changes
2. Proposed Technical Specification Changes (Mark-up)
3. Technical Specification Bases Changes (Mark-up For Information Only)
4. Exemption Request
5. Report No. SIR-02-129

cc: Mr. H. J. Miller, NRC Regional Administrator, Region I
Mr. G. K. Hunegs, NRC Senior Resident Inspector
Mr. P. S. Tam, Senior Project Manager, NRR (2 copies)
Mr. John P. Spath, NYSERDA

ATTACHMENT 1

EVALUATION OF PROPOSED TECHNICAL SPECIFICATION CHANGES

Subject: License Amendment Request Pursuant to 10 CFR 50.90: Revision of Reactor Pressure Vessel Pressure-Temperature Limits and Request for Exemption from Requirements of 10 CFR 50.60

1.0 DESCRIPTION

2.0 PROPOSED CHANGE

3.0 BACKGROUND

4.0 TECHNICAL ANALYSIS

5.0 REGULATORY SAFETY ANALYSIS

6.0 ENVIRONMENTAL CONSIDERATION

1.0 DESCRIPTION

This letter is a request to amend Operating License DPR-63 for Nine Mile Point Unit 1 (NMP1).

The proposed changes would amend the Operating License to revise the Reactor Coolant System (RCS) Pressure-Temperature (P-T) limit curves and associated limit tables specified in Technical Specification (TS) Section 3/4.2.2, "Minimum Reactor Vessel Temperature for Pressurization." Specifically, the proposed changes replace TS Figures 3.2.2.a through 3.2.2.e with new figures, deleting Figures 3.2.2.f and 3.2.2.g, and replace associated Tables 3.2.2.a through 3.2.2.e with new Tables, deleting Tables 3.2.2.f and 3.2.2.g. Specification 3.2.2.c is updated to eliminate the references to the deleted figures. The Bases for TS 3/4.2.2 have been revised to reflect the proposed changes to the TSs.

The proposed changes to the TSs and associated changes to the TS Bases are indicated in the mark-up pages provided in Attachments 2 and 3, respectively. The TS Bases changes are provided for information only and will be controlled by the TS Bases change control process.

The P-T limit curves and tabular listing of P-T limit values contained in the new figures and tables are based, in part, on an alternative methodology and will be valid for 28 Effective Full Power Years (EFPY). The estimated EFPY at the end of the current operating cycle is 21.63 EFPY.

The proposed P-T limit curves and tables have been developed using the alternative methodology permitted by American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Case N-640, "Alternate Reference Fracture Toughness for Development of P-T Limit Curves Section XI, Division 1." Code Case N-640 permits the use of an alternative fracture toughness curve (i.e., K_{Ic} in lieu of K_{Ia}) for the development of P-T limit curves. The use of this alternative methodology represents an exception to the requirements of 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation," and therefore, requires an exemption from the requirements. A formal Exemption Request is provided in Attachment 4.

A report summarizing the inputs, methodology, and results of the calculations used in the development of the proposed (new) P-T limit curves and tables is included in Attachment 5.

2.0 PROPOSED CHANGE

TS Figures 3.2.2.a and b and Tables 3.2.2.a and b are being replaced with new figures and tables to provide RCS P-T limits that continue to be valid for up to 28 EFPY and that are applicable to reactor vessel heatup and cooldown with the reactor core not critical.

TS Figures 3.2.2.c and d and Tables 3.2.2.c and d are being replaced with new figures and tables to provide RCS P-T limits that continue to be valid for up to 28 EFPY and that are applicable to reactor vessel heatup and cooldown with the reactor core critical.

TS Figures 3.2.2.e, f, and g and Tables 3.2.2.e, f, and g are being replaced with a new single Figure 3.2.2.e and a new single Table 3.2.2.e to provide RCS P-T limits that are valid for up to 28 EFPY and that are applicable to hydrostatic and leak tests. Figures 3.2.2.f and g and Tables 3.2.2.f and g are being deleted since they have been superseded by the new single (28 EFPY) figure and new single (28 EFPY) table.

TS 3.2.2.c is being updated to eliminate the references to the deleted figures. This is a conformance change only.

The Bases for TS 3.2.2 and 4.2.2 are being revised to reflect the changes to the TSs.

3.0 BACKGROUND

In accordance with 10 CFR 50, Appendix A, General Design Criterion (GDC) 31, "Fracture prevention of reactor coolant pressure boundary," the reactor coolant pressure boundary is required to be designed with sufficient margin to assure that, when stressed under operating, maintenance, testing, and postulated accident conditions, the boundary behaves in a non-brittle manner. The GDC also requires consideration of the uncertainties in determining the effects of irradiation on material properties. These requirements are reiterated in 10 CFR 50.60. The requirements of 10 CFR 50.60 are described in 10 CFR 50, Appendix G, "Fracture Toughness Requirements," and Appendix H, "Reactor Vessel Material Surveillance Program Requirements."

Fracture toughness and reactor vessel material surveillance program requirements as specified in 10 CFR 50, Appendices G and H, must be considered in establishing RCS P-T limits. Appendix G specifies that the fracture toughness and testing requirements for reactor vessel material meet the requirements of the ASME B&PV Code and requires that the beltline material in the surveillance capsules be tested in accordance with the requirements of 10 CFR 50, Appendix H. Appendix G of 10 CFR 50 endorses ASME B&PV Code, Section XI, Appendix G, as providing a conservative method for developing reactor vessel P-T limits. In addition, Generic Letter 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Impact on Plant Operations," requires that the methods described in Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," be used to predict the effect of neutron irradiation on the Adjusted Reference Temperature (ART). The ART is defined as the sum of the initial nil-ductility transition reference temperature (RT_{NDT}) of the material, the increase in RT_{NDT} caused by neutron irradiation, and a margin to account for uncertainties in the prediction method.

The current P-T limit curves and tables were approved by the NRC on November 25, 1998 and issued as Amendment No. 164 to the NMP1 TSs. Approval of the current P-T limit curves and tables was based on the conformance of the limits to the requirements of

10 CFR 50, Appendix G, and Generic Letter 88-11. The current P-T limits satisfied Generic Letter 88-11 since the method used to calculate the ART conformed to Regulatory Guide 1.99, Revision 2.

4.0 TECHNICAL ANALYSIS

In September 2002, Nine Mile Point Nuclear Station, LLC, (NMPNS) contracted with Structural Integrity Associates (SIA) to recalculate the NMP1 P-T limit curves and tables. The recalculated (proposed) P-T limit curves and tables are based, in part, on the fluence values calculated for the previously approved (current) P-T curves and tables. In addition, the recalculated (proposed) P-T limit curves and tables include improvements that have been made to the calculational methodology contained in Section XI, Appendix G, of the ASME B&PV Code. The proposed new P-T limit curves and tables are all valid for 28 EFPY.

The methodology improvements were the application of ASME B&PV Code Case N-640, which permits fracture toughness curve K_{Ic}, as found in ASME B&PV Code, Section XI, Appendix A, to be used in lieu of curve K_{Ia} of Section XI, Appendix G, for the development of P-T limit curves. The proposed (new) P-T limit curves and tables for NMP1 were, therefore, developed in accordance with 10 CFR 50, Appendix G, and the 1989 Edition of ASME B&PV Code, Section XI, Appendix G, as modified by the ASME N-640 Code Case. Use of the 1989 Edition of the ASME Code is acceptable based on 10 CFR 50, Appendix G, and 10 CFR 50.55a(b)(2). Application of the methodology improvements of ASME N-640 Code Case are further discussed in Section 4.1 below.

4.1 Application of ASME N-640 Code Case

The proposed P-T limits were developed based on the methodology specified in Section XI, Appendix G, of the ASME B&PV Code, as modified by ASME B&PV Nuclear Code Case N-640. ASME Code Case N-640 permits the use of alternate material fracture toughness when developing minimum vessel temperatures. Specifically, fracture toughness K_{Ic} values as defined in ASME B&PV Code, Section XI, Appendix A, Figure A-4200-1, were used in lieu of the K_{Ia} values defined in ASME B&PV Code, Section XI, Appendix G, Figure G-2210-1, for the development of the proposed (new) P-T limit curves and tables.

Use of the K_{Ic} curve in determining the lower bound fracture toughness in the development of P-T limit curves is more technically correct than the K_{Ia} curve. The K_{Ic} curve models the slow heatup and cooldown processes that a Reactor Pressure Vessel (RPV) normally undergoes. These slow heatup and cooldown limits are enforced by NMP1 TS Sections 3.2.1 and 3/4.2.2. Specifications 3.2.1, 3.2.2.a, b, and c, and 4.2.2.a provide assurance that the heatup and cooldown rate limit of ≤ 100° F/HR, as specified in Updated Final Safety Analysis Report (UFSAR) Section V-C.4 and Table V-1, is met.

Use of this approach is justified by the initial conservatism of the K_{Ia} curve when it was incorporated into the ASME B&PV Code in 1974. This initial conservatism was necessary due to the limited knowledge of RPV material fracture toughness at the time. Since that time, considerable knowledge has been gained regarding fracture toughness of RPV materials and their fracture response to applied loads. This increased knowledge has served to demonstrate that the fracture toughness provided by the K_{Ia} curve is well beyond the margin of safety required to protect against potential RPV failure, and the K_{Ic} fracture toughness curve provides an adequate margin of safety for such a failure.

The acceptability of, and technical basis for, the use of ASME Code Case N-640 is described in "Technical Basis for Revised P-T Limit Curve Methodology," by W. H. Bamford (Westinghouse Electric), S. N. Malik (NRC), et. al. This methodology was presented at the 2000 ASME Pressure Vessels and Piping Conference. In general, the revised methodology removes excess conservatism in the current ASME, Section XI, Appendix G, approach. Performance of leak tests at artificially high temperatures could impact test personnel safety, challenge operators with maintaining a high temperature in a limited operating band, and decrease the availability of plant systems, including shutdown cooling, due to the longer RPV heatup and test time.

Notwithstanding that the use of the ASME N-640 Code Case changes the methodology used to calculate the proposed P-T limit curves and tables, the modified methodology continues to satisfy the guidance contained in the 1989 Edition of ASME B&PV Code, Section XI, Appendix G. Therefore, it follows that the proposed P-T limit curves and tables will also continue to satisfy the intent of the guidance contained in 10 CFR 50, Appendices G and H.

The NRC has found the application of the ASME N-640 Code Case acceptable. A number of nuclear facilities have previously requested the use of the N-640 Code Case and their applications have been approved by the NRC. [Reference: Pilgrim (ADAMS Accession Numbers ML010720448 and ML010790519), Brunswick Units 1 and 2 (ADAMS Accession Numbers ML012760157 and ML012780286), and Susquehanna Units 1 and 2 (ADAMS Accession Numbers ML013520568 and ML013520605)]. Also, note that the NRC is currently in the process of providing generic approval of ASME Code Case N-640 by including it in Revision 13 of Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI, Division 1 [Reference: Draft Regulatory Guide DG-1091 (66 FR 67335, 12/28/01)].

Based on the technical basis provided in "Technical Basis for Revised P-T Limit Curve Methodology," by W. H. Bamford (Westinghouse Electric), S. N. Malik (NRC), et. al., and continued compliance with 10 CFR 50, Appendices G and H, NMPNS has concluded that the proposed P-T limit curves and tables maintain an adequate margin of safety for brittle fracture.

4.2 Fluence Calculations

GDC 31 and 10 CFR 50, Appendix G, require the prediction of the effects of neutron irradiation on vessel embrittlement. In accordance with Generic Letter 88-11, the NRC requires the methods described in Regulatory Guide 1.99, Revision 2, to be used to predict these effects. The Regulatory Guide requires the ART to be calculated to account for the effects of neutron embrittlement. One of the key components used in the calculations of the ART is RPV neutron fluence.

Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," provides guidance for the calculation of RPV neutron fluence. The neutron fluence values calculated using the methodology described in Regulatory Guide 1.190 satisfy the requirements of 10 CFR 50, Appendix G, and Regulatory Guide 1.99, Revision 2. Accordingly, ART values calculated using these neutron fluence values would also satisfy 10 CFR 50, Appendix G, and Regulatory Guide 1.99, Revision 2, and thereby satisfy Generic Letter 88-11.

The current P-T limit curves and tables were developed in 1998 following the 1997 withdrawal and testing of the 210 degree surveillance capsule. The calculations supporting the current P-T limit curves and tables utilized RPV neutron fluence values calculated consistent with the methodology of Draft Regulatory Guide DG-1053, which was a previous draft for Regulatory Guide 1.190 and the latest guidance available at the time.

The current P-T limit curves and tables were approved by the NRC on November 25, 1998 and issued as Amendment No. 164 [Reference: TAC No. MA1413] to the NMP1 TSs. The current P-T limits are valid for up to 28 EFPY and satisfy Generic Letter 88-11 since the method used to calculate the ART is consistent with Regulatory Guide 1.99, Revision 2. Accordingly, the current P-T limit curves and tables and supporting RPV neutron fluence values satisfy the requirements of 10 CFR 50, Appendix G.

The RPV neutron fluence values used for the proposed (new) P-T limit curves and tables are unchanged from those previously calculated for the current P-T limit curves and tables. The ART for the limiting beltline material (Plate G-307-4/5) at 28 EFPY is unchanged and remains less than the 200° F limit required by Regulatory Guide 1.99, Revision 2.

As discussed above, the RPV neutron fluence values for NMP1 were calculated consistent with Draft Regulatory Guide DG-1053, which was a draft for Regulatory Guide 1.190, and the most recent guidance for neutron fluence calculations available in 1998. Subsequently, in March 2001, the NRC issued Regulatory Guide 1.190. As a result, the RPV neutron fluence values for NMP1 (previously calculated consistent with DG-1053) were verified to be consistent with the requirements and methodology of Regulatory Guide 1.190. The Regulatory Position 1.4 uncertainty analyses and comparisons with benchmark measurements and calculational benchmark problems (as provided in NUREG/CR-6115) have been completed and the Position 1.4 methodology qualification and uncertainty estimates have been satisfied. A summary of the results of the uncertainty analyses and benchmarking comparisons follows:

1. The Oak Ridge National Laboratory (ORNL) Pool Critical Assembly (PCA) pressure vessel simulator benchmark was used due to its high-accuracy measurement results extending from inside a simulated thermal shield through to the outside of a simulated vessel. The calculational results in the PCA show a slight consistent bias (less than 10%) with respect to the measurements, but no significant change in bias was observed with change in irradiation position. This indicates that the transport methodology is calculating the flux attenuation outside the core region with high accuracy. The observed bias is consistent with that obtained by other synthesis calculations.

2. The calculational benchmark was a typical BWR geometry similar to those for NMP1 and Nine Mile Point Unit 2 (NMP2). Comparisons were made between the results obtained using the calculational methodology for NMP1 [Reference: Letter No. NMP1L 1373, dated 10/22/98] and the results obtained from the calculational benchmark (NUREG/CR-6115). The results of these comparisons showed very good agreement. In the representative RPV surveillance capsule (located at 3° azimuth), the average results were approximately 3% low. Within the RPV, the average results were approximately 2 to 3% high at the vessel inner radius (IR). All compared results were within ±10%.

3. Additional comparisons were made with surveillance capsule measurements in NMP1 and NMP2, and with the core shroud measurements in NMP1 [Reference: Letter No. NMP1L 1373, dated 10/22/98]. In all cases, agreement with measured results within the uncertainty was obtained. The uncertainties were shown to be less than ±20%, which meets the criterion set forth in Regulatory Guide 1.190 for acceptability of the calculations.

Based on the acceptable results of the verifications and benchmarking comparisons of the RPV neutron fluence values and calculational methodology, NMPNS has concluded that the neutron fluence values calculated for the proposed P-T limit curves and tables are consistent with the requirements of Regulatory Guide 1.190. Accordingly, the ART value calculated using these neutron fluence values satisfy 10 CFR 50, Appendix G, and Regulatory Guide 1.99, Revision 2, and thereby satisfy Generic Letter 88-11.

4.3 Conclusion

NRC regulations require that P-T limit curves provide an adequate margin of safety to the conditions at which brittle fracture may occur. These requirements are set forth in GDC 31 and 10 CFR 50, Appendices G and H. Generic Letter 88-11 and Regulatory Guides 1.99 and 1.190 provide guidance for compliance with the requirements of GDC 31 and Appendices G and H. The Appendices reference the requirements and guidance of Section XI, Appendix G, of the ASME B&PV Code for the development of P-T limit curves. The methodologies described in Regulatory Guides 1.99 and 1.190 and the

ASME Code will provide P-T limit curves with the requisite margin against brittle fracture. The proposed P-T limit curves and associated P-T limit tables are consistent with these methodologies, as modified by application of ASME Code Case N-640. The proposed change to Specification 3.2.2.c is a conformance change which serves only to update the requirements to reflect the proposed changes to the P-T limit curves and tables.

ASME Code Case N-640 proposes an alternative to a requirement contained in Section XI, Appendix G, of the ASME B&PV Code. The alternate fracture toughness for RPV materials permitted by the Code Case is based on the additional knowledge gained since the inception of 10 CFR 50, Appendix G. The more appropriate assumptions and provisions allowed by the Code Case maintain a margin of safety that is consistent with the intent of 10 CFR 50, Appendices G and H.

The NRC has granted similar exemptions and approved the associated TS changes for a number of other Boiling Water Reactor (BWR) plants, including: Pilgrim (ADAMS Accession Numbers ML010720448 and ML010790519), Brunswick Units 1 and 2 (ADAMS Accession Numbers ML012760157 and ML012780286), and Susquehanna Units 1 and 2 (ADAMS Accession Numbers ML013520568 and ML013520605).

The comparisons of the RPV neutron fluence values and calculational methodology for NMP1 with the Regulatory Guide 1.190 Position 1.4 methodology and uncertainty estimates are anticipated to require supplemental review by the NRC staff. This review is considered to be independent of the proposed application of the ASME B&PV N-640 Code Case and associated changes to the TS P-T limit curves and tables. However, in order to assist in the NRC staff's review, NMPNS will submit to the NRC the report documenting the results of the benchmark measurements and calculations applicable to the methods used for NMP1 by January 15, 2003. Pending approval of the submittal, NMP1 is prepared to accept, if required, an application period restriction for the proposed P-T limit curves and tables similar to that recently imposed on other facilities requesting application of the ASME N-640 Code Case. It is requested that the application period for the proposed P-T limit curves and tables allow plant operation through the remainder of the current operating cycle (Cycle 15) and also through the next operating cycle (Cycle 16). The estimated EFPY at the end of Cycle 16 is 23.38, which assures that the P-T limits will remain conservatively defined since the proposed P-T limit curves and tables are based on neutron fluence values that are currently accepted for 28 EFPY.

5.0 REGULATORY SAFETY ANALYSIS

5.1 No Significant Hazards Consideration Analysis

The proposed changes to the Technical Specifications (TSs) would replace the current Reactor Coolant System (RCS) Pressure-Temperature (P-T) limit curves and associated tables with revised curves and tables that are based, in part, on the alternate methodology of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel

(B&PV) Code Case N-640. The TS Bases have been revised to reflect the proposed changes to the TSs.

Nine Mile Point Nuclear Station, LLC, (NMPNS) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed changes do not involve physical changes to the plant or alter the RCS pressure boundary (i.e., there are no changes in operating pressure, materials, or seismic loading). The proposed P-T limit curves and tables and supporting changes provide continued assurance that the fracture toughness of the Reactor Pressure Vessel (RPV) is consistent with analysis assumptions and NRC regulations. The proposed P-T curves and tables were developed in accordance with the fracture toughness requirements of 10 CFR 50, Appendix G, and ASME B&PV Code, Section XI, Appendix G, as modified by the alternate criteria and methods of ASME B&PV Code Case N-640. The more appropriate assumptions and provisions allowed by the Code Case maintain sufficient margins of safety to assure that, when stressed, the RPV boundary will behave in a non-brittle manner. Use of this methodology provides assurance that the probability of a rapidly propagating fracture will be minimized. The proposed P-T limit curves and tables and supporting changes will prohibit operation in regions where it is possible for brittle fracture of reactor vessel materials to occur, thereby assuring that the integrity of the RCS pressure boundary is maintained. Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed P-T limit curves and tables and supporting changes do not affect the design or assumed accident performance of any structure, system, or component, or introduce any new modes of system operation or failure modes. Compliance with the proposed P-T curves and tables and supporting requirements will provide sufficient protection against brittle fracture of reactor vessel materials to assure that the RCS pressure boundary performs as previously evaluated. Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No.

NRC regulations require that P-T limit curves provide an adequate margin of safety to the conditions at which brittle fracture may occur. These requirements are set forth in 10 CFR 50, Appendix A, General Design Criterion (GDC) 31 and 10 CFR 50, Appendices G and H. Generic Letter 88-11 and Regulatory Guides 1.99 and 1.190 provide guidance for compliance with the requirements of GDC 31 and Appendices G and H. The Appendices reference the requirements and guidance of Section XI, Appendix G, of the ASME B&PV Code for the development of P-T limit curves. The methodologies described in Regulatory Guides 1.99 and 1.190 and the ASME Code will provide P-T limit curves with the requisite margin against brittle fracture. The proposed P-T limit curves and associated P-T limit tables are consistent with these methodologies, as modified by the application of ASME Code Case N-640.

ASME Code Case N-640 proposes an alternative to a requirement contained in Section XI, Appendix G, of the ASME B&PV Code. The alternate fracture toughness for RPV materials permitted by the Code Case is based on the additional knowledge gained since the inception of 10 CFR 50, Appendix G. The more appropriate assumptions and provisions allowed by the Code Case maintain a margin of safety that is consistent with the intent of 10 CFR 50, Appendices G and H. The proposed P-T limit curves and tables and supporting requirements provide assurance that the established P-T limits are not exceeded. Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Based on the above, NMPNS concludes that the proposed amendment presents no significant hazards considerations under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

The proposed P-T limit curves and associated tables are consistent with the alternate assessment criteria and methods of ASME B&PV Code Case N-640, and satisfy the requirements of GDC 31; 10 CFR 50.60; 10 CFR 50, Appendix G; and the 1989 Edition of ASME B&PV Code, Section XI, Appendix G, as modified by the Code Case. The proposed P-T limit curves and tables also satisfy Generic Letter 88-11 by using methods consistent with Regulatory Guide 1.99, Revision 2, and Regulatory Guide 1.109.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.3 Commitments

The following table identifies those actions committed to by NMPNS in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

REGULATORY COMMITMENTS	Due Date/Event
NMPNS will submit to the NRC the report documenting the results of the RPV neutron fluence benchmark measurements and calculations applicable to the methods used for NMP1.	To be submitted by January 15, 2003

6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

ATTACHMENT 2

PROPOSED TECHNICAL SPECIFICATION CHANGES (MARK-UP)

The current versions of Technical Specification pages 84 through 94d have been marked-up by hand to reflect the proposed changes.

LIMITING CONDITION FOR OPERATION

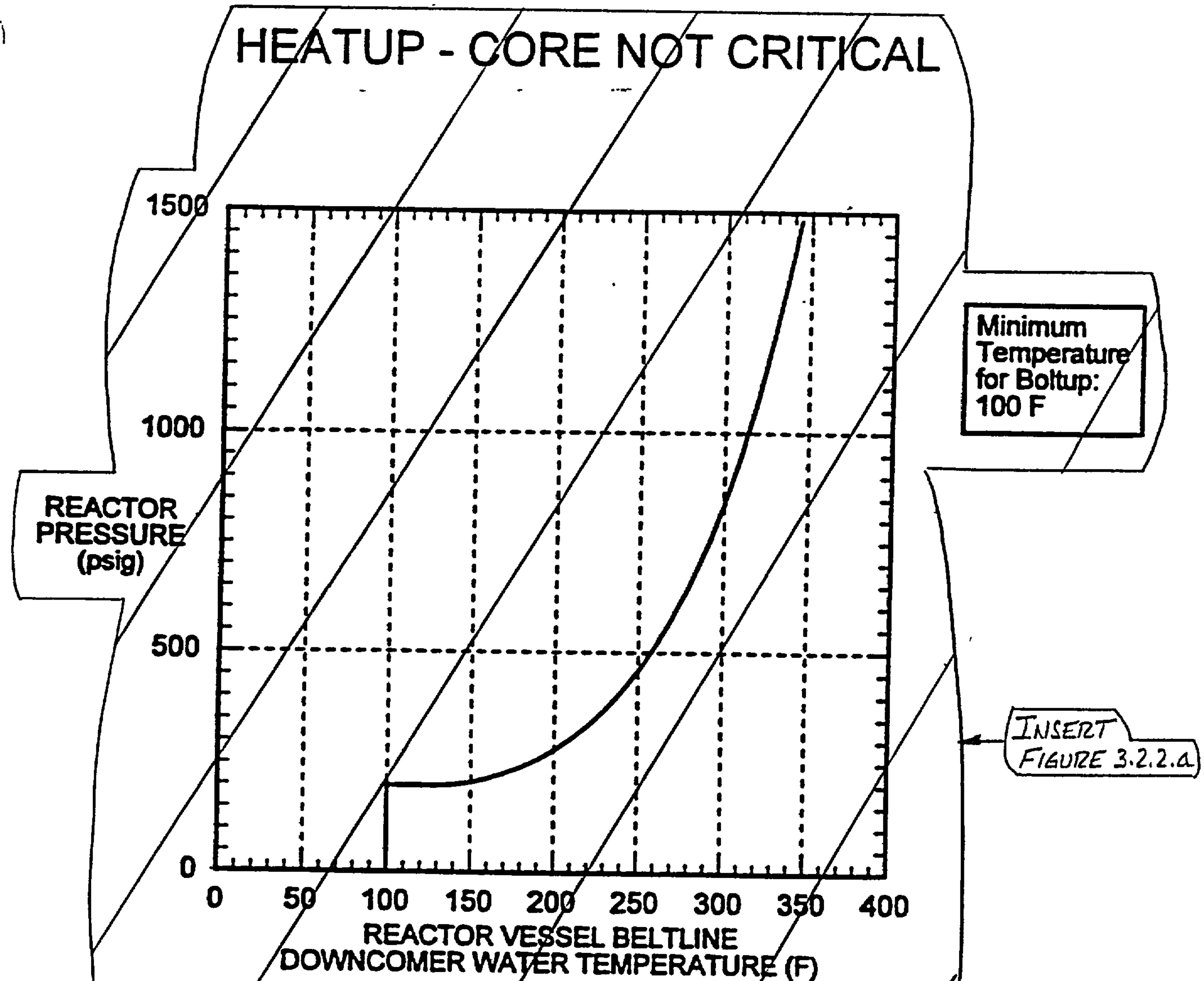
c. During leakage and hydrostatic testing, the reactor vessel temperature and pressure shall satisfy the requirements of Figures 3.2.2.e, 3.2.2.f, or 3.2.2.g, as appropriate, if the core is not critical. During reactor vessel heatup and cooldown for the purpose of leakage and hydrostatic testing, the reactor vessel temperature and pressure shall satisfy the requirements of Figures 3.2.2.a and 3.2.2.b for non-critical heatup and cooldown, respectively.

d. The reactor vessel head bolting studs shall not be under tension unless the temperature of the vessel head flange and the head are equal to or greater than 100°F.

