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10CFR50.60
10CFR50, Appendices G and H

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U.S. Nuclear Regulatory Commission
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**EXEMPTION REQUEST TO USE ASME CODE CASES N-588 AND N-640**

Entergy Nuclear Generation Company (ENGC)-Pilgrim requested NRC review and approval for a change to the pressure-temperature limit curves of Figures 3.6.1, 3.6.2, and 3.6.3 of Pilgrim's Technical Specifications to cover operation between 20, 32 and 48 Effective Full Power Years. A "No Significant Hazards Considerations" evaluation and "Safety Evaluation" were provided in support of the proposed change.

The November 22, 2000, proposed change was developed in accordance with Appendices G and H of 10 CFR Part 50; the ASTM Standards and the ASME Code, which are referenced in Appendices G and H, 10CFR50.36(c)(2); Regulatory Guide 1.99, Revision 2, *Radiation Embrittlement of Reactor Vessel Materials* and Generic Letter 88-11. As stated in the cover letter, the proposed pressure-temperature curves were developed using the following two ASME Code Cases:

- **ASME Code Case N-588, "Alternative to Reference Flaw Orientation of Appendix G for Circumferential Welds in Reactor Vessels, Section XI, Division 1."** This Code Case allows the use of alternative procedures for defining the orientation of postulated flaws in circumferential welds and for calculating the applied stress intensity factors of axial and circumferential flaws. Code Case N-588 was approved for use by the appropriate ASME Boiler & Pressure Vessel Section XI committee on December 12, 1997.

- **ASME Code Case N-640, "Alternative Reference Fracture Toughness for Development of P-T Curves for ASME Section XI, Division 1."** This Code Case provides an alternate method for determining the fracture toughness of reactor vessel materials for use in determining P-T Limits. Code Case N-640 was approved for use by the appropriate ASME Boiler & Pressure Vessel Section XI committee on February 26, 1999.

Code Cases N-588 and N-640 are awaiting final NRC approval. The attached exemption requests to use N-588 and N-640 are an adjunct to the November 22, 2000, amendment request. Pilgrim's November 22, 2000, amendment request provided a "No Significant Hazards Considerations" and "Safety Evaluation."

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This exemption request is made in accordance with 10CFR50.12. Please contact P.M. Kahler at (508) 830-7939 if you require further information on this issue.

Sincerely,

John Alexander

Attachments: 1) Request for Exemption for ASME Code Case N-588
2) Request for Exemption for ASME Code Case N-640

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## Request for Exemption from 10CFR50.60 (ASME Code Case N-588)

10CFR 50.12(a) Requirements:

The requested exemption to allow use of ASME Code Case N-588 to determine stress intensity factors for postulated flaws and postulated flaw orientation for circumferential welds meets the criteria of 10CFR50.12 as discussed below. 10CFR50.12 states that the Commission may grant an exemption from requirements contained in 10CFR50 provided that:

1. *The requested exemption is authorized by law*: 10CFR50.60(b) allows the use of alternatives to 10CFR50, Appendices G and H, when the NRC grants an exemption under 10CFR50.12. No law precludes the activities covered by this exemption request.

2. *The requested exemption does not present an undue risk to the public health and safety*: 10CFR50, Appendix G, requires that Article G-2120 of ASME XI, Appendix G, be used to determine the maximum postulated defects in RPVs for the vessel P-T limits. These limits are determined for normal operation and pressure/leak test conditions. Article G-2120 specifies, in part, that the postulated defect be in the surface of the vessel material and normal (perpendicular in the plane of the material) to the direction of maximum stress. ASME XI, Appendix G, also provides methodology for determining the stress intensity factors for a maximum postulated defect normal to the maximum stress. The purpose of this article is, in part, to ensure the prevention of nonductile fractures by providing procedures to identify the most limiting postulated fractures to be considered in the development of pressure-temperature (P-T) limits.

