

Entergy Nuclear Operations, Inc. Pilgrim Station 600 Rocky Hill Road Plymouth, MA 02360

William J. Riggs Director, Nuclear Assessment

July 1, 2002

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

SUBJECT: Pilgrim Relief Request (PRR)-28 Relief from ASME Code, Section XI, Examinations of Reactor Pressure Vessel Circumferential Shell Welds, Pursuant to Generic Letter 98-05. Docket No. 50-293 License No. DPR-35

LETTER NUMBER: 2.02.059

Dear Sir or Madam:

This letter requests NRC approval of Pilgrim Relief Request (PRR) No. 28, in support of refueling outage (RFO)-14.

Pursuant to 10CFR50.55a(a)(3)(i) and consistent with information contained in NRC Generic Letter (GL) 98-05, Pilgrim is requesting permanent relief (for the remaining portion of the initial license period that expires in 2012) from the in-service inspection requirements of 10CFR50.55a(g) for the volumetric examination of reactor pressure vessel (RPV) circumferential welds. The inspection requirement is specified in the 1989 ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item B1.11.

Attachment 1, Description of Pilgrim Relief Request (PRR)-28, provides justification for the requested change. Attachment 2 provides a summary of PRR-28 that would be incorporated into the ISI Program upon receipt of NRC approval.

Pilgrim intends to implement the approved relief request for RFO-14, which is scheduled to begin in April 2003. Accordingly, Pilgrim seeks NRC approval by March 15, 2003.

The NRC has previously approved relief pursuant to GL 98-05 for Fermi-2 (TAC No. MA3674) and FitzPatrick (TAC No. MA6215).

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If you have any questions regarding the information contained in this letter, please contact Mr. Bryan Ford (508) 830-8403.

/W/.j. Ridd

Attachments: 1. Description of Pilgrim Relief Request No. 28 (8 pages) 2. Pilgrim Relief Request No. 28 (2 pages)

cc:

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Senior Resident Inspector Pilgrim Nuclear Power Station

Attachment 1

DESCRIPTION OF PILGRIM RELIEF REQUEST-28

A. <u>RELIEF REQUEST</u>

Pursuant to 10CFR50.55a(a)(3)(i) and consistent with information contained in NRC Generic Letter (GL) 98-05 (Reference 1), Pilgrim is requesting permanent relief (for the remaining portion of the initial license period that expires in 2012) from ASME Section XI requirements to examine Category B-A reactor pressure vessel (RPV) circumferential shell welds.

B. <u>EXAMINATION REQUIREMENTS</u>

1CCFR50.55a(g) requires examination of Reactor Pressure Vessel (RPV) shell welds specified in item B1.10 of Examination Category B-A, "Pressure Retaining Welds in Reactor Vessel", in Table IWB-2500-1 of the 1989 Edition of Section XI, Division 1, of the ASME Boiler and Pressure Vessel Code for each ISI interval.

C. ALTERNATIVE TO THE EXAMINATION REQUIREMENTS

As an alternative to the examination requirements of circumferential shell welds, Pilgrim proposes the following:

- 1. The examinations of accessible RPV axial welds to the extent possible and the incidental intersecting circumferential welds during RFO-14 and/or 15 (Third ISI interval).
- 2. Compliance with GL 98-05 provisions included in the BWRVIP-05 safety evaluation.

D. BASIS FOR THE ALTERNATIVE PLAN

- Pilgrim complied with 10CFR50.55a(g)(6)(ii)(A)(2) required augmented examination of RPV circumferential and axial shell welds during RFO-10, in the Second ISI interval that ended June 30, 1995. Pilgrim provided the results of these examinations to the NRC (Reference 2). The NRC issued a safety evaluation of the Pilgrim augmented examination results (Reference 3). The examinations detected no flaws in the vessel. The RFO-10 scope of examinations included essentially all-accessible welds.
- 2. Pilgrim will comply with the 1989 ASME Code, Section XI requirements to examine all accessible axial welds and incidental intersecting circumferential welds in accordance with 10CFR50.55a(g). These examinations are planned for RFO-14 and/or 15. Pilgrim will exclude the RPV circumferential welds from the RFO-14 and/or 15 examination scope and permanently defer them based on the approved relief, as provided by GL 98-05.