SURVEILLANCE REQUIREMENT

In order to generate additional plant-specific data, a capsule containing irradiated and unirradiated material will be re-inserted at the B capsule location. Re-insertion capsules have already been installed at the A and C locations. A prime (') is used to indicate a re-insertion capsule. The withdrawal schedule for the re-insertion capsules is as follows:

Fourth capsule (A') - 24 EFPY
Fifth capsule (C') - 32 EFPY
Sixth capsule (B') - 40 EFPY



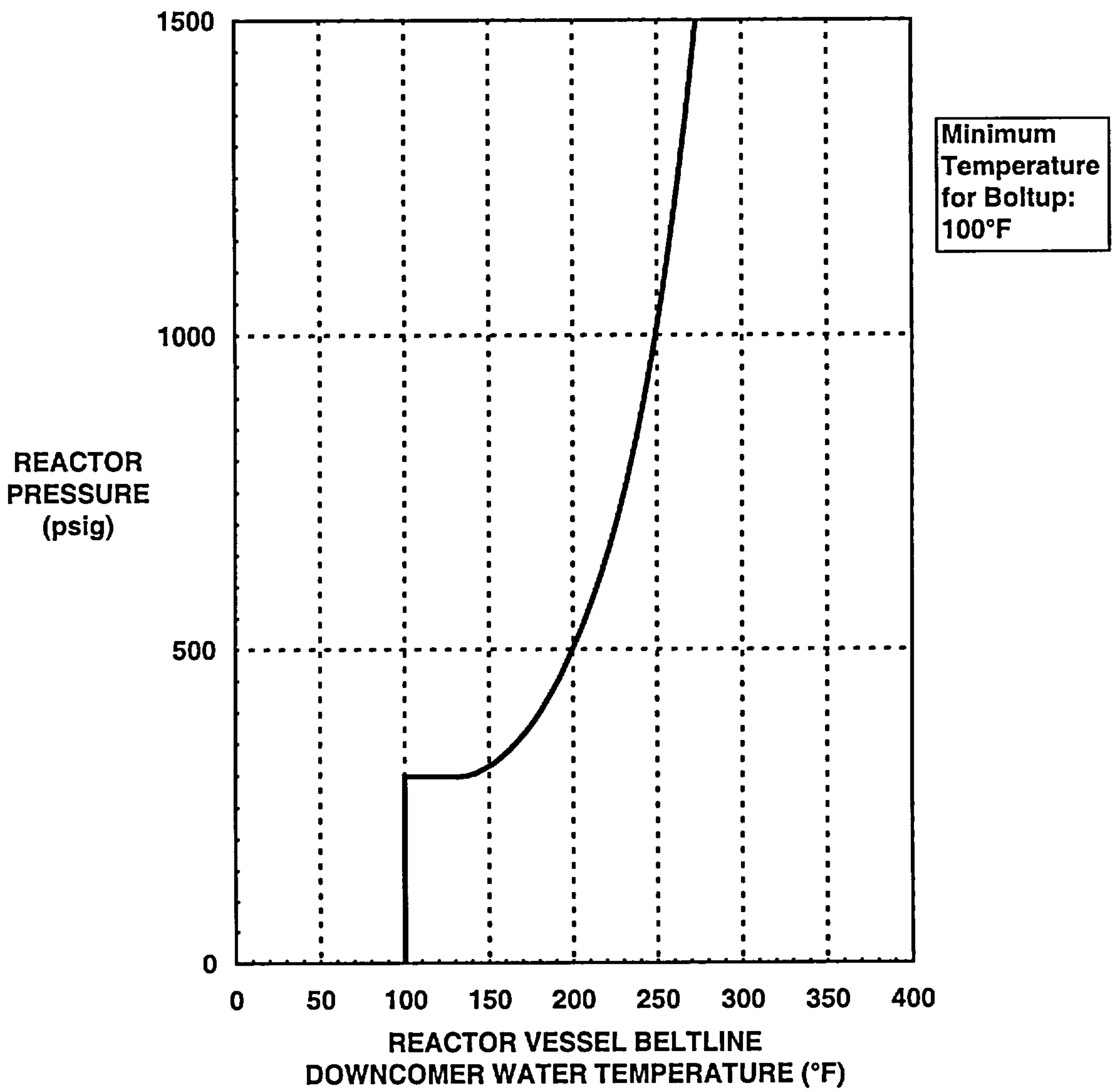
(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.a

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING HEATUP AND LOW-POWER PHYSICS TESTS (CORE NOT CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

INSERT FIGURE 3.2.2.a

HEATUP - CORE NOT CRITICAL



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.a

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING HEATUP AND LOW-POWER PHYSICS TESTS (CORE NOT CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR NON-CRITICAL OPERATION
HEATUP AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
197	100
197	110
197	120
197	130
199	140
205	150
213	160
225	170
239	180
257	190
279	200
304	210
334	220
369	230
410	240
458	250
513	260
577	270
651	280
737	290
835	300
949	310
1079	320

INSERT TABLE 3.2.2.a

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.a

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING HEAT-UP (CORE NOT CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO TWENTY EIGHT EFFECTIVE FULL POWER YEARS OF CORE OPERATION

INSERT TABLE 3.2.2.a

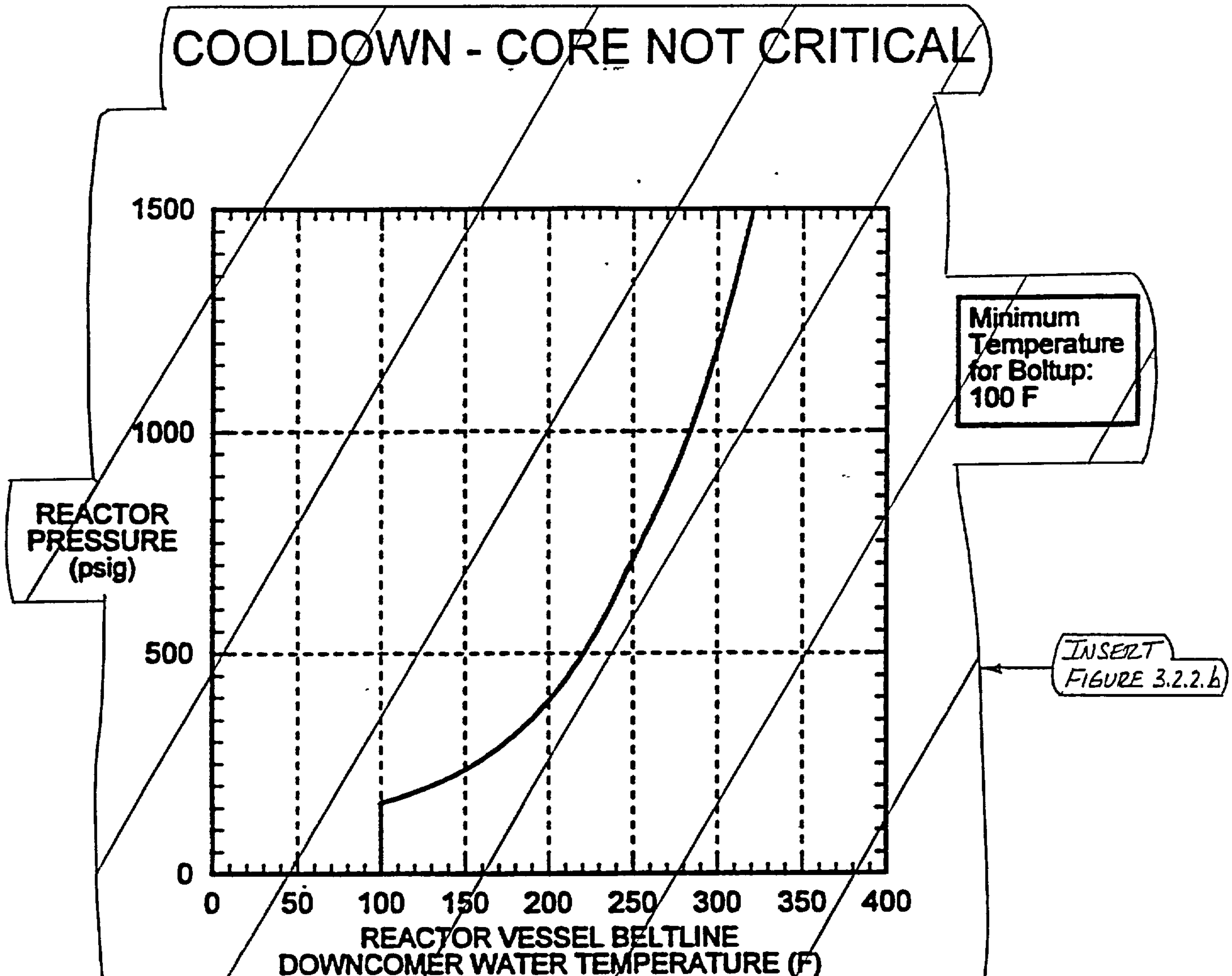
LIMIT FOR NON-CRITICAL OPERATION
HEATUP AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
298	100
298	102
298	107
298	112
298	117
298	122
298	127
298	132
300	137
304	142
311	147
319	152
329	157
340	162
354	167
369	172
387	177
406	182
406	182
429	187
454	192
483	197
515	202
547	207
582	212
622	217
665	222
713	227
767	232
840	238
840	238
895	242
969	247
1050	252
1140	257

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.a

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING HEAT-UP (CORE NOT CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF CORE OPERATION

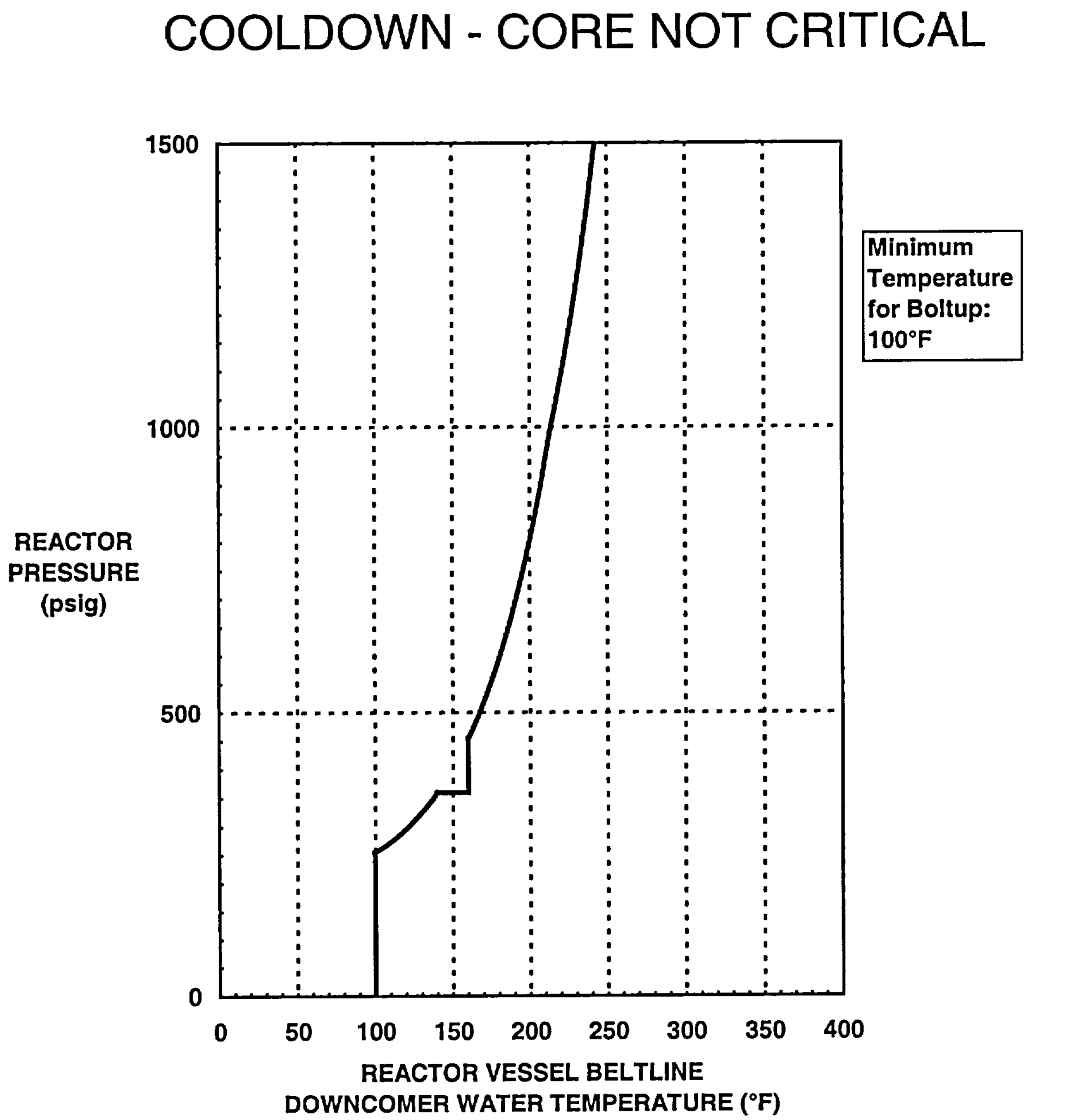


(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.b

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN AND LOW-POWER PHYSICS TESTS (CORE NOT CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

INSERT FIGURE 3.2.2.b



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.b

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN AND LOW-POWER PHYSICS TESTS (CORE NOT CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR NON-CRITICAL OPERATION
COOLDOWN AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
160	100
171	110
184	120
199	130
216	140
235	150
258	160
284	170
315	180
350	190
391	200
438	210
493	220
556	230
630	240
708	250
786	260
866	270
957	280
1062	290

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

INSERT TABLE 3.2.2.b

TABLE 3.2.2.b

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN (CORE NOT CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO TWENTY EIGHT EFFECTIVE FULL POWER YEARS OF CORE OPERATION

INSERT TABLE 3.2.2.b

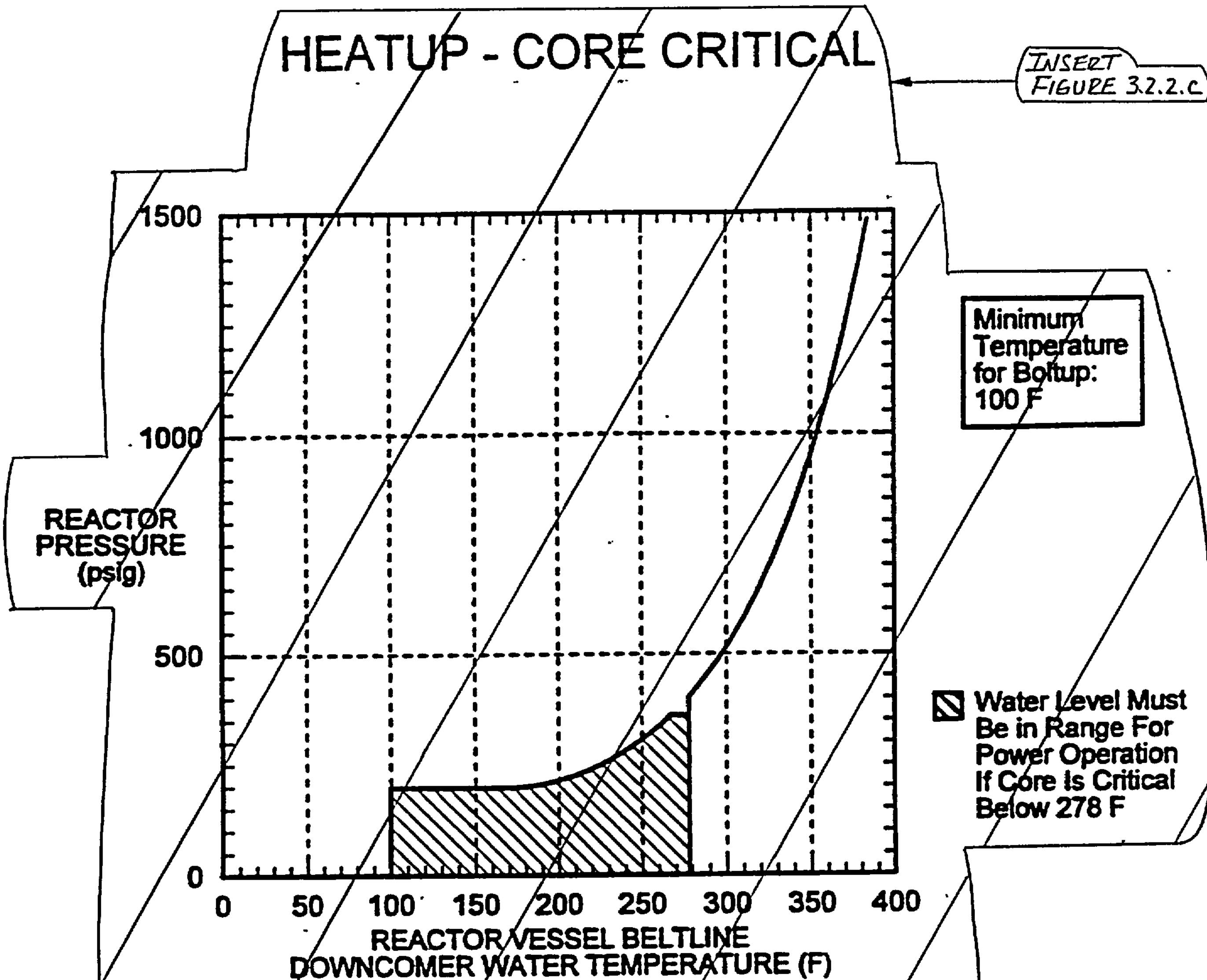
LIMIT FOR NON-CRITICAL OPERATION
COOLDOWN AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
205	100
209	100
213	100
218	100
223	100
229	100
235	100
242	100
250	100
254	100
258	102
268	107
278	112
290	117
302	122
316	127
332	132
349	137
360	140
360	160
455	160
471	163
471	163
498	167
532	172
570	177
613	182
659	187
701	192
737	197
777	202
820	207
869	212
922	217
982	222
1047	227
1119	232

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.b

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING
COOLDOWN (CORE NOT CRITICAL) (COOLING RATE ≤ 100°F/HR)
FOR UP TO 28 EFFECTIVE FULL POWER YEARS
OF CORE OPERATION



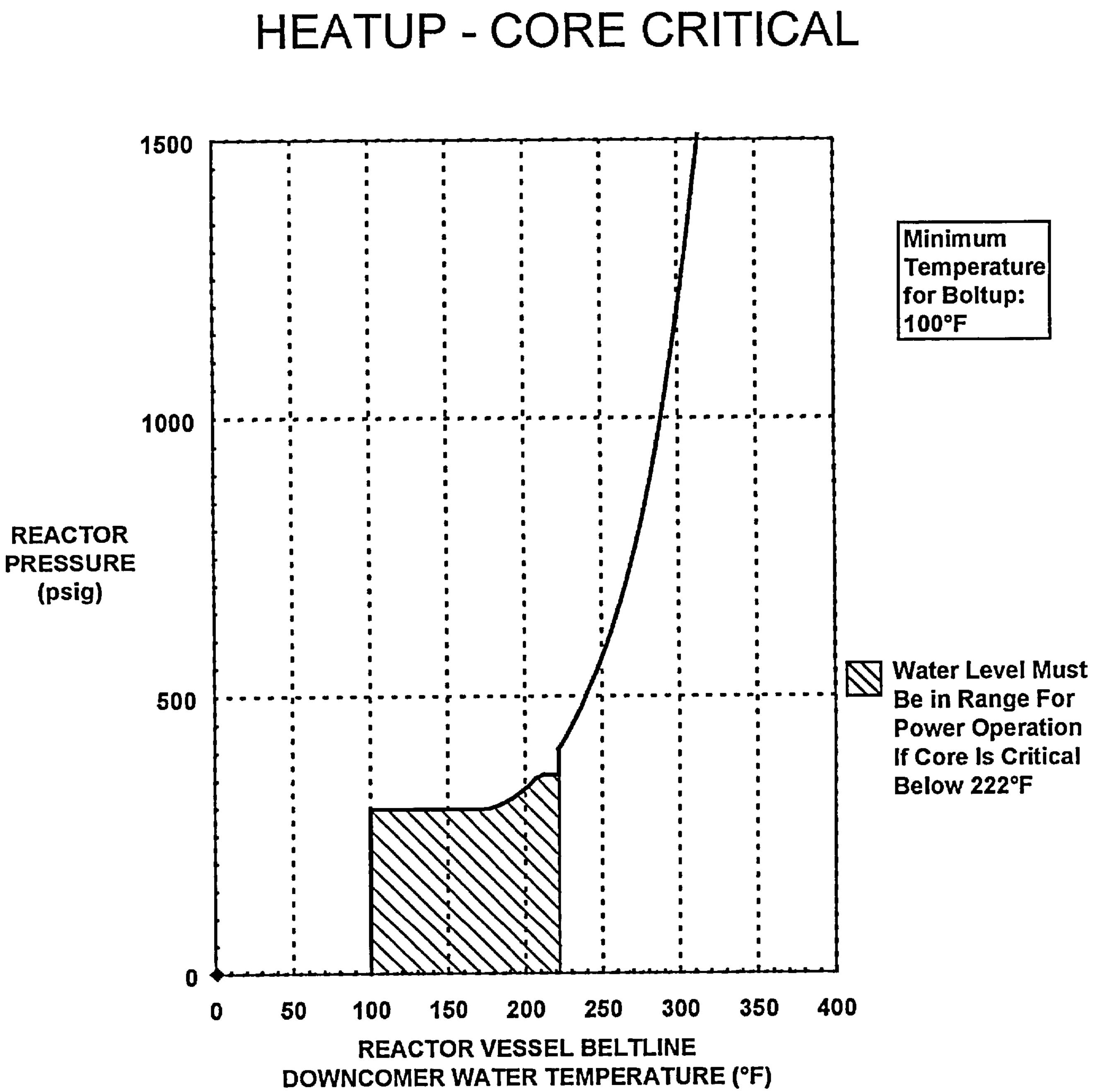
INSERT FIGURE 3.2.2.c

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.c

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING CORE OPERATION (CORE CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

INSERT FIGURE 3.2.2.c



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.c

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING CORE OPERATION (CORE CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR POWER OPERATION (CORE CRITICAL) HEATUP AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
197	100
197	110
197	120
197	130
197	140
197	150
197	160
197	170
199	180
205	190
213	200
225	210
239	220
257	230
279	240
304	250
334	260
360	268
360	270
360	277
402	278*
410	280
458	290
513	300
577	310
651	320
737	330
835	340
949	350
1079	360

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(*water level must be in range for power operation if core is critical below 278 F)
(instrument uncertainties have been included in this table)

INSERT TABLE 3.2.2.C

TABLE 3.2.2.c

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING HEATUP (CORE CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO TWENTY EIGHT EFFECTIVE FULL POWER YEARS OF CORE OPERATION

