February 25, 2000

Mr. Oliver D. Kingsley, President
Nuclear Generation Group
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 500
Downers Grove, IL 60515

SUBJECT: DRESDEN - AUTHORIZATION FOR PROPOSED ALTERNATIVE REACTOR PRESSURE VESSEL CIRCUMFERENTIAL WELD EXAMINATIONS (TAC NOS. MA6228 AND MA6229)

Dear Mr. Kingsley:

By letter dated July 26, 1999, Commonwealth Edison Company (ComEd, the licensee) requested NRC approval of an alternative reactor vessel weld examination pursuant to the provisions of 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(g)(6)(ii)(A)(5) for Dresden, Units 2 and 3. The alternative would allow the licensee to permanently defer the volumetric examination of circumferential reactor pressure vessel (RPV) shell welds. ComEd has proposed that examination of longitudinal RPV shell welds will be completed as scheduled and approximately 2 - 3 percent of the circumferential shell welds will be examined at their points of intersection with the longitudinal welds.

These inspections were proposed as an alternative to the augmented examinations specified in 10 CFR 50.55a(g)(6)(ii)(A)(2) for circumferential welds and as an alternative to the inservice inspection requirements for circumferential welds in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, 1989 Edition.

In Generic Letter (GL) 98-05, dated November 10, 1998, the staff indicated that it would consider technically justified requests for permanent relief from the inspection of Boiling Water Reactor (BWR) circumferential welds.

The staff has reviewed the licensee's request and concluded that the alternative proposal provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(g)(6)(ii)(A)(5), the inspection of the circumferential welds may be permanently deferred for up to 32 Effective Full Power Years (32 EFPY) of operation.

The enclosed safety evaluation contains the basis for this determination. This completes the staff's effort for TAC Nos. MA6228 and MA6229.

Sincerely,

/RA/

Anthony J. Mendiola, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-237 and 50-249

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO ALTERNATIVE TO INSPECTION OF REACTOR

PRESSURE VESSEL CIRCUMFERENTIAL WELDS

DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3

COMMONWEALTH EDISON COMPANY

DOCKET NOS. 50-237 AND 50-249

1.0 INTRODUCTION

By letter dated July 26, 1999, Commonwealth Edison Company (ComEd, the licensee) requested NRC approval of an alternative to performing the reactor pressure vessel (RPV) circumferential shell weld examination requirements of both the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, 1989 Edition (inservice inspection), and the augmented examination requirements of 10 CFR 50.55a(g)(6)(ii)(A)(2) for the Dresden Nuclear Power Station, Units 2 and 3 RPVs. The alternative was proposed pursuant to the provisions of 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(g)(6)(ii)(A)(5) and is consistent with information contained in Generic Letter (GL) 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.

The licensee will perform examinations of the longitudinal RPV shell welds as scheduled and approximately 2-3 percent of the circumferential seam welds will be examined at their points of intersection with the longitudinal welds.

Pursuant to the requirements of 10 CFR 50.55a(g)(4), ASME Code Class 1, 2 and 3 components must meet the requirements, except the design and access provisions and the preservice 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 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of the ASME Code, Section XI, incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The applicable ASME Code,

Section XI, for Dresden, Units 2 and 3, during the current 10-year inservice inspection (ISI) interval is the 1989 Edition.

10 CFR 50.55a(g)(6)(ii)(A) requires that licensees perform an expanded RPV shell weld examination as specified in the 1989 Edition of Section XI of the ASME Code on an "expedited" basis. "Expedited," in this context, effectively meant during the inspection interval when the Rule was approved or the first period of the next inspection interval. The final Rule was published in the *Federal Register* on August 6, 1992 (57 FR 34666). By incorporating into the regulations the 1989 Edition of the ASME Code, the NRC staff required that licensees perform volumetric examinations of "essentially 100 percent" of the RPV pressure-retaining shell welds during all inspection intervals. 10 CFR 50.55a(a)(3)(i) indicates that alternatives to the requirement in 10 CFR 50.55a(g) are justified when the proposed alternative provides an acceptable level of quality and safety.

