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10 CFR 50.55a

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Relief Request for Alternative Reactor Pressure Vessel Circumferential Weld Examinations for Fourth Interval Inservice Inspection Program

References: (1) NRC Generic Letter 98-05, "Boiling Water Reactor Licensees Use of the BWRVIP-05 Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds," dated November 10, 1998

(2) BWRVIP-05, "BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," dated September 28, 1995

(3) Letter from G. C. Lainas (U. S. Nuclear Regulatory Commission) to C. Terry (BWRVIP), "Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report (TAC No. M93925)," dated July 28, 1998

Reference 1 states that the NRC has completed review of the report entitled "BWR Vessel and Internals Project [BWRVIP], BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP)," and that licensees of boiling water reactors (BWRs) may request permanent relief from the inservice inspection requirements of 10 CFR 50.55a(g), "Inservice inspection requirements," for the volumetric examination of circumferential reactor pressure vessel welds. The NRC indicated that it would consider technically justified requests for permanent relief if the licensee demonstrates that: (1) at the expiration of their current license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the NRC's July 28, 1998, safety evaluation, and (2) licensees have implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the NRC's July 28, 1998, safety evaluation. Reference 1 also states

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that licensees will still need to perform the required inspections of "essentially 100 percent" of all axial welds.

Exelon Generation Company, LLC (EGC) requests approval of an alternative reactor pressure vessel examination for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. Approval of this alternative examination is requested, by May 15, 2004, in accordance with 10 CFR 50.55a(a)(3)(i) for the remaining term of the operating licenses for QCNPS Units 1 and 2.

The basis for this alternative inspection is discussed in the attached relief request. The basis is consistent with the methodology used in Reference 2, and the provisions of the NRC's safety evaluation for BWRVIP-05 (i.e., Reference 3). In addition, the alternative inspection meets the aforementioned criteria of Reference 1. EGC has concluded that this alternative inspection provides an acceptable level of quality and safety and satisfies the requirements of 10 CFR 50.55a(a)(3)(i).

If you have any questions or require additional information, please contact Mr. Kenneth M. Nicely at (630) 657-2803.

Respectfully,

Patrick R. Simpson

Patrick R. Simpson
Manager - Licensing
Mid-West Regional Operating Group

Attachment: Relief Request I4R-10

ATTACHMENT
Relief Request I4R-10

ASME Components Affected

Components affected are American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Class 1 pressure retaining reactor pressure vessel (RPV) shell circumferential welds, Examination Category B-A, Item No. B1.11.

Applicable Code Edition and Addenda

The applicable ASME Code, Section XI, for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, during the remaining term of the operating licenses (i.e., the fourth 10-year inservice inspection (ISI) interval) is the 1995 Edition through 1996 Addenda.

Applicable Code Requirement

In accordance with the provisions of 10 CFR 50.55a, "Codes and standards," paragraph (a)(3)(*i*), Exelon Generation Company, LLC (EGC) requests permanent relief for the remaining term of the operating licenses for QCNPS, Units 1 and 2, from the following requirements:

1. ASME Code Section XI, Subarticle IWB-2500, Table IWB-2500-1, Examination Category B-A, Item No. B1.11;

2. ASME Code Section XI, Subsubarticle IWB-2420; and

3. ASME Code Section XI, Subsubarticle IWB-2430.

Reason for Request

Subarticle IWB-2500 requires components specified in Table IWB-2500-1 to be examined. Table IWB-2500-1 requires volumetric examination of all RPV shell circumferential welds each inspection interval (i.e., Examination Category B-A, Item No. B1.11).

Subsubarticle IWB-2420 requires the sequence of component examinations which was established during the first inspection interval to be repeated during each successive inspection interval, to the extent practical. Therefore, performance of successive examinations of RPV shell circumferential welds is required by Subsubarticle IWB-2420.

Subsubarticle IWB-2430 requires examinations performed in accordance with Table IWB-2500-1 that reveal flaws or relevant conditions exceeding the acceptance standards of Table IWB-3410-1 to be extended to include additional examinations during the current outage.

Reference 1 provides the technical basis for permanently deferring the augmented inspections of circumferential welds in boiling water reactor (BWR) RPVs. In the report, the BWR Vessel and Internals Project (BWRVIP) concluded that the probabilities of failure for BWR RPV circumferential welds are orders of magnitude lower than that of the longitudinal welds. The NRC conducted an independent risk-informed, probabilistic fracture mechanics assessment (PFMA) of the analysis presented in Reference 1, and the results are documented in

Reference 2. EGC has determined that the proposed alternative described below provides an acceptable level of quality and safety and satisfies the requirements of 10 CFR 50.55a(a)(3)(i).

