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Technical Evaluation Report on the Third 10-year Interval Inservice Inspection Program Plan: Commonwealth Edison Company, Quad Cities Station, Units 1 and 2, Docket Numbers 50-254 and 50-265

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ABSTRACT

This report presents the results of the evaluation of the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval Inservice Inspection (ISI) Program Plan*, Revision 0, submitted January 7, 1993, including the requests for relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI requirements that the licensee has determined to be impractical. The *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, is evaluated in Section 2 of this report. The ISI Program Plan is evaluated for (a) compliance with the appropriate edition/addenda of Section XI, (b) acceptability of examination sample, (c) correctness of the application of system or component examination exclusion criteria, and (d) compliance with ISI-related commitments identified during previous Nuclear Regulatory Commission (NRC) reviews. The requests for relief are evaluated in Section 3 of this report.

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SUMMARY

The licensee, Commonwealth Edison Company (CECo), has prepared the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval Inservice Inspection (ISI) Program Plan*, Revision 0, to meet the requirements of the 1989 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. The third 10-year interval began February 18, 1993, and ends February 18, 2003, for Unit 1 and began March 10, 1993, and ends March 10, 2003, for Unit 2.

The information in the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, submitted January 7, 1993, was reviewed, as were the requests for relief from the ASME Code Section XI requirements that the licensee has determined to be impractical. As a result of this review, a request for additional information (RAI) was prepared describing the information and/or clarification required from the licensee in order to complete the review. The licensee provided the requested information in the submittal dated October 26, 1994.

Based on the review of the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, the licensee's response to the Nuclear Regulatory Commission's RAI, and the recommendations for granting relief from the ISI examinations that cannot be performed to the extent required by Section XI of the ASME Code, no deviations from regulatory requirements or commitments were identified in the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, except for Request for Relief CR-05.

CONTENTS

TECHNICAL EVALUATION REPORT ON THE
THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN:
QUAD CITIES STATION, UNITS 1 & 2
COMMONWEALTH EDISON COMPANY
DOCKET NUMBERS 50-254 & 50-265

1. INTRODUCTION

Throughout the service life of a water-cooled nuclear power facility, 10 CFR 50.55a(g)(4) (Reference 1) requires that components (including supports) that are classified as American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Class 1, Class 2, and Class 3 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* (Reference 2), to the extent practical within the limitations of design, geometry, and materials of construction of the components. This section of the regulations also requires that inservice examinations of components and system pressure tests conducted during successive 120-month inspection intervals shall comply with the requirements in the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 120-month inspection interval, subject to the limitations and modifications listed therein. The components (including supports) may meet requirements set forth in subsequent editions and addenda of this Code that are incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein, and subject to Nuclear Regulatory Commission (NRC) approval. The licensee, Commonwealth Edison Company (CECo), prepared the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0 (Reference 3), to meet the requirements of the 1989 Edition. The 1989 Edition of the Code was adopted based on anticipated approval in the Code of Federal Regulations (which occurred August 6, 1992). The third 10-year interval began February 18, 1993, and ends February 18, 2003, for Unit 1, and began March 10, 1993, and ends March 10, 2003, for Unit 2.

As required by 10 CFR 50.55a(g)(5), if the licensee determines that certain Code examination requirements are impractical and requests relief from them,

the licensee shall submit information and justification to the NRC to support that determination.

Pursuant to 10 CFR 50.55a(g)(6), the NRC will evaluate the licensee's determination that Code requirements are impractical to implement. The NRC 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.

Alternatively, pursuant to 10 CFR 50.55a(a)(3), the NRC will evaluate the licensee's determination that either (i) the proposed alternatives provide an acceptable level of quality and safety, or (ii) Code compliance would result in hardship or unusual difficulty without a compensating increase in safety. Proposed alternatives may be used when authorized by the NRC.

The information in the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, submitted January 7, 1993, was reviewed, including the requests for relief from the ASME Code Section XI requirements that the licensee has determined to be impractical. The review of the ISI Program Plan was performed using the Standard Review Plans of NUREG-0800 (Reference 4), Section 5.2.4, "Reactor Coolant Boundary Inservice Inspections and Testing," and Section 6.6, "Inservice Inspection of Class 2 and 3 Components."

In a letter dated May 12, 1994 (Reference 5), the NRC requested additional information that was required in order to complete the review of the ISI Program Plan. The requested information was provided by the licensee in the *Response to Request for Information Related to the Inservice Inspection Program Plan* dated October 26, 1994 (Reference 6). In this response, the licensee, Commonwealth Edison Company provided additional documentation and clarification regarding questions on the program. In addition, the licensee revised thirteen relief requests, withdrew two relief requests, and submitted two new relief requests.

The *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan* is evaluated in Section 2 of this report. The ISI Program Plan is evaluated for (a) compliance with the appropriate edition/addenda of Section XI, (b) acceptability of examination sample, (c) correctness of the application of system or component examination exclusion criteria, and (d) compliance with ISI-related commitments identified during the NRC's previous reviews.

The requests for relief are evaluated in Section 3 of this report. Unless otherwise stated, references to the Code refer to the ASME Code, Section XI, 1989 Edition. Specific inservice test (IST) programs for pumps and valves are being evaluated in other reports.

2. EVALUATION OF INSERVICE INSPECTION PROGRAM PLAN

This evaluation consists of a review of the applicable program documents to determine whether or not they are in compliance with the Code requirements and any previous license conditions pertinent to ISI activities. This section describes the submittals reviewed and the results of the review.

2.1 Documents Evaluated

Review has been completed on the following information from the licensee:

(a) *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, dated January 7, 1993 (Reference 3).

(b) Response to the request for additional information, submitted October 26, 1994 (Reference 6).

2.2 Compliance with Code Requirements

2.2.1 Compliance with Applicable Code Editions

The Inservice Inspection Program Plan shall be based on the Code editions defined in 10 CFR 50.55a(g)(4) and 10 CFR 50.55a(b). Based on the starting dates of February 18, 1993, and March 10, 1993, the Code applicable to the third interval ISI program is the 1986 Edition. However, as stated in Section 1 of this report, the licensee prepared the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan* to meet the requirements of 1989 Edition based on anticipated approval. The 1989 Edition of Section XI was subsequently approved for use by reference in the Code of Federal Regulations dated August 6, 1992.

2.2.2 Acceptability of the Examination Sample

Inservice volumetric, surface, and visual examinations shall be performed on ASME Code Class 1, 2, and 3 components and their supports using sampling schedules described in Section XI of the ASME Code and 10 CFR 50.55a(b). The sample size and weld selection have been implemented in accordance with the Code and 10 CFR 50.55a(b) and appear to be correct.

2.2.3 Exemption Criteria

The criteria used to exempt components from examination shall be consistent with Paragraphs IWB-1220, IWC-1220, IWC-1230, IWD-1220, and 10 CFR 50.55a(b). The exemption criteria have been applied by the licensee in accordance with the Code, as discussed in the ISI Program Plan, and appear to be correct.

2.2.4 Augmented Examination Commitments

In addition to the requirements as specified in Section XI of the ASME Code, the licensee has committed to perform the following augmented examination:

Examination of welds subject to Generic Letter 88-01, *NRC Position on Intergranular Stress Corrosion Cracking (IGSCC) in BWR Austenitic Stainless Steel Piping*

2.3 Conclusions

Based on the review of the documents listed above, no deviations from regulatory requirements or commitments were identified in the *Quad Cities Station, Units 1 & 2, Third 10-Year Interval ISI Program Plan*, Revision 0, with the exception of those discussed in the following section.

3. EVALUATION OF RELIEF REQUESTS

The requests for relief from the ASME Code requirements that the licensee has determined to be impractical for the third 10-year inspection interval are evaluated in the following sections.

3.1 Class 1 Components

3.1.1 Reactor Pressure Vessel

3.1.1.1 Request for Relief CR-01, Examination Category B-D, Item B3.100, Standby Liquid Control Nozzle Inner Radius Sections

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-D, Item B3.100 requires a 100% volumetric examination of all reactor vessel nozzle inner radius sections each inspection interval as defined by Figure IWB-2500-7.

Licensee's Code Relief Request: The licensee requested relief from performing the Code-required volumetric examination of the standby liquid control nozzle (N10) inner radius section for both Units 1 and 2.

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

"The Standby Liquid Control (SBLC) nozzle, as shown in Figure CR-01.1[1], is designed with an integral socket to which the boron injection piping is fillet welded. The SBLC nozzle is located near the bottom of the vessel in an area which is inaccessible for ultrasonic examinations (UT) from the inside surface of the reactor vessel. Therefore, UT would need to be performed from the outside radius surface of the reactor vessel. As shown in Figure CR-01.1, the ultrasonic beam would need to travel through the full thickness of the vessel into a complex cladding/socket configuration. These geometric and material reflectors inherent in the design prevent a meaningful examination from being performed on the inner radius of the SBLC nozzle.

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[1]Figures not included with this report.

"In addition, the inner radius socket attaches to piping which injects boron at locations far removed from the nozzle. Therefore, the SBLC nozzle inner radius is not subjected to turbulent mixing conditions that are a concern at other nozzles."

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform a VT-2 visual examination of the subject nozzles each refueling outage in conjunction with the Class 1 System Leakage or Hydrostatic Test."

Evaluation: The Code requires that all reactor vessel nozzle inner radius sections receive volumetric examination each inspection interval. Review of Figure CR-01.1, provided with the submittal, showed the cladding/socket configuration described above. The integral socket design of the SBLC nozzle makes the Code-required examination impractical to perform at Quad Cities Station, Units 1 and 2. The long ultrasonic metal path and potential for multiple geometric reflectors preclude a meaningful ultrasonic examination. To perform the required volumetric examination, the nozzle would have to be redesigned and replaced.

A VT-2 visual examination will be performed every refueling outage. As a result of this examination, corrective action will be taken, if required, providing reasonable assurance of operational readiness.

Conclusions: The Code-required volumetric examination of the SBLC nozzle inner radius is impractical to perform due to the component design. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.1.1.2 Request for Relief CR-11, Examination Category B-G-1, Item B6.10, Surface Examination of the Reactor Vessel Closure Head Nuts

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-G-1, Item B6.10 requires a 100% surface examination of all reactor vessel closure head nuts.

Licensee's Code Relief Request: The licensee requested relief from performing the Code-required surface examination of the reactor vessel closure head nuts as specified in Table IWB-2500-1 of the 1989 Edition of ASME Section XI for Units 1 and 2.

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

"Table IWB-2500-1 of the 1989 Edition of ASME Section XI requires a surface examination to be performed on the reactor vessel closure head nuts. However, Table IWB-2500-1 does not provide the corresponding "Examination Requirements/Figure Number" and "Acceptance Standard". These provisions were still in the course of preparation.

"The incomplete set of rules for the examination of reactor vessel closure head nuts does not allow Quad Cities Station to implement an inspection program to verify the integrity of the pressure retaining bolting.

"The 1989 Edition of ASME Section XI, Category B-G-1, employs a VT-1 visual examination for nuts associated with Heat Exchangers, Piping, Pumps, and Valves (Item Numbers B6.140, B6.170, B6.200, and B6.230, respectively). These Category B-G-1 requirements also provide an Acceptance Standard, IWB-3517, for the VT-1 examinations. Accordingly, these rules are deemed by Quad Cities Station as an acceptable and complete set of rules to assure the integrity of reactor vessel closure nuts.

"Based on the above, Quad Cities Station requests relief from the requirements specified in Table IWB-2500-1 of the 1989 Edition of ASME Section XI for reactor vessel closure head nuts.

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform a VT-1 visual examination of the surface of all reactor closure head nuts, utilizing the acceptance criteria of IWB-3517, as delineated in the 1989 Edition of ASME Section XI."