   Code Case N-588 provides benefits in terms of calculating P-T limits by revising the Article G-2120 reference flaw orientation for circumferential welds in reactor vessels. The reference flaw is a postulated flaw that accounts for the possibility of a prior existing defect that may have gone undetected during the fabrication process. Thus, the intended application of a reference flaw is to account for defects that could physically exist within the geometry of the weldment. The current ASME Section XI, Appendix G, approach mandates the consideration of an axial reference flaw in circumferential welds for purposes of calculating the P-T limits. Postulating the Appendix G reference flaw in a circumferential weld is physically unrealistic and overly conservative, because the length of the flaw is 1.5 times the vessel wall thickness, which is much longer than the width of circumferential welds. The possibility that an axial flaw may extend from a circumferential weld into a plate/forging or axial weld is already adequately covered by the requirement that defects be postulated in plates/forgings and axial welds. The fabrication of RPVs for nuclear power plant operation involved precise welding procedures and controls designed to optimize the resulting weld microstructure and provide the required material properties.

   These Controls are also designed to minimize defects that could be introduced into the weld during the fabrication process. Industry experience with the repair of weld indications found during preservice inspection, inservice nondestructive examinations, and data taken from destructive examination of actual vessel welds confirms that any remaining defects are small, laminar in nature, and do not cross transverse to the weld bead. Therefore, any postulated defects introduced during the fabrication process and not detected during subsequent nondestructive examinations would only be expected to be oriented in the direction of weld fabrication. For circumferential welds, this indicates a postulated defect with circumferential orientation.

   ASME code Case N-588 addresses this issue by allowing consideration of maximum postulated defects oriented circumferentially in circumferential welds. ASME Code Case

N-588 also provides appropriate procedures for determining the stress intensity factors for use in developing reactor pressure vessel P-T limits per ASME XI, Appendix G, procedures. The procedures allowed by ASME Code Case N-588 are conservative and provide a margin of safety in the development of RPV P-T operating and pressure test limits that will prevent nonductile fracture of the vessel.

The proposed P-T limits include restrictions on allowable operating conditions and equipment operability requirements to ensure operating conditions are consistent with the assumptions of the accident analysis. Specifically, RCS pressure and temperature must be maintained within the heatup and cooldown P-T limits specified in Technical Specification 3/4.6. Therefore, this 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*: The common defense and security are not endangered by this exemption request.

4. *Special circumstances are present which necessitate the request for an exemption to the regulations of 10CFR50.60*: In accordance with 10CFR50.12(a)(2), the NRC will consider granting an exemption to the regulations if special circumstances are present. This exemption meets the special circumstances of the following paragraphs:

- (a)(2)(ii) Demonstrates that the underlying purpose of the regulation will continue to be achieved;

- (a)(2)(iii) Will result in undue hardship or other costs that are significant if the regulation is enforced and;

- a)(2)(v) Will provide only temporary relief from the applicable regulation and the licensee has made good faith efforts to comply with the regulations.

*10CFR50.12(a)(2)(ii)*: The underlying purpose of 10CFR50, Appendix G and ASME XI, Appendix G, is to satisfy the underlying requirement that:

- The reactor coolant pressure boundary be operated in a regime having sufficient margin to ensure that when stressed the vessel boundary behaves in a non-brittle manner and the probability of a rapidly propagating fracture is minimized;

- P-T operating and test curves provide margin in consideration of uncertainties in determining the effects of irradiation on material properties.

Application of ASME Code Case N-588 when determining P-T operating and test limit curves per ASME XI, Appendix G, provides appropriate procedures for determining limiting maximum postulated defects and considering those defects in the P-T limits. This application of the code case maintains the margin of safety originally contemplated when ASME XI, Appendix G, was developed. Therefore, use of ASME Code Case N-588, as described above, satisfies the underlying purpose of the ASME Code and the NRC regulations to ensure an acceptable level of safety.

10CFR50.12(a)(2)(iii): The RCS P-T operating window is defined by the P-T operating and test curves developed in accordance with the ASME XI, Appendix G, procedure. Continued operation with these P-T curves without the relief provided by ASME Code Case N-588 will unnecessarily restrict the P-T operating window for Pilgrim. This restriction requires the operations staff to maintain a high temperature during pressure tests and also subjects inspection personnel to increased safety hazards while conducting inspections of systems with the potential for steam leaks in a primary containment at elevated temperatures.

This constitutes an unnecessary burden that can be alleviated by the application of ASME Code Case N-588 in the development of the P-T curves proposed in Pilgrim's amendment request dated November 22, 2000. Implementation of the proposed P-T curves as allowed by ASME Code Case N-588 maintains an acceptable margin of safety.

10CFR50.12(a)(2)(v): The requested exemption provides only temporary relief from the applicable regulation. Pilgrim has made a good faith effort to comply with the regulation. Pilgrim, therefore, requests the exemption be granted until such time that the NRC generically approved ASME Code Case N-588 for use by the nuclear industry.

ASME Code Case N-588, Conclusion for Exemption Acceptability

Compliance with the specified requirements of 10CFR50.60 will result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. ASME Code Case N-588 allows postulation of a circumferential welds to be considered in lieu of requiring the defect to be oriented across the weld from one plate or forging to the adjoining plate or forging. This circumstance was not considered at the time ASME XI, Appendix G, was developed and imposes restrictions on P-T operating limits beyond those originally contemplated.

This proposed alternative is acceptable, because the Code Case N-588 maintains the relative margin of safety commensurate with the margin of safety that existed at the time ASME XI, Appendix G, was approved in 1974. Therefore, application of ASME Code Case N-588 will ensure an acceptable margin of safety. The approach is justified by consideration of the overpressurization design basis events and the resulting margin to RPV failure.

Restrictions on allowable operating conditions and equipment operability requirements are established to ensure operating conditions are consistent with the assumptions of the accident analysis. Specifically, RCS pressure and temperature must be maintained within the heatup and cooldown rate-dependent P-T limits specified in Technical Specification 3/4.6. Therefore, this exemption does not present an undue risk to the public health and safety.

## Request for Exemption from 10CFR50.60 (ASME Code Case N-640)

In accordance with 10CFR50.12, "Specific exemptions," Pilgrim is requesting an exemption from the requirements of 10CFR50.60(a) "Acceptance Criteria for Fracture Prevention Measures for Lightwater Nuclear Power Reactors for Normal Operation." The exemption would permit the use of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI Code Case N-640, "Alternative Requirement Fracture Toughness for Development of P-T Limit Curves for ASME Section XI, Division 1," in lieu of 10CFR50, Appendix G, paragraph IV.A.2.b.

10CFR50.12(a) Requirements

The requested exemption to allow use of ASME Code Case N-640 in conjunction with ASME B&PV XI, Appendix G, to determine the pressure-temperature limits for the reactor pressure vessel meets the criteria of 10CFR50.12 as discussed below.

10CFR50.12 states that the commission may grant an exemption from requirements contained in 10CFR50 provided that the following is met:

1. The requested exemption is authorized by law: 10CFR50.60(b) allows the use of alternatives to 10CFR50, Appendices G and H, when an exemption is granted by the Commission under 10CFR50.12. No law exists that precludes the activities covered by this exemption request.

2. The requested exemption does not present an undue risk to the public health and safety: The revised pressure-temperature (P-T) limits being proposed in Pilgrim's submittal dated November 22, 2000, rely in part on this requested exemption. These revised P-T limits have been developed using the $K_{Ic}$ fracture toughness curve shown on ASME XI, Appendix A, Figure A-4200-1, in lieu of the $K_{Ia}$ fracture toughness curve of ASME XI, Appendix G, Figure G-2210-1, as the lower bound for fracture toughness. 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 operating limits curve is more technically correct than the $K_{Ia}$ curve. The $K_{Ic}$ curve models the slow heat-up and cooldown process of a reactor pressure vessel.

   Use of this approach is justified by the initial conservatism of the $K_{Ia}$ curve when the curve was codified in 1974. This initial conservatism was necessary due to limited knowledge of reactor pressure vessel material fracture toughness. Since 1974, additional knowledge has been gained about the fracture toughness of reactor pressure vessel materials and their fracture response to applied loads. As described in Attachment 5, the additional knowledge demonstrates the power bound fracture toughness provided by the $K_{Ia}$ curve is well beyond the margin of safety required to protect against potential reactor pressure vessel failure. The lower bound $K_{Ic}$ fracture toughness provides an adequate margin of safety to protect against potential reactor pressure vessel failure and does not present an undue risk to public health and safety.

P-T curves based on the Klc fracture toughness limits will enhance overall plant safety by opening the pressure-temperature operating window. The two primary safety benefits that would be realized during the pressure test are a reduction in the challenges to operators in maintaining a high temperature in a limited operating window and personnel safety while conducting inspections in primary containment at elevated temperatures with no decrease to the margin of safety.

3. The requested exemption will not endanger the common defense and security: 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 10CFR50.60: In accordance with 10CFR50.12(a)(2), the NRC will consider granting an exemption to the regulations if special circumstances are present. This requested exemption meets the special circumstances of the following paragraphs of 10CFR50.12:

- (a)(2)(ii) demonstrates the underlying purpose of the regulation will continue to be achieved;
- (a)(2)(iii) would result in undue hardship or other costs that are significant if the regulation is enforced and;
- (a)(2)(v) will provide only temporary relief from the applicable regulation and the licensee has made good faith efforts to comply with the regulations.

10CFR50.12(a)(2)(ii): ASME Boiler and Pressure Vessel (B&PV) Code, Section XI, Appendix G, provides procedures for determining allowable loading on the reactor pressure vessel and is approved for that purpose by 10CFR50, Appendix G. Application of these procedures in the determination of P-T operating and test curves satisfy the underlying requirement that:

1. The reactor coolant pressure boundary be operated in a regime having sufficient margin to ensure, when stressed, the reactor pressure vessel boundary behaves in a non-brittle manner and the probability of a rapidly propagating fracture is minimized, and

2. P-T operating and test limit curves provide adequate margin in consideration of uncertainties in determining the effects of irradiation of material properties.

The ASME (B&PV) Code, Section XI, Appendix G, procedure was conservatively developed based on the level of knowledge existing in 1974 concerning reactor pressure vessel materials and the estimated effects of operation. Since 1974, the level of knowledge about these topics has been greatly expanded. This increased knowledge permits relaxation of the ASME B&PV Code, Section XI, Appendix G, requirements via application of ASME Code Case N-640, while maintaining the underlying purpose of the ASME B&PV Code and the NRC regulations to ensure an acceptable margin of safety.

10CFR50.12(a)(2)(iii): The Reactor Pressure Vessel pressure-temperature operating window is defined by the P-T operating and test limit curves developed in accordance with the ASME B&PV Code, Section XI, Appendix G, procedure. Continued operation of Pilgrim in accordance with these P-T curves without the relief provided by ASME Code Case N-640 would unnecessarily restrict the P-T operating window. This restriction challenges the operations staff during pressure tests to maintain a high temperature within a limited operating window.

This constitutes and unnecessary burden that can be alleviated by the application of ASME Code Case N-640 in the development of the proposed P-T curves. Implementation of the proposed P-T curves as allowed by ASME Code Case N-640 does not significantly reduce the margin of safety below that established by the original requirement.

10CFR50.12(a)(2)(v): The requested exemption provides only temporary relief from the applicable regulation. Pilgrim has made a good faith effort to comply with the regulation. Pilgrim, therefore, requests that the exemption be granted until such time that the NRC generically approved ASME Code Case N-640 for use by the nuclear industry.

ASME Code Case N-640, Conclusion for Exemption Acceptability:

Compliance with the specified requirement of 10CFR50.60(a) would result in hardship and unusual difficulty without a compensating increase in the level of quality and safety. ASME Code Case N-640 allows a reduction in the lower bound fracture toughness used in ASME B&PV Code, Section XI, Appendix G, in the determination of reactor coolant system P-T limits. This proposed alternative is acceptable because the ASME Code Case maintains the relative margin of safety commensurate with that which existed at the time ASME B&PV Code, Section XI, Appendix G, was approved in 1974. Therefore, application of ASME Code Case N-640 for Pilgrim ensures an acceptable margin of safety. The approach is justified by consideration of the overpressurization design basis events and the resulting margin to reactor pressure vessel failure.

Restrictions on allowable operating conditions and equipment operability requirements have been established to ensure that operating conditions are consistent with the assumptions of the accident analysis. Specifically, reactor coolant system pressure and temperature must be maintained within the heatup and cooldown rate dependent pressure-temperature limits specified in TS Section 3/4.6. Therefore, this exemption request does not present risk to the public health and safety.