UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE SECOND 10-YEAR INTERVAL INSERVICE INSPECTION

PROGRAM PLAN REQUEST FOR RELIEF NO. I2R-30

COMMONWEALTH EDISON COMPANY

BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-456 AND STN 50-457

1.0 INTRODUCTION

The Technical Specifications for the Braidwood Station, Units 1 and 2, states that the Inservice inspection of the American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 components shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if (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.

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 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 Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The applicable edition of Section XI of the ASME Code for Braidwood Station's second 10-year Inservice inspection (ISI) interval is the 1989 Edition.

Pursuant to 10 CFR 50.55a(g)(6)(i), if the licensee determines that conformance with the requirements is impractical, information shall be submitted to the Commission in support of that determination and a request made for relief from the ASME Code requirement. After evaluation of the determination, pursuant to 10 CFR 50.55a(g)(6)(i), the Commission may grant relief and may impose alternative requirements that are determined to be authorized by law, will not endanger life, property, or the common defense and security, and are otherwise in the public

interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The licensee, Commonwealth Edison Company (ComEd), submitted Relief Request I2R-30 for the second 10-year interval Inservice inspection plan at Braidwood Station by letter dated April 17, 1998, as supplemented by letter dated August 3, 1998.

2.0 EVALUATION

The information provided by the licensee in support of the relief request has been evaluated and the bases for disposition are documented below.

Relief Request I2R-30, IWA-5242(a), System Pressure Tests for Insulated Bolted Connections

Code Requirement: IWA-5242(a) states that for systems borated for the purpose of controlling reactivity, insulation shall be removed from pressure-retaining bolted connections for a direct VT-2 visual examination.

Licensee's Code Relief Request: The licensee requested relief from the Code-required removal of insulation for VT-2 visual examinations of bolted connections in borated systems for valve numbers 1(2)SI8948A-D, 1(2)SI8949A-D, 1(2)RC8001A-D, 1(2)RH8701A-B, 1(2)RC8002A-D, 1(2)RC8003A-D, and 1(2)RH8702A-B for the second 10 year interval currently scheduled to commence July 29, 1998, and to be completed July 28, 2008, +/- 1-year interval extension as allowed by paragraph (d) of IWA-2430.

Licensee's Basis for Requesting Relief (as stated):

Pursuant to 10 CFR 50.55a(a)(3)(i), relief is requested on the basis that the proposed alternative would provide an acceptable level of quality and safety. Specifically, relief is requested from the requirement to remove insulation for the Class 1 components listed above for VT-2 on the frequency specified in Tables IWB-2500, Category B-P (each refueling outage). The following supports a reduced inspection frequency:

1) ASME Section XI paragraph IWA-5242(a) requires the removal of insulation from pressure retaining bolted connections for VT-2 examinations when the system is borated for the purpose of controlling reactivity. Paragraph IWA-5242(a) requires this for all bolting, regardless of material type, when the system is borated for the purpose of controlling reactivity. For all materials of construction, when the system is not borated for the purpose of controlling reactivity, insulation removal is not required by paragraph IWA-5242(1) for VT-2 examinations.

   ComEd believes that by the Code only requiring insulation removal for borated systems, the intent of this requirement is to address early detection of boric acid wastage of the bolting materials. In either borated or non-borated systems, if leakage results in wetting of the bolting material, the required VT-2 visual

examinations would not be effective at detection of incipient stress corrosion cracking if it occurs; only the volumetric examinations of IWB-2500 Categories B-G-1 would be effective. For this reason, if the bolting material of construction is resistant to boric acid wastage, there is no reduction in margin of safety if the required VT-2 visual examinations are performed without insulation removal each refueling outage as they would be for other Class 1 non-borated systems. The proposed alternative provision of inspecting these components on a once per year 10 year interval basis will provide sufficient assurance that these highly corrosion resistant components have not degraded.

2) For valves listed above both the stud/bolt material and the closure nut material utilize SA-453 Grade 660, Class B. Also known as alloy A-286, the nominal composition of this ferrous alloy is 25Ni-15Cr-2Ti-Al. According to Reference 1, ["Materials Handbook for Nuclear Plant Pressure Boundary Applications," EPRI TR-109668-SI, WO4382-01, Final Report, Revision 0, December 1997], the "high chromium content of alloy A-286 gives it similar resistance to general corrosion in boric acid as possessed by stainless steel, which is essentially immune to wastage or erosion-corrosion problems." Reference 1 determines that for A-286 material stress corrosion cracking is only a concern if bolting material is loaded to 100 ksi or higher. For the valves listed above, review of the installation procedures shows that none of the bolting is loaded to more than 65 ksi. Therefore, stress corrosion cracking is not a concern. Also, Reference 1 states that a review of the available NRC Public Documentation revealed no reports of failures of alloy A-286 used for external reactor vessel bolting service in B&W units over a service period of greater tha[n] 20 years.

3) The valves listed above are among the highest radiation level components in the Borated bolting Inspection Program. Insulation removal combined with scaffolding erection and inspection time are expected to contribute significantly (approximately 1.5 person-rem) to the overall dose received. As discussed above, there is no significant increase in plant safety to be gained by performing VT-2 inspection of these materials on an every refueling outage frequency.

The following Braidwood Station bolting examination commitments and material control programs in conjunction with the Proposed Alternative Provisions provide an acceptable level of safety and quality for bolted connections in systems borated for the purpose of controlling reactivity.

