ENCLOSURE

COMMONWEALTH EDISON COMPANY
BYRON STATION UNIT NUMBERS 1 AND 2

DOCKET NUMBERS 50-454 AND 50-455
SAFETY EVALUATION REPORT SUPPLEMENT

MATERIALS ENGINEERING BRANCH
INSERVICE INSPECTION SECTION

5.2.4 Reactor Coolant Pressure Boundary Inservice Inspection and Testing

This section was prepared with the technical assistance of DOE contractors from the Idaho National Engineering Laboratory.

5.2.4.1 Evaluation of Compliance with 10 CFR 50.55a(g) for Byron Station Unit 1

This evaluation supplements conclusions in this section of NUREG-0876, which addressed the definition of examination requirements and the evaluation of compliance with 10 CFR 50.55a(g).

The PSI Program complies with the requirements of the 1977 Edition of the Code, including Addenda through Summer 1978, except where specific relief is requested. In letters dated March 1, 1983, August 26, 1983, December 6, 1983, December 14, 1983, February 17, 1984, and April 18, 1984, the Applicant submitted revised weld

examination tables for the Preservice Inspection Program along with notes clarifying the extent of examinations performed on particular items and requests for relief from ASME Section XI Code requirements which the Applicant has determined to be not practical. The relief requests were supported by information pursuant to 10 CFR 50.55a(a)(2)(i). The staff evaluated the ASME Code required examinations that the Applicant determined to be impractical and, pursuant to 10 CFR Part 50, Section 50.55a(a)(2), have allowed relief from the impractical requirements that, if implemented, would result in hardships or unusual difficulties without a compensating increase in the level of quality and safety. Based on the granting of relief from these preservice examination requirements, the staff concludes that the preservice inspection program for Byron Station Unit 1 is in compliance with 10 CFR Part 50, Section 50.55a(g)(3). The detailed evaluation supporting this conclusion is provided in Appendix I to this report.

The initial inservice inspection program has not been submitted. This program will be evaluated after the applicable ASME Code Edition and Addenda can be determined based on Section 50.55a(b) of 10 CFR Part 50, but before the first refueling outage when inservice inspection commences.

5.2.4.2 Evaluation of Compliance with 10 CFR 50.55a(g) for Byron Station Unit 2

The PSI Program for Byron Station Unit 2 has not been submitted and will be evaluated by the staff after the Applicant makes a decision on the applicability of the Unit 1 program to Unit 2.

6.6 Inservice Inspection of Class 2 and 3 Components

This section was prepared with the technical assistance of DOE contractors from the Idaho National Engineering Laboratory.

6.6.1 Evaluation of Compliance with 10 CFR 50.55a(g) for Byron Station Unit 1

This evaluation supplements conclusions in this section of NUREG-0876, which addressed the definition of examination requirements and the evaluation of compliance with 10 CFR 50.55a(g).

The PSI Program complies with the requirements of the 1977 Edition of the Code including Addenda through Summer 1978, except where specific relief is requested. In letters dated March 1, 1983, August 26, 1983, December 6, 1983, December 14, 1983, February 17, 1984, and April 18, 1984, the Applicant submitted revised weld

examination tables for the Preservice Inspection Program along with notes clarifying the extent of examinations performed on particular items and requests for relief from ASME Section XI Code requirements which the Applicant has determined to be not practical. The relief requests were supported by information pursuant to 10 CFR 50.55a(a)(2)(i). The staff evaluated the ASME Code required examinations that the Applicant determined to be impractical and, pursuant to 10 CFR Part 50, Section 50.55a(a)(2), have allowed relief from the impractical requirements that, if implemented, would result in hardships or unusual difficulties without a compensating increase in the level of quality and safety. Based on the granting of relief from these preservice examination requirements, the staff concludes that the preservice inspection program for Byron Station Unit 1 is in compliance with 10 CFR Part 50, Section 50.55a(g)(3). The detailed evaluation supporting this conclusion is provided in Appendix I to this report.

The initial inservice inspection program has not been submitted. This program will be evaluated after the applicable ASME Code Edition and Addenda can be determined based on Section 50.55a(b) of 10 CFR Part 50, but before the first refueling outage when inservice inspection commences.

6.6.2 Evaluation of Compliance with 10 CFR 50.55a(g) for Byron Station Unit 2

The PSI Program for Byron Station Unit 2 has not been submitted and will be evaluated by the staff after the Applicant makes a decision on the applicability of the Unit 1 program to Unit 2.

APPENDIX I

COMMONWEALTH EDISON COMPANY
BYRON STATION UNIT NUMBER 1

DOCKET NUMBER 50-454

SAFETY EVALUATION REPORT SUPPLEMENT
PRESERVICE INSPECTION RELIEF REQUEST EVALUATION

I. INTRODUCTION

This section was prepared with technical assistance of DOE contractors from the Idaho National Engineering Laboratory.

For nuclear power facilities whose construction permit was issued on or after July 1, 1974, 10 CFR 50.55a(g)(3) specifies that components shall meet the preservice examination requirements set forth in Editions of Section XI of the ASME Boiler and Pressure Vessel Code and Addenda applied to the construction of the particular component. The provisions of 10 CFR 50.55a(g)(3) also state that components (including supports) may meet the requirements set forth in subsequent Editions and Addenda of this Code which are incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein.

In letters dated March 1, 1983, August 26, 1983, December 6, 1983, December 14, 1983, February 17, 1984, and April 18, 1984, the Applicant submitted revised weld examination tables for the Byron Unit 1 Preservice Inspection Program along with notes clarifying the extent of examinations

performed on particular items and requests for relief from ASME Section XI Code requirements which the Applicant has determined to be not practical. The relief requests were supported by information pursuant to 10 CFR 50.55a(a)(2)(i). Therefore, the staff evaluation consisted of reviewing the Applicant's submittal to the requirements of the above referenced Code and determining if relief from the Code requirements were justified.

