Commonwealth Edison Company
1400 Opus Place
Downers Grove, IL 60515

ComEd

December 12, 1995

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: Relief from Inservice Inspection Requirements for Residual Heat Removal Heat Exchanger Nozzle-to-Vessel Welds

Byron Nuclear Power Station, Units 1 and 2
Facility Operating Licenses NPF-37 and NPF-66
NRC Docket Nos. 50-454 and 50-455

Braidwood Nuclear Power Station, Units 1 and 2
Facility Operating Licenses NPF-72 and NPF-77
NRC Docket Nos. 50-456 and 50-457

References: Attachment 1

Ladies and Gentlemen:

Commonwealth Edison Company (ComEd) proposes to revise Byron Nuclear Power Station, Units 1 and 2 (Byron), and Braidwood Nuclear Power Station, Units 1 and 2 (Braidwood), inservice inspection requirements for residual heat removal heat exchanger (RHX) nozzle-to-vessel welds pursuant to Title 10, Code of Federal Regulations, Part 50, Section 55a, Paragraph g, Subparagraph iii [10 CFR 50.55a (g)(iii)].

The First Ten Year Inservice Inspection (ISI) Interval for both Byron and Braidwood comply with the requirements of Section XI of the 1983 Edition, through Summer 1983 Addenda, of the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code (Code), as modified by United States Nuclear Regulatory Commission (USNRC) Staff approved relief.

A047 1/1

Currently Byron and Braidwood perform a best effort ultrasonic examination of the RHX nozzle-to-vessels welds once per inspection interval. In 1994, examination results of the Braidwood, Unit 2, Train B (2B), RHX Outlet Nozzle (2RHX-01) indicated flaws which exceeded the 60 percent acceptance criteria. The size change from previous inspections was attributed to enhancement in the volumetric examination technique. An ASME Code, Section XI repair by excavation was completed and the unacceptable flaws were removed. Observations made of the excavation areas on the 2RHX-01 repair verified that the indications found in the RHX nozzles are fabrication flaws, slag, incomplete fusion and excess porosity. No service induced flaws were found.

A finite element analysis was also performed and submitted to the USNRC Staff for review (References 13 and 17). The results of this analysis showed that the inside diameter (I.D.) of the nozzle is in compression and the outside diameter (O.D.) is in tension. Consequently, any service induced flaw would be expected to initiate at the O.D. of the nozzle where the weld membrane stresses are in tension. All the fabrication flaws exist within the areas shown in the analysis to be in compressive or negligible stress and are not subject to propagation.

Performance of surface examinations each inspection period will provide the best means for detection of service induced flaws and provide assurance that a service induced defect will be identified prior to component failure. Ultrasonic examinations of the RHX nozzle-to-vessel weld will not provide detection capabilities of service induced flaws beyond that provided by surface examination. Additionally, continued performance of ultrasonic examinations would require extensive labor resources, unnecessary radiation exposure to the examiners, and significant cost to ComEd without a commensurate increase in quality or public safety.

ComEd respectfully requests that the USNRC Staff review and approve the attached relief requests no later than February 2, 1996, so that ComEd may take advantage of the requested relief prior to the Braidwood, Unit 2, Cycle 5, Refuel Outage (A2R05) currently scheduled to begin March 2, 1996. ComEd apologizes for the expedited nature of this request.

To the best of my knowledge and belief, the statements contained in this document are true and correct. In some respects these statements are not based on my personal knowledge, but on information furnished by other ComEd employees, contractor employees, and/or consultants. Such information has been reviewed in accordance with company practice, and I believe it to be reliable.

Please address any comments or questions regarding this matter to this office.

Very truly yours,

Harold D. Pontious, Jr.
Nuclear Licensing Administrator

OFFICIAL SEAL
MARY JO YACK
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 11/29/97

Signed before me

on this 12th day of December, 1995

by ______________.
Notary Public

Attachment 1: References
Attachment 2: Byron Relief Request NR-18
Attachment 3: Braidwood Relief Request NR-23

cc: H. J. Miller, Regional Administrator - RIII
G. F. Dick Jr., Byron Project Manager - NRR
R. R. Assa, Braidwood Project Manager - NRR
H. Peterson, Senior Resident Inspector - Byron
C. J. Phillips, Senior Resident Inspector - Braidwood
Office of Nuclear Facility Safety - IDNS

Attachment 1

References

1. NUREG/CR 4878, "Analysis of Experiments on Stainless Steel Flux Welds," April 1987.

2. Westinghouse Letter Report MMDT-SMT-193, "Fracture Mechanics Evaluation Braidwood Unit 2 Residual Heat Exchanger Tube Side Inlet and Outlet Nozzles," dated November 1991

