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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION OF THE FIRST 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN REQUEST FOR RELIEF NR-29 FOR COMMONWEALTH EDISON COMPANY BRAIDWOOD STATION, UNITS 1 AND 2 DOCKET NOS. STN 50-456 AND STN 50-457

1.0 INTRODUCTION

The Technical Specifications (TS) for Braidwood Station, Units 1 and 2, state that the inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1, 2 and 3 components shall be performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). In 10 CFR 50.55a(a)(3), it states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2 and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and

ENCLOSURE

modifications listed therein. The applicable edition of Section XI of the ASME Code for the Braidwood Station, Units 1 and 2, first 10-year ISI interval is the 1983 Edition through Summer 1983 Addenda.

Pursuant to 10 CFR 50.55a(g)(5), if the licensee determines that conformance with an examination requirement of Section XI of the ASME Code is not practical for its facility, information shall be submitted to the Commission in support of that determination and a request made for relief from the ASME Code requirement. After evaluation of the determination, pursuant to 10 CFR 50.55a(g)(6)(i), the Commission may grant relief and may impose alternative requirements that are determined to be authorized by law, will not endanger life, property, or the common defense and security, and are otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed.

In a letter dated October 8, 1996, Commonwealth Edison Company (ComEd, the licensee), submitted to the NRC its first 10-year ISI interval program plan and associated requests for relief for Braidwood Station, Units 1 and 2. The licensee requested that the staff expedite its review of Request for Relief NR-29 regarding Weld Nos. 1RV-01-003, 1RV-01-004, 1RV-01-005, 1RV-02-001, 1RV-02-002 (Unit 1), and 2RV-01-003, 2RV-01-004, 2RV-01-005, 2RV-02-001, 2RV-02-002 (Unit 2). This relief is evaluated below. The licensee also provided additional information in its letters dated February 25, 1997, March 25, 1997, and April 7, 1997.

2.0 EVALUATION

The staff, with technical assistance from its contractor, the Idaho National Engineering and Environmental Laboratory (INEEL), has evaluated the information provided by the licensee in support of its First 10-Year ISI Interval Program Plan Request for Relief NR-29 for Braidwood Station, Units 1 and 2. Based on the information submitted, the staff adopts the contractor's conclusions and recommendations presented in the Technical Letter Report (TLR) attached.

For Request for Relief NR-29, Section XI, Table IWB-2500-1, Examination Category B-A, Items B1.11, B1.21, and B1.30, requires 100% volumetric examination of reactor pressure vessel welds as defined by Figures IWB-2500-1, -3, and -4, as applicable. Ultrasonic (UT) examinations shall be conducted in accordance with Appendix I. The licensee's proposed, as an alternative pursuant to 10 CFR 50.55a(a)(3)(i), to examine the subject areas using examination procedures, equipment, and personnel qualified by performance demonstration in accordance with the Performance Demonstration Initiative (PDI) program. In the licensee's letter dated April 7, 1997, it proposed to perform the PDI technique from two directions.

The licensee has contracted with Framatome Technologies (FTI) to use the URSULA manipulator to perform the 10 Year UT reactor inspections. It is Braidwood's intent to use the FTI technique qualified in December 1995 to the PDI Program at EPRI NDE Center that meets the intent of Appendix VIII of the 1992 Edition with 1993 Addenda. This FTI qualified PDI technique consists of scanning the examination volume, weld and base metal, as follows:

(1) For flaw detection, the examination volume will be scanned in two directions, one perpendicular and one parallel to the weld axis. The examination volume is scanned from one direction such that all the examination angles pass through the entire examination volume of interest for each transducer. If full coverage is limited, scanning from both directions will be performed when coverage can be maximized.

Note: *By letter dated April 7, 1997, the above scanning information was superseded. ComEd revised the alternative to include scans in two opposing directions for examinations perpendicular and parallel to the weld axis.*

(2) For flaw characterization (or flaw sizing), the examination will be conducted from two opposing directions, in the direction perpendicular to the plane of the flaw, when feasible.