Evaluation: The licensee has proposed to perform a VT-1 visual examination of reactor pressure vessel closure head nuts in lieu of the Code-required surface examination. It is noted that other Examination Category B-G-1 items require a VT-1 visual examination. In addition, the 1989 Addenda of Section XI changes the requirement for the subject reactor pressure vessel closure head nuts to a VT-1 visual examination and provides acceptance criteria. Therefore, it can be concluded that a VT-1 visual

examination is an acceptable alternative as it should detect any significant degradation if present.

Conclusion: The licensee's proposed alternative, to perform a VT-1 visual examination on reactor pressure vessel closure head nuts, should provide an acceptable level of quality and safety. Therefore, it is recommended that the proposed alternative VT-1 visual examination be authorized, pursuant to 50.55a(a)(3)(i).

3.1.1.3 Request for Relief CR-12, Examination Category B-G-1, Items B6.20 and B6.30, Reactor Vessel Closure Stud Examination, IWB-2430, Additional Examinations

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-G-1, Items B6.20 and B6.30 require a 100% volumetric examination or reactor pressure vessel closure studs when examined in place and 100% volumetric and surface examination when removed.

IWB-2430 requires that additional examinations be performed during the current outage if examinations performed in accordance with Table IWB-2500-1 reveal indications exceeding the acceptance standards of Table IWB-3410-1. If indications exceeding the acceptance standards of Table IWB-3410-1 are found as a result of the additional examinations, IWB-2430 requires examinations to be extended in the current outage to include all welds, areas, or parts of similar design, size, and function.

Licensee's Code Relief Request: The licensee requested relief from complying with the sample expansion requirements of IWB-2430 when surface examinations reveal indications exceeding acceptance standards.

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

"Commonwealth Edison Company (CECo) discovered extensive stress corrosion cracking (SCC) in two reactor vessel closure studs at Dresden Unit 2 in late 1988. CECo is currently analyzing the

stud material microstructure and mechanical properties. CECo is also pursuing a proactive program of enhanced stud inspections which exceed the requirements of Section XI and the recommendations of General Electric Nuclear Energy (GE) Rapid Information Communication Services Information Letter (RICSIL) 055, Revision 1, "Reactor Pressure Vessel Head Stud Cracking," September 30, 1991. The CECo program is also intended to include some of the additional recommendations of Regulatory Guide 1.65.

"GE RICSIL 055 recommends that enhanced end shot UT be performed on "at least five RPV head studs either during the next refueling outage or at the next available opportunity." (The enhanced end shot UT technique developed by CECo uses a 3/4" to 1" diameter transducer with a frequency of 3.5 or 5 MHz; the sensitivity of the examination is maximized by setting the background noise level at about 5% full screen height. This technique reliably detects a 0.3" deep saw cut notch from the top end of a reactor vessel stud. Any indications found with the enhanced end shot UT technique will be sized with bore probe UT. The bore probe UT technique developed by CECo reliably detects a 0.1" deep saw cut notch.

"There are several reasons for removing a sample of studs and performing a surface examination:

- To provide data on incipient stud cracking.
- To allow for additional metallurgical evaluation of cracking mechanisms and potential embrittlement phenomena, if cracked studs are found and replaced.
- To provide a correlation between enhanced end shot UT, bore UT, and MT results, if cracked studs are found.

"This information is necessary to make informed decisions on long-term inspection and potential replacement strategies.

"Code structural margins will be assured thru the enhanced end shot UT of studs, and bore probe UT sizing of all cracked studs. Enhanced end shot UT and bore probe UT results will be evaluated in accordance with "Fracture Mechanics Based Structural Margin Evaluation for Commonwealth Edison BWR Reactor Pressure Vessel Head Studs," GE Nuclear Energy Report GE-NE-523-92-0991, DRF 137-0010, September 1991 (submitted with an M. H. Richter (CECo) letter to T. E. Murley (NRC) dated October 3, 1991). The GE structural margin evaluation is based on conservative fracture mechanics methodology and actual fracture toughness testing of material from one of the low-toughness Dresden Unit 2 studs. If the end shot UT is found to be nonconservative, then an expanded sample with the more sensitive bore probe UT will be performed in accordance with the methodology described in the attached flow chart. This approach will assure that Code structural margins are maintained without expanding the MT sample.

"Results of the enhanced end shot UT, bore probe UT, and MT will be compared in order to benchmark the minimum detection limit of the enhanced end shot UT technique. The minimum detection limit of the enhanced end shot UT technique will be judged against a conservative, bounding maximum allowable flaw size (established by the GE structural margin evaluation) which would be acceptable in all 92 studs at the same time (referred to as MAXAF on the attached flow chart). If the minimum flaw detection limit of the enhanced end shot UT is found to be greater than the MAXAF, additional bore probe examinations will be performed in lieu of the Section XI-required MT sample expansion.

"Expanding the MT sample if unacceptable surface indications are found would greatly increase the critical path time and manrem burden. And, as other utilities have found, it may be impossible to remove the desired sample of studs, without damage, within the time constraints of a refueling outage. It is estimated that complete removal of all 92 studs, assuming no stuck studs, would take 10 additional critical path days and expend 8 additional manrem.

"The proposed program is highly proactive, in that Section XI only requires a normal sensitivity end shot UT to be performed in place, and RICSIL 055 only recommends enhanced end shot UT of at least five studs. In accordance with Section XI, structural margin would still be assured by the enhanced end shot and bore probe UT. Yet much essential information could be gained by surface examination of a limited sample of studs. For these reasons, CECo requests relief from the MT sample expansion requirements of Section XI IWB-2430."

Licensee's Proposed Alternative Examination (as stated):

"During the third interval, each stud will be examined in place using enhanced end shot UT. Any flaws detected with enhanced end shot UT will be sized using bore probe UT.

"If MT of a sample of studs reveals indications which are found by bore probe UT to exceed the MAXAF, and were not detected by the enhanced end shot UT, the sample expansion will proceed using bore probe UT in lieu of the Section XI-required MT sample expansion."

Evaluation: For Examination Category B-G-1 bolting, the Code specifies examinations for bolts in place and when removed. It appears that the licensee is requesting relief from removing additional studs when the surface examination reveals flaws that exceed acceptance standards. The licensee is proposing to apply an enhanced end shot ultrasonic technique as an alternative to this Code requirement.

Bolting removed for examination during a refueling outage, requires both a volumetric and surface examination. When performing bolting examinations to the 1989 Edition of Section XI, the ultrasonic examination is required to be performed in accordance with Appendix VI. Appendix VI requires qualification of the technique and personnel performing the bolting examinations. The notch size for greater than 4 inch diameter studs is specified to be 0.157 inch deep with a maximum reflective area of 0.059 square inch. It appears that the enhanced end shot ultrasonic technique described in the licensee's "Basis for Relief" (detection reliability to 0.3 inch deep saw cut) does not provide the required sensitivity. The bore probe (0.1 inch notch depth detectability) does appear to meet the Appendix VI sensitivity requirement. Therefore, the licensee should use the bore probe examination to expand the sample when MT of studs reveals rejectable indications.

Conclusions: The licensee's proposed use of the enhanced end shot examination in lieu of removal of studs when additional examinations are required does not meet the requirements of the 1989 Edition of Section XI, Appendix VI for flaw detection. The use of the bore probe does appear to provide the Code-required sensitivity for flaw detection. As a result, it is recommended that the licensee's proposed alternative for expansion of examinations when flaws are detected in the MT sample group, be authorized pursuant to 10 CFR 50.55a(a)(3)(i), provided the licensee uses the bore probe examination for the expansion sample.

3.1.2 Pressurizer (Does not apply to BWRs)

3.1.3 Heat Exchangers and Steam Generators (No relief requests)

3.1.4 Piping Pressure Boundary

3.1.4.1 Request for Relief CR-02, Examination Category B-J, Items B9.11, B9.12, B9.21, B9.31, B9.32, B9.40, Selection of Class 1 Piping Welds for Examination

Code Requirement: Regarding the selection of Class 1 piping welds for examination, Table IWB-2500-1, Examination Category B-J, Note: (1)(b) states: "All terminal ends in each pipe or branch run connected to other components where the stress levels exceed either of the following limits under load associated with specific seismic events and operational conditions: (1) primary plus secondary stress intensity range of 2.4Sm for ferritic steel and austenitic steel (2) cumulative usage factor, U of 0.4." Note (2) states: "The initially selected welds shall be reexamined during each inspection interval."

Licensee's Code Relief Request: Relief is requested from the selection criteria of Examination Category B-J, Note (1)(b).

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

"Because Quad Cities piping was designed primarily per ANSI B31.1.0-1976, the parameters S_m and U are not available for weld selection purposes. These parameters are ASME Section III piping design characteristics. Stress data per ANSI B31.1.0 does exist (S_e), however, correspondence to Class 1 weld locations is not evident or available in many cases. ANSI B31.1.0 does not include a cumulative usage factor parameter similar to U of ASME Section III.

"As allowed by 10 CFR 50.55a(b)(2)(ii), the criteria used for selecting Category B-J welds during the first and second intervals at Quad Cities Station was based on ASME Section XI, 1974 Edition with Addenda through Summer 1975. This weld selection methodology basically requires the examination of a different 25% of the piping welds each inspection interval, such that 100% of the welds will have been examined at the end of the 40-years licensing period. To continue selecting welds in this manner will result in considerable personnel radiation expenditures to prepare new welds for examination each interval. Additionally, this methodology does not ensure that potentially

high stressed welds are reexamined over the course of plant life to monitor for service induced degradation.

"The use of the proposed alternate weld selection methodology described below will help to maintain the radiation exposure expended for weld preparation "As Low As Reasonable Achievable". In addition, this selection methodology has been designed to choose those welds that have a greater probability of being subject to higher stresses. Putting emphasis on the inspection of potentially higher stressed welds will improve the overall quality and safety levels of the Code Class 1 piping systems.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI, Table IWB-2500-1, Note 1 and 2 requirements regarding the selection of Category B-J welds for examination."

Licensee's Proposed Alternative Examination (as stated):

"Quad Cities Station will select Category B-J welds for examination such that 25% of the total non-exempt welds are examined during the interval. These welds will then be reexamined during subsequent intervals per Table IWB-2500-1, Note 2. The weld population selected for examination will include the following:

a) All accessible terminal end welds in each pipe or branch run connected to vessels.

b) All accessible terminal end welds in each pipe or branch run connected to other components.

c) All dissimilar metal welds between combinations of:

(1) carbon or low alloy steels to high alloy steels
(2) carbon or low alloy steels to high nickel alloys
(3) high alloy steels to high nickel alloys

d) Additional piping welds so that the total number of circumferential butt welds (or branch connection or socket welds) selected for examination equals 25% of the circumferential butt welds (or branch connection or socket welds) in the reactor coolant piping system. This total does not include welds excluded by IWB-1220. These additional welds may be located in one loop (one loop is defined for both PWR and BWR plants in the 1977 Edition). The additional piping welds will be distributed to the degree practicable, in a prorated fashion by system, line sizes and weld sizes and weld joint description (pipe-to-fitting, pipe-to-valve, etc.)."

Evaluation: Note 1(b) of the Code requires an evaluation of primary plus secondary stress intensities and cumulative usage

factors. Quad Cities Station was built to the requirements of ANSI B31.1.0-1967, Power Piping, and not to ASME Section III. Therefore, the parameters S_m and U are not available for weld selection purposes. While stress data per ANSI B31.1.0 does exist (S_e), correspondence to Class 1 weld locations is not evident or available in many cases. ANSI B31.1.0 does not include a cumulative usage factor parameter similar to U of ASME Section III.