- 3. Pilgrim complets with GL 98-05 provisions for seeking relief from the requirements of examination of BWR RPV circumferential shell welds as recommended in the BWRVIP-05 Report (Reference 4). GL 98-05 states that licensees may request relief from the examination of the RPV circumferential shell welds by demonstrating the following:
 - a. At the expiration of the license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the staff's July 30, 1998, safety evaluation related to BWRVIP-05 (Reference 3).
 - b. Licensees have implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the staff's July 30, 1998, safety evaluation related to BWRVIP-05.

Pilgrim has performed an assessment of the above GL 98-05 provisions, as discussed below.

E. PILGRIM ASSESSMENT OF GL 98-05 PROVISIONS

- 1. The following demonstrates that at the expiration of Pilgrim Operating License in 2012, Pilgrim RPV circumferential shell welds will continue to satisfy limiting conditional failure probability for the circumferential welds stated in the Staff's July 30, 1998 evaluation (Reference 3).
 - a. <u>Neutron Fluence/Embrittlement</u>

BWRVIP-05 stated. "Embrittlement issues are addressed in 10CFR50 Appendix G through requirements associated with upper shelf energy (USE) and the reference temperature of nil-ductility transition (RT_{NDT}). In order to account for the effects of embrittlement, adjusted reference temperatures (ARTs), defined as the initial RT_{NDT} plus the irradiation shift for fluence, are determined. It is possible that ARTs may result in pressure-temperature testing criteria that are difficult to meet due to increased temperature requirements. However, due to low BWR fluence, an unacceptable ART will not be reached, even when extended life is planned." Also, the report states that "In addition to increasing RT_{NDT} the USE of low allow steel materials decreases with neutron exposure. However, for the relatively low fluence BWR, maintaining a USE above 50 ft-lbs is not a concern. Also, Code margins required by Appendix G are satisfied at USE values as low as 35 ft-lbs and thus is not a safety concern. Based on the above, it can be seen that although irradiation embrittlement of materials can be a significant concern, its effect is minimal for the relatively low fluence environment of a BWR."

The Pilgrim minimum USE at end-of-license is 59 ft-lbs, which exceeds the upper bound allowable limit of 50 ft-lbs specified in 10 CFR 50, Appendix G, section IV.A.1.a. Thus, the 59 ft-lbs USE provides margin of safety against fracture; therefore, neutron fluence / embrittlement is not a safety concern for Pilgrim vessel.

b. Probabilistic Fracture Mechanics (PFM) Analysis

Although BWRVIP-05 provides a technical basis for this relief, an independent NRC risk informed assessment of the analysis contained in the BWRVIP-05 report was conducted (Reference 6). The independent NRC assessment used the FAVOR code to perform probabilistic fracture mechanics (PFM) analysis to estimate RPV failure probabilities. Three key assumptions in the PFM analysis are: the neutron fluence was estimated to be end-of-license mean fluence, the chemistry values are mean values based on vessel types, and the potential for beyond design basis events were considered.

The following is a statement contained in the "Executive Summary" of the "NRC Staff Final Safety Evaluation of BWRVIP-5 Report (Reference 5). "It should be noted that the failure frequency for axial welds cited above are relatively high, but that there are known conservatisms in these estimates. For example, these analyses were based on the assumption that the flaws in axial weld with the limiting material properties and chemistry are all located at the inside surface of the BWR RPV and at the location of peak end-of-license (EOL) azimuth fluence. Since flaws are distributed throughout the weld and EOL neutron fluence will not occur for many years, the staff has concluded that the present RPV failure frequency is substantially below that reported by the BWRVIP, and independently calculated by the staff, and is not a near-term safety concern."