- In response to NRC Generic Letter 88-05, Braidwood has established a program for Engineering to inspect all boric acid leaks discovered in the containment building and to evaluate the impact of those leaks on carbon steel or low alloy steel components. Any evidence of leakage, including dry boric acid crystals or residue, is inspected and evaluated regardless of whether the leak was discovered at power or during an outage. Issues such as the following are considered in the inspection and evaluation:

1) Evidence of corrosion or metal degradation
2) Effect the leak may have on the pressure boundary
3) Possibility of boric acid traveling along the inside of insulation on piping, and
4) Possibility of dripping or spraying on other components. Based on this evaluation, Braidwood Engineering initiates appropriate corrective actions to prevent reoccurrence of the leak and to repair, if necessary, any degraded materials or components.

- For systems borated for the purpose of controlling reactivity, when the bolting material is SA-453 Grade 660 and therefore immune to boric acid corrosion, ComEd requests relief from the requirement of ASME Section XI paragraph IWA-5242(a) that insulation shall be removed from pressure retaining bolted connections for VT-2 visual examination. Volumetric examinations as applicable to IWB-2500 Categories B-G-1 will continue to be performed.

Licensee's Proposed Alternative:

For ASME Class I systems borated for the purpose of controlling reactivity, a system Inservice leakage test shall be performed in accordance with the frequency required in table IWA-2500 (each refueling outage) without removal of insulation from the bolted connections. The requirements for Inservice leak tests shall be augmented with a minimum 4-hour hold time at system normal operating pressure prior to the VT-2 visual examination to allow for leakage propagation from the insulation. If evidence of leakage is detected, either by discovery of active leakage or evidence of boric acid crystals, the insulation shall be removed and the bolted connection shall be reexamined and, if necessary, evaluated in accordance with the corrective measures of Subarticle IWA-5250 (as modified for Braidwood by pending Relief Request I2R-13).

Pending Relief Request I2R-13 proposes an alternative to the requirements in IWA-5250(a)(2), which requires that, if leakage occurs at a bolted connection, the bolting shall be removed, VT-3 visually examined for corrosion, and evaluated in accordance with IWA-3000. As an alternative, I2R-13 proposes to evaluate the bolting to determine its susceptibility to corrosion, considering, as a minimum, the bolting materials, the corrosive nature of the process fluid, the leakage location and history, the service age of the bolting materials, visual evidence of corrosion at the assembled connection, and plant/industry studies of similar bolting materials in similar environments. In addition, if the initial evaluation indicates the need for further evaluation, the bolt nearest to the source of leakage will be removed, visually examined, and evaluated in accordance with IWA-3100(a). The NRC staff is reviewing I2R-13 under a separate cover.

For the valves listed above, the insulation shall be removed from the bolted connections once per 10-year interval and a VT-2 examination shall be conducted with the system depressurized. These inspections will be distributed throughout the inspection interval. If evidence of leakage is detected, evaluations for corrective measures performed will be performed in accordance with IWA-5250 (as modified for Braidwood by pending Relief

Request I2R-13). These inspections shall be implemented through application of the Braidwood Station predefined surveillance program to assure they are performed within the prescribed time periods.

Regardless of whether a component is scheduled for examination or not, any evidence of leakage will result in evaluations for corrective measures in accordance with IWA-5250 (as modified for Braidwood by pending Relief Request I2R-13).

The relief is requested for the second 10-year inspection interval of the Inservice Inspection Program for Braidwood Unit 1 and Unit 2.

Evaluation:

The staff has developed a position over the years on the use of A-286 stainless steel (SA-453 Grade 660). A Brookhaven National Laboratory report, "Bolting Applications, NUREG/CR-3604" states that A-286 stainless steel is susceptible to stress corrosion cracking in primary water, particularly if preloaded above 100 ksi. Bengtsson and Korhonen of ASEA-ATOM, Vasteras, Sweden, examined the behavior of A-286 in a BWR environment as reported in the Proceedings of the International Symposium on Environmental Degradation of Materials in Nuclear Power Systems-Water Reactors, August 22-25, 1983, Myrtle Beach, South Carolina sponsored by the National Association of Corrosion Engineers, the Metallurgical Society of the AIME, and the American Nuclear Society. They found the A-286 in comparison to other test materials, was the most susceptible material they tested to intergranular stress corrosion cracking in BWR water. They also found that A-286 is less likely to crack as the applied stress is reduced. Piascik and Moore from Babcock & Wilcox reported a number of vessel internals bolt failures of A-286 bolts in Nuclear Technology, Vol. 75, December 1986. They correlated the failures with bolt fillet peak stress and found that bolts loaded below 100 ksi showed no failures. For A-286 stainless steel studs, the preload must be verified to be below 100 ksi or the thermal insulation must be removed and the joint visually inspected. The licensee stated that for the above valves, none of the bolting material is loaded to more than 65 ksi; therefore, the proposed alternative is acceptable.

EPRI Report TR-102748 includes discussion about A-286 (SA-453) as a superior fastening material. The superalloy was designed for resistivity to acid corrosion environments due to its high nickel and chrome content and the inclusion of molybdenum specifically to inhibit inorganic acids such as boric acid. This material has been further evaluated for resistance to boric acid corrosion by material selection expert C.P. Dillon, a subcontractor to Nickel Laboratories in a study done for Union Electric. His evaluation concludes that "the development of intermediate concentrations of boric acid solution in the flange area (due to minor leaks and evaporation of the water) would not attack the bolting significantly and would be a marked improvement over low-alloy steel assemblies." Therefore, the proposed alternative will provide reasonable assurance of structural integrity of the bolting.

3.0 CONCLUSION

The staff concluded that the licensee's alternative contained in Relief Request I2R-30 provides an acceptable level of quality and safety. Therefore, the licensee's alternative contained in Relief I2R-30 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the second 10-year interval.

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Dated: October 2, 1998