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RS-18-055

10 CFR 50.55a(z)

May 3, 2018

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

Braidwood Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Subject: Braidwood Station, Units 1 and 2, Supplement to Relief Request I4R-03 Associated with the Fourth Inservice Inspection Interval

Reference:
1) Letter from David M. Gullott (Exelon Generation Company, LLC) to U.S. NRC, "Braidwood Station, Units 1 and 2, Relief Requests Associated with the Fourth Inservice Inspection Interval," dated March 19, 2018

2) Letter from David M. Gullott (Exelon Generation Company, LLC) to U.S. NRC, "Response to Request for Additional Information Regarding Relief Request I3R-11 Associated with the Repair/Replacement of Control Rod Drive Mechanism (CRDM) Canopy Seal Welds," dated January 24, 2014

In Attachment 3 of Reference 1, Exelon Generation Company, LLC (EGC) submitted relief request I4R-03, for the Fourth Inservice Inspection Interval of Braidwood Station, Units 1 and 2. Subsequently, and similar to the response to Request for Additional Information regarding the precedent relief request I3R-11 in Reference 2, EGC has determined that I4R-03 is more appropriately justified in accordance with 10 CFR 50.55a(z)(2); i.e., "Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety." Attachment 1 contains a revision to the I4R-03 relief request including supplemental information for I4R-03 Section 4, "Reason for Request," and Section 5, "Proposed Alternative and Basis for Use," further supporting the I4R-03 relief request justification in accordance with 10 CFR 50.55a(z)(2).

There are no regulatory commitments contained within this letter. Should you have any questions concerning this letter, please contact Mr. Ryan M. Sprengel at (630) 657-2814.

Respectfully,

David M. Gullott
Manager – Licensing
Exelon Generation Company, LLC

Attachment:

1. 10 CFR 50.55a Request Number I4R-03 Revision 1

ATTACHMENT 1
10 CFR 50.55a Request Number I4R-03 Revision 1
Proposed Alternative In Accordance with 10 CFR 50.55a(z)(2)
--Hardship or Unusual Difficulty without Compensating Increase in Level of Quality or Safety--

1. ASME Code Component(s) Affected

Code Class:	1
Reference:	IWA-4000
Examination Category:	NA
Item Number:	NA
Description:	Alternative Requirements for Repair/Replacement of Control Rod Drive Mechanism (CRDM) Canopy Seal Welds in Accordance with IWA-4000
Component Number:	Reactor CRDM Canopy Seal Welds - Class 1 Appurtenance to the Reactor Vessel

2. Applicable Code Edition and Addenda

The fourth 10-year interval of the Braidwood Station, Units 1 and 2, Inservice Inspection (ISI) Program is based on the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, 2013 Edition.

3. Applicable Code Requirement

The CRDM assemblies were designed and fabricated to the ASME Section III, 1974 Edition through Summer 1974 Addenda.

IWA-4000 of ASME 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.

4. Reason for Request

In accordance with 10 CFR 50.55a(z)(2), relief is requested on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

At this time, this request for relief is associated with a contingency repair. There currently are no known degraded canopy seal welds at Braidwood Station. The principal issues leading to this relief request are the excavation of indications contained within the existing weld, the accompanying 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 in the subject canopy seal weld, the excavation of the leaking portion of the weld would result in a cavity that extends completely through wall. A liquid penetrant (PT) examination 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.

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This PT examination would deposit the penetrant materials onto the inner surfaces of the component. This material would not be readily removed 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 repair weld.