The PDI program was developed by the U.S. nuclear industry to implement selected supplements from the 1992 Edition with 1993 Addenda of Appendix VIII to Section XI of the ASME Code. Appendix VIII was developed to ensure the effectiveness of UT examinations within the nuclear industry by means of a rigorous, item specific, performance demonstration. The performance demonstration is conducted on reactor pressure vessel mockups containing flaws of various sizes and locations. Appendix VIII is not currently a requirement for the licensee.

The licensee has stated that all of the requirements of the 1983 Edition through the Summer 1983 Addenda will be implemented except where specific differences have been identified. A comparison of the differences between the Code prescribed requirements and the PDI qualified procedure is provided below:

1. The examination procedure uses examination angles that are essentially the same as those required by the Code. However, the PDI procedure uses a 45°L in place of a 60° shear wave. The PDI procedure has eliminated the 0° scan. The 0° scan is used to determine the location of laminations that may interfere with the angle beam examination, not for flaw detection. Since the reactor vessel base line examination data include the mapping of laminations that interfere with angle beam examinations, subsequent 0° scans required by Code may be omitted. Because the PDI procedure angles were capable of detecting the qualification flaws, the PDI procedure angles are considered an acceptable alternative to the Code-required examination angles.

2. The calibration and calibration sensitivity are based on side-drilled hole diameters that are equal to or smaller than those required by the Code. As a result, it is concluded that the sensitivities referenced by the PDI qualified procedure result in a higher sensitivity than that required by the Code.

3 The examination scanning sensitivity meets or exceeds the requirements of the Code and Regulatory Guide 1.150.

4. The scan overlap for the PDI procedure is slightly less than that required by the Code (33% versus 50%). However, because the PDI system is calibrated to a higher sensitivity, the staff believes that the reduction in overlap allowed in the PDI procedure does not diminish flaw detection capabilities.

5. The PDI procedure will use tip diffraction for the sizing of flaws. This technique is considered superior to the amplitude-based sizing technique required by Code.

6. The scan speed qualified with the PDI procedure is faster than the scan speed allowed by the Code (up to 9 inches per second versus up to 6 inches per second). However, the INEEL staff believes that the increase in scanning speed is offset by the increased examination sensitivity.

7. The PDI procedure for crack detection and flaw sizing has been demonstrated to be capable of detecting and sizing actual cracks in 12 inch thick carbon steel blocks with 0.44 inch stainless steel clad overlay. This qualification approach to flaw detection and sizing is superior to that required by the Code (i.e., qualification based on the ability to calibrate on side-drilled holes and notches).

8. Use of a certified UT Level II examiner qualified by performance based demonstration using flawed samples is superior to Code requirements.

Based on the comparison of differences between the Code prescribed UT technique and the PDI procedure in combination with the licensee's revised alternative to include scans in two opposing directions for examinations perpendicular and parallel to the weld axis, the staff determined that the PDI procedure is an enhancement over the Code examination technique. Therefore, the staff concludes that implementation of the licensee's proposed alternative, when all associated Code requirements are satisfied, provides an acceptable level of quality and safety.

3.0 CONCLUSIONS

The staff has reviewed the information provided by the licensee in support of the proposed alternative for Weld Nos. 1RV-01-003, 1RV-01-004, 1RV-01-005, 1RV-02-001, 1RV-02-002 (Unit 1), and 2RV-01-003, 2RV-01-004, 2RV-01-005, 2RV-02-001, 2RV-02-002 (Unit 2). The licensee proposes to implement a PDI qualified UT procedure for the examination of reactor pressure vessel welds and to include scans in two opposing directions for examinations perpendicular and parallel to the weld axis provides an acceptable level of quality and safety.

Based on the information provided, the staff has concluded that the proposed alternative provides an acceptable level of quality and safety. Therefore, the licensee's proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for Braidwood Station, Units 1 and 2.