Proposed Alternative and Basis for Use

Proposed Alternative

In accordance with 10 CFR 50.55a(a)(3)(i), and consistent with information contained in Reference 3, EGC considers the following alternate provisions for the subject weld examinations.

Inservice Inspection Scope

The failure frequency for RPV shell circumferential welds is sufficiently low to justify their elimination from the ISI requirement of ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.11.

The ISI and augmented examination requirements of 10 CFR 50.55a(g) for ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.12, RPV shell longitudinal welds (i.e., also known as vertical or axial welds) shall be performed, to the extent possible, and shall include inspection of the circumferential welds only at the intersection of these welds with the longitudinal welds, or approximately 2 to 3 percent of the RPV shell circumferential welds. When this examination is performed, an automated ultrasonic inspection system will provide the best possible examination of the RPV shell longitudinal welds. These welds are generally only accessible from inside surfaces of the RPV. Inspections from the outside surfaces have limited access due to the close proximity of the biological shield to the RPV. Also, the reflective insulation that occupies this space is not designed to be removed.

The procedures for these examinations shall be qualified such that flaws relevant to the RPV integrity can be reliably detected and sized, and the personnel implementing these procedures shall be qualified in the use of these procedures.

Successive Examination of Flaws

For ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.11, RPV shell circumferential welds (i.e., at intersections with longitudinal welds), successive examinations per Subsubarticle IWB-2420 are not required for non-threatening flaws (i.e., original vessel material or fabrication flaws such as inclusions which exhibit negligible or no growth during the life of the vessel), provided that the following conditions are met:

1. The flaw is characterized as subsurface in accordance with BWRVIP-05 (i.e., Reference 1);

2. The non-destructive examination technique and evaluation that detected and characterized the flaw as originating from material manufacture or vessel fabrication is documented in a flaw evaluation report; and

3. The vessel containing the flaw is acceptable for continued service in accordance with Subarticle IWB-3600, "Analytical Evaluation of Flaws," and the flaw is demonstrated acceptable for the intended service life of the vessel.

For ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.12, RPV shell longitudinal welds, all flaws shall be reinspected at successive intervals consistent with ASME Code and regulatory requirements.

Additional Examinations of Flaws

For ASME Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.11, RPV shell circumferential welds (i.e., at intersections with longitudinal welds), additional requirements per Subsubarticle IWB-2430, "Additional Examinations," are not required for flaws provided the following conditions are met:

1. If the flaw is characterized as subsurface in accordance with BWRVIP-05 (i.e., Reference 1), then no additional examinations are required;

2. If the flaw is not characterized as subsurface in accordance with BWRVIP-05 (i.e., Reference 1), then an engineering evaluation shall be performed, addressing the following as a minimum:

   - a determination of the root cause of the flaw,
   - an evaluation of any potential failure mechanisms,
   - an evaluation of service conditions which could cause subsequent failure, and
   - an evaluation per Subarticle IWB-3600 demonstrating that the vessel is acceptable for continued service; and

3. If the flaw meets the criteria of Subarticle IWB-3600 for the intended service life of the vessel, then additional examinations may be limited to those welds subject to the root cause conditions and failure mechanisms, up to the number of examinations required by paragraph (a) of Subsubarticle IWB-2430. If the engineering evaluation determines that there are no additional welds subject to the same root cause conditions or no failure mechanism exists, then no additional examinations are required.

For ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.12, RPV shell longitudinal welds, additional examination for flaws shall be in accordance with Subsubarticle IWB-2430. All flaws in RPV shell longitudinal welds shall require additional weld examinations consistent with ASME Code and regulatory requirements. Examinations of the RPV shell circumferential welds shall be performed if RPV longitudinal welds reveal an active, mechanistic mode of degradation.

Basis for Use

Reference 1 provides the technical basis to justify relief from the examination requirements of RPV shell circumferential welds. The results of the NRC's evaluation of Reference 1 are documented in Reference 2. Reference 3 permits BWR licensees to request permanent (i.e., for the remaining term of operation under the existing, initial, license) relief from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of RPV shell circumferential welds (i.e., ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.11). This relief can be granted by demonstrating that:

1. at the expiration of their 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, and

2. 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.

Reference 3 also states that licensees will still need to perform the required inspections of "essentially 100 percent" of all axial welds.

Generic Letter 98-05, Criterion 1

Demonstrate that at the expiration of their license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the NRC's July 28, 1998, safety evaluation.

Response

The NRC evaluation of BWRVIP-05 utilized the FAVOR code to perform a PFMA to estimate the RPV shell weld failure probabilities. Three key assumptions of the PFMA are: (1) the neutron fluence used was the estimated end-of-life mean fluence, (2) the chemistry values are mean values based on vessel types, and (3) the potential for beyond-design-basis events is considered.