3. T. W. Simpkin (ComEd) letter to Dr. Thomas E. Murley (USNRC), "Braidwood Station Unit 2 Flow Evaluation for RHR Heat Exchanger Nozzle to Shell Welds," dated November 13, 1991

4. Robert M. Pulsifer (USNRC) letter to Thomas J. Kovach (ComEd), "Residual Heat Removal Heat Exchanger Nozzle to Shell Welds (TAC No. M82087)," dated November 21, 1991

5. Westinghouse Letter Report MMDT-SMT-062(92), "Fracture Mechanics Evaluation Byron and Braidwood Units 1 and 2 Residual Heat Exchanger Tube Side Inlet and Outlet Nozzles," dated November 1991

6. David J. Chrzanowski (ComEd) letter to Dr. Thomas E. Murley (USNRC), "Byron Unit 2 Residual Heat Removal Heat Exchanger Inservice Inspection Results," dated May 27, 1992

7. WCAP-13454, "Fracture Mechanics Evaluation Byron and Braidwood Units 1 and 2 Residual Heat Exchanger Tube Side Inlet and Outlet Nozzles," dated August 1992 (Proprietary)

8. T. W. Simpkin (ComEd) letter to Dr. Thomas E. Murley (USNRC), "Byron/Braidwood Stations Flaw Evaluation Methodology for RHR Heat Exchanger Nozzle to Shell Welds," dated August 25, 1992

9. Joseph A. Bauer (ComEd) letter to Dr. Thomas E. Murley (USNRC), "Withdrawal of Request for NRC Review and Approval of Flaw Evaluation Methodology for RHR Heat Exchanger Nozzle to Shell Welds," dated September 15, 1993

References
(Continued)

10. Denise M. Saccomando (ComEd) letter to USNRC Document Control Desk, "Braidwood Station Unit 2 Flaw Evaluation Report for Residual Heat Removal Heat Exchanger Nozzle to Shell Welds," dated November 8, 1995

11. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated November 8, 1994

12. Westinghouse Letter Report MSE-SMT-461(94), "Fracture Mechanics Evaluation of Indications in Byron and Braidwood Units 1 and 2 RHX Tube Side Inlet and Outlet Nozzles," dated November 1994 (Proprietary)

13. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Supplemental Information Regarding the Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated November 9, 1994

14. Ramin A. Assa (USNRC) letter to D. L. Farrar (ComEd), "Residual Heat Removal Heat Exchanger Nozzle Weld Assessment (TAC No. M90840)," dated November 10, 1994

15. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated November 14, 1994

16. Denise M. Saccomando (ComEd) letter to USNRC Document Control Desk, "Supplement to Byron Unit 2 Residual Heat Removal (RHR) Heat Exchanger Inservice Inspection Results," dated November 18, 1994

17. Denise M. Saccomando (ComEd) letter to USNRC Document Control Desk, "Supplement to Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated December 20, 1994

18. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Byron Nuclear Power Station Unit 1 Residual Heat Removal (RHR) Heat Exchanger (HX) Nozzle to Vessel Welds Inservice Inspection Results," dated January 20, 1995

References
(Continued)

19. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Braidwood Nuclear Power Station Unit 1 Residual Heat Removal (RHR) Heat Exchanger (HX) Nozzle to Vessel Welds Inservice Inspection Results," dated January 23, 1995

20. George F. Dick, Jr. (USNRC) letter to D. L. Farrar (ComEd), "Residual Heat Exchanger Nozzle Welds, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2 (TAC Nos. M90894, M80895, M91408 and M90840), " dated February 3, 1995

Attachment 2

Byron Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-18

Byron Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-18

COMPONENT IDENTIFICATION

Code Classification: 2

References: IWC-2500-1
IWC-2420
IWC-2430
IWC-3000

1. NUREG/CR 4878, "Analysis of Experiments on Stainless Steel Flux Welds," April 1987.

2. T. W. Simpkin (ComEd) letter to Dr. Thomas E. Murley (USNRC), "Braidwood Station Unit 2 Flow Evaluation for RHR Heat Exchanger Nozzle to Shell Welds," dated November 13, 1991

3. Robert M. Pulsifer (USNRC) letter to Thomas J. Kovach (ComEd), "Residual Heat Removal Heat Exchanger Nozzle to Shell Welds (TAC No. M82087)," dated November 21, 1991

4. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Supplemental Information Regarding the Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated November 9, 1994