The following information is provided to show the conservatism of the NRC analysis with respect to the Pilgrim plant. Changes in RT_{NDT} may be used as one of the means for monitoring radiation embrittlement of reactor vessel materials. For plants with RPVs fabricated by Combustion Engineering (CE), the mean end-of-license neutron fluence for circumferential welds used in the NRC staff and BWRVIP Limiting Plant-Specific Analysis (32 EFPY), Table 2.6-4 of the Safety Evaluation for BWRVIP-05, was 2.0E + 18 n/cm². However the highest fluence anticipated for Pilgrim belt-line circumferential wells at the end-of-license (32 EFPY) is 8.03E + 17 n/cm². The projected fluence for the Pilgrim plant for 32 EFPY is less than that used in the NRC analysis. Therefore, there is significant conservatism, with regard to the effect of fluence on embrittlement, in the already low circumferential weld failure probabilities as related to the Pilgrim Plant.

The Table below shows a comparison between the NRC Final Evaluation of the BWRVIP-05 Limiting Plant Specific Analysis data and Pilgrim specific data for weld chemistry factor (CF), adjustment of the reference temperature ($\triangle RT_{NDT}$), and mean RT_{NDT} .

Pilgrim RPV Shell Weld Information Bounding Circumferential Weld (1-344) Wire Heat/Lot (21935/3869)			
Parameter Description	Pilgrim NPS Shell Bounding Beltline 32 EFPY Bounding Comparative Parameters (Bounding Circ. Weld)	USNRC Limiting 32 EFPY Bounding CE Vessel Parameters SER Table 2.6-4	
Neutron fluence at the end of the requested relief period (upper bound value @ ¼ t))	8.03x10 ¹⁷ n/cm ²	2.0x10 ¹⁸ n/cm ²	
Initial (unirradiated) reference temperature (RT _{NDT}), °F	-50	0	
Weld Chemistry factor (CF), ^o F	172.2	172.2	
Weld Copper content %	0.183	0.183	
Weld Nickel content %	0.704	0.704	
Increase in reference temperature (ΔRT_{NDT}), ^o F	64.5	98.1	
Mean adjusted reference temperature (ART), ^o F RT _{NDT(u)} + ΔRT _{NDT}	14.5	98.1	

As shown above, the impact of irradiation results in lower plant-specific mean RT _{NDT} for the Pilgrim circumferential weld material, as compared to that for any of the Staff's plant-specific analyses that were performed for the CE fabricated RPV's with the highest adjusted reference temperatures. Therefore, based on plant specific data, there is a lower conditional probability of failure for circumferential welds at Pilgrim than that stated in the NRC's Final Safety Evaluation of the BWRVIP-05.

2. The following demonstrates that Pilgrim has implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the staff's July 30, 1998, safety evaluation.

At an industry meeting on August 8, 1997, the NRC indicated that the potential for, and consequences of, non-design basis events not addressed in the BWRVIP-05 report should be considered. Later, in a Request for Additional Information (RAI) to the BWRVIP, the NRC requested that the BWRVIP evaluate the potential for non-design basis cold over-pressure transients (Reference 6) and responded to in BWRVIP letter to NRC dated December 18, 1997 (Reference 7). The NRC also considered beyond design basis events, such as low temperature over-pressure (LTOP) events in their PFM analysis. In the BWRVIP responses to the RAI the total probability of an occurrence of cold overpressure for other than BWR-4s was reported as 9E-4. It was concluded that it is highly unlikely that a BWR would experience a cold over-pressure transient. In fact, for a BWR to experience such an event would generally require several operator errors. The NRC described several types of events that could be precursors to BWR RPV cold over-pressure transients. These were identified as precursors because no cold over-pressure event has occurred at a U.S. BWR. Also, the NRC identified one actual cold over-pressure event that occurred during shutdown at a non-U.S. BWR. This event apparently included several operational errors that resulted in a maximum RPV pressure of 1150 psi with a temperature range of 79° to 88° F.