INSERT TABLE 3.2.2.c

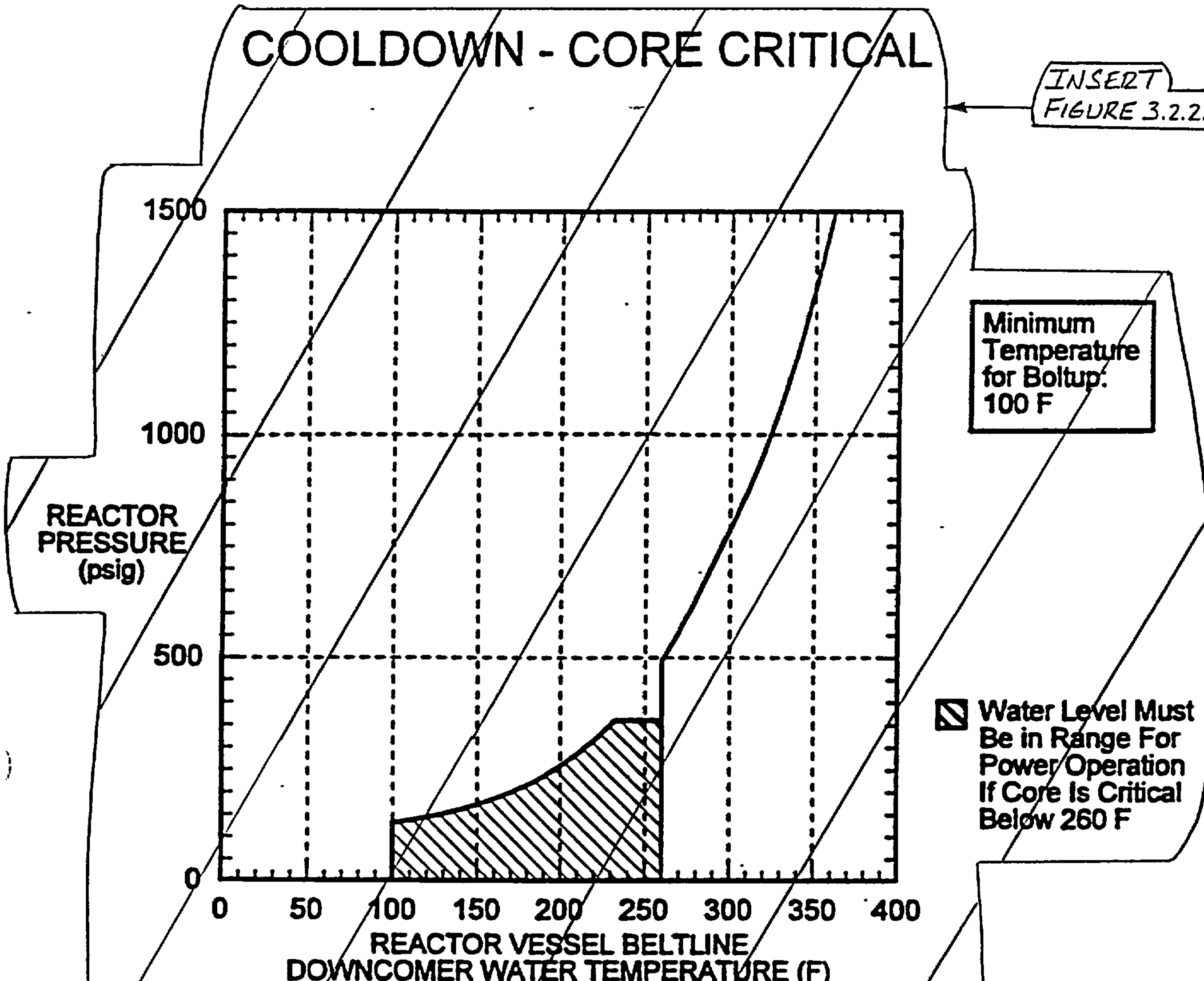
LIMIT FOR POWER OPERATION (CORE CRITICAL)
HEATUP AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
298	100
298	172
300	177
304	182
311	187
319	192
329	197
340	202
354	207
360	212
360	217
360	222 [a]
406	222 [a]
429	227
454	232
483	237
515	242
547	247
582	252
622	257
665	262
713	267
767	272
840	278
840	278
895	282
969	287
1050	292
1140	297

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
([a]water level must be in range for power operation if core is critical below 222°F)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.c

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING
HEATUP (CORE CRITICAL) (HEATING RATE ≤ 100°F/HR)
FOR UP TO 28 EFFECTIVE FULL POWER YEARS
OF CORE OPERATION



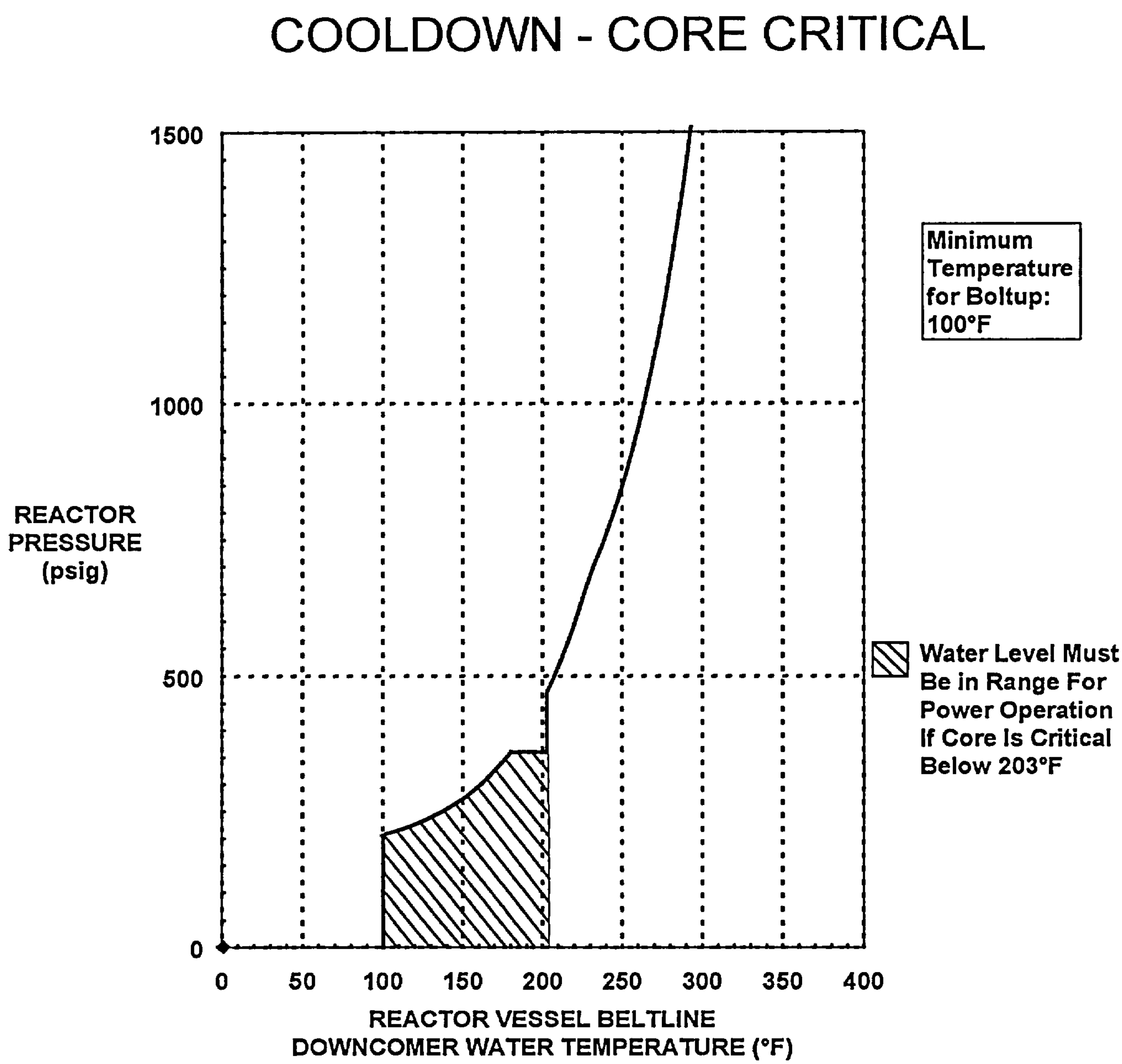
INSERT FIGURE 3.2.2.d

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.d

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING CORE OPERATION (CORE CRITICAL) (COOLING RATE ≤100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

INSERT FIGURE 3.2.2.d



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.d

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING CORE OPERATION (CORE CRITICAL) (COOLING RATE ≤100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR POWER OPERATION (CORE CRITICAL) COOLDOWN AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
130	100
136	110
143	120
151	130
160	140
171	150
184	160
199	170
216	180
235	190
258	200
284	210
315	220
350	230
360	233
360	240
360	250
360	259
493	260[a]
556	270
630	280
708	290
786	300
866	310
957	320
1062	330

INSERT TABLE 3.2.2.d

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
([a]water level must be in range for power operation if core is critical below 260 F)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.d

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN (CORE CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO TWENTY EIGHT EFFECTIVE FULL POWER YEARS OF CORE OPERATION

INSERT TABLE 3.2.2.d

LIMIT FOR POWER OPERATION (CORE CRITICAL)
COOLING AT UP TO 100°F/HR

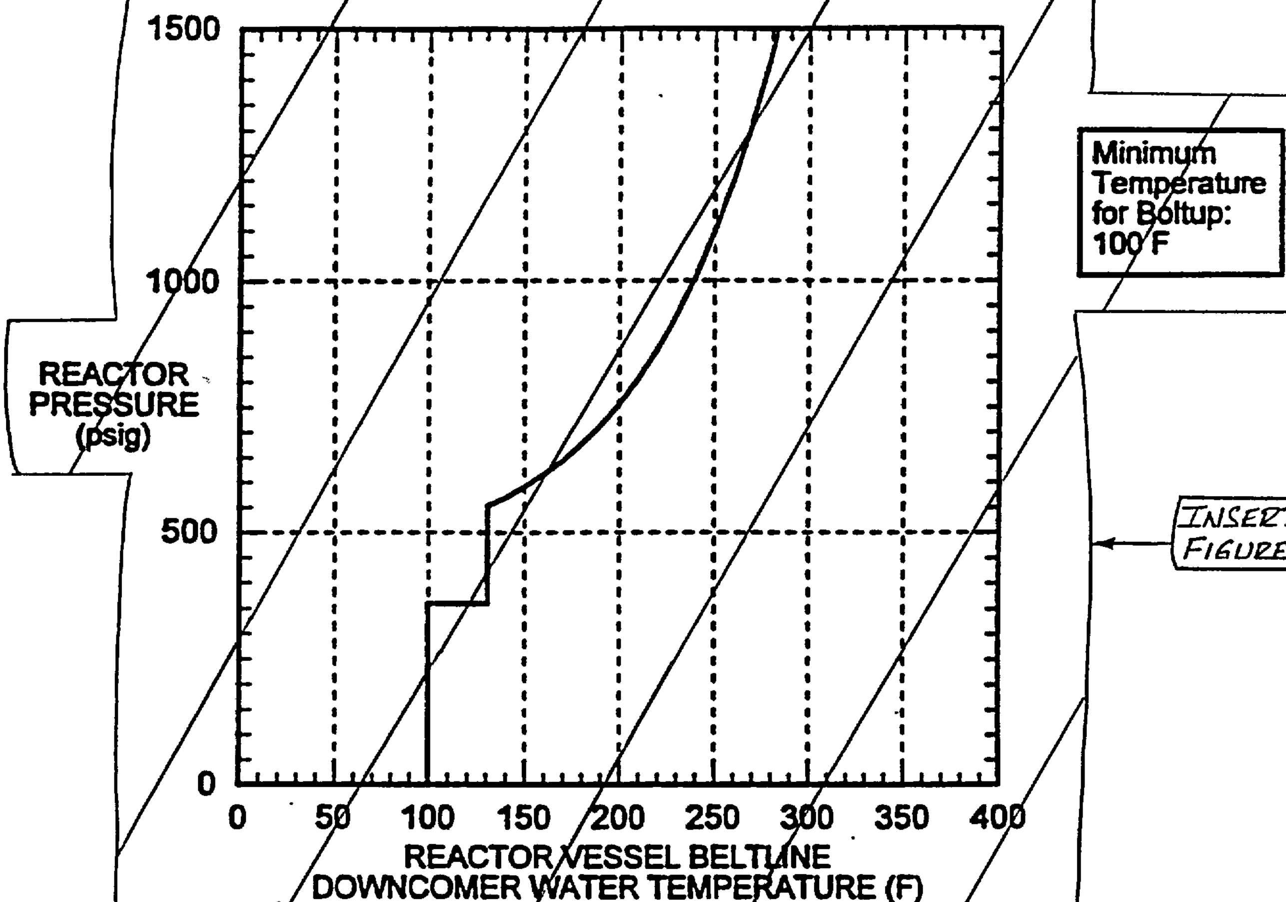
REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
205	100
209	102
213	107
218	112
223	117
229	122
235	127
242	132
250	137
254	140
258	142
268	147
278	152
290	157
302	162
316	167
332	172
349	177
360	180
360	200
360	203 [a]
471	203 [a]
498	207
532	212
570	217
613	222
659	227
701	232
737	237
777	242
820	247
869	252
922	257
982	262
1047	267
1119	272
1199	277

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
([a]water level must be in range for power operation if core is critical below 203°F)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.d

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING
COOLDOWN (CORE CRITICAL) (COOLING RATE ≤ 100°F/HR)
FOR UP TO 28 EFFECTIVE FULL POWER YEARS
OF CORE OPERATION

LEAK/HYDRO TEST - CORE NOT CRITICAL



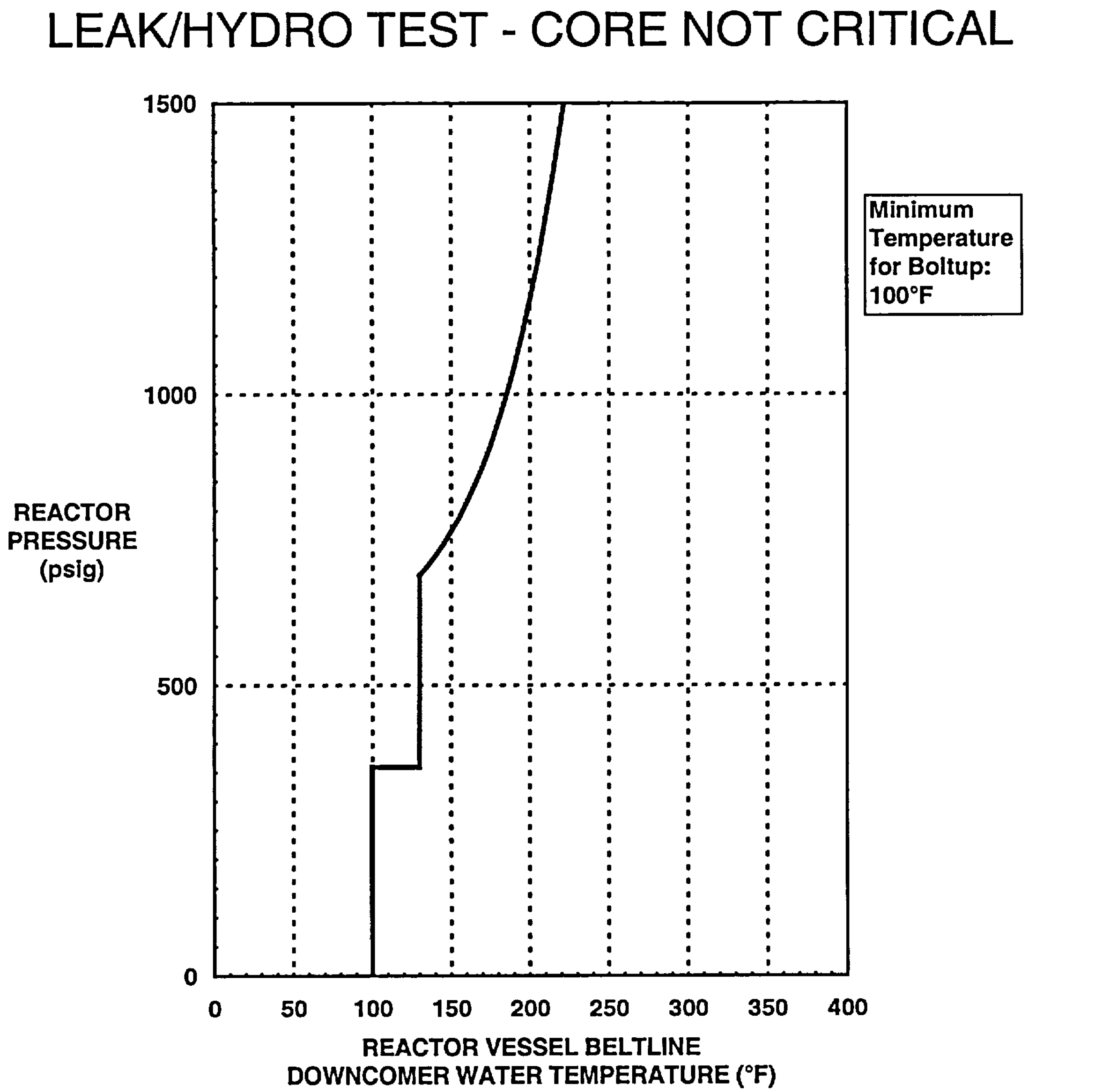
INSERT FIGURE 3.2.2.e

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.e

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING IN-SERVICE HYDROSTATIC TESTING AND LEAK TESTING (CORE NOT CRITICAL) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

INSERT FIGURE 3.2.2.e



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.e

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING IN-SERVICE HYDROSTATIC TESTING AND LEAK TESTING (CORE NOT CRITICAL) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR IN-SERVICE TEST
(CORE NOT CRITICAL, FUEL IN VESSEL)

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
360	100
360	110
360	120
360	130
569	140
590	150
614	160
642	170
675	180
712	190
755	200
805	210
862	220
929	230
1005	240
1032	243
1093	250
1195	260

INSERT TABLE 3.2.2.e

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.e

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING LEAK/HYDROSTATIC TESTING (CORE NOT CRITICAL) FOR UP TO TWENTY EIGHT EFFECTIVE FULL POWER YEARS OF CORE OPERATION

INSERT TABLE 3.2.2.e

LIMIT FOR IN-SERVICE TEST
(CORE NOT CRITICAL, FUEL IN VESSEL)

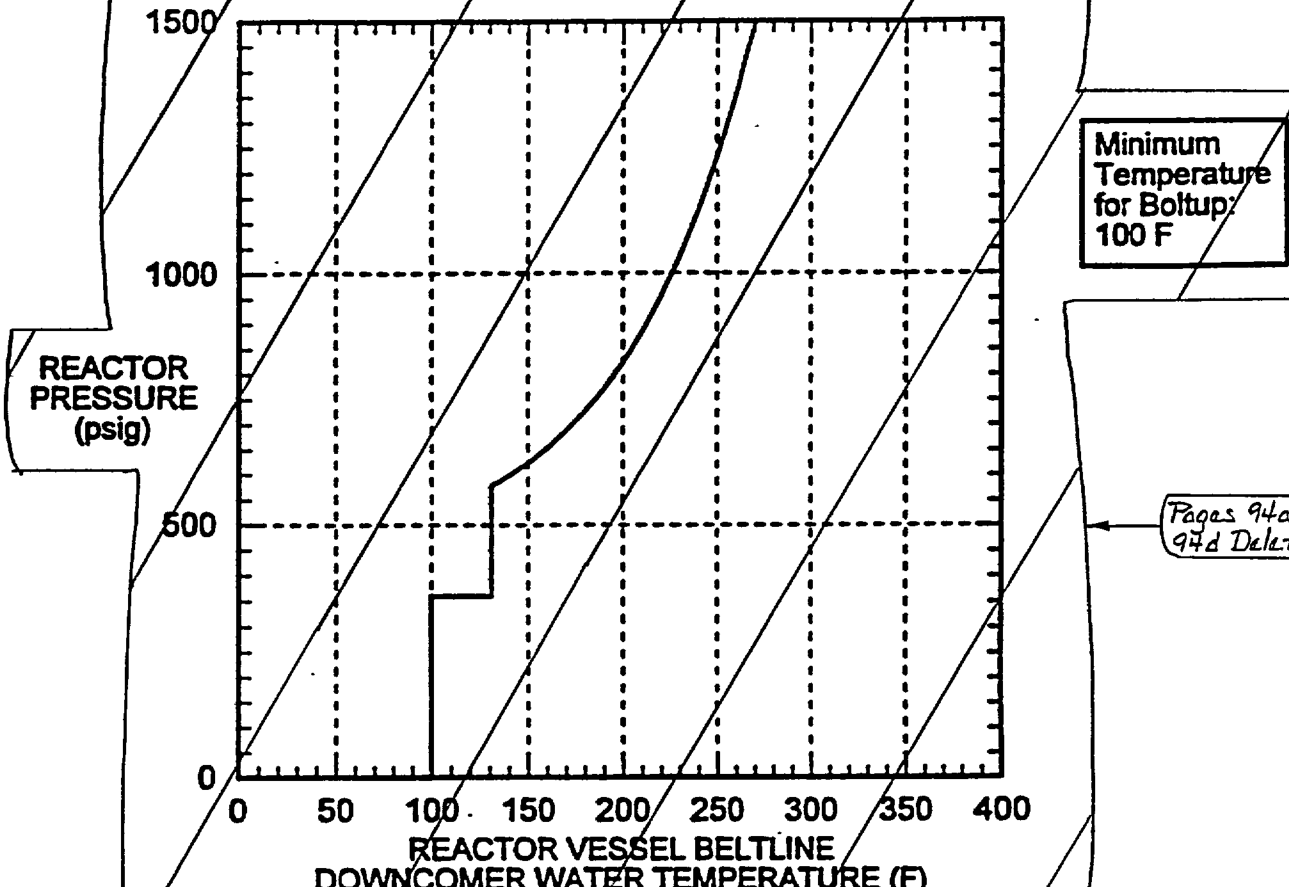
REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
360	100
360	130
688	130
704	135
722	140
742	145
764	150
788	155
815	160
844	165
877	170
913	175
953	180
997	185
1046	190
1100	195
1160	200

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.e

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING
LEAK/HYDROSTATIC TESTING (CORE NOT CRITICAL)
FOR UP TO 28 EFFECTIVE FULL POWER YEARS
OF CORE OPERATION

LEAK/HYDRO TEST - CORE NOT CRITICAL



Pages 94a Through 94d Deleted

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.f

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING IN-SERVICE HYDROSTATIC TESTING AND LEAK TESTING (CORE NOT CRITICAL) FOR UP TO 20 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR IN-SERVICE TEST
(CORE NOT CRITICAL, FUEL IN VESSEL)

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
360	100
360	110
360	120
360	130
597	140
622	150
652	160
685	170
724	180
769	190
821	200
881	210
951	220
1031	230
1123	240
1229	250

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(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.f

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING LEAK/HYDROSTATIC TESTING (CORE NOT CRITICAL) FOR UP TO TWENTY EFFECTIVE FULL POWER YEARS OF CORE OPERATION

LEAK/HYDRO TEST - CORE NOT CRITICAL

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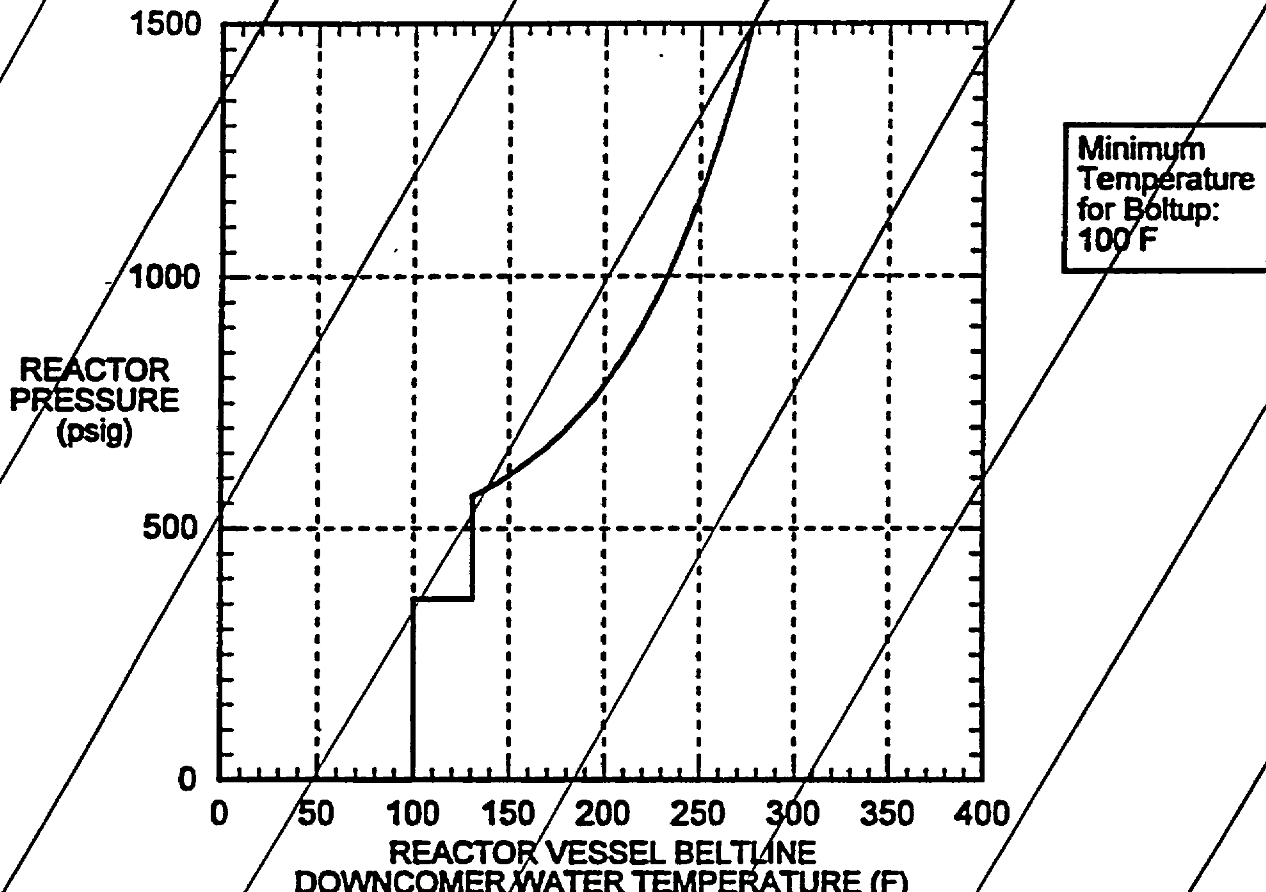

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.g

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING IN-SERVICE HYDROSTATIC TESTING AND LEAK TESTING (CORE NOT CRITICAL) FOR UP TO 24 EFFECTIVE FULL POWER YEARS OF OPERATION

LIMIT FOR IN-SERVICE TEST
(CORE NOT CRITICAL, FUEL IN VESSEL)

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (F)
360	100
360	110
360	120
360	130
582	140
604	150
631	160
661	170
697	180
737	190
785	200
839	210
902	220
974	230
1033	237
1058	240
1154	250

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(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.g

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING LEAK/HYDROSTATIC TESTING (CORE NOT CRITICAL) FOR UP TO TWENTY FOUR EFFECTIVE FULL POWER YEARS OF CORE OPERATION

ATTACHMENT 3

CHANGES TO TECHNICAL SPECIFICATION BASES PAGES

(FOR INFORMATION ONLY)

The current version of Technical Specification Bases page 95 has been marked-up by hand to reflect the proposed changes. These Bases pages are provided for information only and do not require NRC issuance.