The licensee's proposed alternative includes all terminal ends of branch runs connected to vessels and other components. Additional welds will be selected based upon the established criteria in the 1989 Edition. This alternative provides a conservative approach for the selection of welds subjected to high stress levels.

Conclusions: Because the licensee's proposed alternative provides a sound engineering approach to Class 1 piping weld selection by concentrating the examinations on those welds with higher stress levels, an acceptable level of quality and safety will be established. Therefore, it is recommended that the licensee's proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

3.1.4.2 Request for Relief CR-03 (Part 1 of 2), Examination Category B-J, Items B9.31 and B9.32, Class 1 Branch Connection Welds With Reinforcement Saddles

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-J, Item B9.31 requires a 100% surface and volumetric examination of branch connection welds NPS 4 or larger as defined by Figure IWB-2500-9, -10, or -11, and Item B9.32 requires a 100% surface examination of branch connection welds less than NPS 4 as defined by Figure IWB-2500-9, -10, or -11.

Licensee's Code Relief Request: The licensee requested relief from performing 100% of the Code-required volumetric and/or surface examination as applicable for Class 1 branch connection welds designed with reinforcement saddles.

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

"The design of certain Class 1 and 2 branch connection welds calls for the use of reinforcement saddles. These saddles are fillet welded over the actual pressure retaining branch pipe to main pipe, completely encasing it as illustrated on Figures CR-03.1 and CR-03.2[1]. This design precludes any type of surface or volumetric examination from being performed on the pressure retaining branch connection weld. However, additional assurance of the continued integrity of these joints is afforded by the fact that the reinforcement saddle strengthens the joint and reduces the stresses on the internal weld.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for the surface and volumetric examination of Class 1 and 2 branch pipe connection welds that are designed with a reinforcement saddle."

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform a surface examination of both the saddle to main pipe weld and the saddle to branch pipe weld, when the pressure retaining weld is made inaccessible due to the use of a reinforcement saddle. Additionally, a VT-2 visual examination of these joints will be performed in conjunction with the required Class 1 or Class 2 System Pressure Tests."

Evaluation: The Code requires surface and volumetric examinations for branch connection welds NPS 4 and larger and surface examinations for branch connections less than NPS 4. Because of the reinforcement saddle design, there is no access to the pressure-retaining branch connection weld. Therefore, the Code requirement is impractical. The licensee has proposed to perform surface examinations of the reinforcement saddle fillet welds when the pressure-retaining branch connection welds are inaccessible. The proposed surface examination should detect any cracking that may propagate through the reinforcement saddle from

[1]Figures and attachments are not included with this report.

the underlying branch connection weld. Imposition of the Code requirement on the licensee would cause a burden because the weld joint would require redesign. The proposed surface examination, along with the VT-2 visual examination associated with the Class 1 system pressure tests, provides reasonable assurance of the continued structural integrity of the Class 1 branch connection welds.

Conclusions: The surface and volumetric examination of the subject Class 1 pressure-retaining branch connection welds is impractical. The proposed surface examination of the saddle fillet welds, along with the VT-2 visual examination associated with the Class 1 system pressure tests, provides reasonable assurance of the continued structural integrity of the Class 1 branch connection welds. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.1.4.3 Request for Relief CR-07 (Part 1 of 2), Paragraph IWB-2430, Expansion Criteria for Welds Governed by Generic Letter 88-01 and NUREG-0313, Rev. 2

Code Requirement: Section XI, Paragraph IWB-2430 states that: (a) Additional examinations shall be performed during the current outage when indications exceed the acceptance standards of Table IWB-3410-1. The additional examinations shall include the remaining welds, areas, or parts included in the inspection item listing and scheduled for this and the subsequent period.

(b) If the additional examinations required above reveal indications exceeding the acceptance standards of Table IWB-3410-1, the examinations shall be further extended to include additional examinations at this outage. The additional examinations shall include all the welds, areas, or parts of similar design, size, and function.

(c) For the inspection period following the period in which the examinations of (a) or (b) above were completed, the examinations

shall be performed as normally scheduled in accordance with IWB-2400.

Licensee's Code Relief Request: The licensee requested relief from the IWB-2430 additional examination requirements for all full-penetration circumferential and branch pipe connection welds in austenitic stainless steel piping that is NPS 4 or larger and contains reactor coolant at a temperature greater than 200°F during power operation.

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

"Each of the subject welds fall under the augmented inspection program required by Generic Letter 88-01, and NUREG-0313, Rev. 2 (Reference L. Olshan [NRC] letter to T. Kovach [CECo], dated 8/21/90, transmitting SER of CECo's response to Generic Letter 88-01 for Quad Cities Units 1 and 2). This program governs examination methods, examination frequency, and sample expansion. The sample expansion requirements of this program are designed such that additional examinations are limited to welds that have the same susceptibility to Intergranular Stress Corrosion Cracking (IGSCC) as the weld in which the flaw was found. This methodology ensures that welds at a high risk for cracking are examined during the refueling outage, while not requiring expenditure of the Man-rem and outage time associated with examining additional low risk welds.

"In many instances, the examinations performed to meet the requirements of GL 88-01 are also applied to the percentages required by ASME Section XI. In these cases it is not practical to apply the expansion criteria of both Generic Letter 88-01/NUREG-0313 and ASME Section XI when unacceptable IGSCC flaw indications are identified.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for additional examinations when unacceptable flaw indications are identified in the subject welds."

Licensee's Proposed Alternative Examination (as stated):

"Quad Cities Station will perform sample expansions as required by Generic Letter 88-01 and NUREG-0313, Rev. 2 when unacceptable IGSCC flaw indications are identified in the subject welds."

Evaluation: The Code states that examinations that reveal indications exceeding acceptance standards shall be extended to

the remaining welds, areas, or parts included in the inspection item listing and scheduled for examination during this and the subsequent period. NUREG-0313 states that an additional sample of the welds in the appropriate category (Categories A, B, or C) should be inspected, approximately equal in number to the original sample. The additional sample should be similar in distribution (pipe size, system, and location) to the original sample.

The NRC staff has found it acceptable to take Section XI credit for the augmented volumetric examinations performed to Generic Letter 88-01 and NUREG-0313, Rev. 2. However, credit can be taken only if the Code-required surface examination is also performed.

The licensee has requested to use the sample expansion criteria for additional examination areas in accordance with NUREG-0313. The NUREG-0313 sample expansion methodology provides a systematic approach to determination of potential failure trends since the sample is selected from components with similar characteristics. In addition, the structure of the NUREG-0313 scheduling criteria essentially doubles the number of welds receiving volumetric examination during the 10-year interval for those welds susceptible to IGSCC. This original weld sample tends to offset any reduced additional examinations that may be required under the sample expansion criteria if IGSCC is identified.

Conclusions: The licensee's proposed alternative will provide an acceptable level of quality and safety because the additional examination areas selected will more closely relate to the welds where IGSCC is detected. Therefore, it is recommended that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

3.1.4.4 Request for Relief CR-10 (Part 1 of 2), Examination Categories B-F and B-J, Items B5.10, B5.130, B9.11 and B9.12, Weld Overlay Repaired Weld Joints

Code Requirement: Section XI, Table IWB-2500-1, Examination Categories B-F and B-J, Items B5.10, B5.130, B9.11 and B9.12 all require a 100% surface and volumetric examination for pressure-retaining nozzle-to-safe end welds and piping welds NPS 4 and larger as defined by Figure IWB-2500-8.

Figure IWB-2500-8 requires the surface examination to include the weld and 1/2 inch of base metal on each side of the weld, and the volumetric examination to include the lower 1/3 of the weld and base metal 1/4 inch on each side of the weld.

Licensee's Code Relief Request: The licensee requested relief from examining the entire Code-required volume for weld overlay repaired joints.

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

"Weld overlay repairs are examined in accordance with the requirements delineated in Generic Letter 88-01 using the ultrasonic examination (UT) technique developed by the NDE Center of the Electric Power Research Institute (EPRI). (Reference L. Olshan [NRC] letter to T. Kovach [CECo], dated 8/21/90, transmitting SER of CECo's response to Generic Letter 88-01 for Quad Cities Units 1 and 2.)

"This EPRI UT technique is capable of detecting flaws in the weld overlay material and the outer 25% of the original pipe wall thickness. However, this technique cannot reliably detect flaws in the inner 75% of the original pipe wall thickness due to the unique acoustical properties of the weld overlay repairs. In general, the weld overlays are designed to provide most, if not all, load carrying capability for the flawed weld joint. Therefore, only the structural integrity of the outer 25% original pipe wall thickness and of the weld overlay material must be maintained to assure structural integrity of the weld joint.

"Weld overlay repaired joints are sometimes inspected to satisfy the examination percentages required by ASME Section XI, Categories B-F, B-J, and C-F-1. In these cases, the examination

volume required by Figures IWB-2500-8 or IWC-2500-7 of ASME Section XI cannot be satisfied.

"Based on the above, Quad Cities Station requests relief from the required ASME Section XI examination volumes for Categories B-F, B-J, and C-F-1 when examining weld overlay repaired joints."

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform ultrasonic examinations of weld overlay repairs in accordance with the requirements set forth in Generic Letter 88-01. Additionally, when scheduled examinations of weld overlay repairs are being applied to the percentages required by ASME Section XI, a surface examination will be performed on the entire weld overlay surface. Also, a surface and volumetric examination will be performed on at least one pipe diameter length but not more than 12 inches of any intersecting longitudinal welds, as measured from the edges of the weld overlay."

Evaluation: The Code requires that pressure-retaining nozzle-to-safe end welds and piping welds NPS 4 and larger receive surface and volumetric examinations. The volumetric examination shall include the inner 1/3 volume of the weld and base metal 1/4 inch on each side of the weld.

Welds that have received weld overlay repair in accordance with the requirements delineated in GL 88-01 (Category E welds) are required to be inspected every other refueling outage. NUREG-0313 states "... the inspection method should provide positive assurance that cracks have not progressed into the overlay. It is also desirable that the inspection procedure be capable of detecting cracks that originally were deeper than 75% of the original wall thickness, or that have grown to be deeper than 75% of the original wall thickness." (Reference 7). Since the licensee is examining the overlayed welds as recommended by EPRI, it is believed that the examination technique meets or exceeds the Code requirements. As a result, assurance is provided that the weld overlays will continue to have the necessary safety margin.

The licensee should continue to monitor new or improved examination techniques. As improvements in these areas are achieved, the licensee should include them in the ISI examination procedures.

Conclusions: The proposed alternative examination will provide an acceptable level of quality and safety. Therefore, it is recommended that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

3.1.4.5 Request for Relief CR-13, Examination Category B-J, Items B9.11 and B9.12, Cast Stainless Steel Elbow-to-Pump Welds

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-J, Items B9.11 and B9.12 require 100% volumetric and surface examinations of circumferential and longitudinal piping welds NPS 4 or larger as defined by Figure IWB-2500-8.

Licensee's Code Relief Request: The licensee requested relief from performing the Code-required volumetric and surface examinations of Welds 02AS-S15 and 02BS-S15 for Unit 1, and Welds 02AS-S15 and 02BS-S15 for Unit 2.

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

"There are two reactor recirculation pumps in each subject unit. On the suction side of each reactor recirculation pump there is one 28" NPS Cast Stainless Steel Elbow-to-Cast Stainless Steel Pump Body weld. The pump casings and attached elbows are castings fabricated from Grade CF8M stainless steel.

"Ultrasonic examination (UT) and surface examination of these two (2) recirculation welds (per unit) is not practical because of the lack of accessibility to the outer surface of the welds. Additionally, the outer surface contour is not conducive to a meaningful UT.