The following addresses the high-pressure injection sources, administrative controls, and operator training regarding a cold overpressure event for the Pilgrim plant.

a. Review of Potential High Pressure Injection Sources

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1. High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) Systems

The HPCI and RCIC systems use steam driven turbines to pump cold water into the Pilgrim vessel. During reactor cold shutdown condition, there is no steam available to operate these systems, making a cold over pressurization event impossible as the result of operation of these systems.

2. Feedwater / Condensate Systems

The feedwater / condensate systems are a potential source of highpressure water into the reactor vessel. A system design feature is the automatic trip of all reactor feed pumps (RFP) on high water level or pressure in the reactor pressure vessel. When shutting down, Pilgrim procedures require securing RFPs in sequence depending on the reactor power levels. Monitoring of reactor temperature, pressure, and cool down rates, are prescribed in procedures and the Technical Specifications. During refueling outages the feedwater lines are isolated by closing block valves inside the drywell. At low power (approximately <10%), the lines are secured by removing both regulating valves from service and manually controlling feed water with a startup-regulating valve.

Reactor over pressurization by the feedwater/condensate systems is very unlikely since strict controls on temperature and pressure are imposed below 450 degrees F and the capacity of the systems to inject water is limited by using the feedwater startup-regulating valve. Any unexpected change in reactor water level would allow for operator action.

Therefore, these systems do not present a significant potential for over pressurization.

3. Standby Liquid Control System

The Standby Liquid Control System (SLC) is a potential source of high-pressure water into the RPV during cold shutdown conditions. A key lock switch in the control room controls this system, with the key normally removed. As a result, operation of SLC is a deliberate act strictly controlled by plant procedures and training. Even if the system was activated the maximum SLC flow is 40 gallons per minute, a rate that would allow time to control RPV pressure. Therefore, this system does not present a significant potential for over pressurization. 4. The Low-Pressure Coolant Injection, Core Spray, and Residual Heat Removal Systems

The Low-Pressure Coolant Injection, Core Spray, and Residual Heat Removal systems' inadvertent operation do not present a significant potential for over pressurization. The pressure-temperature curves for the Pilgrim RPV permit cooling water pressures up to 310 psig over the temperature range of 70 to 100 degrees F and rapidly increase to 660 psig at 100 degrees F. These systems do not operate at pressures above 400 psig. Therefore, these systems do not present a significant potential for over pressurization.

5. Control Rod Drive (CRD) and Reactor Water Clean-up (RWCU) Systems

The CRD and RWCU systems are used to control RPV water level and pressure during cold shutdown conditions using a feed and bleed process. Reactor pressure is controlled by opening the reactor head vents when the reactor coolant temperature is less than 220 degrees F. The low flow rate of these pumps (CRD 50 gpm, RWCU 222 gpm) allows sufficient time for operator action to react to unanticipated level changes. Therefore, these systems do not present a significant potential for over pressurization.

6. Class 1 Pressure Test

The procedure used at Pilgrim to perform hydrostatic testing incorporates controls, limitations, and precautions that are reviewed by all personnel involved with maintaining RPV pressure/temperature controls. Rigorous abort criteria provides for immediate actions when limits are approached. An assigned Senior Reactor Operator Control Room Supervisor controls the total procedural evolution and a Test Director assures the procedure is coordinated from start to finish. The procedure is only initiated after a detailed pre-job briefing of all affected people at which time all procedural precautions, limitations, and abort criteria are presented. RPV temperature and pressure are monitored throughout the test to ensure compliance with required pressure-temperature limits. Pressurization rates are controlled through out the test and direction is provided for control using the RWCU or the CRD pumps. Therefore, this system test does not present a significant potential for over pressurization.