5. Denise M. Saccomando (ComEd) letter to USNRC Document Control Desk, "Supplement to Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated December 20, 1994

6. George F. Dick, Jr. (USNRC) letter to D. L. Farrar (ComEd), "Residual Heat Exchanger Nozzle Welds, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2 (TAC Nos. M90894, M80895, M91408 and M90840), " dated February 3, 1995

Byron Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-18
(Continued)

Attachment:

1. Residual Heat Removal (RHR) Heat Exchanger Nozzle to Vessel Detail

Examination Categories: C-B

Item Numbers: C2.21

Description: Alternate Examination of Nozzle to Vessel Welds - Residual Heat Removal Heat Exchangers

Component Numbers:

Component	Weld Numbers
1RH02AA	RHXN-01, RHXN-02
1RH02AB	RHXN-01, RHXN-02
2RH02AA	RHXN-01, RHXN-02
2RH02AB	RHXN-01, RHXN-02

CODE REQUIREMENT

Subsection IWC, Table IWC-2500-1, Examination Category C-B. Item C2.21 requires volumetric and surface examination of the Nozzle to Shell welds of the regions described in Figure IWC 2500-4(a) or (b), for nozzles without reinforcing plate in vessels >½ in. nominal thickness. Examinations shall be conducted on nozzles at terminal ends of piping runs selected for examination under Examination Category C-F each inspection interval. In cases of multiple vessels of similar design, size, and service, the required examinations may be limited to one vessel or distributed among the vessels.

Per IWC-2430, additional examinations are required when an examination detects indications exceeding the allowable standards of IWC-3000. These additional examinations shall be extended to include an additional number of similar components (or areas) within the same category.

Byron Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-18
(Continued)

Per IWC-2420, if component examination results require evaluation of flaw indications in accordance with IWC-3000, and the component qualifies as conditionally acceptable for continued service, the areas containing such flaw indications shall be reexamined during the next inspection period listed in the schedule of Inspection Program B of IWC-2412. If the reexamination reveals that the flaw indications remain essentially unchanged for the next inspection period, the component examination schedule may revert to the original schedule of successive inspections.

BASIS FOR RELIEF

History:

The RHR Heat Exchangers at Byron and Braidwood were manufactured by Joseph Oats Corporation in 1975 per the requirements of ASME Section III, 1974 Edition, Summer 1975 Addenda, Subarticle NC3200, Alternate Design Rules for Vessels. The nozzles and shell are fabricated from SA240 type 304 stainless steel material. The RHR heat exchangers tube side is Code Class 2 and the shell side is Class 3. The nozzle to shell welds were not required to be volumetrically examined during fabrication and only liquid penetrant examinations were performed on the final surfaces of the weld.

During the preservice inspections of the Byron and Braidwood components, relief was requested from performing volumetric examinations of the nozzle to vessel welds due to inherent geometric constraints. The fillet weld located directly above the nozzle-to-vessel weld is an obstruction to the proper movement of the inspection instrumentation transducer. These constraints limited the ability to perform a meaningful UT. These relief requests, NR-14 for Byron Unit 1, NR-13 for Byron Unit 2, 1NR-12 for Braidwood Unit 1, and 2NR-12 for Braidwood Unit 2 were approved by the NRC in Byron SSER 7, page 16 and Braidwood SSER 5, page 6-2.

Relief Requests NR-12 for Byron and NR-12 for Braidwood were included with the First Ten Year Interval ISI Program Submittal. These relief requests sought the same Code inspection exemptions for the nozzle to shell welds as did the preservice relief requests. Relief for the nozzle to shell weld examination was denied and NRR requested a best effort UT of the nozzle-to-vessel welds be conducted.

Byron Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-18
(Continued)

The initial UT inspection (1991) performed on the Braidwood Unit 2 "A" RHR heat exchanger found indications which exceeded the ASME Section XI 1983 Edition, Summer 1983 Addenda, Subarticle IWC-3000 allowable limits. The indications which exceeded the acceptance standards of IWC-3000 were subjected to further evaluation in accordance with ASME Section XI Subarticle IWB-3600. The required Fracture Mechanics Analysis was submitted to the NRC (Reference 2) and the indications were found to be acceptable for continued service (Reference 3). Additional examinations were performed in 1992 for Byron Unit 2 and Braidwood Unit 1 heat exchangers, in 1993 for Byron Unit 1 and Braidwood Unit 2 heat exchangers, in 1994 for Braidwood Unit 2 heat exchangers, and in 1995 for Byron Unit 2 heat exchangers. All examinations confirmed the existence of fabrication flaws in the nozzle to vessel welds.