Components associated with the canopy seal welds were assembled using threaded connections, were torqued and seal welded using consumable inserts. The threaded joints between the cap and rod travel housing, rod travel housing and latch housing, and latch housing and head adaptor provide the primary pressure boundary and structural support for the control rod drive mechanisms. The canopy seal weld overlay is for secondary pressure retention only and does not provide any structural support. The general configuration of the canopy seal welds along with their general location on the control rod drive mechanism assembly are provided in Figures I4R-03-1 and I4R-03-2. The approximate diameter of the canopy seal welds ranges from 3.75" (for the upper canopy seal weld) to 6.45" (for the lower canopy seal 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 a CRDM canopy seal weld repair in strict compliance to these ASME Code requirements would be contrary to the intent of the as low as reasonably achievable (ALARA) radiological controls program. In order to reduce the exposure to personnel involved in the welding process, most of the repair activities would be performed remotely using robotic equipment to the extent practical. However, the required excavation and PT examinations would necessitate hands on access to the canopy weld. Based on expected radiation dose levels and time estimates to perform the excavation and PT examination for a single CRDM repair, the estimated total dose for these activities is estimated to be in excess of 0.600 person-Rem. This dose estimate is consistent with industry experience for similar activities.

IWA-4200 requires that the repair material conform to the original Design specification or ASME 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.

In lieu of performance of PT examinations of CRDM seal weld repairs or replacement, a visual examination will be performed after the welding is completed. In addition, Alloy 52/52M nickel-based weld repair material will be used rather than austenitic stainless steel.

Alloy 52/52M nickel-based weld repair material was selected for the repair because of its resistance to stress corrosion cracking. The suitability of the replacement material will be evaluated for each application and determined to be compatible with the existing component and will provide a leakage barrier for the remainder of the intended life of the CRDM.

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The alternative method of repair is being requested to facilitate contingency repair efforts during future outages within the fourth ISI interval. The alternative nondestructive examination method is being requested to facilitate examination of a repair of a CRDM canopy seal weld during the fourth ISI 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, such as water trapped in the cavity behind the seal weld that is mixed with the air initially in the cavity, resulting in higher oxygen content than is in the bulk primary coolant. Based on this operating experience, there were no instances of significant degradation associated with any target surfaces as a result of identified canopy seal leakage.

Should a minor canopy seal weld leak develop during reactor startup, there are no components in the near vicinity of the CRDMs that would be adversely impacted by a canopy seal weld leak. There are also established reactor coolant system (RCS) leak detection methods available to detect RCS leakage from any location. If a leak developed, the leak could be detected by the containment area or process radiation monitoring system; or by the containment sump monitor. In addition, a RCS leakrate surveillance is conducted every shift that would identify leakage.

5. Proposed Alternative and Basis for Use

The CRDM canopy seal weld flaws will not be removed, but an analysis of the repaired weldment will be performed, prior to entering Mode 4, 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 RCS leakage if the mechanical joint leaks. The canopy seal weld and associated overlay weld is separate from the structural pressure retaining threaded segments of the CRDM. The threaded segments are not designed to be leak tight and, therefore, canopy seal welds are utilized as part of the plant design to minimize leakage. The threaded joints between the cap and rod travel housing, rod travel housing and latch housing, and latch housing and head adapter provide the primary pressure boundary and structural support for the control rod drive mechanisms. The proposed overlay simply replaces a leaking section of the canopy seal weld and, because it does not affect the threaded CRDM joint, does not change the probability of a CRDM failure.

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. Should the need arise, a manual GTAW repair may be utilized.

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Welding vendor selection would be based on vendor availability at the time of need, experience welding Alloy 52/52M, and proven performance of the vendor. Based on the accessibility of the canopy seal weld, weld overlay repairs would be performed using an appropriate Welding Procedure Specification (WPS) along with welders or welding operators qualified in accordance with ASME Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators," requirements. Since the existing base materials are relatively thin, special consideration to travel speed and heat input would be critical parameters to be addressed during the weld qualification process.