In conclusion, the review of potential high pressure injection sources confirms that a cold overpressure event at Pilgrim is extremely unlikely.

b. Review of Operator Training and Work Control Process

1. Reactor Operator Training

Licensed Operator Training provides another method to control reactor water level, temperature, and pressure, in addition to the design and procedural barriers discussed above. Simulator training for start-up and shut down scenarios provides an opportunity to perform the operator actions to maintain reactor pressure-temperature limits.

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Procedural controls for reactor temperature, water level, and pressure are an integral part of Operator training. Specifically, operators are trained in methods of controlling RPV water level within specified limits, as well as responding to abnormal RPV water level conditions outside the established limits. Additionally, control room operators receive training on brittle fracture limits and compliance with the Technical Specification pressure-temperature limits curves. Plantspecific procedures have been developed to provide guidance to the operators regarding compliance with the Technical Specification requirements on pressure-temperature limits.

2. Work Control Process

During plant outages work control procedures require that the outage schedule and changes to the schedule receive a risk assessment review commensurate with their safety significance. Senior Reactor Operators provide input to the outage schedule to avoid conditions that could adversely impact reactor water level, pressure, or temperature. Schedules are issued listing the work activities to be performed.

During refueling outages, work is coordinated through the Outage Control Center. In the Control Room, the Shift Manager is required, by procedure, to maintain cognizance of any activity that could potentially affect reactor water level or decay heat removal. The Control Room Operator is required to provide positive control of reactor water level and pressure within the specified bands, and promptly report when operating outside the specified band, including restoration actions being taken. Cognizant individuals involved in the work activity attend pre-job briefings. Expected plant responses and contingency actions to address unexpected conditions, or responses that may be encountered, are included in the briefing discussion.

Based upon the above, the probability of a low temperature RPV over-pressure event at Pilgrim is considered to be less than or equal to that used in the USNRC safety evaluation.

3. Conclusion

Deferral of the RPV circumferential shell weld examinations to the end of the current operating license does not impact quality and safety as discussed above. Entergy believes a permanent deferral in performing the augmented inspections of the RPV circumferential shell welds for the remaining operating license of the plant provides an acceptable level of quality and safety.

F. ALTERNATIVE EXAMINATIONS

The circumferential weld examinations would be permanently deferred for the remainder of the current operating license of the plant. The alternative plan would require examination of RPV axial welds based on accessibility.

This relief request and the alternative method is consistent with the GL 98-05 provisions as described above, and provides an acceptable level of quality and safety as required by 10 CFR 50.55a(a)(3)(i).

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G. <u>REFERENCES</u>

- 1. NRC Generic Letter 98-05, "Boiling Water Reactor Licensee Use of the BWRV!P-05 Report to Request Relief From Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds," dated November 10, 1998.
- 2. Pilgrim Letter 95-099, "Results of Augmented Examination of the RPV Shell Welds and Relief Request Pursuant to 10CFR50.55a(g)(6)(ii)(A), dated September 20, 1995.
- 3. NRC Safety Evaluation, "Pilgrim Nuclear Power Station Request for Authorization of Alternative Reactor Pressure Vessel Examinations," (TAC. No. M93724), dated March 26, 1996.
- 4. EPRI TR-105697, "BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," September 1995.
- 5. NRC Letter from Gus C. Lainas, Acting Director, Division of Engineering, Office of Nuclear Reactor Regulation, to Carl Terry, BWRVIP Chairman, Niagara Mohawk Company, "Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05," Report, dated July 28, 1998.
- 6. NRC Letter from Brian W. Sheron, Director, Division of Engineering, Office of Nuclear Reactor Regulation, to Carl Terry, BWRVIP Chairman, Niagara Mohawk Company, "Transmittal of NRC Staff's Independent Assessment of the Boiling Water Reactor Vessel and Internals Project BWRVIP-05 Report and Proprietary Request for Additional Information," dated August 14, 1997.
- 7. BWRVIP Letter, Carl Terry, BWRVIP Chairman, Niagara Mohawk Company, to the NRC, C.E. Carpenter, "BWRVIP Response to NRC Request for Additional Information on BWRVIP-05", dated December 18, 1997.