The examination results from the inspections performed in 1994 at Braidwood Unit 2 included flaws on the outlet nozzle weld of the 2B RHR vessel which exceeded the 60% acceptance criteria. The size change from previous inspections was attributed to enhancement in the volumetric examination technique. An ASME section XI repair by excavation was completed; the unacceptable flaws were removed.

Safety Significance:

The RHR Heat Exchanger welds are within a class 2 system, on a moderate energy line which operates at a relatively low pressure (≈400 psig). This operating pressure is below the design pressure (600 psig) used for allowable flaw size calculations in the Fracture Mechanics Analysis. The actual induced piping loads on the nozzles are less than 60% of the design loads used by the allowable flaw size calculations.

Observations made of the excavation areas on the Braidwood Unit 2 "B" Outlet RH HX Nozzle (2RHX-01) repair verified that the indications found in the RH HX Nozzles are fabrication flaws, slag, incomplete fusion and excess porosity. No service induced flaws were found.

Byron Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-18
(Continued)

A hydrostatic test was performed by the manufacturer, after fabrication, for all vessels at a pressure of 803 psig. Another hydrostatic test was performed in the field, after installation, at a pressure of 775 psig for Byron Unit 1 and 800 psig for Byron Unit 2 with no leakage noted from these regions. Pressure is the dominant load on the nozzle weld. The hydrotests have demonstrated that these nozzle welds can withstand almost double the operating pressure, without structural failure, despite the presence of the fabrication flaws in the weld.

The Fracture Mechanics Analysis shows that these nozzles have a large flaw tolerance because of material ductility, flexibility (thin walled), and the reinforcement provided by the fillet weld. It has also been shown (Reference 1) that the fracture toughness of flux welds is higher than that used in the allowable flaw size calculation performed as part of the fracture mechanics evaluation.

A finite element analysis was performed and submitted to the NRC for review (Reference 4). The analysis was subsequently supplemented (Reference 5). The results of this analysis show that the inside diameter of the nozzle is in compression and the outside diameter (O.D.) is in tension. Consequently, any service induced flaw would be expected to initiate at the O.D. of the nozzle where the weld membrane stresses are in tension. All the fabrication flaws exist within the areas shown in the analysis to be in compressive or negligible stress and are not subject to propagation. The NRC review of the finite element analysis is documented in Reference 6.

The objective of the Inservice Inspection Program is to find "service induced flaws" before they become safety significant. A service induced flaw will initiate as a surface flaw at the nozzle O.D., as discussed above, so a Penetrant Test will be more likely to detect a service induced flaw than a volumetric exam. Also, due to the low stresses present and given the fracture toughness of stainless steel, leakage from the joint would likely be detected before a leak would occur. A VT-2 examination is being conducted on all RHR Heat Exchangers once per inspection period as required by ASME Section XI Code Item C2.33.

Relief Request NR-18
(Continued)

Performance of surface examinations each inspection period will provide the best means for detection of service induced flaws and provide assurance that a service induced defect will be identified prior to component failure. Ultrasonic examinations for the RHR nozzle-to-vessel weld will not provide detection capabilities of service induced flaws beyond that provided by surface examination. Additionally, performance of the ultrasonic examinations will require extensive labor resources, unnecessary radiation exposure to the examiners and add significant costs to Commonwealth Edison without a commensurate increase in quality or public safety.

Justification:

The volumetric examinations and the repair completed at Braidwood Unit 2 characterize these flaws as fabrication defects, and not service induced cracks. Additionally, the Fracture Mechanics Analysis predicts negligible crack growth. The Fracture Mechanics Analysis also revealed that the inside nozzle surface is in compression and the outside surface is in tension. Therefore, a Section XI surface examination is an adequate test to verify the structural integrity of the welds.