TECHNICAL LETTER REPORT

ON THE FIRST 10-YEAR INSERVICE INSPECTION INTERVAL

REQUEST FOR RELIEF NR-29

COMMONWEALTH EDISON COMPANY

BRAIDWOOD POWER STATION, UNITS 1 AND 2

DOCKET NUMBERS: 50-456 & 50-457

1.0 INTRODUCTION

By letter dated October 8, 1996, the licensee submitted Revision 4 to the Braidwood Nuclear Power Station, Units 1 and 2, first 10-year interval inservice inspection program. Revision 4 included corrections to typographical errors, previously approved relief requests, and several new requests. This Technical Letter Report provides expedited evaluation of Relief Request NR-29. In letters dated February 25, 1997, March 25, 1997, and April 7, 1997, the licensee provided additional information and clarification regarding Relief Request NR-29. The Idaho National Engineering and Environmental Laboratory (INEEL) staff has evaluated the subject request for relief in the following section.

2.0 EVALUATION

The Code of record for the Braidwood Nuclear Power Station, Units 1 and 2, first 10-year interval is the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1983 Edition with the Summer 1983 Addenda. The information provided by the licensee in support of the request has been evaluated and the basis for disposition is documented below.

ATTACHMENT

2.1 Relief Request NR-29, Section XI, Table IWB-2500-1, Examination Category B-A, Items B1.11, B1.21, and B1.30, Volumetric Examination of Reactor Pressure Vessel Shell Welds

Code Requirement: Section XI, Table IWB-2500-1, Examination Category B-A, Items B1.11, B1.21, and B1.30, requires 100% volumetric examination of reactor pressure vessel welds as defined by Figures IWB-2500-1, -3, and -4, as applicable. Ultrasonic examinations shall be conducted in accordance with Appendix I.

Licensee's Proposed Alternative: Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee proposed to examine the subject areas using a Performance Demonstration Initiative (PDI) qualified technique. The licensee stated:

"Braidwood proposes to use FTI's underwater volumetric inspection techniques to inspect the reactor vessel Circumferential shell welds, lower head Circumferential weld and shell to flange weld. FTI's inspection techniques have been demonstrated and qualified to the PDI Program which meets the intent of the rules of Appendix VIII of the ASME Code, Section XI, 1992 Edition with 1993 Addenda. These techniques will be used in place of the currently required Section XI, 1983 Edition with summer 1983 Addenda, techniques."

Note: In the April 7, 1997, submittal, the licensee stated:

"During the reference teleconference the Staff and ComEd specifically discussed Relief Request NR-29 which requested use of one directional Performance Demonstration Initiative (PDI) on the reactor vessel shell welds. ComEd understands that at this time the Staff is reluctant to approve a one directional examination; therefore, ComEd will perform the PDI technique from 2 directions.

Licensee's Basis for the Proposed Alternative (as stated):

"Relief is requested pursuant to the provision of 10 CFR 50.55a(a)(3)(i), the proposed alternative would provide an acceptable level of quality and safety.

"Braidwood is requesting relief from the Section XI, 1983 Addenda, Paragraph IWA-2232 requirements which requires these examinations to be conducted in accordance with Article 4 of Section V, 1983 Edition with Summer 1983 Addenda and as amended by Section XI. The attached Table A

identifies the specific applicable Section V and XI requirements and the proposed corresponding Alternative Performance Demonstration Initiative (PDI) technique.

"The Electric Utility industry has developed a program to qualify ultrasonic inspection techniques. This program, Performance Demonstration Initiative (PDI), is designed to meet the intent of Appendix VIII of the ASME Code, Section XI, 1992 Edition through 1993 Addenda. This program, PDI, used a variety of test blocks to evaluate transducer designs, scanning requirements and flaw sizing techniques.

"Braidwood has contracted with Framatome Technologies to use the URSULA manipulator to perform the 10 Year Ultrasonic (UT) Reactor inspections. It is Braidwood's intent to use the FTI technique qualified in December 1995 to the PDI Program at EPRI NDE Center that meets the intent of Appendix VIII of the 1992 Edition with 1993 Addenda. This FTI qualified PDI technique consists of scanning the examination volume, weld and base metal, as follows:

(1) For flaw detection, the examination volume will be scanned in two directions, one perpendicular and one parallel to the weld axis. The examination volume is scanned from one direction such that all the examination angles pass through the entire examination volume of interest for each transducer. If full coverage is limited, scanning from both directions will be performed when coverage can be maximized.