Attachment 2

PILGRIM RELIEF REQUEST NO. 28

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Pilgrim Station 3rd Interval Inservice Inspection Plan

RELIEF REQUEST NUMBER: PRR-28

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THIRD INTERVAL RELIEF REQUEST

SYSTEM/COMPONENT(S) FOR WHICH RELEIF IS REQUESTED

ASME Code Class: 1

System: Reactor Pressure Vessel (RPV)

Components: RPV Circumferential Shell Welds

ASME SECTION XI REQUIREMENTS:

ASME Section XI, 1989 Edition, Subsection IWB, Table IWB 2500-1, Examination Category B-A, Item No. B1.11, and the augmented examination requirement of 10CFR50.55a(g)(6)(ii)(A)(2)requires volumetric examination of essentially 100% of RPV circumferential weld and base material regions in the reactor pressure vessel each inspection interval.

BASIS FOR RELIEF REQUEST:

Pursuant to 10CFR55.55(a)(3)(i), and consistent with information contained in NRC Generic Letter 98-05, Pilgrim is requesting an alternative from ASME Section XI requirements to examine essentially 100% of accessible Category B-A circumferential welds and is proposing permanent relief (for the remaining portion of the initial license period) from these examinations.

Pilgrim completed the first augmented RPV shell weld examination in 1995 during RFO 10. Refer to BECO Letter 95-099. This examination included both horizontal and vertical RPV shell weld to the extent possible and detected no flaws within the criteria of ASME XI IWB-3500.

Consistent with the NRC Generic Letter 98-05 the following is provided.

1. At expiration of license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the staffs July 30, 1998 safety exclusion. The NRC evaluation of BWRVIP-05 utilized the FAVOR code to perform a probabilistic fracture mechanics analysis to estimate RPV failure probabilities. Although BWRVIP-05 provides the technical basis supporting the relief request, the following information is provided that shows Pilgrim vessel is enveloped by the NRC analysis.

Wire Heat/Lot (21935/3869)			
Parameter Description	Pilgrim RPV Shell Bounding Beltline 32 EFPY Bounding Comparative Parameters (Bounding Circumferential. Weld)	USNRC Limiting32 EFPY Bounding CE Vessel Parameters SER Table 2.6-4	
Neutron fluence at the end of the requested relief period (upper bound value $@ \frac{1}{2}$ t))	8.03x10 ¹⁷ n/cm ²	2.0x10 ¹⁸ n/cm ²	
Initial (unirradiated) reference temperature (RT _{NDT}), F	-50	0	
Weld Chemistry factor (CF), °F	172.2	172.2	
Weld Copper content %	0.183	0.183	
Weld Nickel content %	0.704	0.704	
Increase in reference temperature (ΔRT_{NDT}), °F	64.5	98.1	
Mean adjusted reference temperature (ART), ${}^{\circ}FRT_{NDT(u)} + \Delta RT_{NDT}$	14.5	98.1	

Pilgrim RPV Shell Weld Information Bounding Circumferential Weld (1-344) Wim Heat(1 of (21035/2360)

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2. "Pilgrim has implemented Operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the staffs July 30, 1998 safety evaluation.

ALTERNATIVE:

All longitudinal (axial) RPV shell welds, Code Item B1.11, will be examined to the extent possible. If less than 90% coverage is achieved we shall request additional relief.

APPLICABLE TIME PERIOD

Relief is requested for the remaining portion of the initial Operating License period that expires in 2012. This includes 3^{rd} and 4^{th} ISI intervals.