Based on a review of documented industry experience, most of the difficulties attributed to Alloy 52/52M overlay repairs have been associated with overlays onto existing dissimilar metal welds on nozzle-to-safe end configurations or embedded flaw repairs on pressurized water reactor (PWR) upper head penetrations (i.e., overhead welding). All base materials associated with the canopy seal welds are stainless steel. Overhead welding is not a concern as the lower and upper canopy seal welds are oriented horizontally (see 2G position as depicted in Figure QW-461.4(b), "Groove Welds in Pipe - Test Position," of ASME Section IX). The middle canopy seal welds are also oriented horizontally (see 1G position as depicted in Figure QW-461.3(a) of ASME Section IX. Exelon Generation Company (EGC) procedure CC-AA-501-1028, "Exelon Nuclear Welding Program High Risk/High Value (HR/HV) Welds," will be used to evaluate specific weld repairs and determine whether mock-ups are necessary to ensure a sound weld overlay is successfully applied. All associated canopy seal repair welding activities would be approved in accordance with a repair plan consistent with ASME Section XI, IWA-4150, "Repair/Replacement Program and Plan."

A visual examination of the repaired/replaced weld will be performed using methods and personnel qualified to the standards of ASME Section XI VT-1 visual examination requirements. Conduct of the VT-1 visual examination would be dependent on accessibility of the inspection. If the canopy seal repair was associated with a control rod drive mechanism on the outer periphery of the core, it may be possible to perform the inspection through direct visual observation and a mirror. If inspection access is limited, VT-1 visual examinations would be conducted using remote visual equipment such as a video probe or camera equipment that accompanies the welding equipment. Remote visual equipment resolution will be demonstrated prior to and upon completion of the examination(s) in accordance with ASME Section XI, IWA-2211, "VT-1 Examination," and ASME Section V, "Nondestructive Examination," Article 9, "Visual Examination," requirements. Braidwood Station will utilize the requirements of ASME Section XI, Table IWA-2211-1, “Visual Examinations,” for procedure demonstrations required to support the VT-1 visual examinations. 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 visual examination methods result in significantly lower radiation exposure because the equipment is remotely operated after setup. A post-maintenance VT-2 visual examination will be performed at normal operating temperature and pressure during the System Leakage Test.

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There is no applicable ASME Section XI, Examination Category or Item Number associated with this configuration as canopy seal welds are not subject to Table IWB-2500-1, "Examination Categories," surface or volumetric examinations. Additionally, replacement seal welds are specifically exempted from post-welding pressure testing per ASME Section XI, IWA-4540, “Pressure Testing of Classes 1, 2, and 3 Items,” paragraph (b)(7). The only applicable ASME Section XI NDE requirements associated with the canopy seal welds are those associated with defect removal (i.e., IWA-4422.2.2, "Defect Removal Followed by Welding or Brazing"). A final surface examination is required in accordance with the Code of Construction (i.e., ASME Section III) and the original Design Specification.

The canopy seal welds are contained within the Class 1 system leakage test boundary and are examined by the VT-2 visual examination method each refueling outage as required by ASME Section XI, Table IWB-2500-1, Examination Category B-P, "Pressure Retaining Components," Item Number B15.10, "Pressure Retaining Components." In addition to the Class 1 system leakage test performed at the conclusion of each refueling outage, leakage checks at the beginning of each refueling outage and during forced outages are conducted in accordance with Braidwood Station's commitment to Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants."

The control rod drive mechanism housings are not insulated and are oriented vertically. Accessibility to conduct a VT-2 visual examination of the lower canopy seal welds is relatively unobstructed once the shroud access doors are opened. Staining, due to RCS leakage, would be evident at low points in this area. The intermediate and upper canopy seals cannot be observed directly and are examined to the extent practical in accordance with ASME Section XI, IWA-5241, "Insulated and Noninsulated Components," paragraph (d). Radiation dose rate in this area does not prevent performance of the VT-2 visual examinations.

Repair/Replacement activities, using the process described in this relief request, shall be documented on the required forms (i.e., NIS-2, "Form NIS-2 Owner's Report for Repair/Replacement Activity," or NIS-2A, "Form NIS-2A Repair/Replacement Certification Record.") This relief request will be identified on the NIS-2 / NIS-2A forms. The repair documents will be reviewed by the Authorized Nuclear Inspector, and maintained in accordance with the requirements for archiving permanent plant records.