"The outside surface of the weld and adjacent base material is inaccessible for examination due to the presence of a large whip restraint made of cables and trays. Removal and re-installation of each whip restraint would require in excess of 6.4 person-rem.

"If the welds were made accessible for examination purposes, the current weld configuration (outside surface contour) of each weld would not be conducive to a meaningful UT. As shown in Figure CR-13.1.[1], the 1.70" wide weld crown is located in the middle of a trough approximately 4" wide and 0.5" deep. This configuration is too restrictive for proper placement and movement of transducer search unit(s) to obtain sufficient coverage in the axial direction (i.e., to search for circumferential flaws).

"UT may not be effective even if the outside surface contour is machined to obtain sufficient clearance for the proper placement and movement of the transducer search units. The ability of current ultrasonic techniques to interrogate the complete weld volume in accordance with the requirements of ASME Section XI cannot be assured due to the highly attenuative nature of casting materials.

"Margin of safety is assured without UT because (1) the carbon content and delta ferrite combinations of subject CF8M castings exhibit resistance to Intergranular Stress Corrosion Cracking, and (2) the leakage associated with half of the critical flaw size was determined to be approximately 50 gpm, which far exceeds the minimum allowable unidentified leakage limit of 5 gpm specified in the Quad Cities Technical Specifications (From report SIR-92-002 by Structural Integrity Associates, Inc. for Commonwealth Edison Company, dated 03/12/92).

"Based on the above, Quad Cities Station requests relief from the NDE requirements of ASME Section XI for the subject welds."

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform a VT-2 visual examination of the weld area, in accordance with IWA-5000 and IWB-5000, in conjunction with the Class 1 pressure test at the end of each refueling outage."

Evaluation: The Code requires that Class 1 circumferential and longitudinal pipe welds receive volumetric and surface examinations. However, whip restraints obstruct access to the subject welds. If the whip restraints could be removed, volumetric examinations would still be limited due to the weld configuration (i.e., 4.0" wide, 0.5" deep trough). The current weld configuration, therefore, makes volumetric examination impractical.

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[1]Figures and attachments are not included with this report.

Removal and re-installation of each whip restraint is reported to require in excess of 6.4 person-rem radiation exposure. The benefit from performing the required examinations does not outweigh the ALARA considerations. Examination of similar terminal end welds provides assurance that a pattern of degradation, if present, will be detected. In addition, the licensee's proposed VT-2 visual examination performed every refueling outage should detect flaws before they reach critical flaw size.

Conclusions: The Code-required volumetric and surface examination of Welds 02AS-S15 and 02BS-S15 for Unit 1, and Welds 02AS-S15 and 02BS-S15 for Unit 2 is impractical at Quad Cities. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.1.4.6 Request for Relief CR-14, Examination Category B-J, Items B9.12 and B9.22, Examination of Class 1 Longitudinal Piping Welds

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-J, Item B9.12 requires a 100% surface and volumetric examination of Class 1 piping longitudinal welds in piping 4 inch NPS and larger as defined in Figure IWB-2500-8.

Item B9.22 requires a 100% surface examination of Class 1 piping longitudinal welds in piping less than 4 inch NPS as defined in Figure IWB-2500-8.

Licensee's Code Relief Request: The licensee requested relief from performing 100% of the Code-required volumetric and/or surface examination for Class 1 longitudinal piping welds.

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

"At each of the Quad Cities units, there are approximately 50 Class 1 longitudinal welds that are selected for surface and volumetric examinations. Examining 50 Class 1 longitudinal welds

would incur approximately 5.0 person-rem per interval, assuming a conservative average exposure rate of 100 mR/hr.

"Typically longitudinal welds are high quality welds. They are typically fabricated under controlled shop conditions and the vast majority underwent heat treatment. Heat treatment of the piping and longitudinal welds enhances the material properties of the welds and reduces the welding residual stresses. Just as fabrication processes are typically better controlled in the shop than in the field the original shop examinations were also performed under more favorable conditions. This further increases the confidence level for longitudinal welds.

"To date, there is no evidence of significant loading conditions or known material degradation mechanisms which are specifically related to piping longitudinal welds. Longitudinal weld examination at Quad Cities Units 1 and 2 have not detected any defects compromising piping integrity. This experience is further supported by an industry-wide survey that found no evidence of longitudinal weld defects compromising safety at nuclear generating facilities. This survey was conducted by the ASME Section XI Task Group on Optimization of ISI.

Ultrasonic and/or surface examinations of longitudinal welds to the extent required by ASME Section XI create radiation and cost burdens without generating significant added safety benefits.

"Based on the above reasons, Quad Cities Station requests relief from the volumetric and/or surface examination requirements specified in Table IWB-2500-1 of the 1989 Edition of ASME Section XI for the subject longitudinal welds."

Licensee's Proposed Alternative Examination (as stated):

"Quad Cities Station will perform the following:

"1. Surface examination on portions of the longitudinal welds that fall within the examination boundaries of intersecting circumferential welds when only a surface examination is required.

"2. Surface and volumetric examinations on portions of the longitudinal welds that fall within the examination boundaries of intersecting circumferential welds when both surface and volumetric examinations are required, provided that:

(a) Where longitudinal welds are specified, and locations are known, examination requirements will be met for transverse and parallel flaws at the intersection of the welds and for that length of the longitudinal weld within the circumferential weld examination volume.

(b) Where longitudinal welds are specified, but locations are unknown, or the existence of longitudinal welds is

uncertain, the examination requirements will be met for both transverse and parallel flaws within the entire examination volume of the intersecting circumferential welds."

Evaluation: The licensee has proposed an alternative to the 100% volumetric and/or surface examination of the longitudinal welds to the extent required by the Code. The proposed examinations will be performed in conjunction with the required examinations of the circumferential welds, and only the portion of longitudinal weld that falls within the circumferential weld examination area will be examined. The volumetric examination will include both transverse and parallel scans of the length of longitudinal weld that falls within the circumferential weld examination volume. Based on the extent of surface and volumetric examinations that will be performed in conjunction with examination of the associated circumferential weld, an acceptable level of quality and safety will be provided. This position is supported by Code Case N-524, *Alternative Examination Requirements for Longitudinal Welds in Class 1 and Class 2 Piping*

Conclusion: An acceptable level of quality and safety is provided by the licensee's proposed alternative. Therefore, it is recommended that the proposed alternative examination of longitudinal piping welds be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

3.1.5 Pump Pressure Boundary (No relief requests)

3.1.6 Valve Pressure Boundary (No relief requests)

3.1.7 General (No relief requests)

3.2 Class 2 Components

3.2.1 Pressure Vessels (No relief requests)

3.2.2 Piping

3.2.2.1 Request for Relief CR-03 (Part 2 of 2), Examination Category C-F-2, Item C5.81, Class 2 Branch Connection Welds With Reinforcement Saddles

Code Requirement: Section XI, Table IWC-2500-1, Examination Category C-F-2, Item C5.81, requires a 100% surface examination of branch connection welds greater than NPS 4, as defined by Figures IWC-2500-9 thru -13.

Licensee's Code Relief Request: The licensee requested relief from performing 100% of the Code-required surface examination of Class 2 branch connection welds that are designed with a reinforcement saddle.

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

"The design of certain Class 1 and 2 branch connection welds calls for the use of reinforcement saddles. These saddles are fillet welded over the actual pressure retaining branch pipe to main pipe, completely encasing it as illustrated on Figures CR-03.1 and CR-03.2[1]. This design precludes any type of surface or volumetric examination from being performed on the pressure retaining branch connection weld. However, additional assurance of the continued integrity of these joints is afforded by the fact that the reinforcement saddle strengthens the joint and reduces the stresses on the internal weld.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for the surface and volumetric examination of Class 1 and 2 branch pipe connection welds that are designed with a reinforcement saddle."

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[1]Figures and attachments not included with this report.

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform a surface examination of both the saddle to main pipe weld and the saddle to branch pipe weld, when the pressure retaining weld is made inaccessible due to the use of a reinforcement saddle. Additionally, a VT-2 visual examination of these joints will be performed in conjunction with the required Class 1 or Class 2 System Pressure Tests."

Evaluation: The Code requires that a surface examination be performed on branch connection welds greater than NPS 4. Due to the reinforcement saddle design, there is no access to the subject pressure-retaining branch connection welds; therefore, the Code requirement is impractical. Imposition of the Code requirement on the licensee would cause a burden because the system would have to be redesigned and the branch connections would have to be replaced.

The licensee proposed a surface examination of the reinforcement saddle fillet welds when the pressure-retaining branch connection welds are inaccessible. The proposed surface examination would detect any cracking that may propagate through the reinforcement saddle from the underlying branch connection weld. The proposed surface examination of the reinforcement saddle fillet welds, along with the VT-2 visual examination performed in conjunction with the Class 2 system pressure tests, provides reasonable assurance of the continued structural integrity of the Class 2 branch connection welds.

Conclusions: The Code-required surface examination of the subject Class 2 branch connection welds is impractical at Quad Cities Station, Units 1 and 2. The proposed alternative surface examination, along with the VT-2 visual examination associated with the Class 2 system pressure tests, provides reasonable assurance of the continued structural integrity of the Class 2 branch connection welds. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.2.2.2 Request for Relief CR-07 (Part 2 of 2), Paragraph IWC-2430, Expansion Criteria for Welds Governed by Generic Letter 88-01 and NUREG-0313, Rev. 2

Code Requirement: Section XI, Paragraph IWC-2430 states that: (a) Additional examinations shall be performed during the current outage when indications exceed the acceptance standards of IWC-3000. The additional examinations shall include an additional number of components (or areas) within the same examination category approximately equal to the number of components (or areas) examined initially. (b) If these additional examinations detect further indications exceeding the allowable standards of IWC-3000, the remaining similar components (or areas) within the same examination category shall be examined to the extent specified in Table IWC-2500-1.

Licensee's Code Relief Request: The licensee requested relief from the additional examination requirements of IWC-2430 for all full penetration circumferential and branch pipe connection welds in austenitic stainless steel piping that is NPS 4 or larger and contains reactor coolant at a temperature greater than 200°F during power operation.

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

"Each of the subject welds fall under the augmented inspection program required by Generic Letter 88-01, and NUREG-0313, Rev. 2 (Reference L. Olshan [NRC] letter to T. Kovach [CECo], dated 8/21/90, transmitting SER of CECo's response to Generic Letter 88-01 for Quad Cities Units 1 and 2). This program governs examination methods, examination frequency, and sample expansion. The sample expansion requirements of this program are designed such that additional examinations are limited to welds that have the same susceptibility to Intergranular Stress Corrosion Cracking (IGSCC) as the weld in which the flaw was found. This methodology ensures that welds at a high risk for cracking are examined during the refueling outage, while not requiring expenditure of the Man-rem and outage time associated with examining additional low risk welds.

"In many instances, the examinations performed to meet the requirements of GL 88-01 are also applied to the percentages

required by ASME Section XI. In these cases it is not practical to apply the expansion criteria of both Generic Letter 88-01/ NUREG-0313 and ASME Section XI when unacceptable IGSCC flaw indications are identified.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for additional examinations when unacceptable flaw indications are identified in the subject welds."

Licensee's Proposed Alternative Examination (as stated):

"Quad Cities Station will perform sample expansions as required by Generic Letter 88-01 and NUREG-0313, Rev. 2 when unacceptable IGSCC flaw indications are identified in the subject welds."

Evaluation: The Code states that the examinations that reveal indications exceeding acceptance standards shall be extended, during the outage, to include the remaining welds, areas, or parts included in the inspection item listing and scheduled for this and the subsequent period. In addition, NUREG-0313 states that an additional sample of the welds in the appropriate category (A, B, or C) should be inspected, approximately equal in number to the original sample. The additional sample should be similar in distribution (pipe size, system, and location) to the original sample.

