March 23, 2005

Mr. Christopher M. Crane, President
and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3 AND QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 - AUTHORIZATION FOR PROPOSED ALTERNATIVE REACTOR PRESSURE VESSEL CIRCUMFERENTIAL SHELL WELD EXAMINATIONS (TAC NOS. MC2190, MC2191, MC2192 AND MC2193)

Dear Mr. Crane:

By letter dated February 23, 2004, Exelon Generation Company, LLC requested permanent relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI requirements related to examination of reactor pressure vessel circumferential shell welds at Dresden Nuclear Power Station (DNPS), Units 2 and 3 and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2 for the renewed license operating period.

The staff has reviewed your request and supplemental information, and based on the information provided, concludes that the proposed alternative will provide an acceptable level of quality and safety. Therefore, the proposed alternative under the relief request is authorized pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), for the extended term of the renewed operating licenses for DNPS, Units 2 and 3 and QCNPS, Units 1 and 2.

Our safety evaluation is enclosed.

Sincerely,

/RA/

Gene Y. Suh, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos.: 50-237 and 50-249
50-254 and 50-265

Enclosure: Safety Evaluation

cc w/ encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATIVES FOR EXAMINATION OF REACTOR PRESSURE VESSEL

CIRCUMFERENTIAL SHELL WELDS

DRESDEN NUCLEAR POWER STATION UNITS 2 AND 3

QUAD CITIES NUCLEAR POWER STATION UNITS 1 AND 2

EXELON GENERATION COMPANY

DOCKET NOS. 50-237, 50-249, 50-254 AND 50-265

1.0 INTRODUCTION

By letter dated February 23, 2004, (ML040620661[1]) Exelon Generation Company, LLC (EGC, the licensee), submitted a request for relief from the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements related to examination of reactor pressure vessel (RPV) circumferential shell welds at Dresden Nuclear Power Station (DNPS) Units 2 and 3 and Quad Cities Nuclear Power Station (QCNPS) Units 1 and 2.

The relief request proposed an alternative in accordance with Boiling Water Reactor Vessel and Internals Project (BWRVIP) BWRVIP-05 and BWRVIP-74 to the RPV circumferential shell welds examination requirements of ASME Code, Section XI, for the period of extended operation.

2.0 REGULATORY EVALUATION

2.1 Applicable Requirements

Inservice inspection (ISI) of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable Addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 10 CFR 50.55a(a)(3) states that proposed alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

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[1]The number signifies the accession number for the document in NRC's Agencywide Documents Access and Management System (ADAMS).

Enclosure

Pursuant to 10 CFR 50.55a(g)(4), components (including supports) which are classified as ASME Code Class 1, 2, and 3 shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 120-month interval and subsequent intervals comply with the requirements in the latest Edition and Addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

The applicable ISI Code of records for DNPS and QCNPS are the 1995 Edition through 1996 Addenda of Section XI of the ASME Code.

2.2 Augmented Inservice Inspections Requirements for RPV Shell Welds

Section 10 CFR 50.55a(g)(6)(ii)(A)(2) requires licensees to augment their reactor vessel examinations by implementing, as part of the ISI interval, the examination requirements for reactor vessel shell welds specified in Item B1.10 of Section XI to the ASME Code, Table IWB-2500-1, Examination Category B-A, "Pressure Retaining Welds in Reactor Vessel." Item B1.10 of Section XI to the ASME Code includes the volumetric examination requirements in Item B1.11 in Section XI for RPV circumferential shell welds, and in Item B1.12 of Section XI for RPV longitudinal shell welds. Section 10 CFR 50.55a(g)(6)(ii)(A)(2) defines "essentially 100% examination" as covering 90 percent or more of the examination volume of each weld.

2.3 Additional Regulatory Guidance

2.3.1 Staff Evaluation of the BWRVIP-05 Report

By letter dated September 28, 1995, as supplemented by letters dated June 24 and October 29, 1996, May 16, June 4, June 13, and December 18, 1997, and January 13, 1998, the BWRVIP, a technical committee of the BWR Owners Group (BWROG), submitted the proprietary report, "BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)." The BWRVIP-05 report evaluated the current inspection requirements for RPV shell welds in BWRs, formulated recommendations for alternative inspection requirements, and provided a technical basis for these recommended requirements. As modified, the BWRVIP-05 proposed to reduce the scope of inspection of BWR RPV welds from essentially 100 percent of all RPV shell welds to examination of 100 percent of the RPV axial (i.e., longitudinal) welds and essentially zero percent of the RPV circumferential shell welds, except for the intersections of the axial and circumferential welds. In addition, the report provided proposals for alternatives to ASME Code requirements for successive and additional examinations of circumferential welds, contained in paragraph IWB-2420 and IWB-2430 respectively, of Section XI of the ASME Code.