2.0 BACKGROUND - STAFF REVIEW OF BWRVIP-05 REPORT

By letter dated September 28, 1995, as supplemented by letters dated June 24 and October 29, 1996, and May 16, June 4, June 13 and December 18, 1997, the Boiling Water Reactor Vessel and Internals Project (BWRVIP), a technical committee of the BWR Owners' Group (BWROG), submitted the proprietary report, "BWR Vessel and Internals Project, BWR Reactor Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," which proposed to reduce the scope of inspection of the BWR RPV welds from essentially 100 percent of all RPV shell welds to 50 percent of the axial welds and 0 percent of the circumferential welds. By letter dated October 29, 1996, the BWRVIP modified their proposal to increase the examination of the axial welds to 100 percent from 50 percent while still proposing to inspect essentially 0 percent of the circumferential RPV shell welds, except that the intersection of the axial and circumferential welds would have included approximately 2-3 percent of the circumferential welds.

On May 12, 1997, the staff and members of the BWRVIP met with the Commission to discuss the staff's review of the BWRVIP-05 report. In accordance with guidance provided by the Commission in Staff Requirements Memorandum (SRM) M970512B, dated May 30, 1997, the staff initiated a broader, risk-informed review of the BWRVIP-05 proposal, and issued a final safety evaluation related to the review of BWRVIP-05 on July 28, 1998, which generically approved the reduction in inspection of circumferential RPV welds. In SECY-98-219, the staff provided the Commission with its methods and acceptance criteria for considering both partial and permanent requests for relief from the augmented reactor vessel examinations required by 10 CFR 50.55a(g)(6)(ii)(A)(5).

In GL 98-05, the staff informed licensees owning BWR designs that review of BWRVIP-05 was complete. In the GL, the staff also informed BWR licensees that they could request periodic or permanent (i.e., for the remaining term of operation under the existing, initial license) relief from the inspection of BWR circumferential welds if the licensee meets the following criteria:

1) If at the expiration of the license for the plant, the circumferential welds in the vessel are shown to satisfy the limiting conditional failure probability for circumferential welds in the staff's July 30, 1998, final safety analysis report; and

2) If it is demonstrated that the licensee for a facility has implemented operator training and established procedures that limit the frequency of cold over-pressure events to the degree specified in the staff's July 30, 1998, final safety analysis report. In the GL, the staff also informed BWR licensees that they would still need to perform their required inspections of "essentially 100 percent" of all longitudinal RPV welds.

Technical Report BWRVIP-05 provides the technical basis for permanently deferring the augmented inspections of circumferential welds in BWR RPVs. In the report, the 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 the BWRVIP-05 report.[1] The staff conservatively calculated the probability that a RPV shell weld would catastrophically fail during the licensed operating term for a BWR nuclear plant. During the review, the staff used the FAVOR Code to perform the PFMA. The final failure probability for a RPV weld was calculated as the product of the frequency for the critical (limiting) transient event and the conditional failure probability for the weld using the limiting conditions from that event.

The staff determined the conditional probabilities of failure for longitudinal and circumferential welds in vessels fabricated by Chicago Bridge and Iron (CB&I), Combustion Engineering (CE), and Babcock and Wilcox (B&W). The analysis identified pressures and temperatures resulting from a cold over-pressure event in a foreign reactor as the limiting event for BWR RPV's. The staff estimated that the probability for the occurrence of the limiting over pressurization transient was 1×10^{-3} per reactor year. Table 2.6-4 of the staff's PFMA identifies the conditional failure probabilities for the bounding reference cases for longitudinal and circumferential welds in CB&I, CE, and B&W fabricated vessels. The materials and neutron irradiation parameters used by the staff in calculating the conditional probability failures for the reference cases were also identified in Table 2.6-4 of the staff's PFMA.