II. TECHNICAL REVIEW CONSIDERATIONS

A. The construction permit was issued on December 31, 1975. In accordance with 10 CFR 50.55a(g)(3), components (including supports), which are classified as ASME Code Class 1 and 2, have been designed and provided with access to enable the performance of required preservice examinations set forth in the 1977 Edition of ASME Section XI, including the Addenda through Summer 1978.

B. Verification of as-built structural integrity of the primary pressure boundary is not dependent on the Section XI preservice examination. The applicable construction codes to which the primary pressure boundary was fabricated contain examination and testing requirements which by themselves provide the necessary assurance that the pressure boundary components are capable of

performing safely under all operating conditions reviewed in the FSAR and described in the plant design specification. As a part of these examinations, all of the primary pressure boundary full penetration welds were volumetrically examined (radiographed) and the system will be subjected to hydrostatic pressure tests.

C. The intent of a preservice examination is to establish a reference or baseline prior to the initial operation of the facility. The results of subsequent inservice examination can then be compared with the original condition to determine if changes have occurred. If review of the inservice inspection results shows no change from the original condition, no action is required. In the case where baseline data are not available, all flaws must be treated as new flaws and evaluated accordingly. Section XI of the ASME Code contains acceptance standards which may be used as the basis for evaluating the acceptability of such flaws.

D. Other benefits of the preservice examination include providing redundant or alternative volumetric examination of the primary pressure boundary using a test method different from that employed during the component fabrication. Successful performance of preservice examination also demonstrates that the welds are inspectable during the subsequent inservice examination using a similar test method.

In the case of Byron Station Unit 1, a large portion of the preservice examination required by the ASME Code was performed. Failure to perform a 100% preservice examination of the welds identified below will not significantly affect the assurance of the initial structural integrity.

E. In some instances where the required preservice examinations were not performed to the full extent specified by the applicable ASME Code, the staff may require that these examinations or supplemental examinations be conducted as a part of the inservice inspection program. Requiring supplemental examinations to be performed at this time (before plant startup) would result in hardships or unusual difficulties without a compensating increase in the level of quality or safety. The performance of supplemental examinations, such as surface examinations, in areas where volumetric inspection is difficult will be more meaningful after a period of operation. Acceptable preoperational integrity has already been established by similar ASME Code, Section III fabrication examinations.

In cases where parts of the required examination areas cannot be effectively examined because of a combination of component design or current examination technique limitations, the development of

new or improved examination techniques will continue to be evaluated. As improvements in these areas are achieved, the staff will require that these new techniques be made a part of the inservice examination requirements for the components or welds which received a limited preservice examination.

Several of the preservice inspection relief requests involve limitations to the examination of the required volume of a specific weld. The inservice inspection (ISI) program is based on the examination of a representative sample of welds to detect generic degradation. In the event that the welds identified in the PSI relief requests are required to be examined again, the possibility of augmented inservice inspection will be evaluated during review of the Applicant's initial 10-year ISI program. An augmented program may include increasing the extent and/or frequency of inspection of accessible welds.

III. EVALUATION OF RELIEF REQUESTS

The Applicant requested relief from specific preservice inspection requirements in submittals dated March 1, 1983, August 26, 1983, December 6, 1983, and December 14, 1983. In letters dated February 17, 1984 and April 18, 1984, the Applicant submitted additional information

regarding the ultrasonic examination of cast stainless steel component welds listed in Relief Requests NR-4, NR-6, and NR-8 and also requested that Notes 5 and 11 be evaluated as relief requests. Based on the information submitted by the Applicant and review of the design, geometry, and materials of construction of the components, certain preservice requirements of the ASME Boiler and Pressure Vessel Code, Section XI have been determined to be impractical and imposing these requirements would result in hardships or unusual difficulties without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(2), conclusions that these preservice requirements are impractical are justified as follows. Unless otherwise stated, references to the Code refer to the ASME Code, Section XI, 1977 Edition, including Addenda through Summer 1978.

A. Relief Request NR-1, Examination Category B-J, Chemical and Volume Control System Weld J-15 on Line ICVB7A-3"

Code Requirements: The subject Code Class 1 weld is required to receive a preservice surface examination in accordance with Table IWB-2500-1 (Category B-J), Item B9.21.

Code Relief Request: Relief is requested from performing the required surface examination on the inaccessible weld.

Reason for Request: Circumferential weld J-15 on line ICVB7A-3" is inaccessible for a surface examination because it is located 54" inside the missile barrier wall which prevents any meaningful surface examination. The pipe is fabricated from type 304 austenitic stainless steel which possesses a high toughness and therefore is not expected to experience a rapidly propagating failure.

In addition, the Applicant has proposed a visual examination (leak test) in lieu of the required surface examination. Visual aids suitable to VT-2 requirements will be utilized for the inspection of the subject weld.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject weld received volumetric examination by radiography and surface examination in accordance with the ASME Code Section III, Class 1, requirements during fabrication.

2. Other similar welds in the same piping run received full Code examinations. The integrity of the pressure boundary thus was verified by sampling.

3. The subject piping weld received a system hydrostatic test in accordance with ASME Code Section III requirements, and will also receive a system hydrostatic test each inspection interval in accordance with ASME Code Section XI, Class 1 requirements.

4. Based on the above, the staff has determined that the visual examination (leak test) proposed by the Applicant is an acceptable alternative to the code required surface examination.

B. Relief Request NR-2, Examination Category C-F, 24 Class 2 Welds in the Main Steam, Safety Injection and Residual Heat Removal Systems

Line Number	Weld Number
1MS07BA-28"	C-3, C-4, C-5, C-9, and C-10
1MS07BB-28"	C-3, C-4, C-5, C-6, and C-10
1MS07BC-28"	C-3, C-4, C-5, C-6, and C-7
1MS07BD-28"	C-3, C-4, C-5, C-9, and C-10
1SI06BA-24"	C-18
1SI06BB-24"	C-24
1RH01CA-16"	C-1L
1RH01CB-16"	C-1L

Code Requirements: The subject Class 2 branch connection welds are required to receive preservice surface examinations in accordance with Table IWC-2500-1 (Category C-F) Items C5.31 and C5.32.