Note: By letter dated April 7, 1997, the above scanning information was superseded. ComEd revised the alternative to include scans in two opposing directions for examinations perpendicular and parallel to the weld axis.

(2) For flaw characterization (or flaw sizing), the examination will be conducted from two opposing directions, in the direction perpendicular to the plane of the flaw, when feasible.

In addition, the licensee provided the following comparison table:

TABLE A

COMPARISON OF RPV SHELL WELD EXAMINATION TECHNIQUES		
Description (Code Reference)	Standard Section V, XI, Reg. Guide 1.150 Procedure	FTI PDI/Appendix VIII Qualified Procedure
Examination Angles (Section V, T-441.1 and T-441.6)	Four transducers required to perform the detection scans 0°, 45° Shear wave, and 60°S for Code examination and a 70° Longitudinal wave (L) for clad to base metal interface, Reg Guide 1.150 requirement. Additional transducers used for sizing unacceptable flaws.	Three transducers 45°S calibrated on each ASME calibration standard based on examination thickness range, usually 9.0" and 5.0" blocks. The 70° is calibrated on calibration standard using 1/16" or 1/8" diameter side drilled holes. Three calibration blocks, ten calibrations. 45°S, 45°L, and 70°L. 45°L and 70°L to examine the inner 10% of thickness. 45°S and 45°L to examine beyond 10% thickness.
Calibrations (Section V, T-432 and T-434)	0°, 45°S, and 60°S calibrated on each ASME calibration standard based on examination thickness range, usually 9.0" and 5.0" blocks. The 70° is calibrated on calibration standard using 1/16" or 1/8" diameter side drilled holes. Three calibration blocks, ten calibrations.	One calibration standard designed to establish a calibrated time base and calibration sensitivity for each transducer using 1/16" or 1/8" diameter side drilled holes. One calibration standard, three calibrations.
Scanning Sensitivity (Section V, T-425)	Section XI, +6dB beyond 25% of thickness. Reg. Guide 1.150, +14dB for the first 25%	Minimum +20dB at the maximum thickness of the applicable examination volume.

COMPARISON OF RPV SHELL WELD EXAMINATION TECHNIQUES		
Recording Level (Section V, T-441.3.2.8)	Section XI, 50% DAC (Code required reflectors). Reg. Guide 1.150, 20% DAC for the first 25% of material thickness.	70°L - 20% DAC, (1/16" dia. SDH cal.) 45°S - 20% DAC, (1/8"dia.SDH cal.) 45°L - 10% DAC, (1/8" dia. SDH cal.)
Scan Index (Section V, T-425 and amended by paragraph IWA-2232	Minimum 50% overlap.	33% overlap for detection and 73% overlap for sizing.
Flaw Sizing (Section V, T-441.8)	Amplitude based sizing at 50% DAC. Tip diffraction as option for flaws determined to exceed IWB-3500 acceptance standards based on amplitude sizing. Requires additional transducers, calibration, and scanning. Beam spread calculations are required.	Tip diffraction techniques using the same transducers and calibrations used for the initial detection scans. FTI qualified the examination procedure for Supplement 4 and 6 sizing using the same transducers and calibrations used for detection. In addition, FTI qualified a forward scatter time-of-flight diffraction (TOFD) technique for the Supplement 4 examination volume as a supplemental technique. Beam spread calculations are not performed for these techniques.
Scan Speed (Section V, T-425)	Up to 6.0" per second.	Up to 9.0" per second.
Procedure Qualification	Transducers capable of detecting the calibration reflectors in the applicable calibration block.	Performance demonstration using cracks. Qualified on 12.0" thick samples containing a 12.0" wide band of manual clad 0.44" thick.