BASES FOR 3.2.2 AND 4.2.2 MINIMUM REACTOR VESSEL TEMPERATURE FOR PRESSURIZATION

Figures 3.2.2.a, 3.2.2.b, 3.2.2.c, and 3.2.2.d are plots of pressure versus temperature for heatup and cooldown rates of up to 100°F/hr. maximum (Specification 3.2.1). Figures 3.2.2.e, 3.2.2.f, and 3.2.2.g are plots of pressure versus temperature for leakage and hydrostatic testing. When the minimum temperature for leakage and hydrostatic testing is reached, a thermal soak shall be performed to ensure that the thermal gradient across the vessel wall is negligible. These curves are based on calculations of stress intensity factors according to Appendix G of Section III of the ASME Boiler and Pressure Vessel Code 1980 Edition with Winter 1982 Addenda. In addition, temperature shifts due to fast neutron fluence at twenty-eight effective full power years of operation were incorporated into the figures. These shifts were calculated using the procedure presented in Regulatory Guide 1.99, Revision 2. Reactor vessel flange/reactor head flange boltup is governed by other criteria as stated in Specification 3.2.2.d. The pressure readings on the figures have been adjusted to account for instrument uncertainties and to reflect the calculated elevation head difference between the pressure sensing instrument locations and the pressure sensitive area of the core beltline region. The temperature readings on the figures have been adjusted to account for instrument uncertainties.

The reactor vessel head flange and vessel flange in combination with the double "O" ring type seal are designed to provide a leak-tight seal when bolted together. When the vessel head is placed on the reactor vessel, only that portion of the head flange near the inside of the vessel rests on the vessel flange. As the head bolts are replaced and tensioned, the vessel head is flexed slightly to bring together the entire contact surfaces adjacent to the "O" rings of the head and vessel flanges. Both the head and vessel flanges have an NDT temperature of 40°F and they are not subject to any appreciable neutron radiation exposure. Therefore, the minimum vessel flange and head flange temperature for bolting is established at 40°F + 60°F or 100°F.

Figures 3.2.2.a, 3.2.2.b, 3.2.2.c, 3.2.2.d, (and) 3.2.2.e, 3.2.2.f and 3.2.2.g have incorporated a temperature shift due to the calculated fast neutron fluence. The neutron flux at the vessel wall is calculated from core physics data and has been determined using flux monitors installed inside the vessel. The curves, except for 3.2.2.f and 3.2.2.g, are applicable for up to twenty-eight effective full power years of operation. Curves 3.2.2.f and 3.2.2.g are applicable for up to twenty and twenty-four effective full power years, respectively.

Vessel material surveillance samples are located within the core region to permit periodic monitoring of exposure and changes in material properties. The material sample program conforms with ASTM E185-66 except for the material withdrawal schedule which is specified in Specification 4.2.2.b.

ATTACHMENT 4

EXEMPTION REQUEST

The Reactor Coolant System (RCS) Pressure-Temperature (P-T) limits proposed by Nine Mile Point Nuclear Station, LLC, (NMPNS) for Nine Mile Point Unit 1 (NMP1) are calculated using an alternative method to that described in 10 CFR 50, Appendix G, "Fracture Toughness Requirements," and Appendix H, "Reactor Vessel Material Surveillance Program Requirements." The alternative method is based, in part, on the use of an American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Case. Specifically, ASME Code Case N-640, "Alternate Reference Fracture Toughness for Development of P-T Limit Curves Section XI, Division 1," is used in calculating the RCS P-T limits proposed for the NMP1 Technical Specifications (TSs). Since this Code Case has not yet received formal approval from the NRC for generic application, the use of the alternative method requires an exemption from the current requirements of 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation," which implements 10 CFR 50, Appendices G and H.

Pursuant to 10 CFR 50.12, "Specific exemptions," the NRC may grant an exemption from requirements contained in 10 CFR 50 (10 CFR 50.60 for this exemption) provided the following four conditions are satisfied:

1. The requested exemption is authorized by law,

2. The requested exemption does not present an undue risk to the public health and safety,

3. The requested exemption will not endanger the common defense and security, and

4. Special circumstances are present which necessitate the request for an exemption to the regulations of 10 CFR 50.60.

Previous exemptions permitting use of the ASME N-640 Code Case have been granted by the NRC to a number of nuclear facilities, including: Pilgrim (ADAMS Accession Numbers ML010720448 and ML010790519), Brunswick Units 1 and 2 (ADAMS Accession Numbers ML012760157 and ML012780286), and Susquehanna Units 1 and 2 (ADAMS Accession Numbers ML013520568 and ML013520605). In addition, the NRC is currently in the process of providing generic approval of ASME Code Case N-640 by including it in Revision 13 of Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI, Division 1 [Reference: Draft Regulatory Guide DG-1091 (66 FR 67335, 12/28/01)].

ASME B&PV Code Case N-640

10 CFR 50.12(a) Requirements

The requested exemption to permit use of ASME B&PV Code Case N-640 in conjunction with ASME B&PV Code, Section XI, Appendix G, to determine the RCS P-T limit curves and tables meets the criteria of 10 CFR 50.12 as further discussed below.

1. The requested exemption is authorized by law:

   The provisions of 10 CFR 50.60(b) permit the use of alternatives to 10 CFR 50.60, Appendices G and H, when an exemption is granted by the NRC (Commission) under 10 CFR 50.12.

2. The requested exemption does not present an undue risk to the public health and safety:

   The RCS P-T limit curves and tables proposed for the NMP1 TSs rely, in part, on the requested exemption. In accordance with ASME Code Case N-640, the proposed P-T limit curves and associated tables have been developed using the fracture toughness K_{Ic} values as defined in ASME B&PV Code, Section XI, Appendix A, Figure A-4200-1, in lieu of the K_{Ia} values defined in ASME B&PV Code, Section XI, Appendix G, Figure G-2210-1. Curve K_{Ic} is used as the lower bound for fracture toughness. Except for the changes associated with the use of ASME Code Case N-640, the other margins involved with the ASME B&PV Code, Section XI, Appendix G, process of determining P-T limit curves remain unchanged.

   Use of the K_{Ic} curve in determining the lower bound fracture toughness in the development of P-T limit curves is more technically correct than the K_{Ia} curve. The K_{Ic} curve models the slow heatup and cooldown processes that a Reactor Pressure Vessel (RPV) normally undergoes. These slow heatup and cooldown limits are enforced by NMP1 TS Sections 3.2.1 and 3/4.2.2. Specifications 3.2.1, 3.2.2.a, b, and c, and 4.2.2.a provide assurance that the heatup and cooldown rate limit of ≤ 100° F/HR, as specified in Updated Final Safety Analysis Report (UFSAR) Section V-C.4 and Table V-1, is met.

   Use of this approach is justified by the initial conservatism of the K_{Ia} curve when it was incorporated into the ASME B&PV Code in 1974. This initial conservatism was necessary due to the limited knowledge of RPV material fracture toughness at the time. Since that time, considerable knowledge has been gained regarding fracture toughness of RPV materials and their fracture response to applied loads. This additional knowledge has served to demonstrate that the fracture toughness provided by the K_{Ia} curve is well beyond the margin of safety required to protect against potential RPV failure, and the K_{Ic} fracture toughness curve provides an adequate margin of safety for such a failure.

Use of the K_{Ic} fracture toughness limits as a basis for the proposed P-T limit curves and tables will enhance overall plant safety by widening the P-T operating window, especially in the region of low temperature operations. Safety benefits that would be realized during pressure tests include a reduction in the challenges to operators in maintaining a high temperature in a limited operating band, personnel safety while conducting inspections in primary containment at elevated temperatures, and increased availability of plant systems, including shutdown cooling, due to a reduction of the heatup and test time.

Based on the above justification, NMPNS believes that this requested exemption does not present an undue risk to the public health and safety.

3. The requested exemption will not endanger the common defense and security:

This exemption request is limited to the revision of P-T operating and test limits for the NMPNS NMP1 commercial power reactor in accordance with industry-proposed guidance. As such, this exemption request has no impact on common defense and security. Therefore, the common defense and security are not endangered by approval of this exemption request.

4. Special circumstances are present which necessitate the request for an exemption to the regulations of 10 CFR 50.60:

In accordance with 10 CFR 50.12(a)(2), the NRC will consider granting an exemption to the regulations if "special circumstances" are present. The regulation provides six criteria which licensees can us to provide the basis for the "special circumstance" provision of the regulation. The following three criteria are applicable to this exemption request:

> "(a)(2)(ii) - Application of the regulation in the particular cicumstances would not serve the underlying purpose of the rule or it is not necessary to achieve the underlying purpose of the rule; or
>
> (a)(2)(iii) - Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated; or
>
> (a)(2)(v) - The exemption would provide only temporary relief from the applicable regulation and the licensee or applicant has made good faith efforts to comply with the regulations."

Each of the above three requirements is addressed below.

10 CFR 50.12 (a)(2)(ii):

Appendix G of 10 CFR 50 endorses ASME B&PV Code, Section XI, Appendix G, as providing a conservative method for developing reactor vessel P-T limits. Application of this methodology in the development of P-T operating and pressure test limit curves satisfies the underlying requirement that the RCS pressure boundary be operated in a regime having sufficient margin to assure that, when stressed, the RPV boundary will behave in a non-brittle manner. Use of this methodology provides assurance that the probability of a rapidly propagating fracture will be minimized. Therefore, RCS P-T limit curves developed using this methodology provide assurance that adequate margin exists considering the uncertainties in determining the effects of irradiation on material properties.

The ASME B&PV Code, Section XI, Appendix G, methodology was conservatively developed based on the limited knowledge of RPV material fracture toughness that existed in 1974. Since that time, considerable knowledge has been gained regarding fracture toughness of RPV materials and their fracture response to applied loads. This increased knowledge serves to permit relaxation of the ASME B&PV Code, Section XI, Appendix G, requirements by application of ASME B&PV Code Case N-640. Relaxation of the Appendix G requirements will have no impact on the underlying purpose of the ASME B&PV Code or the regulations of 10 CFR 50.60. Therefore, the associated safety margins are maintained.

10 CFR 50.12(a)(2)(iii):

The RCS P-T operating window is defined by the RCS P-T operating and test limit curves and associated P-T limit tables that are contained in the NMP1 TSs. As previously discussed, the P-T limit curves and tables have been developed in accordance with the ASME B&PV Code, Section XI, Appendix G, methods. Continued operation of NMP1 with the current P-T limit curves and tables, without the relief provided by ASME B&PV Code Case N-640, would unnecessarily restrict the P-T operating band. This restriction challenges the operations staff during pressure tests to maintain a high temperature within a limited operating band. It also subjects inspection personnel to increased safety hazards while conducting inspections of systems with the potential for steam leaks at elevated temperatures.

This constitutes an unnecessary burden that can be alleviated by the application of ASME B&PV Code Case N-640 in the development of the proposed RCS P-T limit curves and tables. Furthermore, implementation of the proposed P-T limit curves and tables, developed using the N-640 Code Case, will not significantly reduce the margin of safety below that established by the original ASME B&PV Code, Section XI, Appendix G, requirements.

10 CFR 50.12(a)(2)(v):

The requested exemption provides only temporary relief since it is anticipated that the provisions of ASME B&PV Code Case N-640 will be incorporated into (or reconciled with) the requirements of 10 CFR 50, Appendix G, in response to ongoing to industry efforts to do so. NRC approval of the N-640 Code Case is pending; however, additional action may be required to permit use of the Code Case without requiring an exemption to 10 CFR 50, Appendix G. The estimated time for the completion of the, as yet, unspecified additional action(s) is not known. Therefore, the effective period for the requested exemption is indefinite.

Summary of Bases for Acceptability of ASME B&PV Code Case N-640

Compliance with 10 CFR 50, Appendix G, as required by 10 CFR 50.60(a), would result in hardship and unusual difficulty without a compensating increase in the level of quality and safety. ASME B&PV Code Case N-640 permits a reduction in the lower bound fracture toughness used in ASME B&PV Code, Section XI, Appendix G, in the determination of RCS P-T limit curves. Use of the alternate methodology of the N-640 Code Case is acceptable based on the margin of safety being maintained commensurate with that which existed in 1974 when the original requirements of ASME B&PV Code, Section XI, Appendix G, were approved. Therefore, application of ASME B&PV Code Case N-640 for the development of the RCS P-T limit curves and tables for NMP1 will maintain an acceptable margin of safety and does not present an undue risk to the public health and safety.

ATTACHMENT 5

REPORT NO. SIR-02-129

Report No.: SIR-02-129
Revision No.: 0
Project No.: NMP-05Q
File No.: NMP-05Q-401
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Revised Pressure-Temperature Curves for Nine Mile Point Unit 1

Prepared for:

Constellation Generation Group

Prepared by:

Structural Integrity Associates
Greenwood Village, CO

Prepared by: Gary L. Stevens — G. L. Stevens, P. E. — Date: 11/5/02

Reviewed by: K K Fujikawa — K. K. Fujikawa, P. E. — Date: 11/5/02

Approved by: Gary L. Stevens — G. L. Stevens, P. E. — Date: 11/5/02

REVISION CONTROL SHEET

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Section	Pages	Revision	Date	Comments
1.0 - 5.0	1-18	A	10/04/02	Initial draft for client review.
1.0 2.0 3.0 4.0 5.0 App. A	1-1 2-1 – 2-2 3-1 – 3-26 4-1 5-1 A1 – A11	0	11/5/02	Initial issue.

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1.0 INTRODUCTION

This report documents the revised set of pressure-temperature (P-T) curves developed for the Nine Mile Point Unit 1 (NMP-1). This work includes a full set of updated P-T curves (i.e., pressure test, core not critical, and core critical conditions) for NMP-1 for 28 effective full power years (EFPYs). The curves were developed using the methodology specified in ASME Code Case N-640 [1], as well as 10CFR50 Appendix G [2], Welding Research Council (WRC) Bulletin No. 175 [3], and the 1989 Edition of ASME Code, Section XI, Appendix G [4]. The revised P-T curves show an increase in the operating window of as much as 50°F or more, which is obtained from using the reference fracture toughness, K_{Ic}, in accordance with Code Case N-640.

2.0 ART ESTIMATE

Reference [5] provides adjusted reference temperature (ART) estimates for the NMP-1 reactor pressure vessel (RPV) materials in accordance with Regulatory Guide 1.99, Revision 2 (RG 1.99) [6] for 28 EFPY. The limiting value for an inside surface (1/4t) postulated flaw is:

ART = 167.7°F for Plate G-307-4/5 [5, Table 4-4]

This value is reproduced in Table 2-1 in accordance with RG 1.99. In addition, the value for a 3/4t flaw is also determined in Table 2-1, with a value of 136.8°F.

Note that per Reference [7], fluence analysis subsequent to the Reference [5] report lowered the best estimate fluence and reduced the limiting plate ART. The conservative 28 EFPY limiting ART value of 167.7°F applied in Reference [5] is again used in this calculation.

Table 2-1. ART Calculations

Location	Initial RT_{NDT} (°F)	Chemistry Cu (wt %)	Chemistry Ni (wt %)	Chemistry Factor (°F)	Adjustments For 1/4t: ΔRT_{NDT} (°F)	Margin Terms σ_Δ (°F)	Margin Terms σ_I (°F)	EFPY	ART_{NDT} (°F)
Plate G-307-4/5 (1/4t)	40	0 27	0 53	173 85	93 7	17 0	0 0	28 0	167 7
Plate G-307-4/5 (3/4t)	40	0 27	0 53	173 85	62 8	17 0	0 0	28 0	136 8

Fluence Information:

Location	Wall Thickness (inches) Full	Wall Thickness (inches) 1/4t, 3/4t	EFPY	Fluence at ID (n/cm^2)	Attenuation, 1/4t $e^{-0.24x}$	Fluence @ 1/4t (n/cm^2)	Fluence Factor, FF $f^{(0.28-0.10 \log f)}$
Plate G-307-4/5 (1/4t)	7 125	1 781	28 0	2 70E+18	0 652	1 759E+18	0 539
Plate G-307-4/5 (3/4t)	7 125	5 344	28 0	2 70E+18	0 277	7 479E+17	0 361

3.0 P-T CURVE METHODOLOGY

3.1 Benchmark Analysis

As a first step in computing the revised P-T curves, a benchmark evaluation was performed using ASME Code, Section XI, Appendix G methodology without application of ASME Code Case N-640 for comparison against NMP-1's previously developed P-T curves. The intent was to reproduce the existing NMP-1 P-T curves for the pressure test and heatup/cooldown conditions so that consistent methodology could be applied to the revised P-T curves using Code Case N-640.

The P-T curve methodology is based on the requirements of References [2] through [4]. The supporting calculations for the curves are contained in References [8] and [9]. From the previous work performed for NMP-1 [5], the beltline region bounds all other regions with respect to brittle fracture.

The approach used for reproducing the previously developed NMP-1 P-T curves is summarized below:

a. Assume a fluid temperature, T.

b. For the temperature, T, assumed in step (a), compute the temperature at the assumed flaw tip, $T_{1/4t}$ (i.e., for an ID 1/4t flaw or an OD 3/4t flaw). This is accomplished by adding a temperature drop term, $\Delta T_{1/4t}$, to T. $\Delta T_{1/4t}$ values were obtained from the heat transfer analysis performed for the Reference [5] report for the appropriate heatup/cooldown conditions, as follows:

$\Delta T_{1/4t}$ for pressure test curve: 0°F (no thermal for pressure test curve)
$\Delta T_{1/4t}$ for core not critical curve: 23.151°F (for 100°F/hr cooldown curve)
$\Delta T_{1/4t}$ for core not critical curve: 0°F (for 0°F/hr cooldown curve)
$\Delta T_{1/4t}$ for core not critical curve: variable (for 100°F/hr heatup curve)

c. Calculate the allowable stress intensity factor, K_{Ia} [4] based on $T_{1/4t}$ using the following relationship:

$$K_{Ia} - 26.78 = 1.223 \exp [0.0145 (T_{1/4t} - ART + 160)]$$

where: $T_{1/4t}$ = flaw tip temperature (°F)

ART = limiting ART value, as defined above (°F)

K_{Ia} = allowable stress intensity factor (ksi$\sqrt{}$inch)

d. Calculate the thermal stress intensity factor, K_{IT}, using the appropriate relationship from Figure G-2214-2 of Reference [4]:

$$K_{IT} = M_t \Delta T_w$$

where: ΔT_w = through-wall temperature drop (°F)

M_t = factor from Figure G-2214-2 of Reference [4].

= 0.3144

The values for ΔT_w were obtained from the heat transfer analysis performed for the Reference [5] report for the appropriate heatup/cooldown conditions, as follows:

ΔT_w for pressure test curve: 0°F (no thermal for pressure test curve)

ΔT_w for core not critical curve: 47.169°F (for 100°F/hr cooldown curve)

ΔT_w for core not critical curve: 0°F (for 0°F/hr cooldown curve)

ΔT_w for core not critical curve: variable (for 100°F/hr heatup curve)

e. Calculate the allowable pressure stress intensity factor, K_{IP}, using the appropriate relationship for the P-T curve under consideration from ¶G-2215 and ¶G-2400 of Reference [4]:

$1.5K_{IP} = K_{Ia}$ for Curve A (i.e., pressure-test curve)

$2.0K_{IP} + K_{IT} = K_{Ia}$ for Curves B and C (i.e., core not critical and core critical curves)

where: K_{IT} = thermal stress intensity factor (ksi$\sqrt{\text{inch}}$)

K_{IP} = allowable pressure stress intensity factor (ksi$\sqrt{\text{inch}}$)

f. Compute the pressure, P. The relationship for the pressure, P, to the allowable pressure stress intensity factor, K_{IP}, is as follows from ¶G-2214 of Reference [4]:

$$K_{IP} = M_m \sigma_m + M_b \sigma_b$$

where: M_m = membrane stress correction factor from Figure G-2214-1 of Reference [4].

σ_m = membrane stress due to pressure (ksi)

= PR/t for the beltline region.

P = pressure (ksi)

R = vessel inside radius (inches)

= 106.5" [5, Table 4-5]

t = vessel wall thickness (inches)

= 7.125" [5, Table 4-5]

M_b = bending stress correction factor

= $(2/3)M_m$ from Figure G-2214-1 of Reference [4].

σ_b = bending stress due to pressure (ksi)

= 0 for a thin-walled vessel

Thus, $P = K_{IP}t/(RM_m)$ for the beltline region.

The values for M_m were selected so that the previous P-T curve results from Reference [5] were matched, as follows:

M_m for pressure test curve: 2.60

M_m for core not critical curve: 2.60 (for 100°F/hr cooldown curve)

M_m for core not critical curve: 2.60 (for 0°F/hr cooldown curve)

M_m for core not critical curve: variable (for 100°F/hr heatup curve)

(varied between 2.80 at lower temperatures to 2.60 at upper temperatures and linear interpolation)

g. Repeat steps (a) through (f) for other temperatures to generate a series of P-T points for each region.

h. Adjust for any applicable instrument errors for temperature and pressure from T and P, respectively. Instrument errors were documented to be 4.0°F for temperature and 10.0 psig for pressure for the leak/hydro curve [5, Table 4-5], and 12.2°F for temperature and 52.2 psig for pressure for the heatup/cooldown curves [5, Table 4-5]*. An additional static head pressure adjustment of 15.4 psig was used to account for the weight of water in a full vessel.

* The temperature and instrument uncertainties were not applied to the 10CFR50 Appendix G limits described below.

The following additional requirements were used to define the lower portion of the P-T curves. These limits are established by the discontinuity regions of the vessel (i.e., flanges), and are specified in Reference [2]:

For Pressure Test Conditions:

- ✓ Thermal stresses were assumed to be negligible during the pressure test condition and were therefore not considered.
- ✓ If P is greater than 20% of the pre-service hydro test pressure, the upper vessel temperature must be greater than RT_{NDT} of the limiting flange material + 90°F. The pre-service hydro test pressure was 1,800 psig [5, Table 4-5].
- ✓ If P is less than or equal to 20% of the pre-service hydro test pressure, the minimum temperature is conservatively assumed to be greater than or equal to the RT_{NDT} of the limiting flange material + 60°F. This additional 60°F margin is not recommended in

Reference [2], but has been a standard recommendation by GE for the BWR industry and was conservatively used in the Reference [5] work. For the NMP-1 flange material, this minimum temperature is 100°F (based on a limiting RT_{NDT} of 40°F for non-beltline materials per Table 4-5 of Reference [5]). Since the 60°F margin is only a recommendation, application of this extra limit is not required by References [2] or [4], but was used in the benchmark evaluation to demonstrate reproduction of the Reference [5] results.

For Core Not Critical Conditions:

- ✓ If P is greater than 20% of the pre-service hydro test pressure, the upper vessel temperature must be greater than RT_{NDT} of the limiting flange material + 120°F.
- ✓ If P is less than or equal to 20% of the pre-service hydro test pressure, the minimum temperature is conservatively assumed to be greater than or equal to the RT_{NDT} of the limiting flange material + 60°F. As identified above for the pressure test, this limit is only a recommendation, application of this extra limit is not required by References [2] or [4], but was used in the benchmark evaluation to demonstrate reproduction of the Reference [5] results.

For Core Critical Conditions:

- ✓ Per the requirements of Table 1 of Reference [2], the core critical P-T limits must be 40°F above any Pressure Test or Core Not Critical curve limits. Core Not Critical conditions are more limiting than Pressure Test conditions, so Core Critical conditions are equal to Core Not Critical conditions plus 40°F.
- ✓ Another requirement of Table 1 of Reference [2] (or actually an allowance for the BWR), concerns minimum temperature for initial criticality in a startup. Given that water level is normal, BWRs are allowed initial criticality at the closure flange region temperature (RT_{NDT} + 60°F) if the pressure is below 20% of the pre-service hydro test pressure. This corresponds to 100°F for NMP-1, as identified above.
- ✓ Also per Table 1 of Reference [2], at pressures above 20% of the pre-service hydro test pressure, the Core Critical curve upper vessel temperature must be at least that required for the pressure test. The temperature was determined in Reference [5] to be 260°F for

the cooldown condition and 278°F for the heatup condition. As a result of this requirement, the Core Critical curve must have at least a temperature of 260°F (for cooldown 1/4t flaws) or 278°F (for heatup 3/4t flaws) for pressures greater than 20% of the pre-service hydro pressure.