PROPOSED ALTERNATIVE EXAMINATIONS

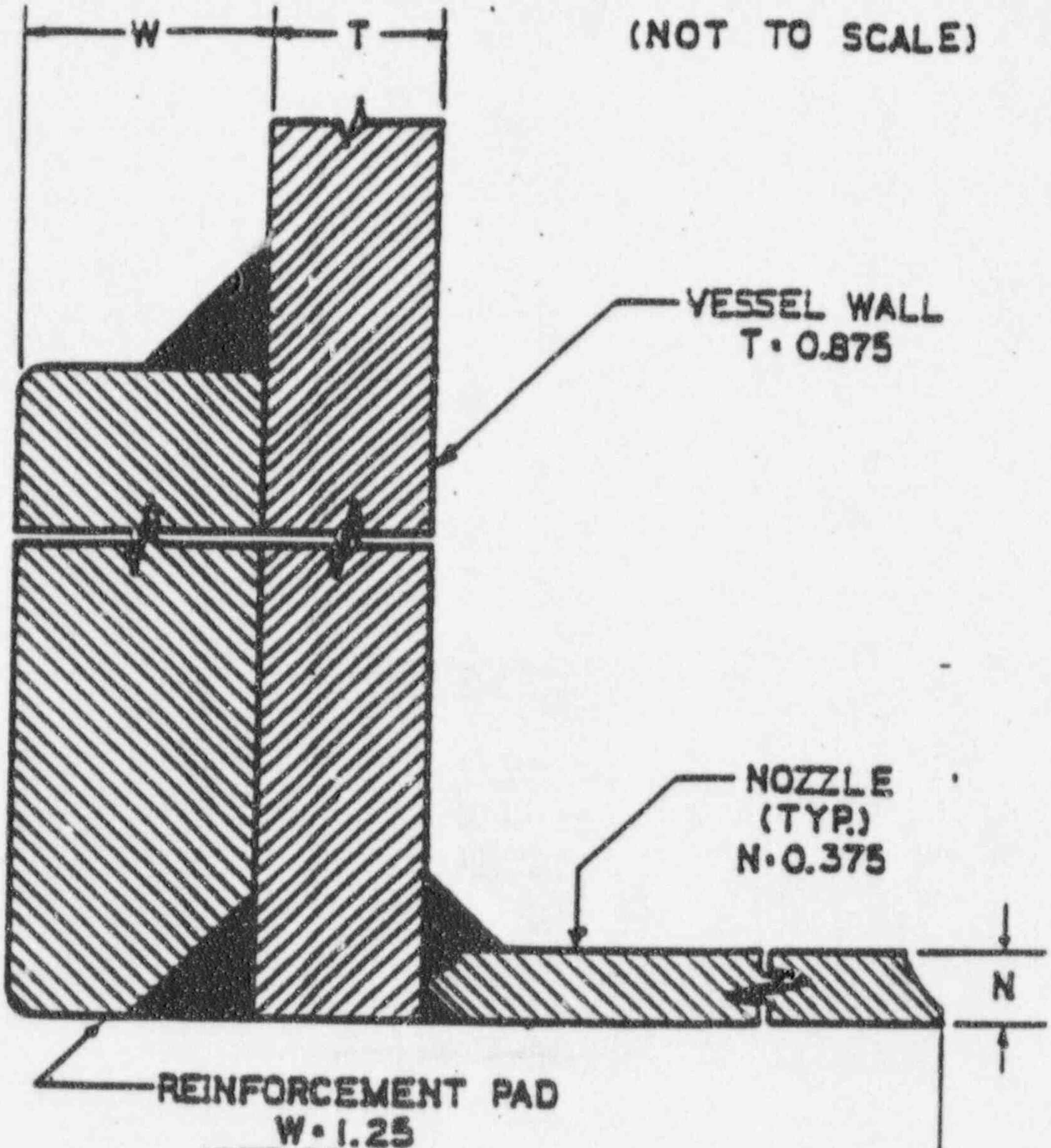
The nozzle-to-vessel welds on the A and B RHR Heat Exchangers for Byron Units 1 and 2 will receive a Section XI surface examination each inspection period. In addition, a visual examination (VT-2) shall be performed each inspection period on all pressure retaining components.

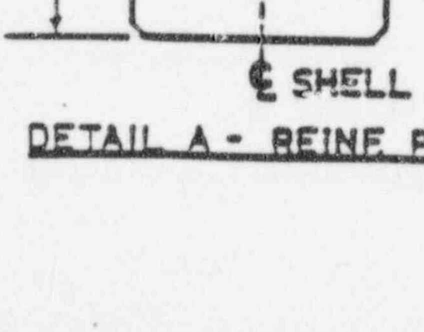
APPLICABLE TIME PERIOD

This relief will be required for the first 120 month inspection interval.

UNIT 1 AND UNIT 2

(NOT TO SCALE)





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DETAIL A - REINF PAD

DIMENSIONS SHOWN
ARE NOMINAL.