The NRC staff has found it acceptable to take credit for the augmented volumetric examinations performed to Generic Letter 88-01 and NUREG-0313, Rev. 2, for Section XI Code-required volumetric examinations scheduled for the same austenitic piping welds when the Code-required surface examination is also performed. The licensee has requested the use of the sample expansion criteria for additional examination areas in accordance with NUREG-0313.

The NUREG-0313 sample expansion methodology provides a systematic approach to aid in the determination of potential failure trends since the sample is selected from components with similar characteristics. In addition, the structure of the NUREG-0313 scheduling criteria essentially doubles the number of welds

receiving volumetric examination during the 10-year interval for those welds susceptible to IGSCC. The larger size of this original weld sample tends to offset any reduced additional examinations that may be required under the sample expansion criteria if IGSCC is identified.

Conclusions: The licensee's proposed alternative will provide an acceptable level of quality and safety because the additional examination areas selected will more closely relate to the welds where IGSCC is detected. Therefore, it is recommended that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

3.2.2.3 Request for Relief CR-10 (Part 2 of 2), Examination Category C-F-1, Items C5.11 and C5.12, Weld Overlay Repaired Weld Joints

Code Requirement: Section XI, Table IWC-2500-1, Examination Category C-F-1, Items C5.11 and C5.12 require 100% surface and volumetric examinations for pressure-retaining nozzle-to-safe end welds and piping welds greater than NPS 4 as defined by Figure IWC-2500-7.

Figure IWC-2500-7 requires the surface examination to include the weld and 1/2 inch of base metal on each side of the weld, and the volumetric examination to include the lower 1/3 of the weld and the base metal 1/4 inch on each side of the weld.

Licensee's Code Relief Request: The licensee requested relief from the Code-required examination volumes when examining weld overlay repaired joints.

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

"Weld overlay repairs are examined in accordance with the requirements delineated in Generic Letter 88-01 using the ultrasonic examination (UT) technique developed by the NDE Center of the Electric Power Research Institute (EPRI). (Reference L.

Olshan [NRC] letter to T. Kovach [CECo], dated 8/21/90, transmitting SER of CECo's response to Generic Letter 88-01 for Quad Cities Units 1 and 2.)

"This EPRI UT technique is capable of detecting flaws in the weld overlay material and the outer 25% of the original pipe wall thickness. However, this technique cannot reliably detect flaws in the inner 75% of the original pipe wall thickness due to the unique acoustical properties of the weld overlay repairs. In general, the weld overlays are designed to provide most, if not all, load carrying capability for the flawed weld joint. Therefore, only the structural integrity of the outer 25% original pipe wall thickness and of the weld overlay material must be maintained to assure structural integrity of the weld joint.

"Weld overlay repaired joints are sometimes inspected to satisfy the examination percentages required by ASME Section XI, Categories B-F, B-J, and C-F-1. In these cases, the examination volume required by Figures IWB-2500-8 or IWC-2500-7 of ASME Section XI cannot be satisfied.

"Based on the above, Quad Cities Station requests relief from the required ASME Section XI examination volumes for Categories B-F, B-J, and C-F-1 when examining weld overlay repaired joints."

Licensee's Proposed Alternative Examination: (as stated):

"As an alternate examination, Quad Cities Station will perform ultrasonic examinations of weld overlay repairs in accordance with the requirements set forth in Generic Letter 88-01. Additionally, when scheduled examinations of weld overlay repairs are being applied to the percentages required by ASME Section XI, a surface examination will be performed on the entire weld overlay surface. Also, a surface and volumetric examination will be performed on at least one pipe diameter length but not more than 12 inches of any intersecting longitudinal welds, as measured from the edges of the weld overlay."

Evaluation: The Code requires that pressure-retaining nozzle-to-safe end welds and piping welds NPS 4 and larger receive surface and volumetric examinations. The volumetric examination shall include the inner 1/3 volume of the weld and base metal 1/4 inch on each side of the weld.

Welds that have received weld overlay repair in accordance with the requirements delineated in GL 88-01 (Category E welds) are required to be inspected every other refueling outage. NUREG-0313 states "... the inspection method should provide

positive assurance that cracks have not progressed into the overlay. It is also desirable that the inspection procedure be capable of detecting cracks that originally were deeper than 75% of the original wall thickness, or that have grown to be deeper than 75% of the original wall thickness." (Reference 7). This examination requirement and schedule exceed the Code requirement and will assure that the weld overlays will continue to provide the necessary safety margin.

The licensee should continue to monitor new or improved examination techniques. As improvements in these areas are achieved, the licensee should adopt them into the ISI examination procedures.

Conclusions: The proposed alternative examinations will provide an acceptable level of quality and safety. Therefore, it is recommended that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

3.2.3 Pumps (No relief requests)

3.2.4 Valves (No relief requests)

3.2.5 General (No relief requests)

3.3 Class 3 Components (No relief requests)

3.4 Pressure Tests

3.4.1 Class 1 System Pressure Tests

3.4.1.1 Request for Relief PR-08, Definition of Pressure-Retaining Boundary for System Leakage Test

Note: In the response to the NRC request for additional information dated October 26, 1994, the licensee withdrew Request for Relief PR-08.

3.4.2 Class 2 System Pressure Tests

3.4.2.1 Request for Relief PR-02, Examination Category C-H, Pressure Testing of the Reactor Pressure Vessel (RPV) Head Flange Seal Leak Detection System

Code Requirement: Section XI, Table IWC-2500-1, Examination Category C-H requires a VT-2 visual examination during system pressure tests and system hydrostatic tests of Class 2 components. Paragraph IWC-5210(a)(2) requires a system pressure test to be conducted during a system inservice test for pressure-retaining components within each system boundary that are required to operate during normal plant operation.

Paragraph IWC-5210(a)(3) requires the pressure-retaining components within each system boundary to receive a system hydrostatic pressure test.

Licensee's Code Relief Request: The licensee requested relief from performing the Code-required system pressure test of the RPV Head Flange Seal Leak Detection System.

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

"The Reactor Vessel Head Flange Leak Detection Line is separated from the reactor pressure boundary by one passive membrane, a

silver plated O-ring located on the vessel flange. A second O-ring is located on the opposite side of the tap in the vessel flange (See Figure PR-02.2)[1]. This line is required during plant operation in order to indicate failure of the inner flange seal O-ring. Failure of the O-ring would result in the annunciation of a High Level Alarm in the control room. On this annunciation, control room operators would quantify the leakage rate from the O-ring and then isolate the leak detection line from the drywell sump by closing the AO 1(2)-220-51 valve (see Figure PR-02.1). This action is taken in order to prevent steam cutting of the O-ring and the vessel flange. Failure of the inner O-ring is the only condition under which this line is pressurized.

"The configuration of this system precludes hydrostatic testing while the vessel head is removed. As Figure PR-02.2 portrays, the odd configuration of the vessel tap, combined with the small size of the tap and the high test pressure requirement (1000 psig minimum), prevents the tap in the flange from being temporarily plugged.

"When the head is installed, an adequate pressure test cannot be performed. The inner O-ring is designed to withstand pressure in one direction only. Due to the groove that the O-ring sits in and the pin/wire clip assembly (See Figure PR-02.3), pressurization in the opposite direction could damage the O-ring and thus result in further damage to the O-ring and vessel flange itself from steam cutting.

"Pressure testing of this line during the Class 1 System Leakage and/or Hydrostatic Test is precluded because the line will only be pressurized in the event of a failure of the inner O-ring. It is extremely impractical to purposely fail the inner O-ring in order to perform a test.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for static and operational pressure testing of the Reactor Vessel Head Flange Seal Leak Detection System. Compliance with the pressure test requirements of Table IWC-2500-1, Category C-H would result in hardship and degraded condition for the system."

Licensee's Proposed Alternative Examination (as stated):

"A VT-2 visual examination will be performed on the line during vessel flood-up during a refueling outage. The hydrostatic head developed due to the water above the vessel flange during flood-up will allow for the detection of any gross indications in the line. This examination will be performed with the frequency specified by table IWC-2500-1 for an IWC-5221 test (once each inspection period)."

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[1]Figures and attachments are not included with this report.

Evaluation: The Code requires that system pressure tests be conducted for those systems required to function during normal plant operation. The RPV Head Flange Leak Detection Line is pressurized only when the inner O-ring fails. To submit these O-rings to a pressure test would require pressurization in a direction opposite that intended by the design and would likely damage the O-rings. The design of this line, therefore, makes the Code-required system pressure tests impractical. To perform the system pressure tests in accordance with the requirements, the RPV Head Flange Leak Detection System and the RPV flange would have to be redesigned, fabricated, and installed.

The licensee has committed to perform a VT-2 visual examination on the RPV Head Flange Leak Detection Line during vessel flood-up. The proposed alternative test will provide adequate assurance that if gross inservice flaws have developed in the subject line, they will be detected and repaired prior to the return of this line to service.

Conclusions: The system pressure test required by Section XI for the subject Class 2 line is impractical because of the possibility of damage to the O-ring seals. The VT-2 visual examination of the RPV Head Flange Leak Detection Line during vessel flood-up will provide adequate assurance that if gross inservice flaws have developed in the subject line they will be detected and repaired. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.4.2.2 Request for Relief PR-04, Alternative Testing For Residual Heat Removal Heat Exchanger Tubes

Code Requirement: IWA-5241(b) requires that if a component's external surfaces are inaccessible for direct VT-2 visual examination, the surrounding area (including floor areas or equipment surfaces located underneath the components) shall be examined for evidence of leakage.

Licensee's Code Relief Request: The licensee requested relief from performing the Code-required VT-2 visual examination of the Residual Heat Exchanger tubes.

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

"The tubing inside the Residual Heat Removal (RHR) Heat Exchanger is inaccessible. A visual examiner cannot enter the RHR Heat Exchanger to perform an examination of the tubes during operational or hydrostatic pressure testing. Disassemble and reassemble the heat exchanger channel head covers for the VT-2 examination is a true hardship. At least 7 person-rem would be incurred to disassemble and reassemble the bottom head channel cover.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for performing a VT-2 visual examination of the RHR Heat Exchanger tubing during hydrostatic and operational pressure tests."

Licensee's Proposed Alternative Examination (as stated):

"When the RHR Heat Exchanger bottom channel head covers are removed for maintenance, the tubing will be pressure tested by applying hydrostatic test pressure of the shell side with the tube side drained. A qualified VT-2 visual examiner will perform visual examination in accordance with the applicable requirements of Articles IWA-5000 and IWC-5000. The hydrostatic pressure will be the pressure of the demineralized water supply, which is in the range of 100 psig to 150 psig.

"Additionally, radiation levels of the tube side cooling water will be monitored by the Service Water Effluent Gross Activity Monitor (SWEGAM). This monitor is located on the discharge of the RHR Service Water system. It is subject to various surveillance, calibration, and tests per Technical Specifications.

"The alternative examinations discussed above assures that structural integrity of the RHR Heat Exchanger tubing is maintained because the tubing is positively challenged by the pressure test and continuously monitored by the SWEGAM."

Evaluation: For those components whose external surfaces are inaccessible for direct VT-2 visual examination, the Code requires that the surrounding area be examined for evidence of leakage. The RHR Heat Exchanger tubes are contained within the vessel shell and are inaccessible during normal pressure tests. The component design, therefore, makes this Code requirement

impractical. Imposition of the Code requirement would necessitate redesign and fabrication of the heat exchanger. The licensee proposes to perform a pressure test of the tubes during maintenance activities when the channel head cover is removed by pressurizing the shell side and monitoring for leakage on the tube side. In addition, the licensee will monitor the radiation levels across the pressure boundary during normal operation. Levels within Technical Specifications will provide reasonable assurance of component integrity.

