September 16, 2003

Mr. John L. Skolds, President
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BRAIDWOOD, UNITS 1 AND 2, AND BYRON, UNITS 1 AND 2 - REQUEST FOR RELIEF FROM ASME SECTION XI REQUIREMENTS FOR CONTROL ROD DRIVE MECHANISM CANOPY SEAL WELDS, (TAC NOS. MB8494, MB8495, MB8492 AND MB8493)

Dear Mr. Skolds:

By letter dated April 23, 2003, Exelon Generating Company, LLC (the licensee) requested relief from the requirements of the 1989 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Article IWA-4000 from using the Code-specified repair technique and the required surface examination of weld repair/replacement on control rod drive mechanism (CRDM) canopy seals for Braidwood Station, Units 1 and 2, and Byron Station, Units 1 and 2. The licensee's proposed alternative follows the guidelines of Code Case N-504-2, "Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping" for the repair and a 5X VT-1 visual examination in lieu of the surface examination of the seal welds and does not affect the structural integrity.

The staff concludes that the Code-required repair method and the surface examination of the canopy seal welds would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to Section 50.55a(a)(3)(ii) of Title 10 of the *Code of Federal Regulations* (10 CFR), the licensee's proposed alternative described in Relief Request I2R-43, Revision 0 for Braidwood Station, Units 1 and 2, and Relief Request I2R-44, Revision 0 for Byron Station, Units 1 and 2, are authorized for the second ten-year inservice inspection interval at each plant. The second ten-year inservice inspection intervals for the plants are as follows: Byron Unit 1 - July 1, 1996 to June 30, 2005, Byron Unit 2 - August 16, 1998 to August 15, 2007, Braidwood Unit 1 - July 29, 1998 to July 28, 2008, and Braidwood Unit 2 - October 17, 1998 to October 16, 2008.

The use of the code case is authorized until such time as the code case is published in a future version of RG 1.147. At that time, if the licensee intends to continue implementing this code case, it must follow all provisions of Code Case N-504-2 with limitations or conditions specified in RG 1.147, if any.

Sincerely,

/RA/

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

Docket Nos.: STN 50-454 and STN 50-455
STN 50-456 and STN 50-457

Enclosure: Safety Evaluation

cc w/encl: See next page

The use of the code case is authorized until such time as the code case is published in a future version of RG 1.147. At that time, if the licensee intends to continue implementing this code case, it must follow all provisions of Code Case N-504-2 with limitations or conditions specified in RG 1.147, if any.

Sincerely,
/RA/

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Docket Nos.: STN 50-454 and STN 50-455
STN 50-456 and STN 50-457

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE REQUESTS FOR RELIEF NO. I2R-43, REV. 0 AND I2R-44, REV. 0

SECOND TEN-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN

BYRON STATION, UNITS 1 AND 2, AND BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-456, STN 50-457, STN 50-454 AND STN 50-455

1.0 INTRODUCTION

By letter dated April 23, 2003, Exelon Generating Company, LLC (Exelon, the licensee), submitted for approval inservice inspection relief requests I2R-43, Rev. 0 for Braidwood Station, Units 1 and 2, and I2R-44, Rev. 0 for Byron Station, Units 1 and 2. I2R-43 and I2R-44 request relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), 1989 Edition, Section XI, IWA-4000, by proposing an alternative method of repair and examination of repairs performed to Control Rod Drive Mechanism (CRDM) canopy seal welds.

If necessary, the repair of leaking seal welds would be performed using the guidelines of ASME Code Case N-504-2, which establishes acceptability of a repair by increasing the weld thickness and performing a 5X VT-1 visual examination and pressure verification test in lieu of the Code-required surface examination for final acceptance of the repaired weld. The licensee's basis for the request is that the Code-required repair method and the required surface examination of the seal welds would expose personnel to high radiation dose and, therefore, would create a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

During a conference call on June 24, 2003, the licensee provided further clarifications in response to a request for additional information (ADAMS accession number ML031700389) submitted on June 18, 2003.