Code Relief Request: Relief is requested from performing the required surface examinations on the inaccessible welds.

Reason for Request: The above listed welds are inaccessible for surface examinations, due to the location of saddle plates covering the pressure retaining branch connection welds. The majority of the saddle plates have "weep holes" to detect degradation of the pressure retaining weld. The Applicant has committed to a surface examination (liquid penetrant) and visual examination (leak test) on the saddle plate fillet welds in lieu of the required surface examinations for the pressure retaining welds listed above.

Staff Evaluation: This relief request is acceptable based on the following considerations:

1. The branch pipe circumferential welds listed above have received radiographic volumetric examinations in accordance with the ASME Code Section III, Class 2, requirements during fabrication.

2. The as-built component geometry makes the required Section XI examination impractical. Removal of the welded reinforcement collars to make the area accessible for a preservice surface examination would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety since the radiography performed during construction on the branch pipe circumferential welds verify the preservice structural integrity. Based on the above, the staff has determined that performing a surface and visual examination of the saddle plate fillet weld is an acceptable alternative to the code required surface examination.

C. Relief Request NR-3, Examination Category B-J, 8 Cast Stainless Steel Elbow-to-Cast Stainless Steel Pump or Valve Welds (Fitting-to-Fitting)

Elbow-to-Pump Welds		Elbow-to-Valve Welds	
Line Number	Weld Number	Line Number	Weld Number
1RC02AA-31"	J-8	1RC01AA-29"	J-4
1RC02AB-31"	J-8	1RC01AB-29"	J-4
1RC02AC-31"	J-8	1RC01AC-29"	J-4
1RC02AD-31"	J-8	1RC01AD-29"	J-5

Code Requirement: The subject Class 1 welds are required to receive a preservice surface and volumetric examination in accordance with Table IWB-2500-1, Category B-J, Item B9.11.

Code Relief Request: Relief is requested from performing a preservice ultrasonic examination on these cast austenitic stainless steel component-to-fitting welds.

Reason for Request: The Applicant has determined that the welds joining the SA-351-CF8A elbows to either the SA-351-CF8 pump casings or SA-351-CF8M valve bodies have very poor acoustic properties which do not lend themselves to a meaningful ultrasonic examination. Attempts were made to ultrasonically examine these welds without success. The Applicant sent a representive section of the elbow material with artificial reflectors to a major manufacturer of transducers to determine whether an effective search unit could be developed. The Applicant reported that after six months effort, the manufacturer failed to find any combination of search unit parameters that would penetrate the material more than 1/2 to 3/4 inch in metal path with a useful signal-to-noise ratio.

The Applicant states that cast austenitic stainless steels are extremely tough and resistant to intergranular stress corrosion cracking and leakage long before complete failure is virtually certain. Leakage within the Reactor Coolant System will be checked each refueling outage. In addition, leakage within the containment will be continuously monitored by two remote methods: (1) leakage flow into the weir box of the containment sump (capable of detecting a 2-gpm leak within 1 hour) and (2) a containment radiation monitoring system (capable of detecting a 1-gpm leak within 1 hour). Additional atmospheric monitoring is provided by pressure, temperature, and humidity monitors. All atmospheric monitors are monitored in the main control room.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject welds received both volumetric examination by radiography and surface examinations during fabrication in accordance with ASME Code Section III requirements.

2. The staff has determined that the Applicant has made a reasonable effort to develop, within the state-of-the-art, effective ultrasonic testing equipment required to examine the cast stainless steel welds.

3. The staff has determined that the radiography and surface examination performed during construction provides reasonable assurance of the preservice structural integrity of the subject welds.

4. In addition, the staff will require that the Applicant include in the first inservice inspection (ISI) program a longitudinal wave ultrasonic examination of the elbow welds subject to ISI. In the event that this examination establishes adequate acoustic penetration of the cast material, the staff will require that angle beam ultrasonic examinations be performed on the elbow side using the best available procedures and instrumentation.

5. The staff will continue to evaluate the development of new or improved procedures and will require that these improved procedures be made a part of the inservice examination requirements.

D. Relief Request NR-4, Examination Category B-F, 8 Cast Stainless Steel Elbow-to-Cast Carbon Steel Nozzle Welds (Steam Generator Safe End Welds)

Line Number	Weld Number
1RC01AA-29"	F-2
1RC02AA-31"	F-1
1RC01AB-29"	F-2
1RC02AB-31"	F-1
1RC01AC-29"	F-2
1RC02AC-31"	F-1
1RC01AD-29"	F-2
1RC02AD-31"	F-1

Code Requirement: The Steam Generator nozzle-to-safe end welds are required to receive a preservice surface and volumetric examination in accordance with Table IWB-2500-1, Category B-F, Item B5.30.

Code Relief Request: Relief is requested from performing the required ultrasonic examination in the axial direction from the elbow side of the weld.

Reason for Request: The steam generator nozzles are cast carbon steel and the elbows are cast stainless steel. Ultrasonic examinations were performed circumferentially in both directions for transverse reflectors, and axially from the steam generator nozzle side for parallel reflectors with a one-half V-path scan. The

Applicant examined these welds using a 45° refracted longitudinal wave transducer calibrated on the safe end-to-cast stainless steel mockup. This procedure was developed and qualified on a mockup consisting of safe end material welded to cast stainless steel fitting.

The Applicant has determined that a one-half V-path examination from the SA-351-CF8A elbow side of the weld could not be performed due to the poor acoustic properties of the cast austenitic stainless steel. The Applicant attempted to develop an ultrasonic transducer to perform the angle beam examirations required by the Code. The cast stainless steel material used for the mockup was obtained from the manufacturer of the cast stainless steel elbows at Byron Units 1 and 2 (and also at Braidwood Units 1 and 2). The mockup contained two holes in the cast stainless material. One hole was at the weld fusion line 1/4 T from the outer diameter (O.D.) of the cast stainless material. The other hole was in the corner of the required inspection volume 1/3 T from the inner diameter and approximately 1/2 inch from the fusion line into the cast material.