The resulting pressure and temperature series constitutes the P-T curve. The P-T curve relates the minimum required fluid temperature to the reactor pressure.

Tabulated values for the resulting benchmark P-T curves for 28 EFPYs are shown in Tables 3-1 through 3-5. The resulting P-T curves are plotted in Figures 3-1 through 3-3.

Based on the results shown in Figures 3-1 through 3-3, the following conclusions can be made with respect to the benchmark analysis:

- ✓ For the Pressure Test curve, the results shown in Figure 3-1 demonstrate that the previous methodology was successfully reproduced. The independently derived curve is essentially identical to the pressure test curve developed in Reference [5]. Any differences are due to round-off and are insignificant.
- ✓ For the Core Not Critical curve, the results shown in Figure 3-2 demonstrate that the previous methodology was successfully reproduced. The independently derived curves are essentially identical to the core not critical curves developed in Reference [5]. Any differences are due to round-off and are insignificant.
- ✓ For the Core Critical curve, the results shown in Figure 3-3 demonstrate that the previous methodology was successfully reproduced. The independently derived curves are essentially identical to the core critical curves developed in Reference [5]. Any differences are due to round-off and are insignificant.

It is therefore concluded that the P-T curve methodology described above is consistent with and the same as that previously used to develop the P-T curves in the Reference [5] report.

Table 3-1. Tabulated Values for Benchmark Pressure Test Curve

Pressure-Temperature Curve Calculation

(Pressure Test)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_t =	0.3144	(per Figure G-2214-2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	167.7	°F ======> 28 EFPY
ΔT_w =	0.0	°F (no thermal for pressure test)
K_T =	0.0	ksi*inch$^{1/2}$ (no thermal for pressure test)
$\Delta T_{1/4t}$ =	0.0	°F (no thermal for pressure test)
Safety Factor =	1.50	(for pressure test)
M_m =	2.60	(per Figure G-2214-1 of App G, assumed value to match Reference [1] results)
Temperature Instrument Error =	4.0	°F
Pressure Instrument Error =	30.8	psig (instrument uncertainty + 15.4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T	1/4t Temperature	K_{Ia}	K_{IP}	Calculated Pressure P	Adjusted Temperature for P-T Curve	Adjusted Pressure for P-T Curve	Temperature from Table 4-10 of MPM Report	Pressure from Table 4-10 of MPM Report	
(°F)	(°F)	(ksi*inch$^{1/2}$)	(ksi*inch$^{1/2}$)	(psig)	(°F)	(psig)	(°F)	(psig)	
100	100.0	31.44	20.96	0	100	0	100	0	
100	100.0	31.44	20.96	360	100	360	100	360	
126	126.0	33.58	22.39	360	130	360	110	360	
126	126.0	33.58	22.39	576	130	545	120	360	
131	131.0	34.09	22.73	585	135	554	130	360	
136	136.0	34.64	23.09	594	140	563	130	550	added this point to match plot
141	141.0	35.23	23.49	604	145	574	140	569	
146	146.0	35.87	23.91	615	150	584	150	590	
151	151.0	36.55	24.37	627	155	596	160	614	
156	156.0	37.28	24.86	640	160	609	170	642	
161	161.0	38.07	25.38	653	165	622	180	675	
166	166.0	38.92	25.95	668	170	637	190	712	
171	171.0	39.83	26.56	683	175	653	200	755	
176	176.0	40.82	27.21	700	180	669	210	805	
181	181.0	41.87	27.91	718	185	687	220	862	
186	186.0	43.01	28.67	738	190	707	230	929	
191	191.0	44.23	29.48	759	195	728	240	1005	
196	196.0	45.54	30.36	781	200	750	243	1032	
201	201.0	46.95	31.30	805	205	775	250	1093	
206	206.0	48.47	32.31	831	210	801	260	1195	
211	211.0	50.10	33.40	859	215	829			
216	216.0	51.85	34.57	889	220	859			
221	221.0	53.73	35.82	922	225	891			
226	226.0	55.76	37.17	957	230	926			
231	231.0	57.94	38.63	994	235	963			
236	236.0	60.28	40.19	1034	240	1003			
241	241.0	62.80	41.87	1077	245	1047			
246	246.0	65.51	43.67	1124	250	1093			
251	251.0	68.42	45.62	1174	255	1143			
256	256.0	71.56	47.70	1227	260	1197			
261	261.0	74.92	49.95	1285	265	1254			
266	266.0	78.54	52.36	1347	270	1317			
271	271.0	82.43	54.96	1414	275	1383			
276	276.0	86.62	57.75	1486	280	1455			
281	281.0	91.12	60.75	1563	285	1532			
286	286.0	95.96	63.97	1646	290	1615			
291	291.0	101.16	67.44	1735	295	1704			
296	296.0	106.75	71.17	1831	300	1800			
301	301.0	112.76	75.18	1934	305	1904			
306	306.0	119.23	79.49	2045	310	2014			
311	311.0	126.18	84.12	2165	315	2134			
316	316.0	133.65	89.10	2293	320	2262			
321	321.0	141.69	94.46	2431	325	2400			
326	326.0	150.33	100.22	2579	330	2548			
331	331.0	159.62	106.41	2738	335	2707			
336	336.0	169.61	113.07	2910	340	2879			
341	341.0	180.35	120.23	3094	345	3063			

Table 3-2. Tabulation for Benchmark Core Not Critical (100°F/hr Cooldown) P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Not Critical – 100°F/hr cooldown)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness t =	7.125	inches
M_t =	0.3144	(per Figure G-2214 2 of Section XI, Appendix G)
Vessel Radius R =	106.5	inches
ART =	167.7	°F =======> 28 EFPY
ΔT_w =	47.169	°F (use value at 70°F from past work)
K_{IT} =	14.8	ksi*inch$^{1/2}$
$\Delta T_{1/4t}$ =	23.151	°F (use value at 70°F from past work)
Safety Factor =	2.00	(for heatup/cooldown)
M_m =	2.60	(per Figure G-2214-1 of App G, assumed to be the same as Curve A)
Temperature Instrument Error =	12.2	°F
Pressure Instrument Error =	67.6	psig (instrument uncertainty + 15 4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	1/4t Temperature (°F)	K_{Im} (ksi*inch$^{1/2}$)	K_{IP} (ksi*inch$^{1/2}$)	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)	Temperature from Table 4-7 of MPM Report (°F)	Pressure from Table 4-7 of MPM Report (psig)	Adjusted Temperature for Curve C (°F)
40	63.2	29.51	7.34	0	100	0	100	0	62
45	68.2	29.72	7.44	192	100	124	100	160	57
50	73.2	29.94	7.55	194	100	127	110	171	62
55	78.2	30.18	7.67	197	100	130	120	184	67
60	83.2	30.43	7.80	201	100	133	130	199	72
65	88.2	30.71	7.94	204	100	137	140	216	77
70	93.2	31.00	8.09	208	100	140	150	235	82
75	98.2	31.32	8.24	212	100	145	160	258	87
80	103.2	31.66	8.42	217	100	149	170	284	92
85	108.2	32.03	8.60	221	100	154	180	315	97
88	111.0	32.25	8.71	224	100	156	190	350	100
90	113.2	32.42	8.80	226	102	159	200	391	102
95	118.2	32.85	9.01	232	107	164	210	438	107
100	123.2	33.30	9.24	238	112	170	220	493	112
105	128.2	33.79	9.48	244	117	176	230	556	117
110	133.2	34.32	9.75	251	122	183	240	630	122
115	138.2	34.89	10.03	258	127	190	250	708	127
120	143.2	35.50	10.33	266	132	198	260	786	132
125	148.2	36.15	10.66	274	137	207	270	866	137
130	153.2	36.86	11.01	283	142	216	280	957	142
135	158.2	37.62	11.39	293	147	226	290	1062	147
140	163.2	38.43	11.80	304	152	236			152
145	168.2	39.31	12.24	315	157	247			157
150	173.2	40.25	12.71	327	162	259			162
155	178.2	41.26	13.22	340	167	272			167
160	183.2	42.35	13.76	354	172	286			172
165	188.2	43.52	14.35	369	177	302			177
170	193.2	44.78	14.97	385	182	318			182
175	198.2	46.13	15.65	403	187	335			187
180	203.2	47.59	16.38	421	192	354			192
185	208.2	49.15	17.16	442	197	374			197
190	213.2	50.84	18.00	463	202	396			202
195	218.2	52.64	18.91	487	207	419			207
207.8	231.0	57.92	21.54	554	220	487			220
207.8	231.0	57.92	21.55	554	220	487			220
213	236.0	60.26	22.72	585	225	517			225
218	241.0	62.78	23.98	617	230	549			230
223	246.0	65.49	25.33	652	235	584			235
228	251.0	68.40	26.79	689	240	622			240
233	256.0	71.53	28.35	729	245	662			245
238	261.0	74.89	30.03	773	250	705			250
243	266.0	78.51	31.84	819	255	752			255
248	271.0	82.40	33.79	869	260	802			260
253	276.0	86.59	35.88	923	265	856			265
258	281.0	91.08	38.13	981	270	913			270
263	286.0	95.92	40.54	1043	275	976			275
268	291.0	101.12	43.14	1110	280	1043			280
273	296.0	106.71	45.94	1182	285	1114			285
278	301.0	112.72	48.94	1259	290	1192			290
283	306.0	119.18	52.17	1342	295	1275			295
288	311.0	126.12	55.65	1432	300	1364			300
293	316.0	133.59	59.38	1528	305	1460			305
298	321.0	141.63	63.40	1631	310	1564			310
303	326.0	150.26	67.72	1742	315	1675			315
308	331.0	159.55	72.36	1862	320	1794			320
313	336.0	169.53	77.35	1990	325	1923			325
318	341.0	180.26	82.72	2128	330	2061			330
323	346.0	191.80	88.49	2277	335	2209			335

Table 3-3. Tabulation for Benchmark Core Not Critical (0°F/hr) P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Not Critical – 0°F/hr cooldown)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_t =	0.3144	(per Figure G-2214-2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	167.7	°F =======> 28 EFPY
ΔT_w =	0.0	°F (use value at 100°F from past work)
K_{IT} =	0.0	ksi*inch$^{1/2}$
ΔT_{UHS} =	0.0	°F (use value at 100°F from past work)
Safety Factor =	2.00	(for heatup/cooldown)
M_m =	2.60	(per Figure G-2214-1 of App G, assumed to be the same as Curve A)
Temperature Instrument Error =	12.2	°F
Pressure Instrument Error =	67.2	psig (instrument uncertainty + 15.4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	1/4t Temperature (°F)	K_{Im} (ksi*inch$^{1/2}$)	K_{IP} (ksi*inch$^{1/2}$)	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)	Temperature from Table 4-7 of MPM Report (°F)	Pressure from Table 4-7 of MPM Report (psig)	Adjusted Temperature for Curve C (°F)
40	40.0	28.73	14.37	0	100	0	100	0	52
45	45.0	28.88	14.44	372	100	304	100	160	57
50	50.0	29.04	14.52	374	100	306	110	171	62
55	55.0	29.21	14.60	376	100	309	120	184	67
60	60.0	29.39	14.70	378	100	311	130	199	72
65	65.0	29.59	14.79	381	100	313	140	216	77
70	70.0	29.80	14.90	383	100	316	150	235	82
75	75.0	30.03	15.01	386	100	319	160	258	87
80	80.0	30.27	15.13	389	100	322	170	284	92
85	85.0	30.53	15.27	393	100	326	180	315	97
88	87.8	30.69	15.34	395	100	328	190	350	100
90	90.0	30.81	15.41	396	102	329	200	391	102
95	95.0	31.12	15.56	400	107	333	210	438	107
100	100.0	31.44	15.72	405	112	337	220	493	112
105	105.0	31.79	15.90	409	117	342	230	556	117
110	110.0	32.17	16.09	414	122	347	240	630	122
115	115.0	32.58	16.29	419	127	352	250	708	127
120	120.0	33.01	16.51	425	132	358	260	786	132
125	125.0	33.48	16.74	431	137	364	270	866	137
130	130.0	33.98	16.99	437	142	370	280	957	142
135	135.0	34.53	17.26	444	147	377	290	1062	147
140	140.0	35.11	17.55	452	152	384			152
145	145.0	35.73	17.87	460	157	393			157
150	150.0	36.41	18.20	468	162	401			162
155	155.0	37.13	18.57	478	167	411			167
160	160.0	37.91	18.96	488	172	421			172
165	165.0	38.75	19.37	499	177	431			177
170	170.0	39.65	19.82	510	182	443			182
175	175.0	40.61	20.31	523	187	455			187
180	180.0	41.65	20.83	536	192	469			192
185	185.0	42.77	21.39	550	197	483			197
190	190.0	43.98	21.99	566	202	499			202
195	195.0	45.27	22.63	582	207	515			207
207.8	207.8	49.04	24.52	631	220	564			220
207.8	207.8	49.04	24.52	631	220	564			220
213	212.8	50.72	25.36	653	225	585			225
218	217.8	52.52	26.26	676	230	608			230
223	222.8	54.45	27.23	701	235	633			235
228	227.8	56.53	28.27	727	240	660			240
233	232.8	58.77	29.38	756	245	689			245
238	237.8	61.17	30.59	787	250	720			250
243	242.8	63.76	31.88	820	255	753			255
248	247.8	66.54	33.27	856	260	789			260
253	252.8	69.53	34.77	895	265	827			265
258	257.8	72.75	36.37	936	270	869			270
263	262.8	76.20	38.10	980	275	913			275
268	267.8	79.92	39.96	1028	280	961			280
273	272.8	83.91	41.96	1080	285	1012			285
278	277.8	88.21	44.11	1135	290	1068			290
283	282.8	92.83	46.41	1194	295	1127			295
288	287.8	97.80	48.90	1258	300	1191			300
293	292.8	103.14	51.57	1327	305	1260			305
298	297.8	108.88	54.44	1401	310	1334			310
303	302.8	115.05	57.53	1480	315	1413			315
308	307.8	121.69	60.84	1566	320	1498			320
313	312.8	128.82	64.41	1657	325	1590			325
318	317.8	136.50	68.25	1756	330	1689			330
323	322.8	144.75	72.37	1862	335	1795			335

Table 3-4. Tabulation for Benchmark Core Not Critical (100°F/hr Heatup) P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Not Critical -- 100°F/hr heatup)

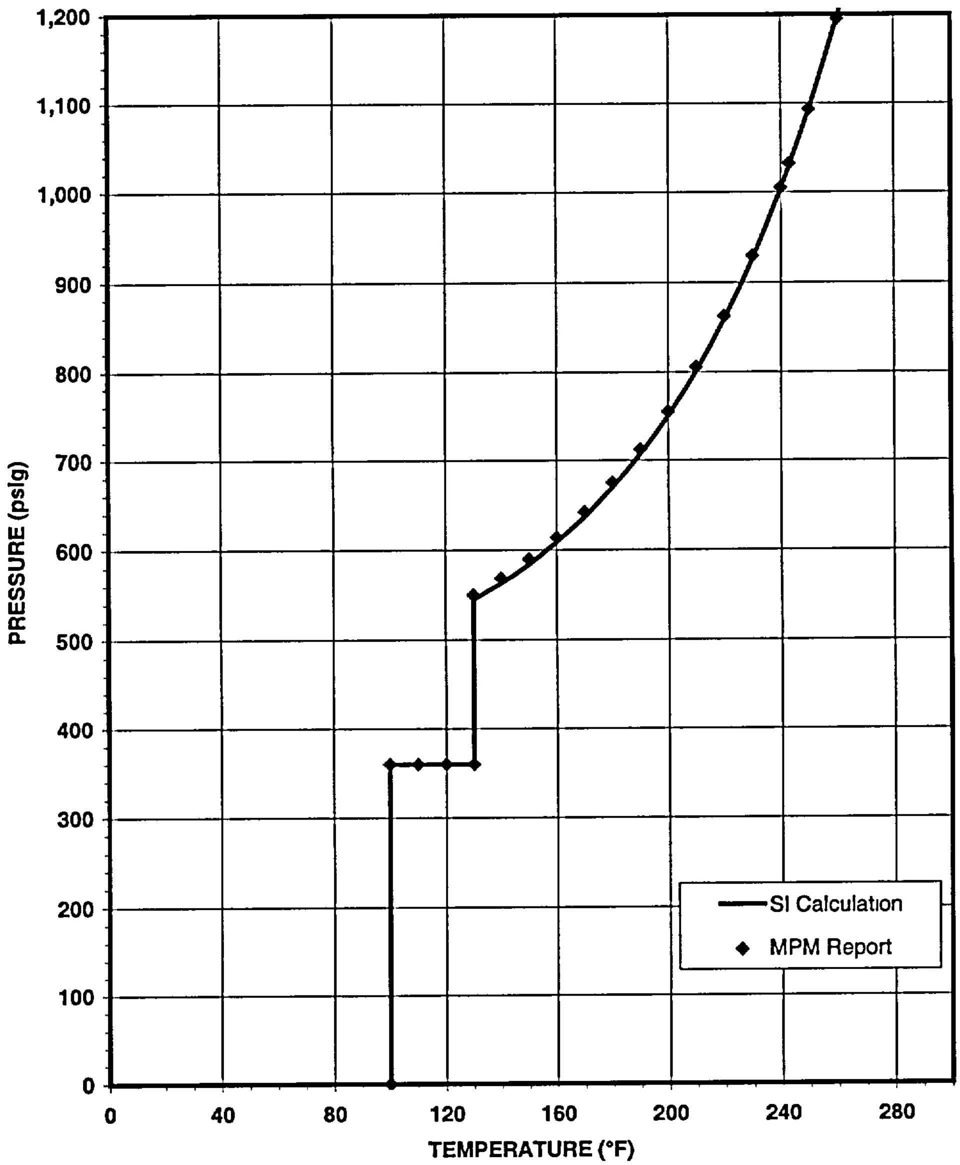
Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_k =	0.3144	(per Figure G-2214 2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	136.8	°F ==== 28 EFPY
Safety Factor =	2.00	(for heatup/cooldown)
Temperature Instrument Error =	12.2	°F
Pressure Instrument Error =	67.6	psig (instrument uncertainty + 15.4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	$\Delta T_{1/4t}$ (°F)	1/4t Temperature (°F)	K_{Ia} (ksi*inch[1/2])	ΔT_w (°F)	K_{IT} (ksi*inch[1/2])	K_{IP} (ksi*inch[1/2])	M_m	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)	Temperature from Table 4-6 of MPM Report (°F)	Pressure from Table 4-6 of MPM Report (psig)	Adjusted Temperature for Curve C (°F)
40	0.000	40.0	29.83	0.000	0.00	14.92	2.80	0	100	0	100	0	52
45	0.000	45.0	30.06	0.000	0.00	15.03	2.80	359	100	200	100	197	57
50	0.000	50.0	30.31	0.000	0.00	15.16	2.80	362	100	200	110	197	62
55	0.000	55.0	30.58	0.000	0.00	15.29	2.80	365	100	200	120	197	67
60	0.000	60.0	30.86	0.000	0.00	15.43	2.80	369	100	200	130	197	72
65	0.000	65.0	31.17	0.000	0.00	15.59	2.80	372	100	200	140	199	77
70	-0.078	69.9	31.50	0.078	0.02	15.74	2.80	376	100	200	150	205	82
75	-4.801	70.2	31.51	4.897	1.54	14.99	2.80	358	100	200	160	213	87
80	-9.523	70.5	31.53	9.715	3.05	14.24	2.80	340	100	200	170	225	92
85	-12.123	72.9	31.70	12.480	3.92	13.89	2.80	332	100	200	180	239	97
88	-14.861	72.9	31.71	15.398	4.84	13.43	2.80	321	100	200	190	257	100
90	-17.324	72.7	31.69	18.009	5.66	13.01	2.80	311	102	200	200	279	102
95	-20.336	74.7	31.83	21.236	6.68	12.58	2.80	301	107	200	210	304	107
100	-23.348	76.7	31.98	24.463	7.69	12.14	2.80	290	112	200	220	334	112
105	-25.662	79.3	32.19	26.944	8.47	11.86	2.80	283	117	200	230	369	117
110	-27.976	82.0	32.40	29.424	9.25	11.58	2.80	277	122	200	240	410	122
115	-29.754	85.2	32.67	31.331	9.85	11.41	2.80	273	127	200	250	458	127
120	-31.532	88.5	32.95	33.238	10.45	11.25	2.80	269	132	200	260	513	132
125	-32.901	92.1	33.29	34.707	10.91	11.19	2.80	267	137	200	270	577	137
130	-34.270	95.7	33.64	36.175	11.37	11.13	2.78	267	142	200	280	651	142
135	-35.328	99.7	34.04	37.310	11.73	11.16	2.77	270	147	202	290	737	147
140	-36.386	103.6	34.47	38.444	12.09	11.19	2.75	272	152	204	300	835	152
145	-37.207	107.8	34.95	39.324	12.36	11.29	2.74	276	157	208	310	949	157
150	-38.027	112.0	35.46	40.204	12.64	11.41	2.72	280	162	213	320	1079	162
155	-38.667	116.3	36.03	40.890	12.86	11.59	2.71	286	167	219			167
160	-39.306	120.7	36.63	41.576	13.07	11.78	2.69	293	172	225			172
165	-39.810	125.2	37.29	42.115	13.24	12.03	2.68	301	177	233			177
170	-40.313	129.7	38.00	42.654	13.41	12.30	2.66	309	182	241			182
175	-40.714	134.3	38.78	43.083	13.55	12.62	2.65	319	187	251			187
180	-41.115	138.9	39.60	43.512	13.68	12.96	2.63	330	192	262			192
185	-41.441	143.6	40.50	43.860	13.79	13.36	2.62	342	197	274			197
190	-41.767	148.2	41.47	44.207	13.90	13.78	2.60	355	202	287			202
195	-42.037	153.0	42.51	44.472	13.98	14.26	2.60	367	207	299			207
200	-42.307	157.7	43.63	44.720	14.06	14.78	2.60	380	212	313			212
205	-42.532	162.5	44.83	44.955	14.13	15.35	2.60	395	217	327			217
210	-42.757	167.2	46.13	45.267	14.23	15.95	2.60	410	222	343			222
215	-42.939	172.1	47.53	45.463	14.29	16.62	2.60	428	227	360			227
220	-43.120	176.9	49.03	45.659	14.36	17.34	2.60	446	232	379			232
225.8	-43.265	182.5	50.93	45.814	14.40	18.26	2.60	470	238	402			238
225.8	-43.265	182.5	50.94	45.969	14.45	18.24	2.60	469	238	402			238
230	-43.409	186.6	52.39	46.095	14.49	18.95	2.60	488	242	420			242
235	-43.526	191.5	54.27	46.220	14.53	19.87	2.60	511	247	444			247
240	-43.643	196.4	56.29	46.325	14.56	20.86	2.60	537	252	469			252
245	-43.742	201.3	58.47	46.430	14.60	21.93	2.60	564	257	497			257
250	-43.840	206.2	60.80	46.520	14.63	23.09	2.60	594	262	526			262
255	-43.923	211.1	63.31	46.610	14.65	24.33	2.60	626	267	558			267
260	-44.006	216.0	66.01	46.688	14.68	25.67	2.60	660	272	593			272
265	-44.078	220.9	68.92	46.765	14.70	27.11	2.60	698	277	630			277
270	-44.150	225.9	72.04	46.834	14.72	28.66	2.60	737	282	670			282
275	-44.214	230.8	75.40	46.902	14.75	30.33	2.60	780	287	713			287
280	-44.278	235.7	79.01	46.965	14.77	32.12	2.60	827	292	759			292
285	-44.337	240.7	82.89	47.027	14.79	34.05	2.60	876	297	809			297
290	-44.395	245.6	87.06	47.087	14.80	36.13	2.60	930	302	862			302
295	-44.452	250.5	91.54	47.147	14.82	38.36	2.60	987	307	919			307
300	-44.508	255.5	96.35	47.206	14.84	40.75	2.60	1049	312	981			312
305	-44.563	260.4	101.52	47.265	14.86	43.33	2.60	1115	317	1047			317
310	-44.618	265.4	107.08	47.324	14.88	46.10	2.60	1186	322	1119			322
315	-44.673	270.3	113.04	47.382	14.90	49.07	2.60	1263	327	1195			327