2.0 REGULATORY EVALUATION

The inservice inspection of ASME Code Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Section 50.55a(g) of Title 10 of the *Code of Federal Regulations* (10 CFR), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states in part that 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 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

ENCLOSURE

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) 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 (ISI) 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 ten-year 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 ten-year interval, subject to the limitations and modifications listed therein. The Code of record for the second ten-year inservice inspection (ISI) interval at Byron Station, Units 1 and 2 and Braidwood Station, Units 1 and 2 are the 1989 Edition of Section XI of the ASME Boiler and Pressure Vessel Code.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Component Affected (as stated)

Reactor control rod drive mechanism (CRDM) canopy seal welds - Class 1 appurtenance to the reactor vessel.

3.2 Applicable Code Edition and Addenda (as stated)

The current inservice inspection program is based on the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, 1989 Edition with no Addenda. The CRDM assemblies were designed and fabricated to the ASME B&PV Code, Section III, 1974 Edition through Summer, 1974 Addenda.

3.3 Applicable Code Requirements (as stated)

IWA-4000 of Section XI requires that repairs be performed in accordance with the owner's original construction Code of the component or system, or later editions and addenda of the Code. The canopy seal weld is described in Section III and a repair to this weld would require the following activities:

a. Excavation of the rejectable indications,
b. A surface examination of the excavated areas,
c. Re-welding and restoration to the original configuration and materials, and
d. Final surface examination

3.4 Reason for the Request (as stated)

The principal issues leading to this request for relief are the excavation of the existing weld, the accompanying radiation dose received during the excavation and examination activities, and the weld material used for the repair or replacement.

Due to the nature of the flaw, the excavation of the leaking portion of the weld would necessitate a cavity that extends completely through wall. A liquid penetrant examination (PT) of this cavity is required to verify the removal of the rejectable flaw or to verify that the flaw is

removed or reduced to an acceptable size. This PT examination would deposit the penetrant materials onto the inner surfaces of the component. This material would not be readily removable prior to re-welding due to the inaccessibility of the inside surface. The remaining penetrant material would introduce contaminants to the new weld metal and reduce the quality of the repair weld. The configuration of the canopy assembly would prevent the establishment and maintenance of an adequate back-purge during the welding process and would further reduce the quality of the repaired weld.

The CRDM canopy seal welds are located above the reactor vessel closure head, which is highly congested and subject to high radiation levels. The high radiological dose associated with strict compliance with these requirements would be contrary to the intent of the As Low As Reasonably Achievable (ALARA) radiological controls program. Most of the repair activities would be performed remotely using robotic equipment. This will reduce the radiation exposure to personnel involved in the welding process. However, the required excavation and PT examinations would necessitate hands-on access to the canopy weld and are estimated to result in a total occupational radiation dose of 1.688 person-Rem per CRDM canopy seal weld. The excavation and examinations are activities that would not be required if granted relief from these requirements and thus, represent the estimated occupational radiation dose savings. This dose estimate is comprised of the following:

ACTIVITY	**DOSE (PERSON-REM)**
MANUAL EXCAVATION OF FLAW(S)	
Access/egress to perform the excavation (0.072 per trip, 1 trip required)	0.072
Performance of the excavation (total residence time of five minutes)	0.180
PT OF EXCAVATED AREA(S)	
Access/egress to perform the examination (0.072 per trip, 5 trips required)	0.359
Performance of the PT examination (total residence time of ten minutes)	0.359
FINAL PT OF NEW WELD	
Access/egress to perform the examination (0.072 per trip, 5 trips required)	0.359
Performance of the PT examination (total residence time of ten minutes)	0.359
TOTAL EXPOSURE FOR EXCAVATION AND SURFACE EXAMINATIONS	**1.688**

Dose estimate based on a recent survey performed on the Braidwood Station, Unit 1 head canopy area. The Braidwood Station units are comparable to the Byron Station units.