Straight beam examinations were performed during the preservice inspection to measure the wall thickness of the elbows. In addition, when a test of the attenuation characteristics of

the mockup material and the cast elbows was performed using a 1 MHz straight beam transducer on the cast side of the mockup, 24 to 26 decibels (dB) gain was needed to obtain an 80 percent back wall reflection. With a 2.25 MHz transducer, 32 to 34 dB gain was needed to see the back reflection on the mockup. Performing the same test on a Byron Unit 2 pipe-to-elbow weld, 28 to 32 dB gain was needed for the 1 MHz transducer and 40 dB gain was required for the 2.25 MHz transducer. Thus, it was concluded that the cast elbows installed in the plant are more attenuative than the cast material in the mockup. The elbows installed in Byron Unit 1 can be expected to have the same attenuation properties since the same manufacturer provided elbows for all four units. This conclusion is substantiated by the fact that straight beam examinations performed on the Byron Unit 1 welds for thickness measurements required 30 to 40 dB gain to obtain a back reflection.

The 45° refracted longitudinal wave transducer was chosen to be used on the steam generator primary nozzle-to-elbow welds in an attempt to perform a meaningful examination on the cast material. However, during calibration the hole at the fusion line 1/4 T from the O.D. could not be seen from the cast side. As a result of this and because the elbows have even higher attenuation properties

than the mockup, the Applicant concluded that an axial scan from the cast side of the welds using refracted longitudinal waves would also be meaningless. Therefore, these scans were not performed from the elbow side.

Refracted longitudinal waves were used to examine these welds axially from the nozzle side. During calibration on the mockup both holes in the cast stainless material were seen with 1/2 V-path examining across the weld. Therefore, it is estimated that during the scans from the nozzle side the heat-affected-zone (HAZ) on the cast stainless side was examined up to 1/2 inch beyond the fusion line.

Circumferential ultrasonic scans were also done in both directions and prior to the preservice inspections, ASME Code Section III radiographs were made during fabrication. Leakage within the Reactor Coolant System will be checked each refueling outage. In addition, leakage within the containment will be continuously monitored by two remote methods: (1) leakage flow into the weir box of the containment sump (capable of detecting a 2-gpm leak within 1 hour) and (2) a containment radiation monitoring system (capable of detecting a 1-gpm leak within 1 hour). Additional atmospheric monitoring is provided by pressure, temperature, and humidity monitors. All atmospheric monitors are monitored in the main control room.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject welds received both volumetric (radiography) and surface examinations during fabrication in accordance with ASME Code Section III requirements.

2. The staff has determined that the Applicant made a reasonable effort to develop, within the state-of-the-art, an effective ultrasonic testing equipment required to examine the cast stainless steel welds.

3. The staff has determined that the radiography and surface examinations performed during construction provides reasonable assurance of the preservice structural integrity of the subject welds.

4. The staff will require that the Applicant include in the first inservice inspection program the angle beam examinations from the steam generator safe end using a refracted longitudinal wave transducer to examine the weld metal and heat affected zone on the cast side to the maximum extent practical. In the event that this examination established adequate acoustical penetration of the cast material, the staff will require that angle beam ultrasonic examinations be performed on the elbow side using the best available procedures and instrumentation.

5. The staff will continue to evaluate the development of new or improved procedures and will require that these improved procedures be made a part of the inservice examination requirements.

E. Relief Request NR-5, Examination Category C-F, 5 Component-to Component Welds in the Safety Injection System

Line Number	Weld Number	Configuration
1SI04B-12"	C-14	Tee-to-Reducer
1SI05CA-8"	C-48	Reducer-to-Valve
1SI05CC-8"	C-3	Reducer-to-Elbow
1SI05CC-8"	C-4	Reducer-to-Valve
1SI05CD-8"	C-5	Reducer-to-Valve

Code Requirement: These welds are required to receive a pre-service surface and volumetric examination in accordance with Table IWC-2500-1, Examination Category C-F, Item C5.21.

Code Relief Request: Relief is requested from performing the required ultrasonic examination in the axial direction to detect reflectors parallel to the weld.

Reason for Request: The axial scan could not be performed from either side of the weld due to the geometric configuration of the components. An ultrasonic examination in the circumferential direction for reflectors transverse to the weld was performed. A 0 degree calibrated L-wave examination was also performed as an alternative to the axial scan. These examinations showed no reportable indications. Also, the Section III hydrostatic test was performed without any reportable indications.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject welds received both radiographic and liquid penetrant examinations during fabrication in accordance with ASME Code Section III requirements.

2. The staff has determined that the radiography, liquid penetrant examination, and the hydrostatic test performed during construction and the 0 degree ultrasonic examination performed during PSI provide reasonable assurance of the preservice structural integrity.

F. Relief Request NR-6 and NR-8, Examination Category B-J, 40 Cast Stainless Steel Component-to-Wrought Stainless Steel Pipe or Safe End Welds

Cast Stainless Steel SA-351-CF8A (Elbow)-to-Stainless Steel SA-376 Type 304N (Pipe), Relief Request NR-6

Line Number	Weld Numbers
1RC02AA-31"	J-1, J-2, J-3, J-7
1RC02AB-31"	J-1, J-2, J-3, J-7
1RC02AC-31"	J-1, J-2, J-3, J-7
1RC02AD-31"	J-1, J-2, J-3, J-7
1RC03AA-27.5"	J-10
1RC03AB-27.5"	J-9
1RC03AC-27.5"	J-11
1RC03AD-27.5"	J-9

Cast Stainless Steel SA-351-CF8 (Pump)-to-Stainless Steel SA-376 Type 304N (Pipe), Relief Request NR-6

Line Number	Weld Numbers
1RC03AA-27.5"	J-1
1RC03AB-27.5"	J-1
1RC03AC-27.5"	J-1
1RC03AD-27.5"	J-1

Cast Stainless Steel SA-351-CF8M (Valve)-to-Stainless Steel SA-376 Type 304N (Pipe), Relief Request NR-6

Line Number	Weld Number
1RC01AA-29"	J-3
1RC01AB-29"	J-3
1RC01AC-29"	J-3
1RC01AD-29"	J-4
1RC03AA-27.5"	J-4, J-5
1RC03AB-27.5"	J-4, J-5
1RC03AC-27.5"	J-4, J-5
1RC03AD-27.5"	J-3, J-4

Cast Stainless Steel SA-351-CF8A
(Elbow)-to-Stainless Steel SA-182 GR-F316
(Safe-end), Relief Request NR-8

Line Number	Weld Number
1RC03AA-27.5"	J-11
1RC03AB-27.5"	J-10
1RC03AC-27.5"	J-12
1RC03AD-27.5"	J-10

Code Requirement: These welds are required to receive a pre-service volumetric and surface examination in accordance with Table IWB-2500-1, Examination Category B-J, Items B9.11 and B9.12.