Conclusions: The Code-required VT-2 visual examination of the heat exchanger tubes during pressure testing has been determined to be impractical at the Quad Cities Station, Units 1 and 2. The licensee's proposed alternative, to perform a leak test during maintenance activities and monitor radiation levels across the pressure boundary, will provide assurance of component integrity. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.4.2.3 Request for Relief PR-06, Paragraph IWC-5222(a), Alternative Testing for High Pressure Coolant Injection (HPCI) Turbine and Connected Steam Inlet and Discharge Piping

Code Requirement: Section XI, Table IWC-2500-1, Examination Category C-H requires a VT-2 visual examination during system pressure tests and system hydrostatic tests of Class 2 components. Paragraph IWC-5222(a) states that the system hydrostatic test pressure shall be at least 1.25 times the system pressure, P_{sv}, for systems with a design temperature above 200°F. It also states that the system pressure, P_{sv}, shall be the lowest pressure setting among the number of safety or relief valves provided for overpressure protection within the boundary of the system to be tested (or Design Pressure, P_d, if overpressure protection is not provided).

Licensee's Code Relief Request: The licensee requested relief from performing the hydrostatic pressure test of the HPCI Turbine and associated steam supply and discharge piping up to the last isolation valve before discharge into the Torus.

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

"In lieu of the hydrostatic test required by Table IWC-2500-1, Category C-H, Code Case N-498 allows for performing a VT-2 visual examination at nominal operating pressure, provided that a four hour hold time for insulated piping has been met. The Code Case also states that when these requirements are impractical, the rules and regulations of ASME Section XI, Subsection IWC shall govern.

"Quad Cities' experience from conducting normal IST Surveillance Testing Procedures on the HPCI System have demonstrated that Technical Specification Torus level and temperature limits are reached in 45 minutes to an hour. This deems the four hour hold time requirement of Code Case N-498 impractical and thus reverts the pressure test back to Section XI.

"However, the hydrostatic test required by Table IWC-2500-1, Category C-H, is also impractical based on the following. The HPCI Turbine and HPCI Stop Valve shafts utilize a labyrinth design to provide a steam seal at the shafts (see Figure PR-06.1)[1]. The labyrinth seals reduce the pressure in the steam and, eventually, steam and condensate are collected by low pressure collection piping that is routed to the gland seal condenser. This low pressure piping cannot be isolated from the turbine shaft and/or the stop valve shaft seals. During a static test this piping would experience the same pressure as the HPCI Turbine. Because this seal leak collection piping is of a much lower design pressure, a hydrostatic test at the HPCI Turbine design pressure could result in damage to the leak collection piping.

"Based on the above, Quad Cities Station requests relief from the ASME XI requirements for performing a hydrostatic test of the HPCI Turbine and associated steam supply and discharge piping up to the last isolation valve before discharge into the Torus."

In response to the NRC's request for additional information, the licensee provided the following information (as stated):

"The HPCI system is designed to provide coolant to the reactor vessel under emergency conditions that do not result in rapid

[1]Figures and attachments are not included in this report.

depressurization of the pressure vessel. Emergency conditions include a loss of reactor feedwater or a small line break which does not cause immediate depressurization of the reactor vessel. The HPCI subsystem is designed to operate within a reactor pressure range of about 1150 psig to 150 psig. It is estimated that several hours would be required to depressurize the reactor pressure from the nominal operating pressure to 150 psig, assuming no line break.

"Per plant Technical Specifications, the HPCI subsystem is subject to an operability test every 3 months. During this test, the HPCI turbine and associated piping are under nominal system operating pressure for approximately 30 minutes. The frequent testing of the HPCI subsystem per plant Technical Specifications assists the propagation of leakage through insulation. Therefore, there is a high level of confidence that leakage will be identified, even with a 10 minutes hold time."

Licensee's Proposed Alternative Examination (as stated):

"A system functional test will be conducted (per IWC-5210(a)(1) and IWA-5213(b)) in lieu of the system hydrostatic test required once each interval. Operability test of the HPCI Turbine and associated piping per Technical Specifications every 3 months would provide added assurance that leakage or indication of leakage would be observed during the system functional test. Therefore, the system functional test coupled with periodic operability tests per Technical Specifications are deemed to provide reasonable assurance of structural integrity of the HPCI Turbine and associated piping."

Evaluation: The Code-required system hydrostatic test pressure is 1.25 times the system pressure for systems with a design temperature above 200°F. In performing the hydrostatic test, the labyrinth seals would be subjected to a pressure above their design pressure. As a result, the Code-required test could damage low pressure piping associated with the leak collection piping of the HPCI Turbine and HPCI Stop Valve shafts. The Code-required test is, therefore, impractical.

The licensee proposes an operability test at operating pressure on three month intervals in lieu of the required hydrostatic pressure test for the subject system. During the operability test, the operating pressure is maintained for approximately 30 minutes. In consideration of the plant Technical Specification limits for testing the HPCI system, it is believed

that a 30 minute hold time for the operability test should provide adequate time for leakage to become evident if it occurred during this test. Therefore, reasonable assurance of system operational readiness will be provided by the licensee's proposed alternative.

Conclusions: The hydrostatic test is impractical because of possible damage to the low pressure leak collection piping of the HPCI Turbine and HPCI Stop Valve shafts. The operability test should provide reasonable assurance of the continued inservice structural integrity of the subject piping because the test will be performed at operating pressure on a 3 month frequency. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3.4.3 Class 3 System Pressure Tests

3.4.3.1 Request for Relief PR-03, Hydrostatic Testing of Residual Heat Removal Service Water, Diesel Generator Cooling Water, and Control Room HVAC Service Water Piping

Code Requirement: Section XI, IWD-5223(a) states that the system hydrostatic test pressure shall be at least 1.10 times the system pressure, P_{sv}, for systems with design temperatures of 200°F or less and at least 1.25 times the system pressure, P_{sv}, for systems with design temperatures greater than 200°F.

Table IWA-5265(b) requires the pressure-measuring instrument to be connected to a point in the pressure boundary, such that the imposed pressure on any component, including static head, will not exceed 106% of the specified test pressure in the system.

Licensee's Code Relief Request: The licensee requested relief from performing a hydrostatic pressure test to 1.10 P_{sv} of the test volumes listed in Table PR-03.1.

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

"Due to the relatively low design pressure and large elevation change in the subject systems it is impossible to pressurize the highest elevation in the Test Block to the specified test pressure without pressurizing the lower elevations above 106% of this pressure.

"The system configurations do not include any additional valves that could be closed to subdivide the test volumes into smaller runs of piping with less elevation change. Thus, the change in test pressure within the boundary due to static head exceeds the 6% limit established in IWA-5265(b).

"In order to adhere to the limitations of IWA-5265(b) and to allow margin for pressure control, it will be necessary to test the upper elevations of the piping at a reduced pressure. This reduced pressure testing will only be performed when no other isolation is available that would reduce the elevation change experienced in a test volume.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for hydrostatic testing to 1.10 or 1.25 times P_{sv} of the test volumes listed in Table PR-03.1. Performance of the leakage test at the slightly reduced pressure would have an insignificant impact on the ability to detect leakage, therefore, will provide adequate assurance that systems integrity is maintained."

Licensee's Proposed Alternative Examination (as stated):

"The components will be hydrostatically tested such that the pressure at the lowest point in the test volume will equal 105% ($\pm$1%) of the Code required test pressure (1.10 x P_{sv} or 1.25 x P_{sv} based on design temperature). The minimum test pressure that the test volume will experience (at the highest elevation in the boundary) is listed in Table PR-03.1[1] as P_{min}. This approach is consistent with that outlined in Code Interpretation XI-1-89-66."

Evaluation: The Code states that the imposed pressure on any component, including static head, will not exceed 106% of the specified test pressure. If the pressure-measuring instruments are placed such that the test boundary high point receives the hydrostatic test at a pressure as close to the Code-required test pressure as possible without exceeding the 106% system test pressure maximum at the test boundary low point, the Code requirements are met.

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[1]Figures, tables, and attachments are not included with this report.

Conclusions: Because the intent of the Code is being met, relief is not required.

3.4.3.2 Request for Relief PR-05, Examination Category D-B, Item D2.10, Functional and Hydrostatic Pressure Testing for the Main Steam Relief Valve Discharge Lines

Note: In the response to the NRC request for additional information dated October 26, 1994, the licensee withdrew Request for Relief No. PR-05.

3.4.4 General

3.4.4.1 Request for Relief PR-01, Paragraph IWB-5221(a), System Leakage Test Pressure Following the Disassembly and Reassembly of Class 1 Mechanical Connections

Code Requirement: Section XI, Paragraph IWB-5221(a) states that the system leakage test following the opening and reclosing of a component in the system shall be conducted at a test pressure not less than the nominal operating pressure associated with 100% rated reactor power.

Licensee's Code Relief Request: The licensee requested relief from ASME Section XI requirements regarding the system leakage test pressure when pressure testing reassembled, unisolable Class 1 mechanical connections.

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

"The nominal operating pressure associated with 100% rated reactor power is 1000 psig. Near the end of each refueling outage, a system pressure test of all Class 1 pressure retaining components is conducted at 1000 psig.

"Subsequent to the system pressure test conducted during a refueling outage, or during forced maintenance outages which can occur during an operating cycle, it may become necessary to disassemble and reassemble Class 1 mechanical connections that are located in the drywell and cannot be isolated from the

reactor vessel. For these situations, the performance of a Class 1 system leakage test at 1000 psig would have a significant impact on the unit's critical path outage time and personnel exposure.

"The normal Class 1 system pressure test, which is performed with the vessel flooded up, requires numerous equipment outages (e.g., approximately 380 valves must be taken out-of-service and Main Steam safety valves must be gagged). Performance of the equipment outages, coupled with the performance of the system leakage test, takes approximately 5 days (3 shifts per day) with a total personnel exposure of approximately 2.5 Man-Rem.

"Performance of a system leakage test during normal startup is possible, however, the test can not be performed at 1000 psig. During unit startup, the Electro-Hydraulic Control System precludes a reactor pressure above 950 psig without significant increases in reactor power. In order to achieve a pressure of 1000 psig, the reactor would have to be at approximately 100% rated power. The radiation levels in the drywell at this power level are prohibitive, and prevent drywell entry by plant personnel.

"A drywell entry to inspect for leakage can be performed at 920 psig, which is associated with approximately 15% reactor power. Drywell entry at 15% reactor power would significantly reduce the personnel exposure. Performance of the leakage test at 920 psig would have an insignificant impact on the ability to detect leakage from a reassembled mechanical connection, therefore, would provide an acceptable level of quality and safety. It would also significantly reduce critical path outage time required for the test.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for the system leakage test pressure when performing pressure testing of reassembled, unisolable Class 1 mechanical connections."

Licensee's Proposed Alternative Examination (as stated):

"As an alternate examination, Quad Cities Station will perform a system leakage test at 920 psig during unit start-up when an unisolable Class 1 mechanical connection in the drywell has been disassembled and reassembled either: 1) subsequent to performance of the system pressure test conducted near the end of each refueling outage; or 2) during a forced maintenance outage in the course of an operating cycle."

Evaluation: Paragraph IWB-5221(a) requires that system leakage tests be performed at a test pressure not less than the nominal operating pressure associated with 100% rated reactor power. To

obtain nominal operating pressure for Quad Cities Station, Units 1 and 2 (1000 psig), the reactor must achieve 100% power.

To perform a system leakage test at 100% power for nonisolable portions of a system following the disassembly and reassembly of Class 1 mechanical connection is a major effort requiring many manhours from skilled maintenance and inspection personnel while causing excessive radiation exposure. The INEL staff believes that requiring the licensee to perform a system pressure test at 100% reactor power will result in a hardship without a compensating increase in quality and safety.

As an alternative to the system pressure test at operating pressure, the licensee proposes to perform the system leakage test at 920 psig, at approximately 15% power during startup.

Conclusion: Relief is being requested from Code system pressure test requirement following the reassembly of nonisolable Class 1 mechanical connections. For Quad Cities Station, Units 1 and 2, a system pressure test at 15% reactor power (920 psig) should provide reasonable assurance of continued inservice integrity of mechanical connections. Requiring the licensee to perform a system pressure test at 100% reactor power would result in a hardship without a compensating increase in quality and safety. Therefore, it is recommended that the proposed alternative to perform a system pressure test at 15% reactor power (920 psig) following the reassembly of Class 1 mechanical connection be authorized pursuant to 10 CFR 50.55a(a)(3)(ii).

3.4.4.2 Request for Relief PR-07, Paragraph IWA-4700(a), Alternative Pressure Tests for Class 1 and 2 Repaired/Replaced Components

Note: In the response to the NRC RAI, the licensee submitted new Request for Relief PR-09, which addresses alternative pressure tests for Class 1, Class 2, and Class 3 systems following repair, replacements, and modifications. As a result, Request for Relief PR-07 is also contained in Request for Relief PR-09. Therefore,

Request for Relief PR-07 is evaluated with Request for Relief PR-09.

3.4.4.3 Requests for Relief PR-07 and PR-09, IWA-4700(a) and (b), Alternative Pressure Test Requirements For Code Class 1, Class 2, and Class 3 Systems Following Repair, Replacements and Modifications

Code Requirement: IWA-4700(a), Pressure Test, requires that after repair by welding on the pressure-retaining boundary a system hydrostatic test shall be performed in accordance with IWA-5000.

IWA-5214, Repairs and Replacements, requires that a component repair or replacement shall be pressure tested prior to resumption of service if required by IWA-4400 and IWA-4600.

The test pressure and temperature for a system hydrostatic test subsequent to the component repair or replacement shall comply with the system test pressure and temperature specified in IWB-5222, IWC-5222, and IWD-5223, as applicable to the system that contains the repaired or replaced component.

Licensee's Code Relief Request: The licensee requested relief from performing a hydrostatic test following repairs, replacements, and modifications on Code Class 1, Class 2, and Class 3 systems.

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

"Hydrostatic tests conducted at elevated pressure are difficult to perform and often represent a true hardship. Some of the difficulties associated with the elevated pressure testing include the following:

- Hydrostatic testing often requires complicated or abnormal valve line-ups in order to properly vent, fill, and isolate the component requiring testing.

- Relief valves with setpoints lower than the hydrostatic test pressure must be gagged or removed and blind flanged.

- Valves that are not normally used for isolation (e.g., normally open pump discharge valves) are often required to provide pressure isolation for an elevated pressure hydrostatic test. These valves frequently require time consuming seat maintenance in order to allow for pressurization.

- The radiation exposure required to perform a hydrostatic pressure test is high (in comparison to operational pressure testing) due to large amount of time required to prepare the volume for testing (i.e. installing relief valve gags, performing appropriate valve line-ups, etc.)

"The difficulties encountered in performing a hydrostatic pressure test are prohibitive when weighed against the benefits. Industry experience, which is corroborated by Quad Cities Station's experience, shows that most through wall leakage is detected during system operation as opposed to during elevated pressure tests, such as the ten-year hydrostatic tests.

"Little benefit is gained from the added challenge to the piping system provided by an elevated pressure hydrostatic test (when compared to an operational test, especially when one considers that the piping stress experienced during a hydrostatic test does not include the more significant stresses affiliated with the thermal growth and dynamic loading associated with design basis events.

"The acceptability of performing nominal operating pressure tests in lieu of hydrostatic tests is also supported by the recent approval by the Board of Nuclear Codes and Standards (BNCS) of Code Case N-416-1, "Alternative Pressure Test Requirement for Welded Repairs or Installation of Replacement Items by Welding for Class 1, 2, and 3 Systems, Section XI, Division 1". This Code Case allows a system leakage test at nominal operating pressure and temperature (in accordance with IWA-5000 of the 1992 Edition of Section XI) to be used in lieu of a hydrostatic test, provided that Nondestructive Examination (NDE) of the weld(s) is performed in accordance with the methods and acceptance criteria of the applicable Subsection of the 1992 Edition of Section III.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI requirements for performing elevated pressure hydrostatic tests after repairs by welding, or installation or replacement items by welding, on the pressure retaining boundary of Class 1, 2, and 3 components."

Licensee's Proposed Alternative Examination (as stated):

"As an alternate to the existing Section XI requirements, Quad Cities Station will adopt the provisions of Code Case N-416-1, as approved by BNCS."

Evaluation: The Code requires a system hydrostatic pressure test for Class 1, Class 2, and Class 3 pressure-retaining components following a repair and/or replacement. Code Case N-416-1, "Alternative Pressure Test Requirements for Welded Repairs or Installation of Replacement Items by Welding" requires a VT-2 visual examination to be performed in conjunction with a system leakage test at nominal operating pressure and temperature, using the 1992 Edition of Section XI. This Code Case also specifies that NDE of the welds be performed in accordance with the applicable subsection of the 1992 Edition of Section III.

Considering the Code requirements for NDE of Class 1 and Class 2 systems, the INEL staff believes that the increased assurance of the integrity provided by the hydrostatic test is not commensurate with the burden for Class 1 and Class 2 welds. For Code Class 3 components, there are no ongoing NDE requirements, except for visual examination for leaks in conjunction with the 10-year hydrostatic tests and the periodic pressure tests. Therefore, eliminating the hydrostatic test and only performing the system pressure test for Class 3 components should only be considered acceptable if additional surface examinations are performed on the root pass layer of butt and socket welds on the pressure-retaining boundary of Class 3 components during repair or replacement activities.

Conclusion: Compliance with the Code hydrostatic testing requirements for welded repairs and replacements of Code Class 1, Class 2, and Class 3 components would result in hardship without a compensating increase in the level of quality and safety. Therefore, it is recommended that the licensee's proposed alternative, use of Code Case N-416-1, be authorized for Quad Cities Station, Unit 1 and Unit 2, pursuant to 10 CFR 50.55a(a)(3)(ii), provided that additional surface examinations are performed on the root pass layer of butt and socket welds on the pressure-retaining boundary during repair and replacement of Class 3 components. The surface examination method shall be in accordance with Section III. Use of Code Case

N-416-1, with the provision noted above, should be authorized until such time as the Code Case is incorporated into future revisions of Regulatory Guide 1.147. At that time, the licensee should follow any provisions established by the Regulatory Guide.

3.5 General

3.5.1 Ultrasonic Examination Techniques

3.5.1.1 Request for Relief CR-04, Appendix III, Paragraph III-3411, Calibration Block Material Specification Requirements

Code Requirement: Section XI, IWA-2232 states that ultrasonic examination shall be conducted in accordance with Appendix I.

Appendix I, I-2200 states that ultrasonic examination of vessel welds less than 2 inches thick and all piping welds shall be conducted in accordance with Appendix III, as supplemented by Appendix I.

Appendix III, Paragraph III-3411 outlines the material specification requirements for calibration blocks. It requires calibration blocks to be fabricated from material of the same specification as the piping being joined by the weld. It also states that if material of the same specification is not available, material of similar chemical analysis, tensile properties, and metallurgical structure may be used.

Licensee's Code Relief Request: The licensee requested relief from the Appendix III, Paragraph III-3411, requirements for calibration block material specifications.

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

"Several of the calibration blocks currently being used at Quad Cities Station lack the documentation necessary to demonstrate compliance with the material specification requirements of Appendix III. This is because the documentation requirements

existing at the time of their fabrication did not require traceability to the material's chemical or physical certifications. Consequently, the only documentation available for these existing calibration blocks is verification of the appropriate P-number grouping.

"All other requirements of Appendices I and III are being met.

"It would be impractical to fabricate a new set of calibration blocks in order to satisfy the documentation requirements of the current Code. Existing records, which indicate the appropriate P-number grouping, provide adequate assurance that the blocks will establish the proper ultrasonic calibration and sensitivity.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI, Appendix III requirements for calibration block material specifications, in order to allow the continued use of the existing calibration blocks."

Licensee's Proposed Alternative Examination (as stated):

"All future calibration blocks will meet the material specification requirements of ASME Section XI, Appendix III and will be provided with the documentation necessary to demonstrate compliance with these requirements. Additionally, when using existing calibration blocks that lack the appropriate documentation, a comparison will be made between the attenuation of the calibration block and the material being examined."

Evaluation: The material specification documentation required by the 1989 Edition was not required by the original fabrication code; the original calibration blocks were fabricated based on P-number groupings. The procurement of new calibration blocks of the same material specifications would result in an unusual difficulty without a compensating increase in the level of quality and safety. The licensee has committed to compare the attenuation of the calibration block and the material being examined. However, a comparison of material velocities should also be performed. With this additional comparison, adequate assurance will be provided that the existing blocks will establish the proper ultrasonic calibration and sensitivity.

Conclusions: Acquiring materials for new calibration blocks to satisfy current Code requirements is an unusual hardship for Quad Cities Station. The imposition of this requirement would create a burden on the licensee without a compensating increase in

quality and safety. Therefore, it is recommended that relief be authorized pursuant to 10 CFR 50.55a(a)(3)(ii), provided the material velocities and attenuation of the calibration block and material being examined are compared and documented.

3.5.1.2 Request for Relief CR-08, Paragraph IWA-2311(b), Appendix VII Ultrasonic Examination Personnel Qualification Requirements

Code Requirement: Section XI, Paragraph IWA-2311(b) requires that the training, qualification, and certification of ultrasonic examination personnel shall also comply with the requirements specified in Appendix VII.

Appendix VII states requirements for the employer's written practice, qualification of ultrasonic examiners, qualification records, and the minimum content of initial training courses for the ultrasonic examination method.

Licensee's Code Relief Request: The licensee requested relief from the Appendix VII requirements for the qualification of nondestructive examination personnel for ultrasonic examination.

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

"Appendix VII was first introduced in the 1988 Addenda to Section XI. This Appendix represents a dramatic change from previous Code editions and current industry practices in the requirements for qualification of ultrasonic examination personnel. For instance, new training programs must be developed and taught by trained instructors, employer's written practices must be completely rewritten, examination question banks must be developed, and specimen banks of at least 15 specimens (with 5 containing actual or simulated flaws) must be developed and purchased.

"Implementation of this Appendix will require a massive industry effort. And although the industry is currently working towards compliance with Appendix VII, full implementation is still on-going. In fact, since Appendix VII allows for the use of specimens prepared for ultrasonic performance demonstrations per Appendix VIII, many NDE vendors are developing these two programs simultaneously in order to avoid purchasing dual specimens.

"In order to properly implement Appendix VII criteria, the Commonwealth Edison Company is in the process of establishing an internal program in place by December 31, 1994, at which time Quad Cities Station will fully comply with the requirements of Appendix VII. Until this time, Quad Cities Station will maintain the current levels of quality and safety by continuing to invoke all other requirements of IWA-2300 for the qualification of ultrasonic examination personnel.

"Based on the above, Quad Cities Station requests relief from the ASME Section XI, Appendix VII requirements for the qualification of nondestructive examination personnel for ultrasonic examination."

Licensee's Proposed Alternative Examination (as stated):

"Quad Cities Station will utilize ultrasonic examination personnel qualified in accordance with the requirements of IWA-2300, with the exception of IWA-2311(b). Additionally, personnel utilized to perform ultrasonic examinations on IGSCC susceptible welds will be qualified in accordance with the latest EPRI guidelines".

Evaluation: The Code requires that training, qualification, and certification of ultrasonic examination personnel comply with the requirements specified in Appendix VII. The licensee is requesting that these requirements be postponed until the end of December, 1994, due to the hardship associated with implementation. The licensee will utilize ultrasonic examination personnel qualified in accordance with the requirements of IWA-2300, with the exception of IWA-2311(b) (implementation of Appendix VII). Personnel performing ultrasonic examinations on IGSCC susceptible welds will be qualified in accordance with the latest EPRI guidelines.

Quad Cities Station voluntarily adopted the 1989 Edition and is, therefore, one of the initial plants required to implement Appendix VII. To require full compliance without sufficient time for implementation would result in hardship without a compensating increase in the level of quality and safety.

Conclusions: Implementation of the Appendix VII requirements for the qualification of ultrasonic examination personnel without adequate time to develop a program would result in hardship or

unusual difficulty. Allowing the licensee to comply with the Code by the end of December, 1994, as committed, provides sufficient time for implementation of Appendix VII. Therefore, it is recommended that relief be authorized pursuant to 10 CFR 50.55a(a)(3)(ii), provided the requirements of Appendix VII are implemented by the end of December, 1994.

3.5.2 Exempted Components (No relief requests)

3.5.3 Other

3.5.3.1 Request for Relief CR-05, Article IWA-4000, Exemption of Piping, Valves, and Fittings NPS 1 and Smaller, and Their Associated Supports From Requirements of IWA-4000

Code Requirement: Section XI, Paragraph IWA-4000 specifies rules for welded repairs for pressure-retaining components and their supports, including appurtenances, subassemblies, parts of a component, and core support structures.

Licensee's Code Relief Request: The licensee requested relief from the requirements of IWA-4000 for components NPS 1 inch and less (e.g. exempt piping, valves, and fittings NPS 1 and smaller, and their associated supports).

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

"The rules governing Repair Procedures in IWA-4000 allow for repairs to be performed in accordance with the Owners Design Specifications (ODS) and the original Construction Code (OCC) of the component or system in lieu of the rules of Section XI as detailed in IWA-4120.

"When repairs are performed on Code Class 1, 2, and 3 components in accordance with the ODS/OCC, the requirements of IWA-4130, Repair Program; IWA-4140, Inspection; IWA-4600, EXAMINATION; IWA-4700, PRESSURE TEST; and IWA-4800, RECORDS; remain applicable. The rules of paragraphs IWA-4200, MATERIAL; IWA-4300, DEFECT REMOVAL; IWA-4400, WELDING AND WELDER QUALIFICATIONS; and, IWA-4500, REPAIR WELDING; will be satisfied by the rules of the ODS/OCC and reference procedures.

"When performing repairs per the ODS/OCC on Code Class 1, 2, and 3 components 1" NPS and less, preservice baseline examinations per IWA-4600 (as specified in IWB-2200, IWC-2200, and IWD-2200) are not required; however, post repair examinations as required by ODS/OCC would be performed. Similarly, system hydrostatic testing of Code Class 1, 2, and 3 components 1" NPS and less is not required per IWA-4700.

"The remaining Code Sections noted above as applicable, repair program essential requirements (IWA-4130), Authorized Inspection Agency involvement (IWA-4140), and record keeping/reporting requirements (IWA-4800), do not represent activities and documentation which constitute an improvement in plant safety, particularly for components 1" NPS and less.

"A similar situation is the case of the replacement of 1" NPS and less components, which are clearly exempted by IWA-7400 from parallel requirements of IWA-7000 (see IWA-7130, IWA-7140, and IWA-7520).

"Based on the requirements of IWA-4000 being unnecessary to maintain the integrity of components 1" NPS and less, and thus they do not provide a commensurate increase in plant safety, Quad Cities Station requests relief from these rules as detailed previously."

Licensee's Proposed Alternative Examination (as stated):

"Quad Cities Station will document and perform repairs on components 1" NPS and less in accordance with the applicable Design Specification, Construction Codes and referenced Quality Assurance procedures. These documents will include specific instructions for the design, materials, fabrication, construction, testing and certification associated with the repair. The repair documentation will be maintained and filed with the applicable Station Work Package."

Evaluation: IWA-4000 states that repair procedures must conform to the rules of Section XI, IWA-4120. The licensee has not demonstrated that these Code requirements are impractical or represents a hardship or unusual difficulty. Therefore, whenever a repair or replacement involves welding, the rules of IWA-4000, Repair Procedures apply, or the licensee's repair procedures must meet the requirements of the original construction code.

Conclusions: Based on the above evaluation, it is recommended that relief be denied.

3.5.3.2 Request for Relief CR-06, Article IWF, Examination Category F-A, Item Nos. F1.10 through F1.70, Component Support Examination Requirements

Code Requirement: Section XI, Articles IWF-1000, IWF-2000, and IWF-3000, defines the examination requirements for examination of all Class 1, 2, and 3 Component Supports.

Licensee's Code Relief Request: The licensee requested relief from all requirements of ASME Section XI, 1989 Edition, Articles IWF-1000, IWF-2000, and IWF-3000.

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

"Subsection IWF, Articles IWF-1000, IWF-2000, and IWF-3000 in the 1989 Edition of Section XI lacks a complete, concise set of rules for the inservice inspection of component supports. In particular, IWF-1230, Supports Exempt from Examination and Test; IWF-2510, Supports Selected for Examination; and Table IWF-2500-1 are lacking the information and detail needed to develop an effective inspection program.

"Code Case N-491, Alternative Rules for Examination of Class 1, 2, 3, and MC Component Supports of Light Water Cooled Power Plants presents a set of requirements for IWF-1000, IWF-2000, and IWF-3000 which are complete and clarify questionable wording in the 1989 Edition.

"Although currently not included in Regulatory Guide 1.147, Quad Cities Station understands that the NRC has reviewed Code Case N-491 and has no technical concerns with the included requirements.

"Based on the above, Quad Cities Station requests relief from the requirements of ASME Section XI, 1989 Edition, Articles IWF-1000, -2000, and -3000."

Licensee's Proposed Alternative Examination (as stated):

"In lieu of the requirements of ASME Section XI, 1989 Edition, Articles IWF-1000, -2000, and -3000, Quad Cities Station will implement the alternative rules detailed in Code Case N-491."

Evaluation: Code Case N-491 was approved for use subsequent to the start of the third 10-year intervals at Quad Cities Station. Because this Code Case is approved for general for use by the

NRC, as referenced in Regulatory Guide 1.147, Revision 10, issued July 1993, relief is not required.

3.5.3.3 Request for Relief CR-09, Use of Technical Specifications for Testing and Visual Examination of Code Class Snubbers

Note: This request for relief is considered part of the Inservice Testing Program (IST) and is, therefore, not included in this evaluation. The Snubber Testing Program will be evaluated by the Mechanical Engineering Branch of the NRC.

4. CONCLUSION

Pursuant to 10 CFR 50.55a(g)(6)(i), it has been determined that certain inservice examinations cannot be performed to the extent required by Section XI of the ASME Code. In the case of Requests for Relief Nos. CR-01, CR-03 (Parts 1 and 2), CR-13, PR-02, PR-04, and PR-06, the licensee has demonstrated that specific Section XI requirements are impractical; it is therefore recommended that relief be granted as requested. The granting of relief will not endanger life, property, or the common defense and security and is 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.

Pursuant to 10 CFR 50.55a(a)(3), it is concluded that for Requests for Relief Nos. CR-02, CR-07 (Parts 1 and 2), CR-10 (Parts 1 and 2), CR-11, CR-14, and PR-01, the licensee's proposed alternatives will (i) provide an acceptable level of quality and safety, or (ii) Code compliance will result in hardship or unusual difficulty without a compensating increase in safety. In these cases, it is recommended that the proposed alternative be authorized. The proposed alternative for Requests for Relief CR-04, CR-08, CR-12 and PR-09 (also addresses PR-07) are recommended to be authorized *only* if the licensee satisfies the conditions stated in the Request for Relief evaluations.

For Request for Relief CR-05, it is concluded that the licensee has not provided sufficient information to support the determination that the Code requirement is impractical, or that requiring the licensee to comply with the Code requirement would result in hardship. Therefore, in these cases it is recommended that relief be denied.

Requests for Relief Nos. PR-05 and PR-08 were withdrawn by the licensee. For Requests for Relief Nos. CR-06 and PR-03, relief is not required. Request for Relief CR-09 is not within the scope of this program review and was, therefore, not evaluated.

This technical evaluation has not identified any practical method by which the licensee can meet all the specific inservice inspection requirements of Section XI of the ASME Code for Quad Cities Station, Units 1 and 2.

Compliance with all the exact Section XI required inspections would necessitate redesign of a significant number of plant systems, procurement of replacement components, installation of the new components, and performance of baseline examinations for these components. Even after the redesign efforts, complete compliance with the Section XI examination requirements probably could not be achieved. Therefore, it is concluded that the public interest is not served by imposing certain provisions of Section XI of the ASME Code that have been determined to be impractical. Pursuant to 10 CFR 50.55a(g)(6), relief is allowed from the requirements that are impractical to implement, or alternatively, pursuant to 10 CFR 50.55a(a)(3), alternatives to the Code-required examinations may be authorized provided that either (i) the proposed alternatives provide an acceptable level of quality and safety or that (ii) Code compliance would result in hardship or unusual difficulty without a compensating increase in safety.

The licensee should continue to monitor the development of new or improved examination techniques. As improvements in these areas are achieved, the licensee should incorporate them in the ISI program plan examination requirements.

Based on the review of the *Quad Cities Station, Units 1 and 2, Third 10-Year Interval Inservice Inspection Program Plan*, Revision 0, the licensee's response to the NRC's request for additional information, and the recommendations for granting relief from the ISI examinations that cannot be performed to the extent required by Section XI of the ASME Code, no deviations from regulatory requirements or commitments were identified, with the exception of Request for Relief CR-05.

5. REFERENCES

1. Code of Federal Regulations, Title 10, Part 50.

2. American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Division 1: 1989 Edition

3. *Quad Cities Station, Units 1 and 2, Third 10-Year Interval Inservice Inspection Program Plan*, Revision 0, submitted January 7, 1993.

4. NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*, Section 5.2.4, "Reactor Coolant Boundary Inservice Inspection and Testing," and Section 6.6, "Inservice Inspection of Class 2 and 3 Components," July 1981.

5. Letter dated May 12, 1994, C. P. Patel (NRC) to D. Farrar (CECo) containing NRC Request for Additional Information (RAI), May 12, 1994.

6. Letter dated October 26, 1994, J. L. Schrage (CECo) to Document Control Desk (NRC) containing response to May 12, 1994 Request for Additional Information.

7. NRC, NUREG-0313 Revision 2, *Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping*, January 1988.

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11. ABSTRACT (200 words or less)

This report presents the results of the evaluation of the *Quad Cities Station, Units 1 and 2, Third 10-Year Interval Inservice Inspection (ISI) Program Plan*, Revision 0, submitted January 7,1993, including the requests for relief from the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section XI requirements that the licensee has determined to be impractical. The *Quad Cities Station, Units 1 and 2, Third 10-Year Interval Inservice Inspection Program Plan*, Revision 0, is evaluated in Section 2 of this report. The ISI Program Plan is evaluated for (a) compliance with the appropriate edition/addenda of Section XI, (b) acceptability of examination sample, (c) correctness of the application of system or component examination exclusion criteria, and (d) compliance with ISI-related commitments identified during previous Nuclear Regulatory Commission reviews. The requests for relief are evaluated in Section 3 of this report.

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