6. Duration of Proposed Alternative

Relief is requested for the fourth ISI interval for Braidwood Station, Units 1 and 2.

7. Precedents

Braidwood Station, Units 1 and 2, third ISI interval Relief Request I3R-11 was authorized per Nuclear Regulatory Commission (NRC) SE dated April 28, 2014 (ADAMS Accession No. ML14084A549). This relief request for the Braidwood Station, Units 1 and 2, fourth ISI interval, utilizes a similar approach to the previously approved relief request.

8. References

None.

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Figure I4R-03-1
Structure of CRDM Housing

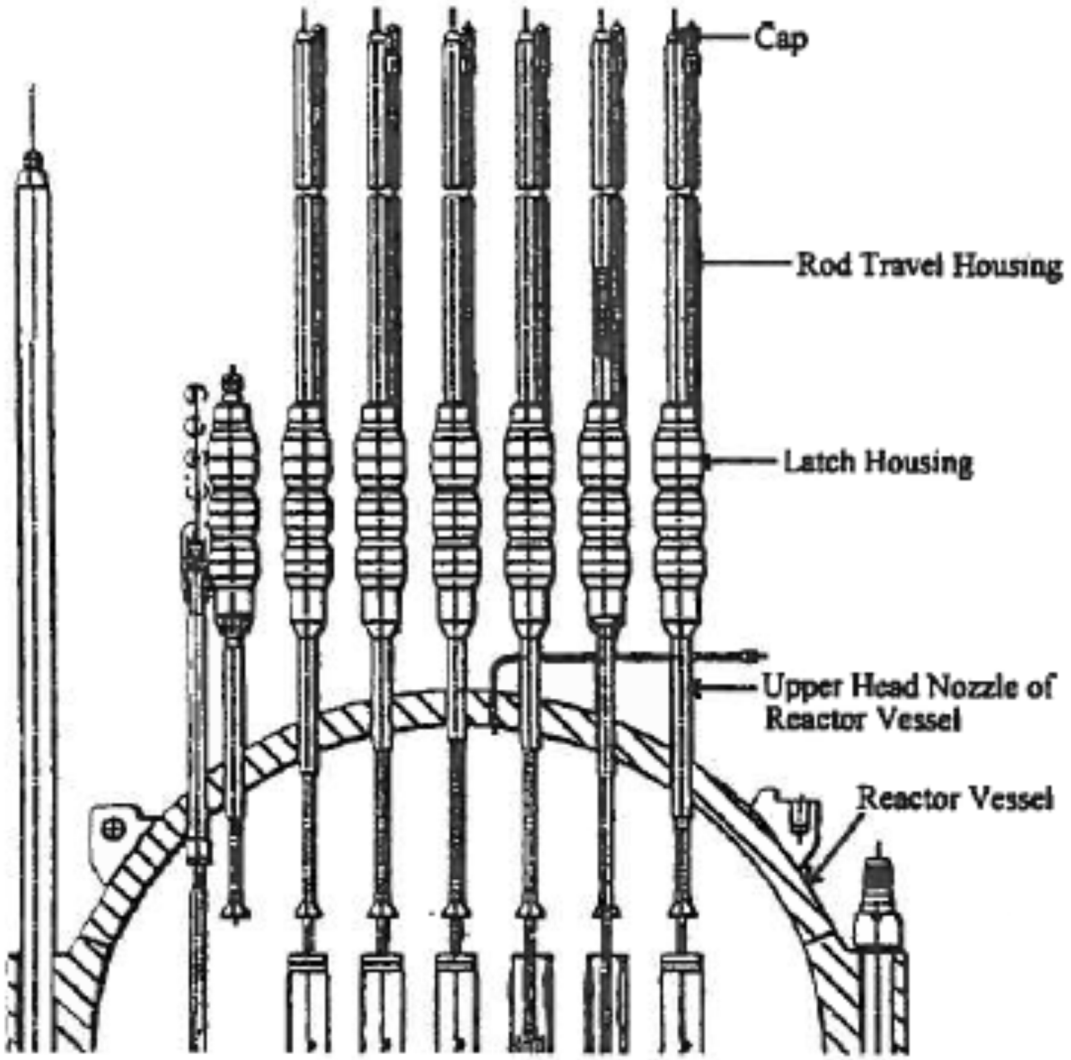

Fig. 1 Structure of CRDM Housing

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Figure I4R-03-2
Sectional View of Canopy Seals