Code Relief Request: Relief is requested from performing the required ultrasonic examination in the axial direction to detect reflectors parallel to the weld from the cast stainless steel component or elbow side of the weld.

Reason for Request: The Applicant has determined that a one-half V-path examination from the component side of the weld cannot be performed due to the poor acoustic properties of the cast stainless

steel. The Applicant attempted to develop an ultrasonic transducer to perform the examinations required by the Code, but the effort was not successful.

Relief Request NR-6: Ultrasonic examinations were performed on these welds with a 45°-shear wave transducer calibrated on a block made of the pipe material per ASME Section XI. Axial scans were made from the pipe side to examine the required inspection volume of the piping material and weld metal for reflectors parallel to the weld.

Straight beam examinations were made on all welds to obtain thickness measurements and to detect any defects parallel to the surface. Since an additional 30 to 40 dB gain was needed to detect the back reflection on the cast stainless steel side, the Applicant concluded that shear wave examinations on this side would be meaningless. Therefore, axial scans from the cast side were not performed.

Additional examinations of these welds included circumferential ultrasonic scans on the weld crown in both directions for transverse reflectors and the ASME Code Section III radiography during fabrication.

Relief Request NR-8: The reactor nozzle safe end-to-cast stainless steel elbow welds originally were to be examined from the inner diameter by the automated reactor vessel examination tool. However, discovering that this could not be done and being aware that 45°-shear wave examinations are meaningless on cast stainless steel, an examination procedure utilizing a 2.25 megahertz (MHz) 45-refracted longitudinal wave transducer was developed. This procedure was developed and qualified on a mockup consisting of safe end material welded to cast stainless steel. The cast stainless steel material was obtained from the manufacturer of the cast stainless steel elbows at Byron Units 1 and 2 (and also at Braidwood Units 1 and 2). The mockup contained two holes in the cast stainless material. One hole was at the weld fusion line 1/4 T from the outer diameter (O.D) of the cast stainless material. The other hole was in the corner of the required inspection volume, 1/3 T from the inner diameter and approximately 1/2 inch from the fusion line into the cast material.

A test of the attenuation characteristics of the mockup material and the cast elbows was performed. Using a 1 MHz straight beam transducer on the cast side of the mockup, 24 to 26 decibels (dB) gain was needed to obtain an 80 percent back wall reflection.

With a 2.25 MHz transducer, 32 to 34 dB gain was needed to see the back reflection on the mockup. Performing the same test on a Byron Unit 2 pipe-to-elbow weld, 28 to 32 dB gain was needed for 1 MHz transducer and 40 dB gain was required for 2.25 MHz transducer. Thus, it was concluded that the cast elbows installed in the plant are more attenuative than the cast material in the mockup. The elbows installed in Byron Unit 1 can be expected to have the same attenuation properties since the same manufacturer provided elbows for all four units. This conclusion is substantiated by the fact that straight beam examinations performed on the Byron Unit 1 welds for thickness measurements required 30 to 40 dB gain to obtain a back reflection.

The 45°-refracted longitudinal wave transducer was chosen to be used on the reactor safe end-to-elbow welds in an attempt to perform a meaningful examination on the cast material. However, during calibration the hole at the fusion line 1/4 T from the O.D. could not be seen from the cast side. As a result of this, and because the elbows have even higher attenuation properties than the mockup, the Applicant concluded that an axial scan from the cast side of the welds using refracted longitudinal waves would also be meaningless. Therefore, these scans were not performed from the elbow side.

Refracted longitudinal waves were used to examine these welds axially from the safe-end side. During calibration on the mockup both holes in the cast stainless material were seen with 1/2 V-path examining across the weld. Therefore, it is estimated that during the scans from the safe-end side the heat-affected-zone (HAZ) on the cast stainless side was examined up to 1/2 inch beyond the fusion line.

Circumferential ultrasonic scans were also done in both directions and prior to the preservice inspections, ASME Code Section III radiographs were made. Leakage within the Reactor Coolant System will be checked each refueling outage. In addition, leakage within the containment will be continuously monitored by two remote methods: (1) leakage flow into the weir box of the containment sump (capable of detecting a 2-gpm leak within 1 hour and (2) a containment radiation monitoring system (capable of detecting 1-gpm leak within 1 hour. Additional atmospheric monitoring is provided by pressure, temperature, and humidity monitors. All atmospheric monitors are monitored in the main control room.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject welds received both volumetric (radiographic) and surface examinations during fabrication in accordance with ASME Code Section III requirements.

2. The staff has determined that the Applicant made a reasonable effort to develop, within the state-of-the-art, an effective ultrasonic testing equipment required to examine the cast stainless steel welds.

3. The staff has determined that the radiography performed during construction provides reasonable assurance of the preservice structural integrity of the subject welds.

4. During the preservice inspection, the welds identified in Relief Request #6 were examined with a 45°-shear wave transducer from the pipe side. Shear waves may not be the most effective method of wave propagation to examine cast stainless steel as indicated in Relief Request #8. The staff will require that the Applicant include in the first inservice inspection program the angle beam examinations from the pipe side and reactor nozzle safe end with refracted longitudinal wave transducer to examine the weld metal and heat affected zone on the cast side to the maximum

extent practical. In the event that this examination establishes adequate acoustical penetration of the cast material, the staff will require that angle beam ultrasonic examinations be performed on the elbow side using the best available procedures and instrumentation.