IWA-4200 requires that the repair material conform to the original design specification or Section III. In this case, the replacement material would have the same resistance to stress corrosion cracking as the original material. Use of the original material does not guarantee that the repaired component will continue to maintain leakage integrity throughout the intended life of the item.

3.5 Proposed Alternative and Basis for Use (as stated)

Braidwood Station requests relief from the requirements of IWA-4000 in accordance with 10 CFR 50.55a(a)(3)(ii) by proposing an alternative method of repair and nondestructive examination due to hardship and unusual difficulty without a compensating increase in quality or safety. Applicable portions of ASME Code Case N-504-2 "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1," will be used as guidance for repair by weld overlay to provide a new leakage barrier. In lieu of performance of [liquid penetrant] PT examinations of CRDM seal weld repairs or replacement, a 5X or better magnification visual examination will be performed after welding is completed. In addition, Alloy 52 nickel-based weld repair material will be used rather than austenitic stainless steel as required by Code Case N-504-2.

Alloy 52 nickel-based weld repair material was selected for the repair rather than austenitic stainless steel because of its resistance to stress corrosion cracking. Consequently, the ferrite requirements of Code Case N-504-2 do not apply. The suitability of the replacement material has been evaluated and is determined to be compatible with the existing component and will provide a leakage barrier for the remainder of the intended life of the CRDM.

The alternative method of repair is being requested to facilitate contingency repair efforts during future outages within the second ten-year inservice inspection interval. The alternative nondestructive examination method is being requested to facilitate examination of either a repair or replacement of a CRDM canopy seal weld during the second ten-year inservice inspection interval.

Industry experience with failure analyses performed on leaking canopy seal welds removed from service at other plants has attributed the majority of the cases to transgranular stress corrosion cracking (SCC). The size of the opening where the leakage occurs has been extremely small, normally a few thousandths of an inch. The crack orientations vary, but often radiate outward such that a pinhole appears on the surface, as opposed to a long crack. The SCC results from exposure of a susceptible material to residual stress, which is often concentrated by weld discontinuities, and to a corrosive environment. A corrosive environment can form with water being trapped in the cavity behind the seal weld that is mixed with air initially in the cavity, resulting in a higher oxygen content than is in the bulk primary coolant.

Following the guidance of Code Case N-504-2, the CRDM canopy seal weld flaws will not be removed, but an analysis of the repaired weldment has been performed using Paragraph (g) of the Code Case as guidance to assure that the remaining flaw will not propagate unacceptably.

The canopy seal weld is not a structural weld, nor a pressure-retaining weld, but provides a seal to prevent reactor coolant leakage if the mechanical joint leaks. The weld buildup is considered a repair in accordance with IWA-4110. Applicability of the original Code of construction or design specification is mandated because the weld is performed on an appurtenance to a pressure-retaining component. The alternative CRDM canopy seal weld repair uses a gas tungsten arc welding (GTAW) process controlled remotely.

A visual examination of the repaired/replaced weld will be performed using methods and personnel qualified to the standards of ASME VT-1 requirements. The visual examination will be performed using the welding equipment video camera with 5X or better magnification within several inches of the weld, qualified to ensure identification of flaws to assure an adequate margin of safety is maintained. The examination technique will be demonstrated to resolve a 0.001" thick wire against the surface of the weld. The repaired/replaced weld will be examined for quality of workmanship and discontinuities will be evaluated and dispositioned to ensure the adequacy of the new leakage barrier.

The automated GTAW weld repair and alternate VT-1 examination methods result in significantly lower radiation exposure because the equipment is remotely operated after setup. A post-maintenance pressure test (VT-2) at nominal temperature and pressure will be performed.

Repair/replacement activities, using the process described in this request for relief, shall be documented on the required NIS-2 forms. This request for relief will be identified on the NIS-2 forms in lieu of an adopted or invoked ASME Code Case. The repair documents will be reviewed by the Authorized Nuclear Inspector, and maintained in accordance with the requirements for archiving permanent plant records.

3.6 Staff Evaluation

The licensee has proposed to perform the repair of leaking seal welds using the applicable provisions of ASME Code Case N-504-2, which establishes acceptability of a repair by increasing the weld thickness and performing a 5X VT-1 visual examination and pressure verification test in lieu of the Code-required surface examination for final acceptance of the repaired welds. The code case allows deposition of one or more layers of weld overlay to seal unacceptable indications in the area to be repaired without excavation. The code case further requires an analysis of the repaired weldment to assure that the existing flaw will not propagate unacceptably for the design life of the repair, considering potential flaw growth due to fatigue and SCC, the mechanism believed to have caused the flaw. This analysis will establish a critical flaw size that can be used as a bench-mark to qualify the VT-1 examination method to ensure the capability of detecting flaws of a size small enough to assure that an adequate margin of safety is maintained. Since the seal weld is neither a structural weld nor a pressure-retaining weld, the staff finds the proposed alternative repair method to be acceptable. The licensee also proposed to use Alloy 52 nickel-base weld repair material in place of austenitic stainless steel as required by Code Case N-504-2. The staff finds the use of this material acceptable due to its resistance to stress corrosion cracking.

The proposed remote visual examination would be conducted using a video camera with 5X magnification and 0.001 inch resolution within several inches of the weld. The visual resolution

of this video camera system has greater capability than that of the Code-required direct VT-1 visual examination of resolving a wire segment as narrow as 1/32-inch black line on a 18 percent neutral gray card. Therefore, the licensee's proposed alternative is an enhanced visual examination technique with resolution and consistency much greater than that provided by the requirements of a Code (visually unaided) VT-1 and comparable to flaw sizes detectable using PT. Based on the capability of the remote visual examination system to resolve flaws of a size 0.001 inch in width, reasonable assurance of the weld integrity is provided. Therefore, the staff has determined that the remote visual examination is acceptable in lieu of the code-required surface examination.

The welding process consists of multiple layers of weld metal welded over the existing seal weld. The multiple layers of weld metal provide a redundant CRDM nozzle-to-canopy seal. Each layer is a seal of itself. The adequacy of the seal is verified with a routine system leakage test that is performed at normal operating temperature and pressure, and held at such conditions for a Code-required soak time prior to returning to the system to service.

The licensee's basis for performing the remote 5X enhanced visual examination with a resolution of 0.001 inch width in lieu of a manual PT examination process, results in the dose saving that is anticipated to be achieved through the use of the remote visual examination process. The licensee estimated a total dose resulting from the performance of a PT examination on each weld repair to be in the range of 1.436 person-Rem. This dose estimate represents the total amount that could be averted for the examination since the dose associated with setting up the remote visual examination system is included in the dose associated with installing and removing the GTAW apparatus.

4.0 CONCLUSION

Based on the above evaluation, the staff concludes that the Code-required repair/replacement and surface examination of the canopy seal weld repairs would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the proposed alternative stated in Relief Request I2R-43, Rev. 0 for Braidwood Station, Units 1 and 2, and Relief Request I2R-44, Rev. 0 for Byron Station, Units 1 and 2, for each plant's second ten-year ISI interval. The second ten-year inservice inspection intervals for the plants are as follows: Byron Unit 1 - July 1, 1996 to June 30, 2005, Byron Unit 2 - August 16, 1998 to August 15, 2007, Braidwood Unit 1 - July 29, 1998 to July 28, 2008, and Braidwood Unit 2 - October 17, 1998 to October 16, 2008. The use of the code case is authorized until such time as the code case is published in a future version of RG 1.147. At that time, if the licensee intends to continue implementing this code case, it must follow all provisions of Code Case N-504-2 with limitations or conditions specified in RG 1.147, if any. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.