B&W fabricated vessels were determined to have the highest conditional probability of failure for circumferentially oriented flaws (8.17×10^{-5} per reactor year). The corresponding mean RT_{NDT} value used to calculate the conditional probability of failure for the B&W reference case was 99.8 degrees Fahrenheit. Using this data, the staff calculated the best-estimate failure probability for B&W fabricated circumferential welds to be 8.17×10^{-8} per reactor year.[2] Vessels with RT_{NDT} values less than those resulting from the staff's assessment are considered to have less embrittlement than the vessels simulated in the review. Therefore, these vessels should have a conditional probability of failure less than or equal to the values in the staff's final safety analysis report.

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[1] The staff's PFMA of BWRVIP-05 is documented in a letter dated June 28, 1998, to Mr. Carl Terry, Chairman of the BWRVIP.

[2] This value is the product of the conditional probability of failure for the B&W reference case (8.17×10^{-5} per reactor year) and the estimated frequency for the limiting event (1×10^{-3} per reactor year).

3.0 EVALUATION

3.1 Proposed Alternative

The alternative proposed by the licensee is to eliminate the ultrasonic examination of the RPV circumferential shell welds from the ISI and the augmented examination requirements of 10 CFR 50.55a(g). This includes the successive and the additional examination of flaws required by IWB-2420 and IWB-2430, respectively, of the ASME Code, Section XI. The licensee will perform examinations of the longitudinal RPV shell welds as scheduled. Approximately 2-3 percent of the circumferential welds will be examined at their points of intersection with the longitudinal welds. The submittal states that examinations of the RPV shell circumferential welds shall be performed if RPV longitudinal (axial) welds reveal an active, mechanistic mode of degradation.

3.2 Licensee's Technical Justification

3.2.1 RPV Embrittlement

The licensee indicated in its July 26, 1999, letter that the basis for requesting the alternative inspections is the BWRVIP-05 report, which stated that the probability of failure of BWR RPV circumferential shell welds is orders of magnitude lower than that of the axial shell welds. This conclusion was also demonstrated in the staff's final safety analysis report. Although BWRVIP-05 provides the technical basis supporting the alternative, the following table illustrates that Dresden, Units 2 and 3, have additional conservatism in comparison to the NRC's limiting case in the final safety analysis report.

Parameter Description	**Dresden Unit 2 RPV Circumferential Weld Information at 32 EFPY***	**Dresden Unit 3 RPV Circumferential Weld Information at 32 EFPY**	**NRC's Limiting Plant-Specific Analysis for B&W Circumferential Welds at 32 EFPY**
Fluence, 10^{19} n/cm^2	0.036	0.051	0.095
Initial RT_{NDT}, °F	10	-5	20
Chemistry Factor, °F	168	220.6	196.7
Cu%	0.23	0.34	0.31
Ni%	0.59	0.68	0.59
ΔRT_{NDT}, °F	33.05	53.33	79.8
Mean RT_{NDT}, °F ($RT_{NDT(u)} + \Delta RT_{NDT}$)	43.05	48.33	99.8

*Dresden, Unit 2, was manufactured by New York Shipbuilding. The Dresden, Unit 2, vessel properties are similar to B&W.

The chemistry factor, ΔRT_{NDT}, and mean RT_{NDT} are calculated consistent with the guidelines of Regulatory Guide 1.99, Revision 2. The mean RT_{NDT} values (and, therefore, the embrittlement) for the Dresden, Units 2 and 3, circumferential welds are less than the value from the staff's analysis. Therefore, the licensee concluded that the Dresden, Units 2 and 3, circumferential weld failure probabilities are bounded by the conditional failure probabilities in the staff's safety evaluation report through the projected expiration of license.

3.2.2 Operator Training and Procedures to Prevent Cold Over-Pressurization Events

During review of the BWRVIP-05 report, "BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations," the staff identified non-design basis events which should have been considered in the BWRVIP-05 report. In particular, the potential for and consequences of cold over-pressure transients should be considered. The licensee has assessed the systems that could lead to a cold over-pressurization of the Dresden, Units 2 and 3, RPV. These include the high pressure core injection (HPCI), the control rod drive system (CRD), and the feedwater system.

While not discussed in the licensee's submittal, the standby liquid control system (SLC) is an additional high pressure source. However, there are no automatic starts associated with the SLC system. The system is only initiated by manual operator action in accordance with the plant emergency operating procedures or during controlled test conditions, therefore, inadvertent manual initiation of SLC is an unlikely event. In addition, in the event of manual initiation during shutdown, the SLC injection rate of approximately 40 gpm would allow operators sufficient time to control reactor pressure.

The HPCI pumps are steam driven and do not function during cold shutdown and could not cause a low-temperature overpressure (LTOP) event.

In all cases, the operators are trained in methods of controlling water level within specified limits in addition to responding to abnormal water level conditions during shutdown. The licensee also stated that procedures and administrative controls for reactor temperature, level and pressure are in place to minimize the potential for RPV cold over-pressure events. Plant-specific procedures have been established to provide guidance to the operators regarding compliance with the Technical Specification pressure-temperature limits.

On the basis of the evaluation of high pressure injection sources, operator training and established plant-specific procedures, the licensee concluded that sufficient guidance is in place to prevent an LTOP event. The staff concludes that a non-design basis cold over-pressure transient is unlikely to occur at Dresden, Units 2 and 3, and that the information provided by the licensee regarding the Dresden, Units 2 and 3, high pressure injection systems, operator training, and plant-specific procedures provides a sufficient basis to support approval of the alternative examination request.

3.3 Staff Review of Licensee's Technical Justification

The staff confirmed that the RT_{NDT} values for the circumferential welds through the projected end-of-license are less than the values in the reference case for the B&W fabricated vessels.

RT_{NDT} is a measure of the amount of irradiation embrittlement. Since the RT_{NDT} values are less than the values in the reference case for B&W fabricated vessels, the Dresden, Units 2 and 3, RPVs have less embrittlement than the reference case and are considered to have a conditional probability of vessel failure less than or equal to that estimated in the staff's final safety evaluation.

The staff reviewed the information provided by the licensee regarding the Dresden, Units 2 and 3, high pressure injection sources, operator training, and established plant-specific procedures to prevent RPV cold over-pressurization. The information provided sufficient basis to support approval of the alternative examination request. The staff concludes that a non-design basis cold over-pressure transient is unlikely to occur at Dresden, Units 2 and 3, which is consistent with the staff's analysis.

4.0 CONCLUSIONS

Based upon its review the staff reached the following conclusions:

(1) Based on the licensee's assessment of the materials in the circumferential welds in the Dresden, Units 2 and 3, RPVs, the conditional probability of vessel failure is considered to be less than or equal to that estimated from the staff's analysis.

(2) Based on the licensee's high pressure injection sources, operator training, and established plant-specific procedures, the staff concludes that a non-design basis cold over-pressure transient is unlikely to occur at Dresden, Units 2 and 3.

(3) Based on the above, the staff concludes that the licensee has proposed a reasonable alternative for permanently deferring the augmented inspections of the circumferential welds required by 10 CFR 50.55a(g)(6)(ii)(A)(2). This includes the successive and the additional examination of flaws required by IWB-2420 and IWB-2430, respectively, of the ASME Code, Section XI. The staff has also determined that the alternative program provides an acceptable level of quality and safety.

Therefore, pursuant to 10 CFR 50.55a(g)(6)(ii)(A)(5), the augmented inspections of the circumferential welds in the Dresden, Units 2 and 3, RPVs may be permanently deferred for up to 32 EFPY of operation.

Principal Contributors: A. Lee
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Date: February 25, 2000