5. The staff will continue to evaluate the development of new or improved procedures and will require that these improved procedures be made part of the inservice examination requirements.

G. Relief Request NR-7, Examination Categories B-L-2 and B-M-2, 41 Valve Bodies in the Reactor Coolant, Pressurizer, Safety Injection, and Residual Heat Removal Systems

Code Requirements: Examination category B-L-2, B-M-2, Item B12.40 requires a visual (VT-1) examination of the valve body internal surfaces on valves exceeding 4-in. nominal pipe size. Examinations are limited to one valve within each group of valves that are of the same constructional design, e.g., globe, gate or check valve, manufacturing method and that are performing similar functions in the system, e.g., containment isolation and system overpressure protection.

Code Relief Request: Relief is requested from disassembly of an operable valve for the sole purpose of performing a preservice visual examination (VT-1).

Reason for Request: The requirement to disassemble an operable valve for the sole purpose of performing a visual examination (VT-1) of the internal pressure retaining boundary is impractical and not commensurate to the increased safety achieved by this inspection. Class 1 valves are installed in their respective systems and many have completed functional testing. To disassemble these valves would provide a very small potential for increasing plant safety margins with a very disproportionate impact on expenditures of plant manpower and resources.

The Applicant states that the manufacturer's test data will be used in lieu of a preservice visual examination (VT-1). This includes documentation of examinations performed during fabrication and installation of the subject valves. The examinations performed may include volumetric, surface, and visual examinations, as required by ASME Section II, Material Specifications for Ferrous and Nonferrous Materials.

The Applicant also states that the integrity of the pressure retaining boundary of both carbon steel and stainless steel valve bodies has been excellent. Class 1 valve bodies cannot

historically be linked to breaching of the pressure retaining boundary in plant systems. Class 1 valves are subjected to numerous types of nondestructive testing and a rigorous quality assurance program during all stages of fabrication, storage, and installation. These valves have been found acceptable by the manufacturer, the ASME Authorized Nuclear Inspector and Commonwealth Edison's Quality Assurance.

Staff Evaluation: The staff concludes that disassembly of these valves at this time solely to perform the required Section XI preservice visual examination of the internal surface is impractical. The staff has determined that the nondestructive examinations and functional tests performed to date significantly exceed the requirements of the Section XI visual examination and, therefore, these examinations and tests are an acceptable alternative to the Code requirement.

H. Relief Request NR-9, Examination Category B-A, 3 Reactor Pressure Vessel Welds RPVC-WR29, RPVC-WR16 and RPVC-WR7

Code Requirement: The subject Class 1 reactor pressure vessel welds are required to receive a preservice volumetric examination of 100% of the welds in accordance with Table IWB-2500-1, Category B-A, Items B1.11, B1.21, and B1.30.

Code Relief Request: Relief is requested from performing preservice volumetric examination of the inaccessible portions of the subject reactor pressure vessel welds.

Reason for Request: Configuration, permanent attachments and/or structural interferences prohibit 100% ultrasonic examination coverage of the required volume.

1. The lower shell course-to-Dutchman weld RPVC-WR29 has six (6) core barrel-locating lugs welded to the interior surface of the reactor vessel approximately 4.0 in. above the weld. These lugs restricted the automated inspection tool from inspecting the required volume from the shell course side in the areas of the lugs. All of the weld metal was examined from the shell course side where access was available between the lugs. Examinations from the Dutchman side for parallel reflectors covered 100% of the weld metal and heat-affected zone (HAZ). Likewise, 84% of the weld metal and HAZ was examined for transverse reflectors in two opposing directions.

2. The lower disk-to-Dutchman weld RPVC-WR16 has 58 instrument tubes that penetrate the lower disk and physically obstruct the search unit and/or search unit position device. The weld and HAZ received essentially 100% coverage for parallel reflectors

from the Dutchman side and for transverse reflectors in two opposing directions. Full coverage for parallel reflectors from the disk side was limited to about 40% of the weld length; partial coverage was achieved on the remainder of the weld.

3. The nozzle shell course-to-flange weld RPVC-WR7 is located just below the tapered portion of the flange which prevents 100% examination of the required adjacent base metal. All of the required volume was inspected for parallel reflectors, manually, from the vessel flange. All of the weld metal and approximately 80% of the adjacent base metal was inspected for transverse reflectors.

4. Drawings and tables defining the specific regions that could not be examined are discussed in the Applicant's letter dated December 14, 1983.

Staff Evaluation: This relief request is acceptable based on the following considerations:

1. All of the reactor pressure vessel welds passed volumetric examinations during fabrication in accordance with the rules of ASME Code Section III for Class 1 components.

2. All of the identified welds will be subject to a system pressure test in accordance with Section XI Class 1 requirements.

3. Accessible portions of the above-listed welds received a preservice volumetric examination in accordance with the ASME Code Section XI.

4. Therefore, the limited Section XI ultrasonic examination, the radiography performed during fabrication and the hydrostatic test provide an acceptable level of preservice structural integrity.

I. Relief Request NR-10, Examination Category B-D, 4 Nozzle-to-Reactor Pressure Vessel Welds, RPVN-A, D, E, and H

Code Requirement: The subject Class 1 reactor pressure vessel nozzle welds are required to receive preservice volumetric examination of 100% of the weld in accordance with Table IWB-2500-1, Category B-D, Item B3.90.

Code Relief Request: Relief is requested from performing preservice volumetric examination of the inaccessible portions of these reactor pressure vessel nozzle welds.

Reason for Request: Nozzle-to-vessel welds on outlet nozzles A, D, E, and H are obstructed by the integral extension from receiving complete ultrasonic examination. The required volume was inspected for parallel reflectors from the inside diameter surface of the nozzle; however, approximately 15% of the required base metal was not inspected for transverse reflectors from the vessel side.

Staff Evaluation: This relief request is acceptable based on the following considerations:

1. All of the reactor pressure vessel nozzle welds passed volumetric examinations during fabrication in accordance with the rules of ASME Code Section III for Class 1 components.