Table I4R-10.1 provides a comparison of the limiting RPV circumferential weld parameters for each QCNPS unit to those found in Table 2.6-4 of the NRC final safety evaluation of BWRVIP-05 (i.e., Reference 2) for a Babcock and Wilcox vessel. The chemistry composition and chemistry factor for Unit 1 are less than or equal to the limits of the NRC analysis. While the nickel content for Unit 2 is higher than the value utilized in the NRC analysis, the Unit 2 copper content and the chemistry factor are considerably lower than the values utilized in the NRC analysis. Additionally, the unirradiated reference temperatures for both QCNPS units are lower than the NRC limits. The combination of unirradiated reference temperature and embrittlement shift yields adjusted reference temperatures considerably lower than the NRC mean analysis values.

The end of life (i.e., 32 effective full power year (EFPY)) inside diameter fluences for QCNPS Units 1 and 2 are considerably lower than the NRC estimated 32 EFPY fluence. As a result, the shifts in reference temperature for both units are lower than the 32 EFPY shift from the NRC

analysis. Therefore, for each unit, the RPV shell weld embrittlement due to fluence is calculated to be less than the NRC's limiting case, and each unit's RPV shell circumferential weld failure probabilities are bounded by the conditional failure probability, P(FIE), in the NRC's limiting plant specific analysis (32 EFPY) through the projected end of license. For these reasons, the QCNPS Units 1 and 2 RPVs are bounded by Reference 2.

Table I4R-10.1: Effects of Irradiation on RPV Circumferential Weld Properties			
Parameter Description	**QCNPS Unit 1 Parameters at 32 EFPY (Weld Wire Heat/Flux Lot # 406L44/8688)**	**QCNPS Unit 2 Parameters at 32 EFPY (Weld Wire Heat/Flux Lot # S3986/3870) Linde 124**	**NRC Limiting Plant Specific Analysis (32 EFPY)**
Copper (weight %)	0.27	0.05	0.31
Nickel (weight %)	0.59	0.96	0.59
Chemistry Factor	183	68	196.7
End of Life Inside Diameter Fluence (10^{19} n/cm^2)	0.024	0.024	0.095
ΔRT_{NDT} (°F)	35	13	79.8
$\Delta RT_{NDT(U)}$ (°F)	-5	-32	20
Mean RT_{NDT} (°F)	30	-19	99.8

Generic Letter 98-05, Criterion 2

Demonstrate that licensees have implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the NRC's July 28, 1998, safety evaluation.

Response

EGC has procedures in place for QCNPS, Units 1 and 2, that guide operators in controlling and monitoring reactor pressure during all phases of operation, including cold shutdown. Use of these procedures minimizes the potential for low temperature over-pressurization (LTOP) events, and is reinforced through operator training. A Primary System Leakage test is performed prior to each restart after a refueling outage. The associated station test procedure has sufficient guidance to minimize the likelihood of an LTOP event, and requires a pre-job briefing prior to test commencement with all involved personnel. During pressure testing, measures are taken to limit the potential for system perturbations that could lead to pressure transients. These measures include both administrative and/or hardware controls, such as limiting testing or work activities, or installing jumpers to defeat system actuations that are not required operable. RPV temperature and pressure are required to be monitored and controlled to within the Technical Specifications pressure and temperature (P/T) limits curve during all

portions of the testing. The normal and contingency methods to enact pressure control are specified in the test procedure.

A designated Test Coordinator is responsible for the coordination of the test (i.e., from initiation to conclusion) and maintains cognizance of test status. A controlled rate of pressure increase is administratively limited in the test procedure to no greater than 50 pounds per square inch per minute. If the rate of pressurization exceeds this limit, a contingency sequence portion of the testing procedures provides directions to reduce the rate of pressure increase by depressurizing through the Reactor Water Cleanup System and/or securing Control Rod Drive (CRD) pumps. Other pressure control contingencies are specified in the test procedure including: pressure control via the Automatic Depressurization System (ADS) and/or Main Steam Line drain lines.

Other than the CRD system, the other high pressure coolant sources that could inadvertently initiate and result in an LTOP event are the Condensate/Feedwater, the Safe Shutdown Makeup Pump (SSMP), Reactor Core Isolation Cooling (RCIC), and High Pressure Coolant Injection (HPCI) Systems.

During a normal RPV fill sequence prior to pressure testing, the Condensate System is used to fill the reactor. This evolution is carefully controlled per the test procedure to minimize the potential for an LTOP. The feedwater pump motors are prevented from starting by the reactor water level high feedwater pump trip signal, which is present due to the high reactor water levels required during pressure testing. The SSMP is a manually operated system that has no automatic initiation signals. Initiation of the SSMP is strictly governed by station procedures. During pressure testing, the reactor is in cold shutdown, and as a result, there is no steam available to drive the turbine driven RCIC or HPCI pumps. In addition, the HPCI and RCIC steam supply and pump discharge valves are closed and their associated motor operator breakers are opened in accordance with the test procedures.