On July 28, 1998, the NRC staff issued a Safety Evaluation (SE) (Legacy Library 9808040037) of BWRVIP-05. This evaluation concluded that the failure frequency of RPV circumferential welds in BWRs was sufficiently low to justify elimination of ISI of these welds. In addition, the evaluation concluded that the BWRVIP proposals on successive and additional examinations of circumferential welds were acceptable. The evaluation indicated that examination of the circumferential welds will be performed if axial weld examinations reveal an active degradation mechanism. The NRC staff supplemented the SE to the BWRVIP on March 7, 2000 (ML003690281). In the latter SE, the staff updated the interim probabilistic failure frequencies for RPV axial shell welds and revised Table 2.6-4 in the SE dated July 28, 1998, to correct a typographical error in the 32 effective full power years (EFPY) chemistry factor (CF) cited for the limiting Chicago Bridge and Iron (CB&I) case study for circumferential welds. The correction changed the 32 EFPY CF for the CB&I case study from 109.5 to 134.9.

The BWRVIP-05 report concluded that the conditional probabilities of failure for BWR RPV circumferential welds are orders of magnitude lower than that of the axial welds. As a part of its review of the report, the NRC conducted an independent probabilistic fracture mechanics assessment of the results presented in the BWRVIP-05 report. The staff's assessment conservatively calculated the conditional probability of failure values for RPV axial and circumferential welds during the current 40-year license period and at conditions approximating an 80-year vessel lifetime for a BWR nuclear plant. The failure frequency is calculated as the product of the frequency for the critical (limiting) transient event and the conditional probability of failure for the weld.

The staff determined the conditional probability of failure for axial and circumferential welds in BWR vessels fabricated by CB&I, Combustion Engineering (CE), and Babcock and Wilcox (B&W). The analysis identified a cold overpressure event that occurred in a foreign reactor as the limiting event for BWR RPVs, with the pressure and temperature from this event used in the probabilistic fracture mechanics calculations. The staff estimated that the probability for the occurrence of the limiting overpressurization transient was 1×10^{-3} per reactor year. For each of the vessel fabricators, Table 2.6-4 of the March 7, 2000, SE supplement identifies the conditional failure probabilities for the plant-specific conditions with the highest projected reference temperature (for that fabricator) through the expiration of the initial 40-year license period.

On November 10, 1998, the NRC issued Generic Letter (GL) 98-05 which states that BWR licensees may request permanent relief for the remaining term of operation under the initial license from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of RPV circumferential shell welds by demonstrating that at the expiration of the initial operating license, the limiting probability of failure for their limiting RPV circumferential welds will continue to satisfy (i.e., be less than) the limiting conditional failure probability for circumferential weld assessed in the applicable BWRVIP-05 limiting case study. In addition, licensees would have to implement operator training and establish procedures that limit the frequency of cold overpressure events to the amount specified in the July 28, 1998, SE.

2.3.2 Staff Evaluation of the BWRVIP-74 Report

However, the March 7, 2000, SE supplement notes that the safety evaluation is limited to the period of the current operating license, and will be reassessed, on a plant-specific basis for the extended period of operation. At the time, the staff was reviewing BWRVIP-74, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines," dated September 21, 1999, to determine the applicability of this alternative for the extended period of operation (under license renewal). The staff's evaluation of BWRVIP-74 was provided by SE, dated October 18, 2001, (ML012920549) which concluded that Appendix E of the July 28, 1998, SE conservatively evaluated BWR RPV's to 64 EFPY, which is 10 EFPY greater than what is realistically expected for the end of an additional 20-year license renewal period. Therefore, the staff's analysis provides a technical basis for relief from the current ISI requirements of the ASME Section XI for volumetric examination of the circumferential welds as they may apply for the license renewal period. The October 18, 2001, SE further states that to obtain relief, each licensee will have to demonstrate that:

(1) At the end of the renewal period, the circumferential welds will satisfy the limiting conditional failure probabilities for circumferential welds in the Appendix E of the staff's July 28, 1998, SE, and

(2) That they have implemented operator training and established procedures that limit the frequency of cold overpressure events to the amount specified in the staff's July 28, 1998, SE.

The July 28, 1998, SE provides Table 2.6-5 which also includes the conditional failure probabilities identified in Appendix E for each vessel fabricator, along with the corresponding highest projected reference temperature. Therefore, this table provides the limiting case studies for plants requesting relief to the end of the extended period of operation. This relief does not apply to the axial welds, and therefore the licensees still need to perform the required ASME Code inspections of "essentially 100 percent" of all axial welds.

3.0 TECHNICAL EVALUATION

3.1 Code Requirement for which Relief is Requested

The licensee requested relief from the following requirements of ASME Code, Section XI, 1995 Edition through 1996 Addenda:

- Subarticle IWB-2500, Table IWB 2500-1, Examination Category B-A, "Pressure Retaining Welds in Reactor Vessel," Item No. B1.11, "Circumferential Shell Welds."

This relief is requested for the following components:

ISI Class 1, Examination Category B-A, Code Item No. B1.11, "Circumferential Shell Welds."

3.2 Licensee's Proposed Alternative to the ASME Code

In accordance with 10 CFR 50.55a(a)(3)(i) and using the guidelines of BWRVIP-05, and the July 28, 1998, SE on BWRVIP-05, the licensee proposed to use a probabilistic fracture mechanics evaluation for the circumferential shell welds in the DNPS, Unit 2 and 3 RPVs, and QCNPS, Units 1 and 2 RPVs as the basis for eliminating the required volumetric examinations and augmented volumetric examinations for the welds through the expiration of the extended periods of operation for DNPS, Units 2 and 3 and QCNPS, Units 1 and 2. The licensee proposed the following alternative in lieu of performing the required volumetric examinations of the RPV circumferential shell welds:

The ISI examination requirements of the 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 using an automated ultrasonic inspection system, which provides the best possible examination of the RPV shell longitudinal welds. 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 for removal.

3.3 Licensee's Bases for Alternative

BWRVIP-05 provides the technical basis to justify relief from the examination requirements of RPV shell circumferential welds. The results of the NRC's evaluation of BWRVIP-05 are documented in the July 28, 1998, SE. BWR licensees may request permanent relief from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of circumferential RPV welds (ASME Code Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.11, Circumferential Shell Welds) by demonstrating that:

(1) At the expiration of the license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the NRC staff's July 28, 1998, SE, (Criterion 1), 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 staff's July 28, 1998, SE (Criterion 2) .

The relief request also stated that the licensee has demonstrated that the safety criteria specified in GL 98-05 and the July 28, 1998, SE will continue to be met for the entire extended period of operation.

3.3.1 License Basis for Conforming with Criterion 1 - Criterion for Conditional Probabilities of Failure

The licensee provided Tables 1 and 2, as duplicated in Tables 1 and 2 of this SE, which included a comparison of the limiting RPV circumferential weld parameters for each DNPS and QCNPS unit to those found in Table 2.6-5 of the July 28, 1998, SE for a B&W vessel. These parameters included the 54 EFPY Mean RT_{NDT} calculations for the limiting circumferential welds in the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPVs in order to support its basis for meeting Criterion 1 by demonstrating that the 54 EFPY Mean RT_{NDT} values for DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 are bounded by the Mean 64 EFPY RT_{NDT} value for the limiting B&W vessel plant specific analysis.

3.3.2 License Basis for Conforming with Criterion 2 - Criterion on Mitigating the Probability of Cold Overpressurization Events

The licensee provided the following technical basis for meeting Criterion 2:

> EGC has procedures in place for DNPS, Units 2 and 3, and 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 overpressurization (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 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 to be 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 approximately 30 pounds per square inch (psi) per minute at DNPS, and not greater than 50 psi per minute at QCNPS. 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, securing Control Rod Drive (CRD) pumps, and opening the main steam 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 system, the Safe Shutdown Makeup Pump (SSMP) at QCNPS, Reactor Core Isolation Cooling (RCIC) at QCNPS, 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 to be 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 limits curve 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 EF.

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

4.0 STAFF EVALUATION

As discussed in Section 2.3.2 of this SE, the October 18, 2001, SE for BWRVIP-74 provides two criteria that BWR licensees requesting relief from ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of RPV circumferential shell welds must satisfy. These criteria are intended to demonstrate that the conditions at the applicant’s plants are bounded by those in the SE. The licensee will still need to perform the required inspections of “essentially 100 percent” of all axial welds.

4.1 Neutron Fluence Calculation for Relief Request

For any given RPV circumferential or axial weld material, the conditional probability of failure increases with the material's neutron fluence value and Mean RT_{NDT} value, as projected to the expiration of the operating license for the facility. At the expiration of the operating license, the Mean RT_{NDT} estimates for RPV circumferential shell welds should satisfy the limiting conditional failure probability for the weld materials, as stated in the July 28, 1998, SE. The neutron fluence values for the RPV circumferential shell welds at the inside surface of the RPV are critical inputs to the Mean RT_{NDT} estimate calculations.