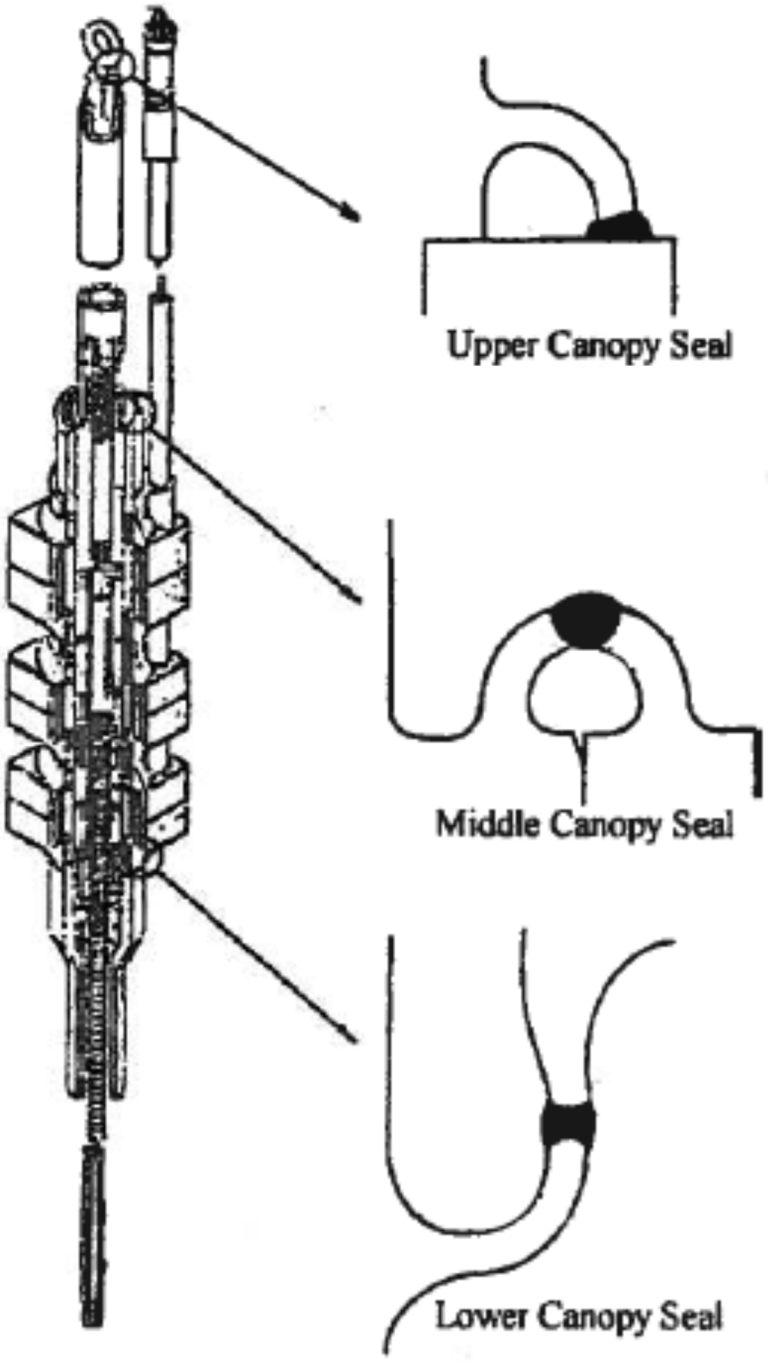

Fig. 2 Sectional View of Canopy Seals