Table 3-5. Tabulated Values for Benchmark Core Critical Curve

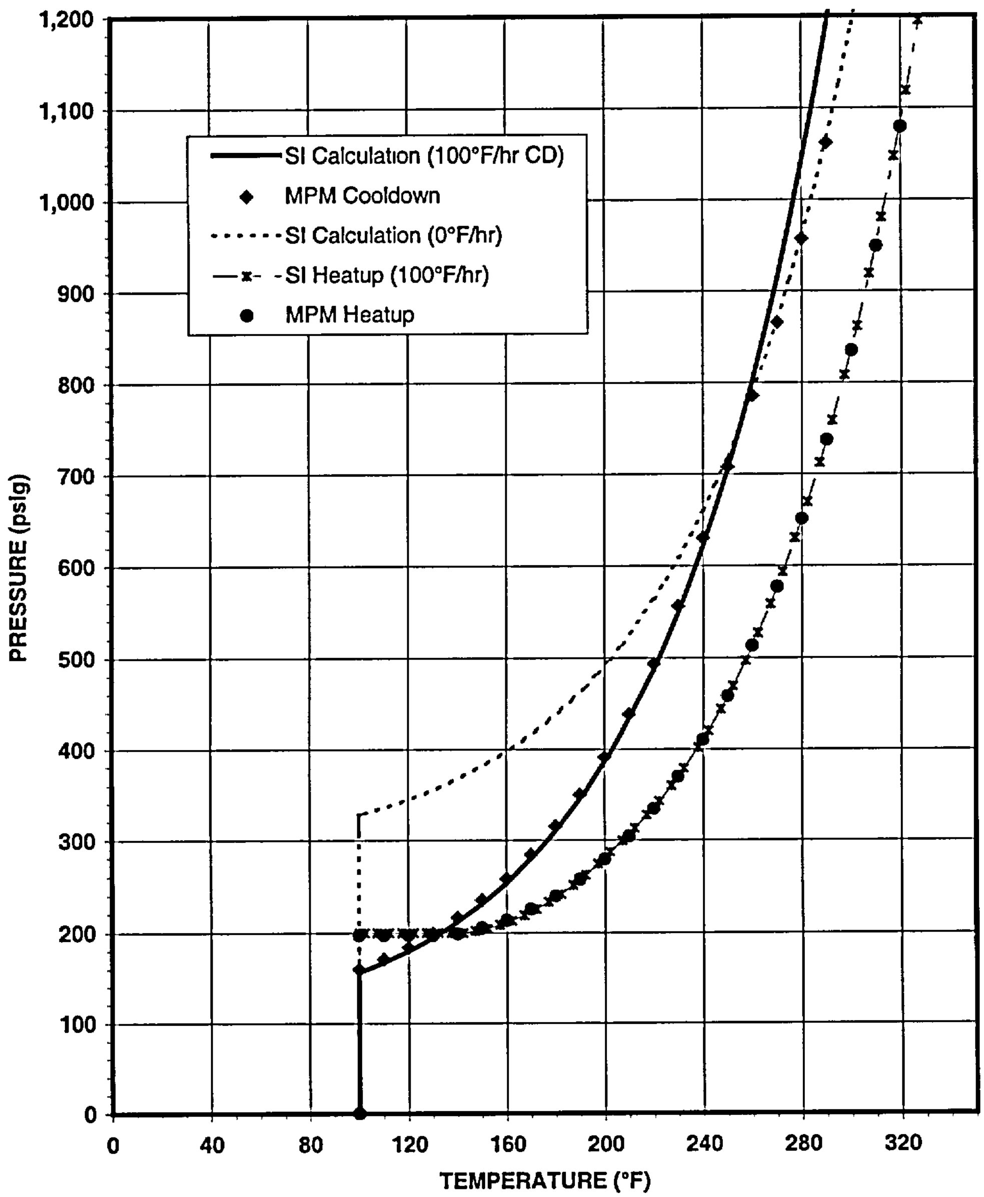
Pressure-Temperature Curve Calculation (Core Not Critical -- Bounding Curve)										
								Cooldown		
100°F/hr Cooldown Curve		0°F/hr Curve		100°F/hr Heatup Curve		Cooldown Bounding Curve		100°F/hr	0°F/hr	Bounding
Adjusted Curve B Temperature (°F)	Adjusted Curve B Pressure for (psig)	Adjusted Curve B Temperature (°F)	Adjusted Curve B Pressure for (psig)	Adjusted Curve B Temperature (°F)	Adjusted Curve B Pressure for (psig)	Adjusted Curve B Temperature (°F)	Adjusted Curve B Pressure for (psig)	Adjusted Temperature for Curve C (°F)	Adjusted Temperature for Curve C (°F)	Adjusted Temperature for Curve C (°F)
100	0	100	0	100	0	100	0	52	52	52
100	124	100	304	100	200	100	124	57	57	57
100	127	100	306	100	200	100	127	62	62	62
100	130	100	309	100	200	100	130	67	67	67
100	133	100	311	100	200	100	133	72	72	72
100	137	100	313	100	200	100	137	77	77	77
100	140	100	316	100	200	100	140	82	82	82
100	145	100	319	100	200	100	145	87	87	87
100	149	100	322	100	200	100	149	92	92	92
100	154	100	326	100	200	100	154	97	97	97
100	156	100	328	100	200	100	156	100	100	100
102	159	102	329	102	200	102	159	102	102	102
107	164	107	333	107	200	107	164	107	107	107
112	170	112	337	112	200	112	170	112	112	112
117	176	117	342	117	200	117	176	117	117	117
122	183	122	347	122	200	122	183	122	122	122
127	190	127	352	127	200	127	190	127	127	127
132	198	132	358	132	200	132	198	132	132	132
137	207	137	364	137	200	137	207	137	137	137
142	216	142	370	142	200	142	216	142	142	142
147	226	147	377	147	202	147	226	147	147	147
152	236	152	384	152	204	152	236	152	152	152
157	247	157	393	157	208	157	247	157	157	157
162	259	162	401	162	213	162	259	162	162	162
167	272	167	411	167	219	167	272	167	167	167
172	286	172	421	172	225	172	286	172	172	172
177	302	177	431	177	233	177	302	177	177	177
182	318	182	443	182	241	182	318	182	182	182
187	335	187	455	187	251	187	335	187	187	187
192	354	192	469	192	262	192	354	192	192	192
197	374	197	483	197	274	197	374	197	197	197
202	396	202	499	202	287	202	396	202	202	202
207	419	207	515	207	299	207	419	207	207	207
220	487	220	564	212	313	220	487	220	220	220
220	487	220	564	217	327	220	487	220	220	220
225	517	225	585	222	343	225	517	225	225	225
230	549	230	608	227	360	230	549	230	230	230
235	584	235	633	232	379	235	584	235	235	235
240	622	240	660	238	402	240	622	240	240	240
245	662	245	689	238	402	245	662	245	245	245
250	705	250	720	242	420	250	705	250	250	250
255	752	255	753	247	444	255	752	255	255	255
260	802	260	789	252	469	260	789	260	260	260
265	856	265	827	257	497	265	827	265	265	265
270	913	270	869	262	526	270	869	270	270	270
275	976	275	913	267	558	275	913	275	275	275
280	1043	280	961	272	593	280	961	280	280	280
285	1114	285	1012	277	630	285	1012	285 0	285	285
290	1192	290	1068	282	670	290	1068	290 0	290	290
295	1275	295	1127	287	713	295	1127	295 0	295	295
300	1364	300	1191	292	759	300	1191	300 0	300	300
305	1460	305	1260	297	809	305	1260	305 0	305	305
310	1564	310	1334	302	862	310	1334	310 0	310	310
315	1675	315	1413	307	919	315	1413	315 0	315	315
320	1794	320	1498	312	981	320	1498	320 0	320	320
325	1923	325	1590	317	1047	325	1590	325 0	325	325
330	2061	330	1689	322	1119	330	1689	330 0	330	330
335	2209	335	1795	327	1195	335	1795	335 0	335	335

Figure 3-1. Benchmark Pressure Test P-T Curve



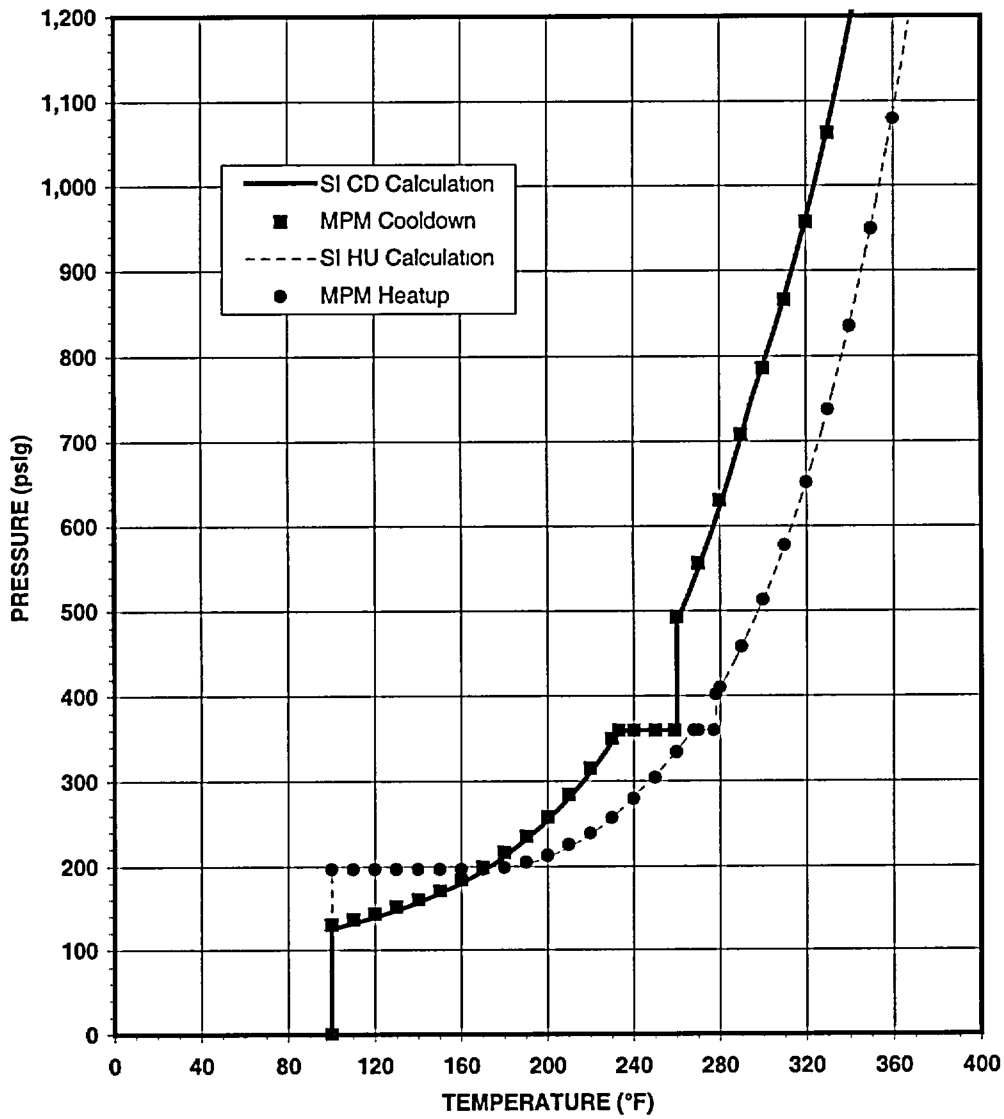
NMP-1 Pressure and Temperature Limits
Hydrostatic and Leak Tests ≤ 28 EFPY

Figure 3-2. Benchmark Core Not Critical Curve



NMP-1 Pressure and Temperature Limits
Core Not Critical Conditions ≤ 28 EFPY

Figure 3-3. Benchmark Core Critical Curve



NMP-1 Pressure and Temperature Limits
Core Critical Conditions ≤ 28 EFPY

3.2 Revised P-T Curves

Revised P-T curves for 28 EFPYs were developed for NMP-1 using ASME Code Case N-640 [1]. The same methodology described above was used with three exceptions. First, Step (c) was modified to use K_{Ic} in place of K_{Ia}, as follows:

$$K_{Ic} = 20.734\, e^{[0.02(T_{1/4t} - ART_{NDT})]} + 33.2 \qquad [10, A\text{-}4200]$$

Second, for the Pressure Test case only, the static head described in Step (h) was determined to be 20.8 psig, for a 576" water column (bottom of beltline to inside surface of top head) at a density of 62.4lb/ft^3 at 70°F. All other curves used a static head based on the operating temperature.

Third, the minimum temperature requirements for the core critical curve were changed as follows:

For Core Critical Conditions:

✓ Per Table 1 of Reference [6], at pressures above 20% of the pre-service hydro test pressure, the Core Critical curve upper vessel temperature must be at least that required for the pressure test. The temperature requirements is as follows:

Minimum Temperature for Critical Core Operation

B =	113.625	inches	
A =	106.5	inches	
P =	1,030	psig	
S_m =	17,520	psi	
σ_{ys} =	69.4	ksi	
M_m =	2.52		
K_I =	66.299	ksi(inch)$^{0.5}$	using K_{Ic}

						$\Delta T_{1/4T} + T_{error}$	T_c
ART(1/4t) =	167.7	°F	T_{crit} =	191	°F	12.2	**203**
ART(3/4t) =	136.8	°F	T_{crit} =	160	°F	62.0	**222**

As a result of this requirement, the Core Critical curve must have at least a temperature of 203°F (for cooldown 1/4t flaws) or 222°F (for heatup 3/4t flaws) for pressures greater than 20% of the pre-service hydro pressure.

Tabulated values for the resulting P-T curves are shown in Tables 3-6 through 3-10. The resulting P-T curves are shown in Figures 3-4 through 3-8.

P-T curve plots and tabulations formatted consistent with the NMP-1 plant Technical Specifications are provided in Appendix A.

Table 3-6. Tabulated Values for Revised Pressure Test P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Pressure Test)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_t =	0.3144	(per Figure G-2214-2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	167.7	°F ======> 28 EFPY
ΔT_w =	0.0	°F (no thermal for pressure test)
K_{IT} =	0.0	ksi*inch$^{1/2}$ (no thermal for pressure test)
$\Delta T_{1/4t}$ =	0.0	°F (no thermal for pressure test)
Safety Factor =	1.50	(for pressure test)
M_m =	2.60	(per Figure G-2214-1 of App. G, assumed value to match Reference [1] results)
Temperature Instrument Error =	4.0	°F
Pressure Instrument Error =	36.2	psig (instrument uncertainty + 20 8 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	1/4t Temperature (°F)	K_{Ic} (ksi*inch$^{1/2}$)	K_{IP} (ksi*inch$^{1/2}$)	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)
100	100 0	38 55	25.70	0	100	0
100	100 0	38 55	25.70	360	100	360
126	126.0	42.20	28.14	360	130	360
126	126.0	42.20	28 14	724	130	688
131	131.0	43.15	28.77	740	135	704
136	136 0	44.20	29 47	758	140	722
141	141.0	45.36	30.24	778	145	742
146	146 0	46 63	31.09	800	150	764
151	151.0	48 05	32.03	824	155	788
156	156 0	49 61	33 07	851	160	815
161	161.0	51.33	34 22	881	165	844
166	166.0	53 24	35 49	913	170	877
171	171.0	55.35	36.90	949	175	913
176	176.0	57.68	38.45	989	180	953
181	181.0	60.25	40.17	1034	185	997
186	186 0	63.10	42.07	1082	190	1046
191	191.0	66.24	44.16	1136	195	1100
196	196.0	69.72	46 48	1196	200	1160
201	201.0	73.56	49 04	1262	205	1226
206	206.0	77.80	51.87	1335	210	1298
211	211.0	82.49	55 00	1415	215	1379
216	216.0	87.68	58 45	1504	220	1468
221	221.0	93.41	62.27	1602	225	1566
226	226.0	99.74	66 49	1711	230	1675
231	231.0	106 74	71.16	1831	235	1795
236	236 0	114.47	76.31	1964	240	1927
241	241.0	123 02	82.01	2110	245	2074

Table 3-7. Tabulated Values for Revised Core Not Critical (100°F/hr Cooldown) P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Not Critical -- 100°F/hr cooldown)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_t =	0.3144	(per Figure G-2214-2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	167.7	°F ======> 28 EFPY
ΔT_w =	47.169	°F (use value at 70°F from past work)
K_{IT} =	14.8	ksi*inch$^{1/2}$
$\Delta T_{1/4t}$ =	23.151	°F (use value at 70°F from past work)
Safety Factor =	2.00	(for heatup/cooldown)
M_m =	2.60	(per Figure G-2214-1 of App G, assumed to be the same as Curve A)
Temperature Instrument Error =	12.2	°F
Pressure Instrument Error =	67.6	psig (instrument uncertainty + 15.4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	1/4t Temperature (°F)	K_{Ic} (ksi*inch$^{1/2}$)	K_{IP} (ksi*inch$^{1/2}$)	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)	Adjusted Temperature for Curve C (°F)
40	63.2	35.76	10.47	0	100	0	52
45	68.2	36.03	10.60	273	100	205	57
50	73.2	36.33	10.75	277	100	209	62
55	78.2	36.66	10.91	281	100	213	67
60	83.2	37.02	11.10	286	100	218	72
65	88.2	37.42	11.30	291	100	223	77
70	93.2	37.87	11.52	296	100	229	82
75	98.2	38.36	11.76	303	100	235	87
80	103.2	38.90	12.04	310	100	242	92
85	108.2	39.50	12.34	317	100	250	97
88	111.0	39.86	12.52	322	100	254	100
90	113.2	40.16	12.67	326	102	258	102
95	118.2	40.90	13.03	335	107	268	107
100	123.2	41.71	13.44	346	112	278	112
105	128.2	42.60	13.89	357	117	290	117
110	133.2	43.59	14.38	370	122	302	122
115	138.2	44.68	14.93	384	127	316	127
120	143.2	45.89	15.53	400	132	332	132
125	148.2	47.22	16.20	417	137	349	137
128	151.1	48.06	16.62	428	140	360	140
138	161.2	51.39	18.28	470	150	360	150
140	163.2	52.13	18.65	480	152	360	152
145	168.2	54.12	19.65	506	157	360	157
148	171.2	55.42	20.29	522	160	360	160
148	171.2	55.42	20.29	522	160	455	160
150.8	174.0	56.70	20.93	539	163	471	163
150.8	174.0	56.70	20.93	539	163	471	163
155	178.2	58.75	21.96	565	167	498	167
160	183.2	61.44	23.31	600	172	532	172
165	188.2	64.41	24.79	638	177	570	177
170	193.2	67.69	26.43	680	182	613	182
175	198.2	71.32	28.25	727	187	659	187
180	203.2	75.33	30.25	778	192	711	192
185	208.2	79.76	32.47	835	197	768	197
190	213.2	84.66	34.91	898	202	831	202
195	218.2	90.07	37.62	968	207	900	207
200	223.2	96.05	40.61	1045	212	977	212
205	228.2	102.66	43.92	1130	217	1062	217
210	233.2	109.97	47.57	1224	222	1156	222
215	238.2	118.04	51.61	1328	227	1260	227
220	243.2	126.97	56.07	1443	232	1375	232
225	248.2	136.83	61.00	1570	237	1502	237
230	253.2	147.73	66.45	1710	242	1642	242
235	258.2	159.77	72.47	1865	247	1797	247
240	263.2	173.08	79.13	2036	252	1968	252
245	268.2	187.79	86.48	2225	257	2158	257

Table 3-8. Tabulated Values for Revised Core Not Critical (0°F/hr) P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Not Critical – 0°F/hr cooldown)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_t =	0.3144	(per Figure G-2214-2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	167.7	°F ======> 28 EFPY
ΔT_w =	0.0	°F (use value at 100°F from past work)
K_{IT} =	0.0	ksi*inch$^{1/2}$
$\Delta T_{1/4t}$ =	0.0	°F (use value at 100°F from past work)
Safety Factor =	2.00	(for heatup/cooldown)
M_m =	2.60	(per Figure G-2214-1 of App G, assumed to be the same as Curve A)
Temperature Instrument Error =	12.2	°F
Pressure Instrument Error =	67.2	psig (instrument uncertainty + 15.4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	1/4t Temperature (°F)	K_{Ic} (ksi*inch$^{1/2}$)	K_{IP} (ksi*inch$^{1/2}$)	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)	Adjusted Temperature for Curve C (°F)
40	40.0	34.81	17.41	0	100	0	52
45	45.0	34.98	17.49	450	100	383	57
50	50.0	35.17	17.58	452	100	385	62
55	55.0	35.38	17.69	455	100	388	67
60	60.0	35.61	17.80	458	100	391	72
65	65.0	35.86	17.93	461	100	394	77
70	70.0	36.14	18.07	465	100	398	82
75	75.0	36.45	18.22	469	100	402	87
80	80.0	36.79	18.39	473	100	406	92
85	85.0	37.17	18.58	478	100	411	97
88	87.8	37.39	18.70	481	100	414	100
90	90.0	37.58	18.79	484	102	416	102
95	95.0	38.04	19.02	489	107	422	107
100	100.0	38.55	19.28	496	112	429	112
105	105.0	39.12	19.56	503	117	436	117
110	110.0	39.74	19.87	511	122	444	122
115	115.0	40.43	20.21	520	127	453	127
120	120.0	41.19	20.59	530	132	463	132
125	125.0	42.03	21.01	541	137	474	137
130	130.0	42.95	21.48	553	142	485	142
135	135.0	43.98	21.99	566	147	499	147
140	140.0	45.11	22.56	580	152	513	152
145	145.0	46.37	23.18	597	157	529	157
148	148.0	47.18	23.59	607	160	540	160
149	149.0	47.46	23.73	611	161	543	161
151	150.8	47.99	24.00	617	163	550	163
152	152.0	48.35	24.17	622	164	555	164
155	155.0	49.28	24.64	634	167	567	167
160	160.0	50.97	25.49	656	172	589	172
165	165.0	52.84	26.42	680	177	613	177
170	170.0	54.91	27.46	706	182	639	182
175	175.0	57.19	28.60	736	187	669	187
180	180.0	59.72	29.86	768	192	701	192
185	185.0	62.51	31.25	804	197	737	197
190	190.0	65.59	32.79	844	202	777	202
195	195.0	68.99	34.50	888	207	820	207
200	200.0	72.76	36.38	936	212	869	212
205	205.0	76.92	38.46	990	217	922	217
210	210.0	81.52	40.76	1049	222	982	222
215	215.0	86.60	43.30	1114	227	1047	227
220	220.0	92.21	46.11	1186	232	1119	232
225	225.0	98.42	49.21	1266	237	1199	237
230	230.0	105.28	52.64	1354	242	1287	242
235	235.0	112.86	56.43	1452	247	1385	247
240	240.0	121.24	60.62	1560	252	1493	252
245	245.0	130.50	65.25	1679	257	1612	257
250	250.0	140.73	70.37	1811	262	1743	262
255	255.0	152.04	76.02	1956	267	1889	267
260	260.0	164.54	82.27	2117	272	2050	272

Table 3-9. Tabulated Values for Revised Core Not Critical (100°F/hr Heatup) P-T Curve for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Not Cntical -- 100°F/hr heatup)

Plant =	Nine Mile Point 1	
Component =	Beltline	
Vessel thickness, t =	7.125	inches
M_t =	0.3144	(per Figure G-2214-2 of Section XI, Appendix G)
Vessel Radius, R =	106.5	inches
ART =	136.8	°F ===== 28 EFPY
Safety Factor =	2.00	(for heatup/cooldown)
Temperature Instrument Error =	12.2	°F
Pressure Instrument Error =	67.6	psig (instrument uncertainty + 15 4 psig static head)
Hydro Test Pressure =	1,800	psig
Flange RT_{NDT} =	40	°F