The Standby Liquid Control (SLC) system is also a high pressure water source to the RPV. Similar to the SSMP, there are no automatic initiation signals associated with this system. Operation of the SLC system is strictly governed by station emergency operating procedures, and requires an operator to manually start the system from the main control room via a keylock switch manipulation.

The low pressure coolant sources include the Emergency Core Cooling Systems (ECCS) (i.e., Core Spray and Residual Heat Removal) and the Condensate System. Operation of the ECCS systems is also governed by station emergency operating procedures. Although certain automatic initiation signals are required operable during pressure testing, an ECCS actuation would occur only when reactor conditions warranted RPV injection (for example, during a low water level condition). In addition, the shutoff head of the ECCS pumps is relatively low and the injection valves are interlocked closed at pressures greater than approximately 300 psig. For these reasons, an LTOP event that would exceed the P/T curve limits due to an inadvertent ECCS injection is considered unlikely. As mentioned above, the Condensate System is normally used for RPV fill and is carefully governed by the test procedure.

During cold shutdown when the reactor head is tensioned, an LTOP event is prevented by the normal unit shutdown procedure, which requires the operator to place the RPV head vent valves in an open position when reactor coolant temperatures are below 190°F.

In addition to the procedural barriers, licensed operators are provided specific training on the P/T curves and requirements of the Technical Specifications. Simulator sessions are conducted which include plant heat-up and cool-down. Additionally, in response to industry operating experience, the operating training program is routinely evaluated and revised, as necessary, to reduce the possibility of events such as an LTOP.

Summary

In summary, EGC has reviewed the methodology used in Reference 1, and considering QCNPS plant specific materials properties, fluence, operational practices, and the provisions of Reference 2, the criteria established in Generic Letter 98-05 (i.e., Reference 3) are satisfied. Therefore, permanent relief is requested from the examination requirements of 10 CFR 50.55a for RPV circumferential shell welds since the proposed alternative provides an acceptable level of quality and safety.

Duration of Proposed Alternative

Permanent relief is requested for the remaining term of the operating licenses for QCNPS, Units 1 and 2.

Precedents

The NRC has previously approved similar relief for several nuclear power plants, including Dresden Nuclear Power Station, Units 2 and 3 (i.e., Docket Numbers 50-237 and 50-249, TAC Nos. MA6228 and MA6229), and Susquehanna Steam Electric Station, Units 1 and 2 (i.e., Docket Numbers 50-387 and 50-388, TAC Nos. MB0484 and MB0485). The relief request for Dresden Nuclear Power Station was submitted to the NRC in Reference 4, and the NRC granted the relief in Reference 5. The relief request for Susquehanna Steam Electric Station was submitted to the NRC in Reference 6, and the NRC granted the relief in Reference 7.

References

1. BWRVIP-05, "BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," dated September 28, 1995

2. Letter from G. C. Lainas (U. S. Nuclear Regulatory Commission) to C. Terry (BWRVIP), "Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report (TAC No. M93925)," dated July 28, 1998

3. NRC Generic Letter 98-05, "Boiling Water Reactor Licensees Use of the BWRVIP-05 Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds," dated November 10, 1998

4. Letter from J. M. Heffley (Commonwealth Edison Company) to U. S. Nuclear Regulatory Commission, "Relief Request for Alternative Weld Examination of Circumferential Reactor Pressure Vessel Shell Welds," dated July 26, 1999

5. Letter from A. J. Mendiola (U. S. Nuclear Regulatory Commission) to O. D. Kingsley (Commonwealth Edison Company), "Dresden – Authorization for Proposed Alternative Reactor Pressure Vessel Circumferential Weld Examinations (TAC Nos. MA6228 and MA6229)," dated February 25, 2000

6. Letter from R. G. Byram (PPL Susquehanna, LLC) to U. S. Nuclear Regulatory Commission, "Request for Alternative to 10CFR50.55a Examination Requirements of Category B1.11 Reactor Pressure Vessel Welds for PPL Susquehanna LLC Units 1 and 2 PLA-5251," dated November 7, 2000

7. Letter from M. Gamberoni (U. S. Nuclear Regulatory Commission) to R. G. Byram (PPL Susquehanna, LLC), "Relief Request No. 22 (RR-22) from American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Susquehanna Steam Electric Station Units 1 and 2 (TAC Nos. MB0484 and MB0485)," dated February 28, 2001