Attachment 3

Braidwood Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-23

Braidwood Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-23

COMPONENT IDENTIFICATION

Code Classification: 2

References:
IWC-2500-1
IWC-2420
IWC-2430
IWC-3000

1. NUREG/CR 4878, "Analysis of Experiments on Stainless Steel Flux Welds," April 1987.

2. T. W. Simpkin (ComEd) letter to Dr. Thomas E. Murley (USNRC), "Braidwood Station Unit 2 Flow Evaluation for RHR Heat Exchanger Nozzle to Shell Welds," dated November 13, 1991

3. Robert M. Pulsifer (USNRC) letter to Thomas J. Kovach (ComEd), "Residual Heat Removal Heat Exchanger Nozzle to Shell Welds (TAC No. M82087)," dated November 21, 1991

4. Harold D. Pontious, Jr. (ComEd) letter to USNRC Document Control Desk, "Supplemental Information Regarding the Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated November 9, 1994

5. Denise M. Saccomando (ComEd) letter to USNRC Document Control Desk, "Supplement to Fracture Mechanics Evaluation of Residual Heat Removal System Heat Exchanger Inlet and Outlet Nozzle to Shell Welds," dated December 20, 1994

6. George F. Dick, Jr. (USNRC) letter to D. L. Farrar (ComEd), "Residual Heat Exchanger Nozzle Welds, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2 (TAC Nos. M90894, M80895, M91408 and M90840), " dated February 3, 1995

Braidwood Nuclear Power Station, Units 1 and 2
Inservice Inspection Program
First Ten Year Inspection Interval

Relief Request NR-23
(Continued)

Attachment:

1. Residual Heat Removal (RHR) Heat Exchanger Nozzle to Vessel Detail

Examination Categories: C-B

Item Numbers: C2.21

Description: Alternate Examination of Nozzle to Vessel Welds - Residual Heat Removal Heat Exchangers

Component Numbers:

Component	Weld Numbers
1RH02AA	RHXN-01, RHXN-02
1RH02AB	RHXN-01, RHXN-02
2RH02AA	RHXN-01, RHXN-02
2RH02AB	RHXN-01, RHXN-02

CODE REQUIREMENT

Subsection IWC, Table IWC-2500-1, Examination Category C-B, Item C2.21 requires volumetric and surface examination of the Nozzle to Shell welds of the regions described in Figure IWC 2500-4(a) or (b), for nozzles without reinforcing plate in vessels >½ in. nominal thickness. Examinations shall be conducted on nozzles at terminal ends of piping runs selected for examination under Examination Category C-F each inspection interval. In cases of multiple vessels of similar design, size, and service, the required examinations may be limited to one vessel or distributed among the vessels.

Per IWC-2430, additional examinations are required when an examination detects indications exceeding the allowable standards of IWC-3000. These additional examinations shall be extended to include an additional number of similar components (or areas) within the same category.

Relief Request NR-23
(Continued)

Per IWC-2420, if component examination results require evaluation of flaw indications in accordance with IWC-3000, and the component qualifies as conditionally acceptable for continued service, the areas containing such flaw indications shall be reexamined during the next inspection period listed in the schedule of Inspection Program B of IWC-2412. If the reexamination reveals that the flaw indications remain essentially unchanged for the next inspection period, the component examination schedule may revert to the original schedule of successive inspections.

BASIS FOR RELIEF

History:

The RHR Heat Exchangers at Byron and Braidwood were manufactured by Joseph Oats Corporation in 1975 per the requirements of ASME Section III, 1974 Edition, Summer 1975 Addenda, Subarticle NC3200, Alternate Design Rules for Vessels. The nozzles and shell are fabricated from SA240 type 304 stainless steel material. The RHR heat exchangers tube side is Code Class 2 and the shell side is Class 3. The nozzle to shell welds were not required to be volumetrically examined during fabrication and only liquid penetrant examinations were performed on the final surfaces of the weld.

During the preservice inspections of the Byron and Braidwood components, relief was requested from performing volumetric examinations of the nozzle to vessel welds due to inherent geometric constraints. The fillet weld located directly above the nozzle-to-vessel weld is an obstruction to the proper movement of the inspection instrumentation transducer. These constraints limited the ability to perform a meaningful UT. These relief requests, NR-14 for Byron Unit 1, NR-13 for Byron Unit 2, 1NR-12 for Braidwood Unit 1, and 2NR-12 for Braidwood Unit 2 were approved by the NRC in Byron SSER 7, page 16 and Braidwood SSER 5, page 6-2.

Relief Requests NR-12 for Byron and NR-12 for Braidwood were included with the First Ten Year Interval ISI Program Submittal. These relief requests sought the same Code inspection exemptions for the nozzle to shell welds as did the preservice relief requests. Relief for the nozzle to shell weld examination was denied and NRR requested a best effort UT of the nozzle-to-vessel welds be conducted.