Fluid Temperature T (°F)	$\Delta T_{1/4t}$ (°F)	1/4t Temperature (°F)	K_{Io} (ksi*inch$^{1/2}$)	ΔT_w (°F)	K_{IT} (ksi*inch$^{1/2}$)	K_{IP} (ksi*inch$^{1/2}$)	M_m	Calculated Pressure P (psig)	Adjusted Temperature for P-T Curve (°F)	Adjusted Pressure for P-T Curve (psig)	Adjusted Temperature for Curve C (°F)
40	0 000	40 0	36 19	0 000	0 00	18 10	2 80	0	100	0	52
45	0 000	45 0	36 51	0 000	0 00	18 25	2 80	436	100	298	57
50	0 000	50 0	36 85	0 000	0 00	18 43	2 80	440	100	298	62
55	0 000	55 0	37 24	0 000	0 00	18 62	2 80	445	100	298	67
60	0 000	60 0	37 66	0 000	0 00	18 83	2 80	450	100	298	72
65	0 000	65 0	38 13	0 000	0 00	19 07	2 80	456	100	298	77
70	-0 078	69 9	38 64	0 078	0 02	19 31	2 80	461	100	298	82
75	-4 801	70 2	38 67	4 897	1 54	18 57	2 80	444	100	298	87
80	-9 523	70 5	38 70	9 715	3 05	17 82	2 80	426	100	298	92
85	-12 123	72 9	38 97	12 480	3 92	17 53	2 80	419	100	298	97
88	-14 861	72 9	38 98	15 398	4 84	17 07	2 80	408	100	298	100
90	-17 324	72 7	38 95	18 009	5 66	16 64	2 80	398	102	298	102
95	-20 336	74 7	39 18	21.236	6 68	16 25	2 80	388	107	298	107
100	-23 348	76 7	39 43	24 463	7 69	15 87	2 80	379	112	298	112
105	-25 662	79 3	39 77	26 944	8 47	15 65	2 80	374	117	298	117
110	-27 976	82 0	40 13	29 424	9 25	15 44	2 80	369	122	298	122
115	-29 754	85 2	40 59	31 331	9 85	15 37	2 80	367	127	298	127
120	-31 532	88 5	41 09	33 238	10 45	15 32	2 80	366	132	298	132
125	-32 901	92 1	41 68	34 707	10 91	15 38	2 80	368	137	300	137
130	-34 270	95 7	42 32	36 175	11.37	15 47	2 78	372	142	304	142
135	-35 328	99 7	43 07	37 310	11 73	15 67	2 77	379	147	311	147
140	-36 386	103 6	43 88	38 444	12 09	15 89	2 75	386	152	319	152
145	-37 207	107 8	44 81	39 324	12 36	16 22	2 74	396	157	329	157
150	-38 027	112 0	45 82	40 204	12 64	16 59	2 72	408	162	340	162
155	-38 667	116 3	46 97	40 890	12 86	17 06	2 71	421	167	354	167
160	-39 306	120 7	48 22	41 576	13 07	17 58	2 69	437	172	369	172
165	-39 810	125 2	49 64	42 115	13 24	18.20	2 68	455	177	387	177
169 8	-40 313	129 5	51 11	42 654	13 41	18 85	2 66	474	182	406	182
169 8	-40.313	129 5	51 12	42 654	13 41	18 85	2 66	474	182	406	182
175	-40 714	134 1	52 84	43 083	13 55	19 65	2 65	497	187	429	187
180	-41 115	138 7	54 73	43 512	13 68	20 53	2 63	522	192	454	192
185	-41 441	143 4	56 84	43 860	13 79	21 53	2 62	551	197	483	197
190	-41.767	148 0	59 16	44 207	13 90	22 63	2 60	582	202	515	202
195	-42 037	152 8	61 73	44 472	13 98	23 88	2 60	614	207	547	207
200	-42 307	157 5	64 56	44 720	14 06	25 25	2 60	650	212	582	212
205	-42 532	162 3	67 71	44 955	14 13	26 79	2 60	689	217	622	217
210	-42 757	167 0	71 16	45.267	14 23	28 47	2 60	732	222	665	222
215	-42 939	171 9	75 00	45 463	14 29	30 36	2 60	781	227	713	227
220	-43 120	176 7	79 23	45 659	14 36	32 44	2 60	835	232	767	232
225 8	-43 265	182 5	84 95	45 814	14 40	35 27	2 60	908	238	840	238
225 8	-43 265	182 5	84 96	45 969	14 45	35 26	2 60	907	238	840	238
230	-43 409	186 6	89 33	46 095	14 49	37 42	2 60	963	242	895	242
235	-43 526	191 5	95 08	46.220	14 53	40 28	2 60	1036	247	969	247
240	-43 643	196 4	101 43	46 325	14 56	43 43	2 60	1118	252	1050	252
245	-43 742	201 3	108 46	46 430	14 60	46 93	2 60	1208	257	1140	257
250	-43 840	206 2	116 21	46 520	14 63	50 79	2 60	1307	262	1239	262
255	-43 923	211.1	124 79	46 610	14 65	55 07	2 60	1417	267	1349	267
260	-44 006	216 0	134 25	46 688	14 68	59 79	2 60	1538	272	1471	272
265	-44 078	220 9	144 72	46 765	14 70	65 01	2 60	1673	277	1605	277
270	-44 150	225 9	156 27	46 834	14 72	70 77	2 60	1821	282	1754	282
275	-44 214	230 8	169 04	46 902	14 75	77 15	2 60	1985	287	1918	287
280	-44 278	235 7	183 14	46 965	14 77	84 19	2 60	2166	292	2099	292
285	-44 337	240 7	198 71	47 027	14 79	91 96	2 60	2366	297	2299	297
290	-44 395	245 6	200 00	47 087	14 80	92 60	2 60	2383	302	2315	302
295	-44 452	250 5	200 00	47 147	14 82	92 59	2 60	2382	307	2315	307
300	-44 508	255 5	200 00	47 206	14 84	92 58	2 60	2382	312	2315	312

Table 3-10. Tabulated Values for Revised Core Critical P-T Curves for 28 EFPY

Pressure-Temperature Curve Calculation

(Core Critical)

Inputs:

Cooldown Curve

Plant = Nine Mile Point 1
EFPY = 28
Critical Temperature = 203 °F
Hydro Test Pressure = 1,800 psig
Flange RT_{NDT} = 40 °F

Heatup Curve

Plant = Nine Mile Point 1
EFPY = 28
Critical Temperature = 222 °F
Hydro Test Pressure = 1,800 psig
Flange RT_{NDT} = 40 °F

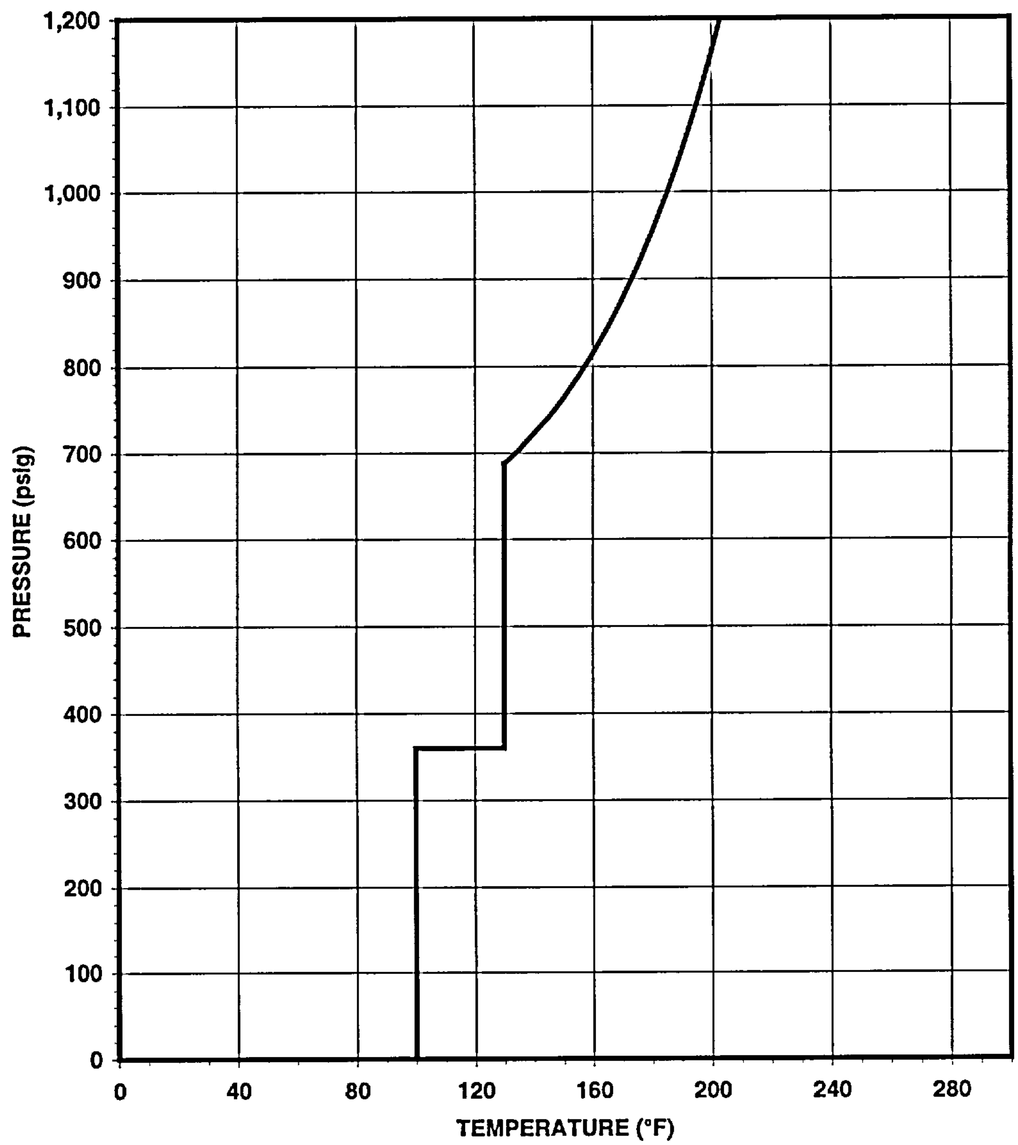
Cooldown Curve

Adjusted Curve B Temperature (°F)	Adjusted Curve B Pressure for (psig)	Curve C Temperature (°F)	Curve C Pressure (psig)
52	0	100	0
57	205	100	205
62	209	102	209
67	213	107	213
72	218	112	218
77	223	117	223
82	229	122	229
87	235	127	235
92	242	132	242
97	250	137	250
100	254	140	254
102	258	142	258
107	268	147	268
112	278	152	278
117	290	157	290
122	302	162	302
127	316	167	316
132	332	172	332
137	349	177	349
140	360	180	360
147	360	187	360
152	360	192	360
157	360	197	360
160	360	200	360
160	455	200	360
163	471	203	360
163	471	203	471
167	498	207	498
172	532	212	532
177	570	217	570
182	613	222	613
187	659	227	659
192	701	232	701
197	737	237	737
202	777	242	777
207	820	247	820
212	869	252	869
217	922	257	922
222	982	262	982
227	1047	267	1047
232	1119	272	1119
237	1199	277	1199
242	1287	282	1287
247	1385	287	1385
252	1493	292	1493
257	1612	297	1612
262	1743	302	1743
267	1889	307	1889
272	2050	312	2050

Heatup Curve

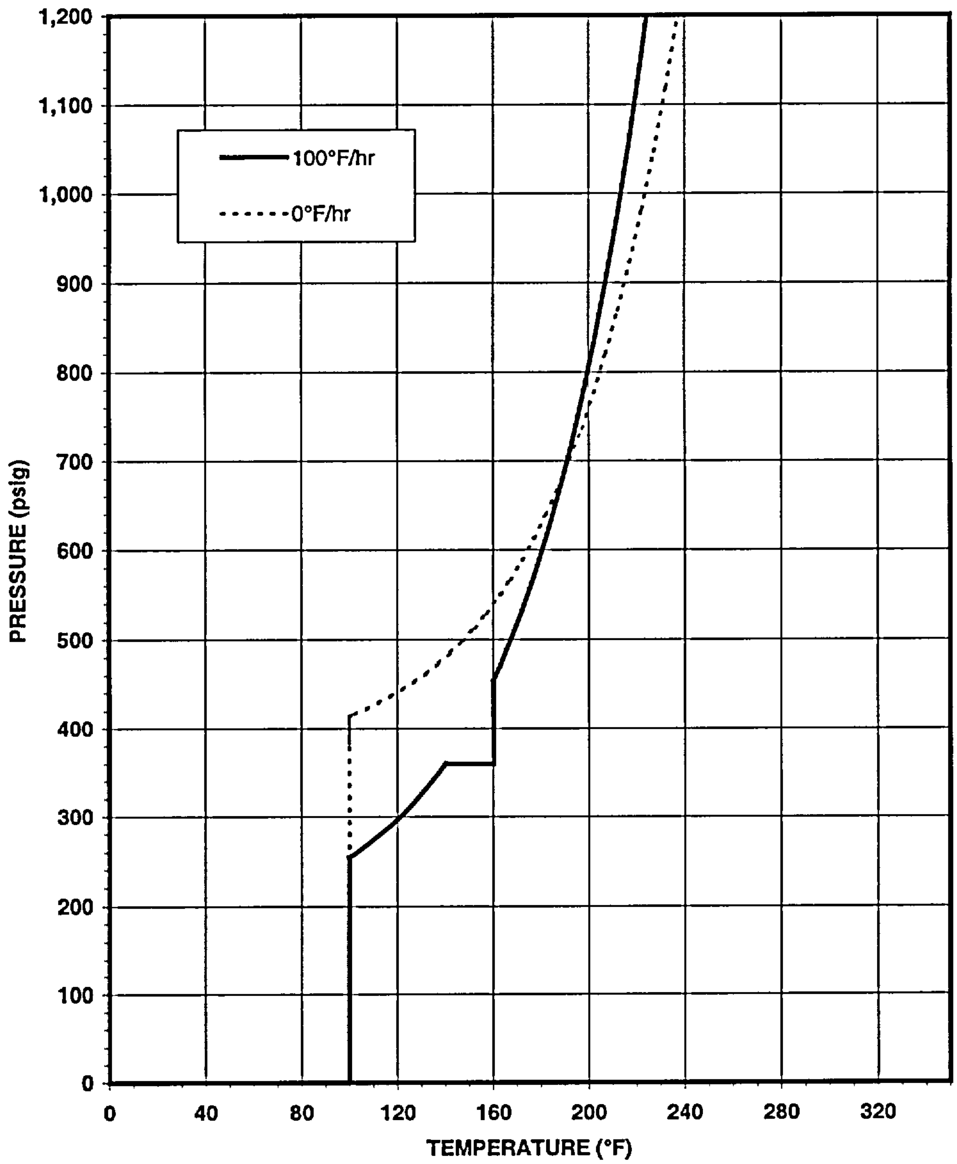
Adjusted Curve B Temperature (°F)	Adjusted Curve B Pressure for (psig)	Curve C Temperature (°F)	Curve C Pressure (psig)
52	0	100	0
57	298	100	298
62	298	102	298
67	298	107	298
72	298	112	298
77	298	117	298
82	298	122	298
87	298	127	298
92	298	132	298
97	298	137	298
100	298	140	298
102	298	142	298
107	298	147	298
112	298	152	298
117	298	157	298
122	298	162	298
127	298	167	298
132	298	172	298
137	300	177	300
142	304	182	304
147	311	187	311
152	319	192	319
157	329	197	329
162	340	202	340
167	354	207	354
172	369	212	360
177	387	217	360
182	406	222	360
182	406	222	406
187	429	227	429
192	454	232	454
197	483	237	483
202	515	242	515
207	547	247	547
212	582	252	582
217	622	257	622
222	665	262	665
227	713	267	713
232	767	272	767
238	840	278	840
238	840	278	840
242	895	282	895
247	969	287	969
252	1050	292	1050
257	1140	297	1140
262	1239	302	1239
267	1349	307	1349
272	1471	312	1471
277	1605	317	1605
282	1754	322	1754
287	1918	327	1918
292	2099	332	2099
297	2299	337	2299
302	2315	342	2315
307	2315	347	2315
312	2315	352	2315
317	2314	357	2314
322	2314	362	2314
327	2314	367	2314

Figure 3-4. Revised Pressure Test P-T Curve for 28 EFPY



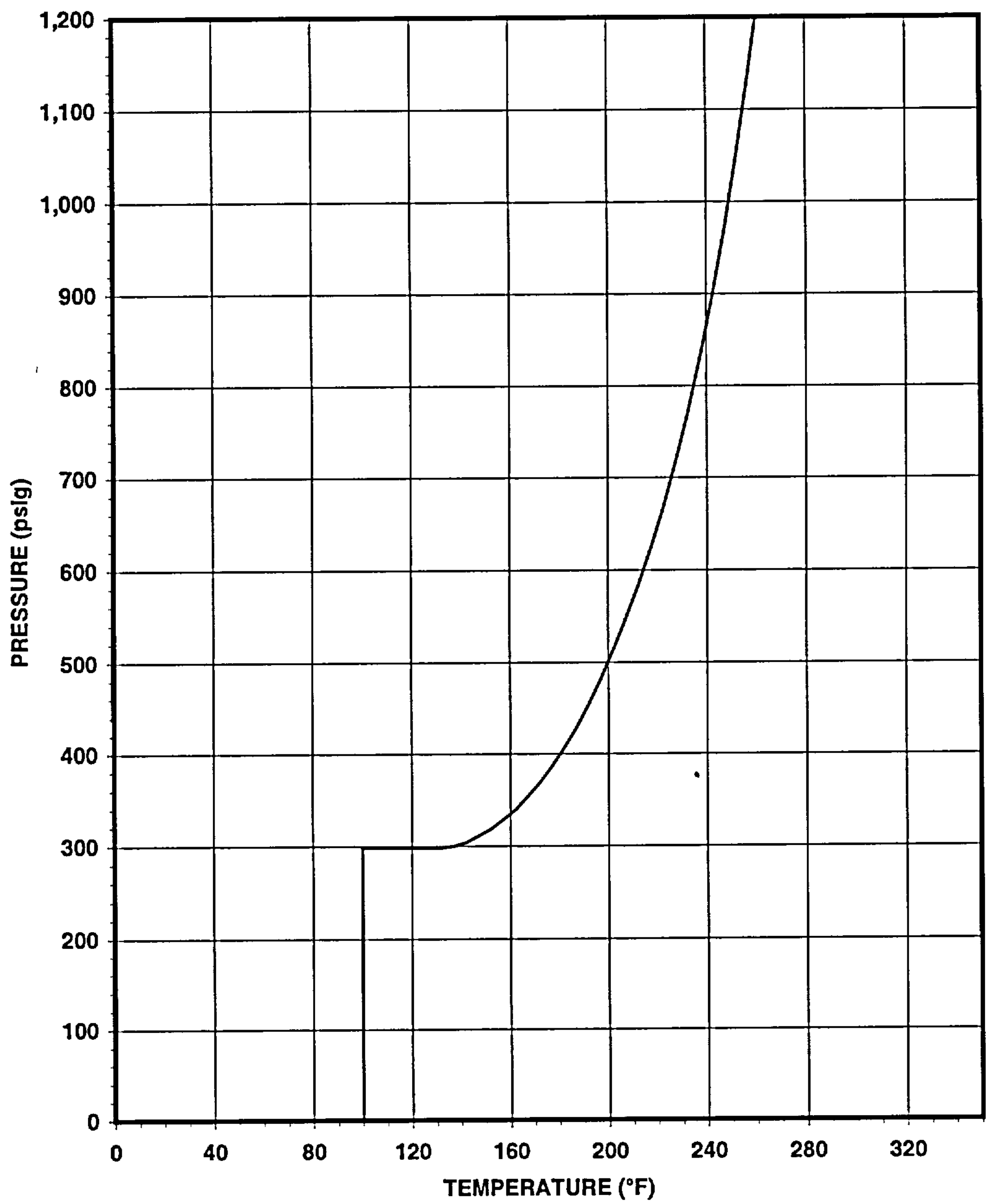
NMP-1 Pressure and Temperature Limits
Hydrostatic and Leak Tests ≤ 28 EFPY

Figure 3-5. Revised Cooldown Core Not Critical P-T Curve for 28 EFPY



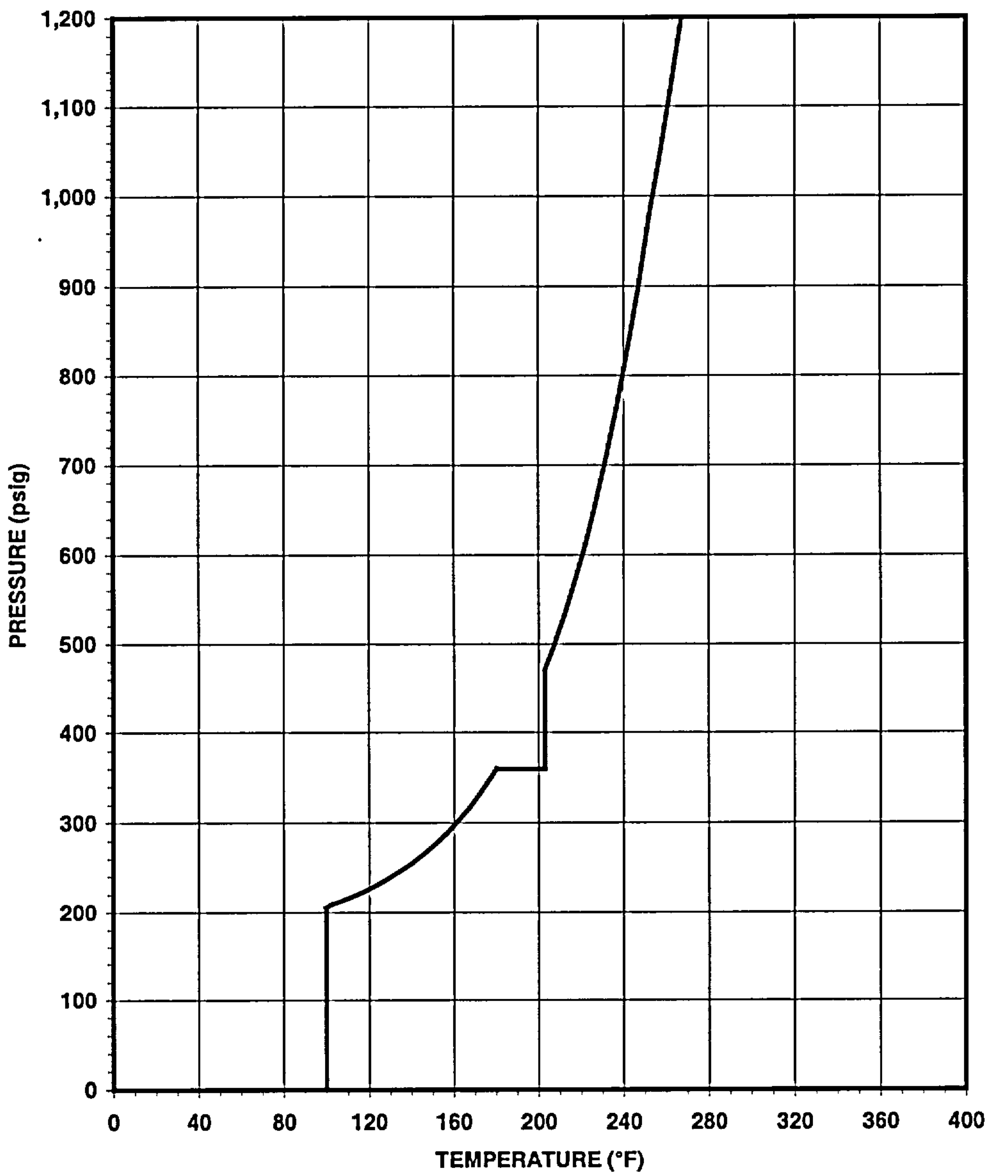
NMP-1 Pressure and Temperature Limits
Core Not Critical Conditions (COOLDOWN) ≤ 28 EFPY

Figure 3-6. Revised Heatup Core Not Critical P-T Curve for 28 EFPY



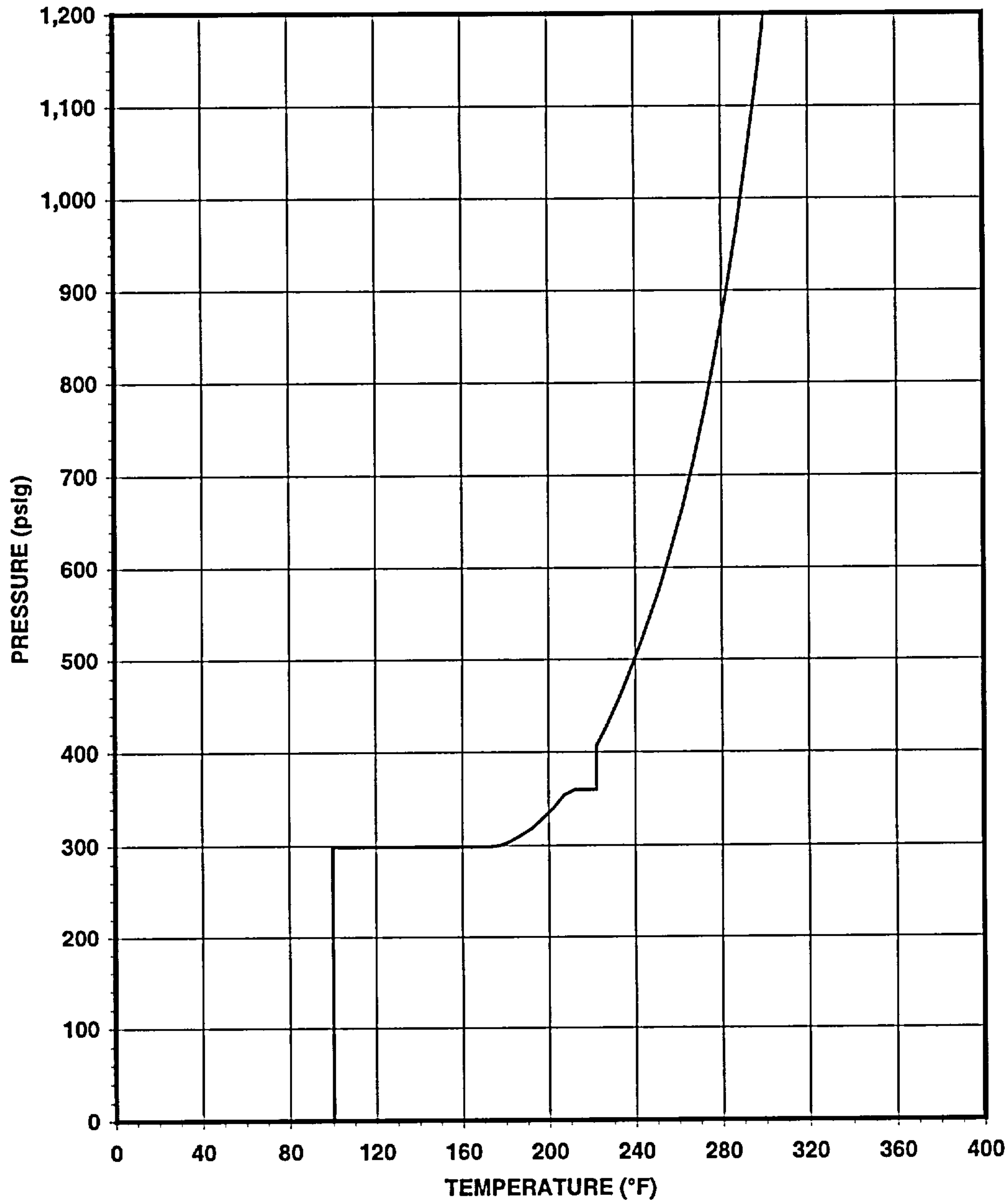
NMP-1 Pressure and Temperature Limits
Core Not Critical Conditions (HEATUP) ≤ 28 EFPY

Figure 3-7. Revised Cooldown Core Critical P-T Curve for 28 EFPY



NMP-1 Pressure and Temperature Limits
Core Critical Conditions (COOLDOWN) ≤ 28 EFPY

Figure 3-8. Revised Heatup Core Critical P-T Curve for 28 EFPY



NMP-1 Pressure and Temperature Limits
Core Critical Conditions (HEATUP) ≤ 28 EFPY

4.0 CONCLUSIONS

The revised P-T curves for NMP-1 are shown in Figures 3-4 through 3-8 for 28 EFPYs for incorporation into the NMP-1 plant Technical Specifications. The curves utilize the same methodology as was used for the previously approved P-T curves with the exception that K_{Ic} was applied in place of K_{Ia} as allowed by ASME Code Case N-640 [1].

5.0 REFERENCES

1. ASME Boiler and Pressure Vessel Code, Code Case N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves," Section XI, Division 1, Approved February 26, 1999.

2. U. S. Code of Federal Regulations, Title 10, Part 50, Appendix G, "Fracture Toughness Requirements," 1-1-98 Edition.

3. Welding Research Council Bulletin No. 175, "PVRC Recommendations on Toughness Requirements for Ferritic Materials," PVRC Ad Hoc Group on Toughness Requirements, Welding Research Council, August 1972.

4. ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Nonmandatory Appendix G, "Fracture Toughness Criteria for Protection Against Failure," 1989 Edition.

5. MPM Report No. MPM-59838, "Pressure-Temperature Operating Curves for Nine Mile Point Unit 1," May 1998, SI File No. NMP-05Q-207.

6. USNRC Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," U. S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, (Task ME 305-4), May 1988.

7. Niagara Mohawk Power Corporation Document No. FA98-195, "Pressure-Temperature Operating Curves for Nine Mile Point Unit 1, Rev. 1," 12/16/98, SI File No. NMP-05Q-207.

8. Structural Integrity Associates Calculation No. NMP-05Q-301, Revision 0, "Benchmark Analysis," 11/5/02.

9. Structural Integrity Associates Calculation No. NMP-05Q-302, Revision 0, "P-T Curves Generated Using Code Case N-640," 11/5/02.

10. ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Nonmandatory Appendix A, "Analysis of Flaws," 1995 Edition.

APPENDIX A

P-T CURVE PLOTS AND TABULATIONS IN TECHNICAL SPECIFICATION FORMAT

LIMIT FOR NON-CRITICAL OPERATION
HEATUP AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
298	100
298	102
298	107
298	112
298	117
298	122
298	127
298	132
300	137
304	142
311	147
319	152
329	157
340	162
354	167
369	172
387	177
406	182
406	182
429	187
454	192
483	197
515	202
547	207
582	212
622	217
665	222
713	227
767	232
840	238
840	238
895	242
969	247
1050	252
1140	257

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.a

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING HEAT-UP (CORE NOT CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF CORE OPERATION

LIMIT FOR NON-CRITICAL OPERATION
COOLDOWN AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
205	100
209	100
213	100
218	100
223	100
229	100
235	100
242	100
250	100
254	100
258	102
268	107
278	112
290	117
302	122
316	127
332	132
349	137
360	140
360	160
455	160
471	163
471	163
498	167
532	172
570	177
613	182
659	187
701	192
737	197
777	202
820	207
869	212
922	217
982	222
1047	227
1119	232

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.b

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN (CORE NOT CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF CORE OPERATION

LIMIT FOR POWER OPERATION (CORE CRITICAL)
HEATUP AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
298	100
298	172
300	177
304	182
311	187
319	192
329	197
340	202
354	207
360	212
360	217
360	222 [a]
406	222 [a]
429	227
454	232
483	237
515	242
547	247
582	252
622	257
665	262
713	267
767	272
840	278
840	278
895	282
969	287
1050	292
1140	297

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
([a]water level must be in range for power operation if core is critical below 222°F)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.c

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING
HEATUP (CORE CRITICAL) (HEATING RATE ≤ 100°F/HR)
FOR UP TO 28 EFFECTIVE FULL POWER YEARS
OF CORE OPERATION

LIMIT FOR POWER OPERATION (CORE CRITICAL)
COOLING AT UP TO 100°F/HR

REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
205	100
209	102
213	107
218	112
223	117
229	122
235	127
242	132
250	137
254	140
258	142
268	147
278	152
290	157
302	162
316	167
332	172
349	177
360	180
360	200
360	203 [a]
471	203 [a]
498	207
532	212
570	217
613	222
659	227
701	232
737	237
777	242
820	247
869	252
922	257
982	262
1047	267
1119	272
1199	277

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
([a]water level must be in range for power operation if core is critical below 203°F)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.d

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN (CORE CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF CORE OPERATION

LIMIT FOR IN-SERVICE TEST
(CORE NOT CRITICAL, FUEL IN VESSEL)

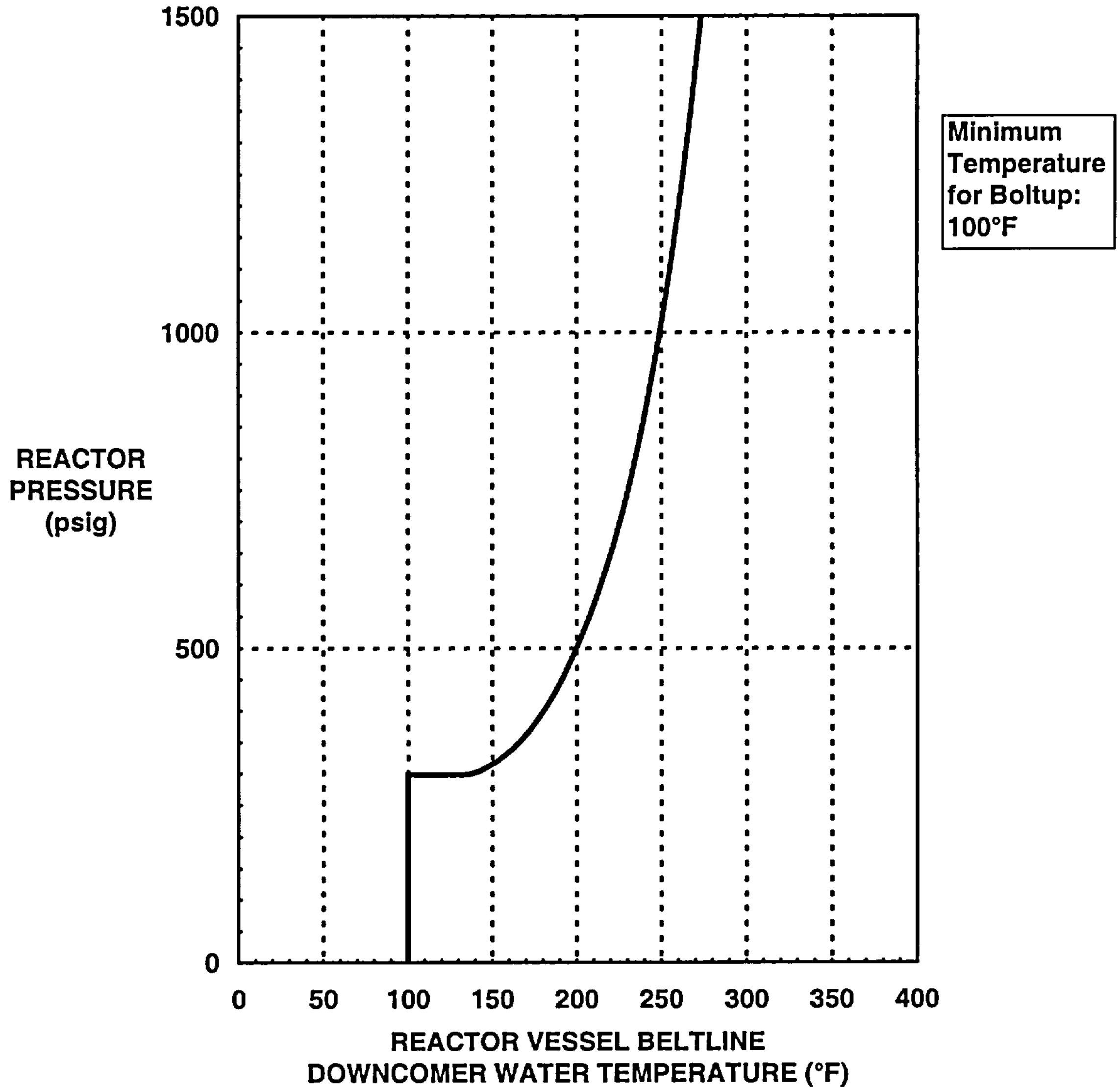
REACTOR PRESSURE (psig) IN TOP DOME	REACTOR VESSEL BELTLINE DOWNCOMER WATER TEMPERATURE (°F)
0	100
360	100
360	130
688	130
704	135
722	140
742	145
764	150
788	155
815	160
844	165
877	170
913	175
953	180
997	185
1046	190
1100	195
1160	200

(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this table)

TABLE 3.2.2.e

MINIMUM TEMPERATURE FOR PRESSURIZATION DURING
LEAK/HYDROSTATIC TESTING (CORE NOT CRITICAL)
FOR UP TO 28 EFFECTIVE FULL POWER YEARS
OF CORE OPERATION

HEATUP - CORE NOT CRITICAL

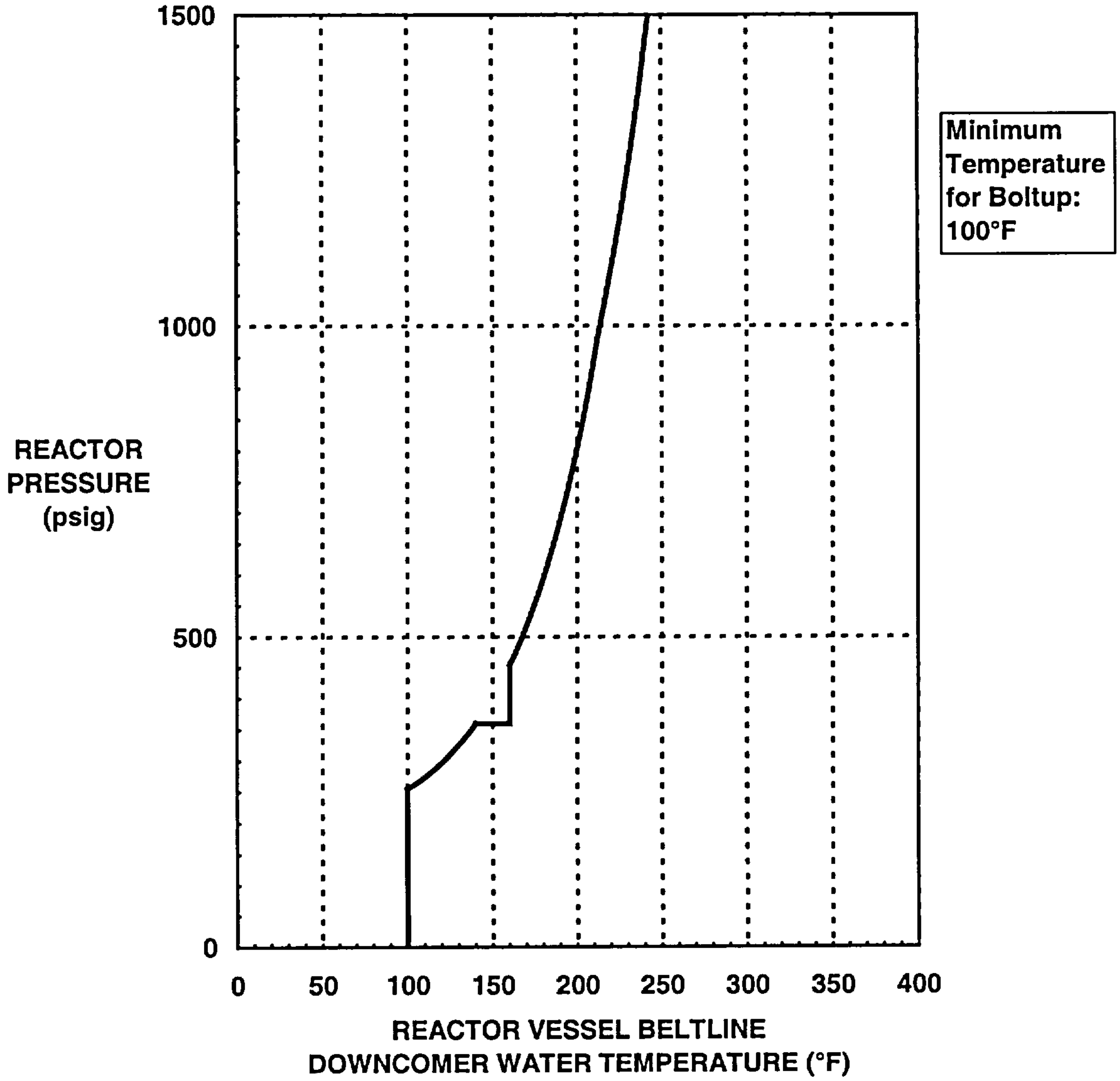


(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.a

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING HEATUP AND LOW-POWER PHYSICS TESTS (CORE NOT CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

COOLDOWN - CORE NOT CRITICAL

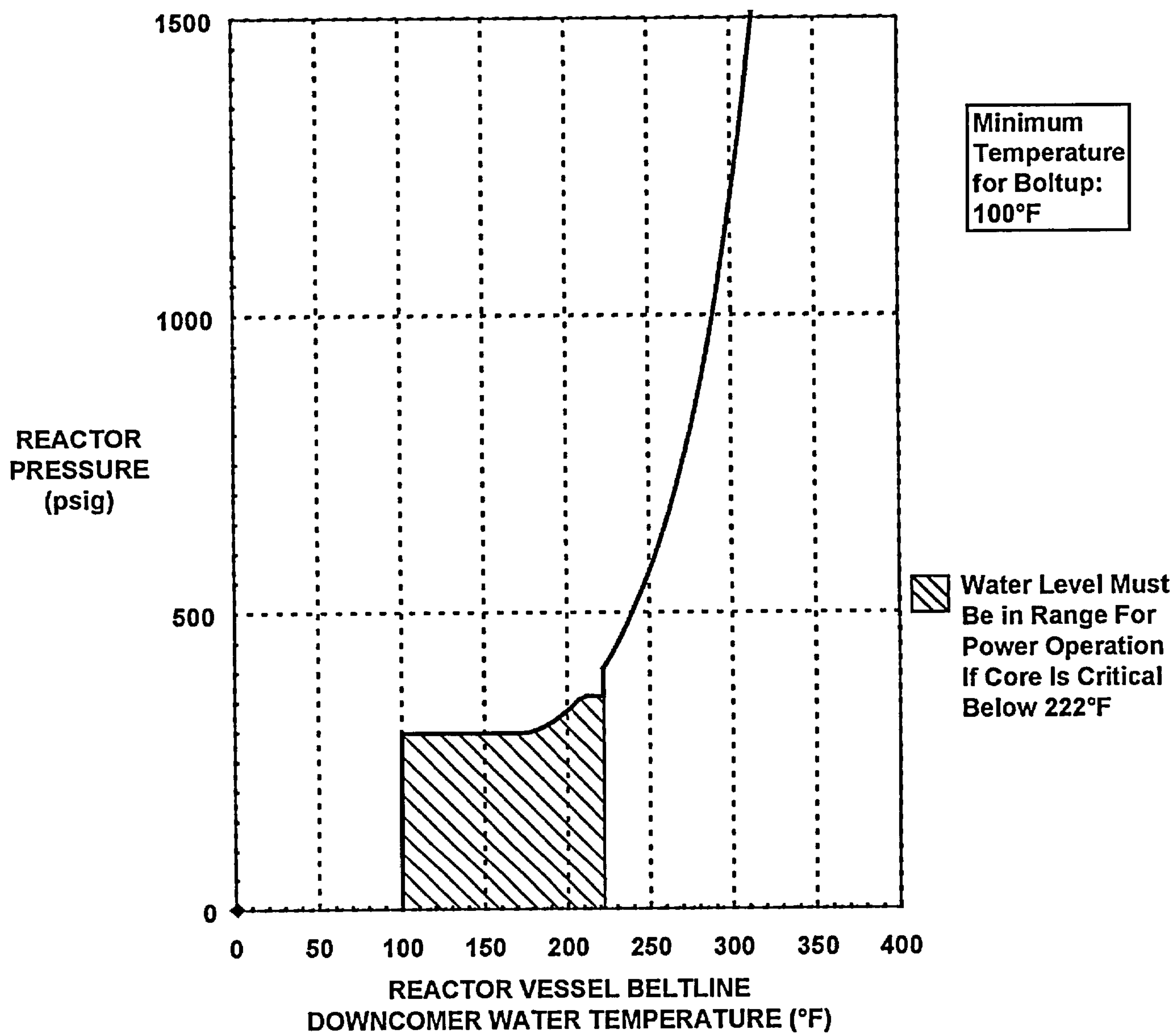


(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.b

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING COOLDOWN AND LOW-POWER PHYSICS TESTS (CORE NOT CRITICAL) (COOLING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION

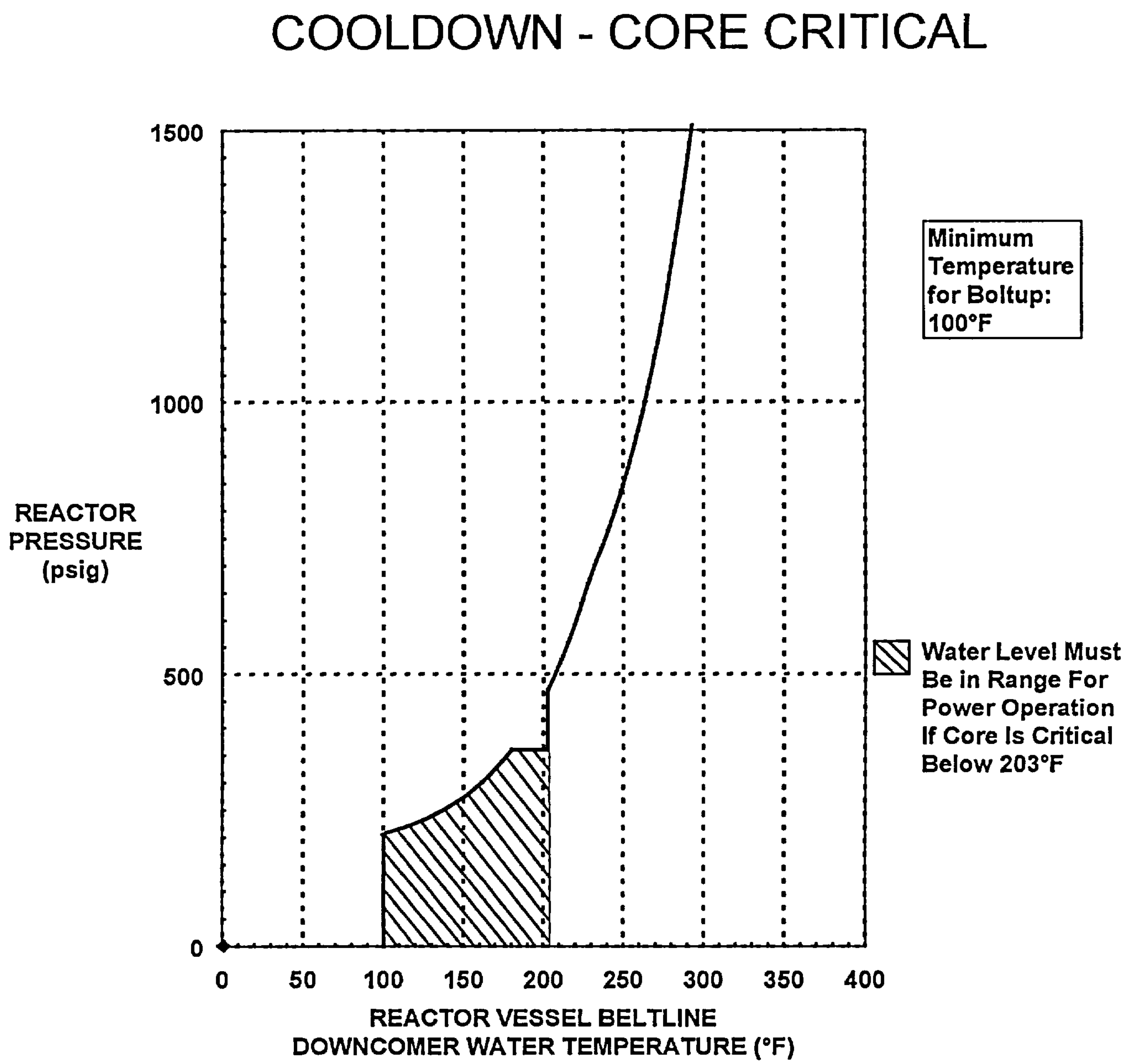
HEATUP - CORE CRITICAL



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.c

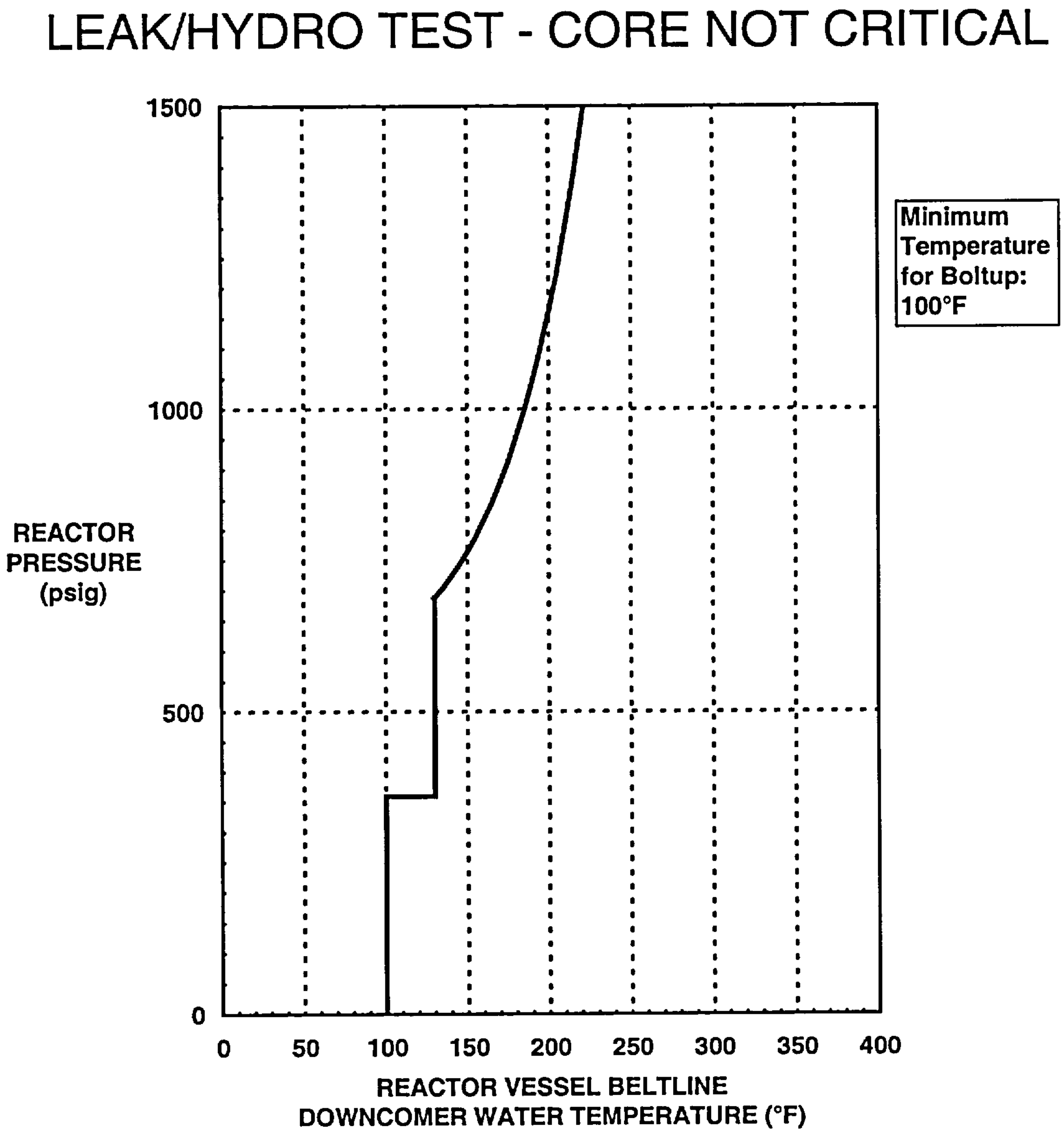
MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING CORE OPERATION (CORE CRITICAL) (HEATING RATE ≤ 100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.d

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING CORE OPERATION (CORE CRITICAL) (COOLING RATE ≤100°F/HR) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION



(reactor vessel beltline downcomer water temperature is measured at recirculation loop suction)
(instrument uncertainties have been included in this figure)

FIGURE 3.2.2.e

MINIMUM BELTLINE DOWNCOMER WATER TEMPERATURE FOR PRESSURIZATION DURING IN-SERVICE HYDROSTATIC TESTING AND LEAK TESTING (CORE NOT CRITICAL) FOR UP TO 28 EFFECTIVE FULL POWER YEARS OF OPERATION