The licensee has used an NRC approved methodology to estimate the end of life (i.e., 54 EFPY) peak fluence value at the inside surface of the pressure vessel. The resulting values of $4.2X10^{17}$ n/cm^2 for DNPS Unit 2 and $4.1X10^{17}$ n/cm^2 for DNPS Unit 3 and QCNPS, Units 1 and 2, are lower than the limiting value of 1.9 $X10^{18}$ n/cm^2 used in the July 28, 1998, SE. The licensee also stated the 54 EFPY fluence values were calculated using the fluence methodology of General Electric Nuclear Energy licensing topical report NEDC-32983 P, which was approved by the NRC in the SE dated September 14, 2001 (ML012400381), and adheres to the guidance of Regulatory Guide 1.190. These 54 EFPY fluence values also include the extended power uprate approved by the NRC in letters dated December 21, 2001 (ML013540187 for DNPS, and ML013540222 for QCNPS). The staff has determined that the fluence values of $4.2X10^{17}$ n/cm^2 for DNPS Unit 2 and $4.1X10^{17}$ n/cm^2 for DNPS Unit 3 and QCNPS, Units 1 and 2 are acceptable because: (1) the methodology followed the guidance in Regulatory Guide 1.190, (2) the assumed load factor is conservative, and (3) the calculated fluence values are smaller than the corresponding values in the July 28, 1998, SE.

4.2 Circumferential Weld Conditional Failure Probability

The July 28, 1998, SE evaluated the conditional failure probabilities for axial and circumferential shell welds in the limiting BWR RPV designs manufactured by CE, CB&I, and B&W. The SE also reported the Mean RT_{NDT} calculations and values that were derived from the conditional failure probabilities for the limiting case studies. For a plant granted a renewed operating license, the evaluation criteria for the limiting conditional failure probabilities and Mean RT_{NDT} values are those listed for the limiting case studies specified in Table 2.6-5 of the July 28, 1998, SE and for no more than 64 EFPY of power operation.

The renewed operating licenses for DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 were approved and issued by the NRC on October 28, 2004. In the renewed operating licenses, the staff granted power operation through December 22, 2029, for DNPS Unit 2, January 12, 2031, for DNPS Unit 3, and December 14, 2032, for QCNPS Units 1 and 2, which represent operations through 54 EFPY of power operation. The period of applicability in Table 2.6-5 of the July 28, 1998, SE is bounding for operations of the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 reactors to the expiration of the extended operating licenses and is representative of the evaluation for the subject relief request. Since the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPVs were fabricated by B&W, the B&W limiting case study in Table 2.6-5 provides the applicable conditional probability of failure value and Mean RT_{NDT} value for the evaluation of this relief request.

In the license renewal application for the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 reactors, EGC identified the calculation of the Mean RT_{NDT} values for the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPV circumferential welds as a time-limiting aging analysis (TLAA) for the application. In the staff's evaluation in Section 4.2.2.6 of NUREG-1796, *Safety Evaluation Report Related to the License Renewal of the Dresden Nuclear Power Station, Units 2 and 3 and Quad Cities, Units 1 and 2 (October 2004)* (ML042050507), the staff concluded that EGC had performed a valid TLAA analysis to justify re-submittal of the alternative inspection proposal for the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPV circumferential welds to the expiration of the extend periods of operation for the reactor units. EGC's submittal of a relief request on February 23, 2004, was performed to justify elimination of the volumetric examinations and augmented volumetric examinations for the RPV circumferential welds through the expiration of the extended periods of operation for DNPS, Units 2 and 3 and QCNPS, Units 1 and 2.

The staff performed an independent calculation of the Mean RT_{NDT} values for the limiting DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPV circumferential welds through 54 EFPY. Tables 1 and 2 on page 11 of this SE provides a summary and a comparison of the corresponding Mean RT_{NDT} values calculated by EGC and the Mean RT_{NDT} value criterion for the limiting B&W case study at 64 EFPY.

The results in Tables 1 and 2 demonstrate that the Mean RT_{NDT} values calculated by the licensee for the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPV circumferential welds are less than that for the limiting B&W case study and are in agreement with those calculated by the staff. Based on this analysis, the staff concludes that EGC has provided a valid basis for concluding that the conditional probability of failure values for the DNPS, Units 2 and 3 and QCNPS, Units 1 and 2 RPV circumferential welds are sufficiently low to justify elimination of the volumetric examinations that are required for these welds through 54 EFPY.

4.3 Minimizing the Possibility of Low Temperature Overpressurization

The licensee established operator procedures to control vessel pressure at low coolant temperatures. These procedures are reinforced through periodic operator training. Reactor conditions which may result in cold overpressurization are: primary system leakage test, normal vessel fill sequence, and cold shutdown with tensioned head.

Primary System Leakage Test: Prior to the commencement of the test, the personnel involved are briefed on the procedure. During the test, potential overpressurization paths are avoided by administrative and/or hardware controls. Pressure vessel P/T limits are monitored and controlled to be within the P/T limits. A test coordinator is designated who maintains cognizance of the test status. The test procedures specify a variety of depressurization paths in case the plant approaches the P/T limits.

Normal Vessel Fill Sequence: The condensate system is used to fill the reactor. To minimize the potential of overpressurization, the feedwater pumps are prevented from starting during reactor testing when the reactor water level is high. The safe shutdown makeup pump can only be started manually, and does not have an automatic initiation signal. The reactor core isolation cooling and the high pressure coolant injection systems are steam driven and cannot be operated during a cold shutdown. Finally, the standby liquid control system is also a high pressure delivery system, but it does not have an automatic initiation signal.

Cold Shutdown with Tensioned Head: With the head tensioned and the coolant temperature at or lower than 190 EF, plant operating procedures require that the reactor vessel head vent valves be in the open position to prevent pressurization.

In summary, the probability of cold overpressurization is minimized by a combination of operator training, procedures and hardware modifications. The measures instituted by the licensee at DNPS, Units 2 and 3, and QCNPS, Units 1 and 2, are reasonable and appropriate for the task, i.e., prevent cold overpressurization. The staff finds the proposed measures acceptable.

5.0 CONCLUSION

The NRC staff has reviewed the licensee’s submittal and has determined that the licensee has acceptably demonstrated conformance to the applicable safety evaluation criteria in NRC GL 98-05 and in the staff’s evaluation of the BWRVIP-05 and BWRVIP-74 reports. The staff has also determined that the licensee has acceptably demonstrated that the conditional probability of failure values for the DNPS, Units 2 and 3, and QCNPS, Units 1 and 2, RPV circumferential welds are sufficiently low enough to justify elimination of the augmented volumetric examinations that are required by 10 CFR 50.55a(g)(6)(ii)(A)(2) and the volumetric examinations that are required by the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.11.

Based on this analysis, the staff concludes that the licensee’s alternative will provide an acceptable level of quality and safety in lieu performing the required volumetric examinations for the 20 year extended period of operation. Therefore, the licensee's alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i).

Additional requirements of the ASME Code, Section XI for which relief has not been specifically requested and approved by the staff remain applicable, including third party reviews by the Authorized Nuclear Inservice Inspector.

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Table 1: Effects of Irradiation on RPV Circumferential Weld Properties - DNPS

Parameter Description	DNPS Unit 2 RPV Circumferential Weld Information at 54 EFPY (Weld Wire Heat/Flux Lot # 71249/8504)	DNPS Unit 3 RPV Circumferential Weld Information at 54 EFPY (Weld Wire Heat/Flux Lot # 299L44/8650 (WF-19/WF-25))	NRC's Limiting Plant-Specific Analysis for B&W Circumferential Welds at 64 EFPY
End of Life Inside Diameter Fluence, (10^{19} n/cm^2)	0.042	0.041	0.19
Chemistry Factor, EF	168	221	196.7
Cu%	0.23	0.34	0.31
Ni%	0.59	0.68	0.59
Initial RT_{NDT}, EF	10	-5	20
ΔRT_{NDT}, EF	44	58	109.4
Mean RT_{NDT}, EF ($RT_{NDT(u)} + \Delta RT_{NDT}$)	54	53	129.4

Table 2: Effects of Irradiation on RPV Circumferential Weld Properties - QCNPS

Parameter Description	QCNPS Unit 1 RPV Circumferential Weld Information at 54 EFPY (Weld Wire Heat/Flux Lot #406L44/8688)	QCNPS Unit 2 RPV Circumferential Weld Information at 54 EFPY (Weld Wire Heat/Flux Lot #S3986/3870) Linde 124	NRC's Limiting Plant-Specific Analysis for B&W Circumferential Welds at 64 EFPY
End of Life Inside Diameter Fluence, (10^{19} n/cm^2)	0.041	0.041	0.19
Chemistry Factor, EF	183	68	196.7
Cu%	0.27	0.05	0.31
Ni%	0.59	0.96	0.59
Initial RT_{NDT}, EF	-5	-32	20
ΔRT_{NDT}, EF	48	18	109.4
Mean RT_{NDT}, EF ($RT_{NDT(u)} + \Delta RT_{NDT}$)	43	-14	129.4