Relief Request NR-23
(Continued)

The initial UT inspection (1991) performed on the Braidwood Unit 2 "A" RHR heat exchanger found indications which exceeded the ASME Section XI 1983 Edition, Summer 1983 Addenda, Subarticle IWC-3000 allowable limits. The indications which exceeded the acceptance standards of IWC-3000 were subjected to further evaluation in accordance with ASME Section XI Subarticle IWB-3600. The required Fracture Mechanics Analysis was submitted to the NRC (Reference 2) and the indications were found to be acceptable for continued service (Reference 3). Additional examinations were performed in 1992 for Byron Unit 2 and Braidwood Unit 1 heat exchangers, in 1993 for Byron Unit 1 and Braidwood Unit 2 heat exchangers, in 1994 for Braidwood Unit 2 heat exchangers, and in 1995 for Byron Unit 2 heat exchangers. All examinations confirmed the existence of fabrication flaws in the nozzle to vessel welds.

The examination results from the inspections performed in 1994 at Braidwood Unit 2 included flaws on the outlet nozzle weld of the 2B RHR vessel which exceeded the 60% acceptance criteria. The size change from previous inspections was attributed to enhancement in the volumetric examination technique. An ASME section XI repair by excavation was completed; the unacceptable flaws were removed.

Safety Significance:

The RHR Heat Exchanger welds are within a class 2 system, on a moderate energy line which operates at a relatively low pressure (≈400 psig). This operating pressure is below the design pressure (600 psig) used for allowable flaw size calculations in the Fracture Mechanics Analysis. The actual induced piping loads on the nozzles are less than 60% of the design loads used by the allowable flaw size calculations.

Observations made of the excavation areas on the Braidwood Unit 2 "B" Outlet RH HX Nozzle (2RHX-01) repair verified that the indications found in the RH HX Nozzles are fabrication flaws, slag, incomplete fusion and excess porosity. No service induced flaws were found.

Relief Request NR-23
(Continued)

A hydrostatic test was performed by the manufacturer, after fabrication, for all vessels at a pressure of 803 psig. Another hydrostatic test was performed in the field, after installation, at a pressure of 750 psig for Braidwood Unit 1 and 800 psig for Braidwood Unit 2 with no leakage noted from these regions. Pressure is the dominant load on the nozzle weld. The hydrotests have demonstrated that these nozzle welds can withstand almost double the operating pressure, without structural failure, despite the presence of the fabrication flaws in the weld.

The Fracture Mechanics Analysis shows that these nozzles have a large flaw tolerance because of material ductility, flexibility (thin walled), and the reinforcement provided by the fillet weld. It has also been shown (Reference 1) that the fracture toughness of flux welds is higher than that used in the allowable flaw size calculation performed as part of the fracture mechanics evaluation.

A finite element analysis was performed and submitted to the NRC for review (Reference 4). The analysis was subsequently supplemented (Reference 5). The results of this analysis show that the inside diameter of the nozzle is in compression and the outside diameter (O.D.) is in tension. Consequently, any service induced flaw would be expected to initiate at the O.D. of the nozzle where the weld membrane stresses are in tension. All the fabrication flaws exist within the areas shown in the analysis to be in compressive or negligible stress and are not subject to propagation. The NRC review of the finite element analysis is documented in Reference 6.

The objective of the Inservice Inspection Program is to find "service induced flaws" before they become safety significant. A service induced flaw will initiate as a surface flaw at the nozzle O.D., as discussed above, so a Penetrant Test will be more likely to detect a service induced flaw than a volumetric exam. Also, due to the low stresses present and given the fracture toughness of stainless steel, leakage from the joint would likely be detected before a leak would occur. A VT-2 examination is being conducted on all RHR Heat Exchangers once per inspection period as required by ASME Section XI Code Item C2.33.

Relief Request NR-23
(Continued)

Performance of surface examinations each inspection period will provide the best means for detection of service induced flaws and provide assurance that a service induced defect will be identified prior to component failure. Ultrasonic examinations for the RHR nozzle-to-vessel weld will not provide detection capabilities of service induced flaws beyond that provided by surface examination. Additionally, performance of the ultrasonic examinations will require extensive labor resources, unnecessary radiation exposure to the examiners and add significant costs to Commonwealth Edison without a commensurate increase in quality or public safety.

Justification:

The volumetric examinations and the repair completed at Braidwood Unit 2 characterize these flaws as fabrication defects, and not service induced cracks. Additionally, the Fracture Mechanics Analysis predicts negligible crack growth. The Fracture Mechanics Analysis also revealed that the inside nozzle surface is in compression and the outside surface is in tension. Therefore, a Section XI surface examination is an adequate test to verify the structural integrity of the welds.