COMPARISON OF RPV SHELL WELD EXAMINATION TECHNIQUES		
Data Analyst	Certified Level II per Code of record (Section XI, Summer 1983 Addenda and 1980 SNT-TC-1A).	A minimum of a certified Level II (Section XI, Summer 1983 Addenda and 1980 SNT-TC-1A) and qualified by performance demonstration using flawed samples.

In the March 25, 1997, submittal the licensee provided the following additional information:

1) The licensee verified that all Code requirements except for those described in the Table will be met. The remaining requirements of ASME Section XI 1983 Edition through the 1983 Summer Addenda will be implemented.

2) All essential variables used for the PDI procedure qualification will be implemented for the Braidwood Unit 1 and 2 inspections.

Evaluation: As an alternative to the volumetric examination techniques prescribed by Code, the licensee has requested approval to implement a Performance Based Initiative (PDI) qualified ultrasonic examination procedure. The licensee has stated that all of the requirements of the 1983 Edition through the Summer 1983 Addenda will be implemented except where specific differences have been identified. Provided below is a comparison of the differences between the Code prescribed requirements and the PDI qualified procedure:

1) The examination procedure uses examination angles that are essentially the same as those required by the Code. However, the PDI procedure uses a 45°L in place of a 60° shear wave. The PDI procedure has eliminated the 0° scan. The 0° scan is used to determine the location of laminations that may interfere with the

angle beam examination, not for flaw detection. Since the reactor vessel base line examination data include the mapping of laminations that interfere with angle beam examinations, subsequent 0° scans required by Code may be omitted. Because the PDI procedure angles were capable of detecting the qualification flaws, the PDI procedure angles are considered an acceptable alternative to the Code-required examination angles.

2) The calibration and calibration sensitivity are based on side-drilled hole diameters that are equal to or smaller than those required by the Code. As a result, it is concluded that the sensitivities referenced by the PDI qualified procedure result in a higher sensitivity than that required by the Code.

3) The examination scanning sensitivity meets or exceeds the requirements of the Code and Regulatory Guide 1.150.

4) The scan overlap for the PDI procedure is slightly less than that required by the Code (33% versus 50%). However, because the PDI system is calibrated to a higher sensitivity, the INEEL staff believes that the reduction in overlap allowed in the PDI procedure does not diminish flaw detection capabilities.

5) The PDI procedure will use tip diffraction for the sizing of flaws. This technique is considered superior to the amplitude-based sizing technique required by Code.

6) The scan speed qualified with the PDI procedure is faster than the scan speed allowed by the Code (up to 9 inches per second versus up to 6 inches per second). However, the INEEL staff believes that the increase in scanning speed is offset by the increased examination sensitivity.

7) The PDI procedure for crack detection and flaw sizing has been demonstrated to be capable of detecting and sizing actual cracks in 12 inch thick carbon steel blocks with 0.44 inch stainless steel clad overlay. This qualification approach to flaw detection and sizing is superior to that required by the Code (i.e., qualification based on the ability to calibrate on side-drilled holes and notches).

8) Use of a certified ultrasonic Level II examiner qualified by performance based demonstration using flawed samples is superior to Code requirements.

Based on the information provided and the comparison of differences between the Code prescribed ultrasonic technique and the PDI procedure, in combination with the licensee's revised alternative to include scans in two opposing directions for examinations perpendicular and parallel to the weld axis, it can be concluded that the PDI procedure is an enhancement over the Code examination technique. As a result, the INEEL staff believes that implementation of the licensee's proposed alternative, when all associated Code requirements are satisfied, provides an acceptable level of quality and safety.

3.0 CONCLUSION

The INEEL staff has reviewed the information provided by the licensee in support of the proposed alternative. The licensee proposes to implement a PDI qualified ultrasonic procedure for the examination of reactor pressure vessel welds. Based on the information provided, it has been determined that the proposed alternative that includes scans in two opposing directions for examinations perpendicular and parallel to the weld axis will provide an acceptable level of quality and safety. Therefore, it is recommended that the licensee's proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i) for Braidwood 1 and 2.