2. All of the identified welds will be subject to a system pressure test in accordance with Section XI Class 1 requirements.

3. Accessible portions of the above-listed welds received a preservice volumetric examination in accordance with ASME Code Section XI.

4. Therefore, the limited Section XI ultrasonic examination, the radiography performed during fabrication and the hydrostatic test provide an acceptable level of preservice structural integrity.

J. Relief Request NR-11, Examination Category C-A, Weld LHXC-01
Chemical and Volume Control, Letdown Heat Exchanger

Code Requirement: This weld is required to receive a volumetric preservice examination in accordance with Table IWC-2500-1, Category C-A, Item C1.10.

Code Relief Request: Relief is requested from performing the Code required ultrasonic circumferential scan for reflectors transverse to the weld seam.

Reason for Request: The circumferential scan could not be performed due to flange bolting extending over the weld crown. An ASME Code Section XI ultrasonic examination for reflectors parallel to the weld seam and an alternative surface examination has been completed.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject weld received radiographic examination and a hydrostatic test during fabrication in accordance with ASME Code Section III requirements.

2. The staff has reviewed the design configuration of the flange, the wall thickness of the shell and the condition of the weld crown and has determined that disassembly of the bolting solely for the purpose of PSI examination would result in hardships or unusual difficulties without a compensating increase in the level of quality and safety. The staff has also determined that the radiography, surface examination and limited ultrasonic examination established an acceptable level of preservice structural integrity.

3. However, in the event the bolted connection is dissassembled for repair or maintenance during service, the staff will require that the preservice examination be performed.

K. Relief Request NR-12, Examination Category C-A, Weld ELHXC-03, Chemical and Volume Control, Excess Letdown Heat Exchanger

Code Requirement: This weld is required to receive a preservice volumetric examination in accordance with Table IWC-2500-1, Category C-A, Item C1.20.

Code Relief Request: Relief is requested from performing ultrasonic examination on the Code required volume.

Reason for Request: Ultrasonic examination of weld ELHXC-03 was limited for approximately 70% of the weld length due to four branch connections welded to the vessel. A liquid penetrant test was performed as an alternative test.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. An alternative surface examination was performed in addition to the limited ultrasonic examination.

2. The ASME Section III radiographic and hydrostatic test along with the limited Section XI ultrasonic examination and alternative surface examination demonstrate an acceptable level of preservice structural integrity.

L. Relief Request NR-13, Examination Category B-D, Inside Radius Section on Pressurizer and Steam Generator Vessel Nozzles (14 Items)

Component Number	Weld Numbers
1RC01BA	Primary Nozzles (2)
1RC01BB	Primary Nozzles (2)

Component Number	Weld Numbers
1RC01BC	Primary Nozzles (2)
1RC01BD	Primary Nozzles (2)
1RY01S	PN-1, PN-2, PN-3, PN-4, PN-5, PN-6

Code Requirement: These nozzle inside radii are required to receive a preservice volumetric examination in accordance with Table IWB-2500-1, Category B-D, Items B3.120 and B3.140.

Code Relief Request: Relief is requested from performing the ultrasonic examination on the Code required volume of the nozzle inner radii.

Reason for Request: These nozzles all contain inherent geometric constraints and clad inner surfaces which limit the ability to perform meaningful volumetric examinations. In an attempt to develop a technique to locate flaws in the nozzle inner radii area, a mock-up was used with little success. The only notch which was detectable was the deepest one which penetrated the cladding and extended to a depth of approximately 5/16" into the carbon steel. The steam generator primary side nozzles received an alternative liquid penetrant surface examination.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. All pressure retaining components were hydrostatically tested to the requirements of ASME Section III prior to plant startup.

2. The staff review of the design configuration of the nozzle inner radius has concluded that the Code required volumetric examination is impractical. The staff has determined that performing the ASME Section III hydrostatic test along with the surface examination is an acceptable alternative.

3. The staff will continue to evaluate the development of new or improved procedures and will require that these procedures be made part of the ISI examination requirements.

M. Relief Request NR-14, Examination Category C-B, Steam Generator Vessel (Secondary Side) Nozzles (8 Items) and Residual Heat Exchanger Nozzles (2 Items)

Component Number	Nozzle Number
1RC01BA	SGN-2,3
1RC01BB	SGN-2,3

Component Number	Nozzle Number
1RC01BC	SGN-2,3
1RC01BD	SGN-2,3
1RH02AB	RHXN-1,2

Code Requirement: Table IWC-2500-1, of Section XI requires surface and volumetric examination of the regions described in Figure IWC-2500-4 for nozzles in vessels over 1/2 in. nominal thickness. Figure IWC-2500-4 requires volumetric examination of the inner radii on nozzles over 12 in. nominal pipe size.

Code Relief Request: Relief is requested from performing the surface and volumetric examination on the Code required volume of the nozzle inner radii.

Reason for Request: The nozzles listed above contain inherent geometric constraints which limit the ability to perform meaningful ultrasonic examination. The main steam nozzles (SGN-3's) have an internal multiple venturi type flow restrictor. This design does not have a nozzle inner radii as described in

Figure IWC-2500-4. This nozzle has seven individual inner radii, corresponding to each venturi, none of which could be examined by ultrasonic examination. The main feedwater nozzles (SGN-2's) also have an internal multiple venturi type flow restrictor but have a thermal sleeve in addition. This design could not be examined due to the geometry of the nozzles internal design.

The Residual Heat Removal Heat Exchanger nozzles are 14 inch diameter and approximately 3/8 inch nominal wall thickness. The Residual Heat Removal Heat Exchanger is approximately 7/8 inch nominal wall thickness. In an attempt to develop a technique to locate flaws in the nozzle inner radii area, a mockup was used with little success. The only notch which was detectable was the deepest one which penetrated the cladding and extended to a depth of approximately 5/16 in. into the carbon steel. Although the nozzles listed above are not internally clad, it was determined by the Applicant that this mockup was representative of the required inspection.