PROPOSED ALTERNATIVE EXAMINATIONS

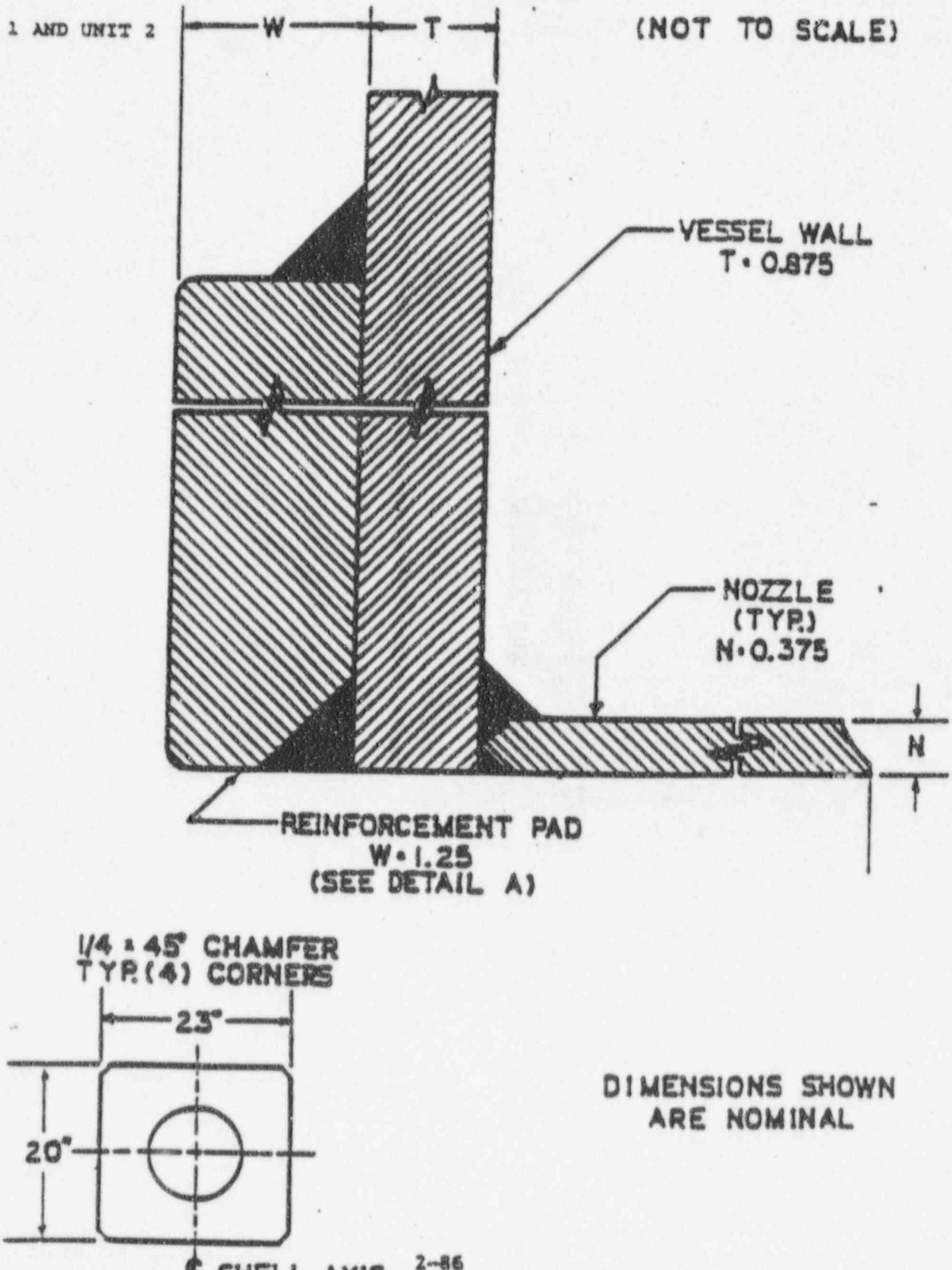
The nozzle-to-vessel welds on the A and B RHR Heat Exchangers for Braidwood Units 1 and 2 will receive a Section XI surface examination each inspection period. In addition, a visual examination (VT-2) shall be performed each inspection period on all pressure retaining components.

APPLICABLE TIME PERIOD

This relief will be required for the first 120 month inspection interval.

UNIT 1 AND UNIT 2

(NOT TO SCALE)



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DETAIL A - REINF PAD

DIMENSIONS SHOWN
ARE NOMINAL