Ultrasonic examination of the above listed nozzle inner radii is not practicable and the inner radii are not accessible to direct contact for surface examination or even remote visual examination.

However, these nozzles have been examined at the point of attachment to the vessel by radiography per ASME Section III, and by ultrasonic examination per ASME Section XI. In addition, a system hydrostatic test, at 125% of the design pressure, has been performed in accordance with ASME Section III.

The above listed main steam and main feedwater nozzles are designed with multiple venturi type flow restrictors to limit flow during a main steam line or main feedwater line break. This design thus enhances the plant's inherent level of safety but does not allow meaningful ultrasonic examination of the nozzles inner radii. However, the increased safety margin afforded by these nozzles makes them a desirable part of plant design.

Staff Evaluation: This relief request is acceptable for PSI based on the following considerations:

1. The subject weld area received radiographic examination and a hydrostatic test during fabrication in accordance with ASME Code Section III requirements. An ultrasonic examination has been performed on the nozzle to vessel welds per ASME Code Section XI requirements.

2. The staff review of the design configuration of the nozzle inner radius has concluded that the Code required volumetric examination is impractical. The staff has determined that the ASME Section III examinations demonstrate an acceptable level of preservice structural integrity.

N. Relief Request NR-15, Examination Category C-C and C-E, 8 Integrally Welded Attachments to Pumps in Containment Spray, Chemical and Volume Control, and Residual Heat Removal Systems

Component Number	Weld Numbers
1CS01PA	CSPE-01, CSPE-02, and CSPE-03
1CY01PA	CVPE-01, CVPE-04
1RH01PA	RHPE-01, RHPE-02, and RHPE-03

Code Requirement: Table IWC-2500-1, Examination Category C-C and C-E, Item C3.70 requires surface examination for integrally welded attachments to pumps.

Code Relief Request: Relief is requested from performing a 100% surface examination of the required areas of each support attachment.

Reason for Request: The required PSI examination was performed on three sides of each attachment, but the fourth side could not be examined due to installed structural support members. The above listed welds connect the support lugs to the pump casings. These integrally welded attachments were examined by the manufacturers using a surface examination technique. In addition, the preservice examination was performed on three sides of each attachment.

The Applicant has proposed a visual (VT-1) examination for the inaccessible portions of these welds.

Staff Evaluation: The staff has determined that the manufacturer's surface examination, the partial preservice examination and the proposed visual examination are an acceptable alternative to the Code requirements.

O. Relief Request Note 5, Examination Category B-L-1, B-M-1, Visual Examination of Reactor Coolant Pump Internal Surfaces

Pumps

1RC01PA

1RC01PB

1RC01PC

1RC01PD

Code Requirement: Table 1WB-2500-1, Category B-L-1, B-M-1, Item B12.10 requires volumetric and surface examination on pump casing welds and Item B12.20 requires visual (VT-1) examination of the pump casing internal surfaces.

Code Relief Request: Relief is requested from performing the Code required visual (VT-1) examination of the pump casing internal surfaces.

Reason for Request: The above-listed pumps are of the integrally cast type and therefore have no pump casing welds. All internal surfaces received liquid penetrant tests performed by the manufacturer. This exceeds the Section XI requirements for visual examination.

Staff Evaluation: The staff has determined that the manufacturer's liquid penetrant examination of all internal surfaces of these pumps exceeds the Section XI requirements for visual examination and, therefore, is an acceptable alternative to the Code requirement.

P. Relief Request Note 11, Examination Categories C-A and C-F, Welds Chemical and Volume Control, Excess Letdown Heat Exchanger; Safety Injection Piping

Component Number	Weld Number
1CV01AA	ELHXC-02
ISI05CB-8"	C-17

Code Requirement: Table IWC-2500-1, Category C-A, Item C1.10, requires volumetric examination of vessel shell circumferential welds. Category C-F, Item C5.21 requires surface and volumetric examination for circumferential welds in piping over 1/2-in. nominal wall thickness.

Code Relief Request: Relief is requested from performing volumetric examination on 100% of the required examination volume due to geometric interferences.

Reason for Request: Weld ELHXC-02 was examined axially for reflectors parallel to the weld seam for approximately 97% of the weld length. There is a 3/4-in. drain connection on the bottom of the shell which prevented complete ultrasonic examination. Weld C-17 was examined axially for reflectors parallel to the weld seam for approximately 90% of the weld length.

There is a pipe which runs perpendicular to 1SI05CB-8" at weld C-17 which obstructed the examination. In addition, weld C-17 received the surface examination required by Item C5.21.

Staff Evaluation: This relief is acceptable based on the following considerations:

1. Welds ELHXC-02 and C-17 received radiographic examinations during fabrication in accordance with ASME Code Section III requirements.

2. Both welds received 100% circumferential ultrasonic examination for reflectors transverse to the weld seam. The axial examination for parallel reflectors exceeded 90% of the required volume.

3. A large portion of the preservice examination required by the ASME Code was performed. Failure to perform a 100% preservice examination of the welds identified below will not significantly affect the assurance of the initial structural integrity.

IV. CONCLUSIONS

Based on the foregoing, pursuant to 10 CFR 50.55a(a)(2), certain Section XI required preservice examinations are impractical, and compliance with the requirements would result in hardships or unusual difficulties without a compensating increase in the level of quality and safety.

The staff technical evaluation has not identified any practical method by which the existing Byron Station Unit 1 can meet all the specific preservice inspection requirements of Section XI of the ASME Code. Requiring compliance with all the exact Section XI required inspections would delay the startup of the plant in order to redesign a significant number of plant systems, obtain sufficient replacement components, install the new components, and repeat the preservice examination of these components. Examples of components that would require redesign to meet the specific preservice examination provisions are the reactor vessel and a significant number of the piping and component support systems. Even after the redesign effort, complete compliance with the preservice examination requirements probably could not be achieved. However, the as-built structural integrity of the existing primary pressure boundary has already been established by the construction code fabrication examinations.

Based on the staff review and evaluation, 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(a)(2), relief is allowed from these requirements which are impractical to implement and would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety.