11/6/02 10AM (EST)

Conference Call to Discuss Quad Cities ISI Program re: CRD Welds

Participants:
NRR: Chan, Wichman, Raghavan, Lyon
Exelon: Simpson, Gesior, Deboo, Hien Do, Wojick, Nicely, Beck, Chrissotimos
Region III: Ring, Jones, Kurth

Status: Unit 1 began an RFO yesterday. Unit 2 completed its last RFO on 3/5/02. The 3rd ISI interval for Units 1 and 2 ends in February and March 2003, respectively. The 1989 Edition of the ASME Code is the applicable Code for the current ISI interval.

Before the call, the licensee provided design information that they felt supported their use of Section XI, IWB-1220, to exempt the CRD housing welds from volumetric or surface examination (see attached pages). The welds have never been in the licensee's ISI program.

During the call, the staff stated that it had reviewed the information provided and concluded that Section XI, Table IWB-2500-1, Category B-O, Item B14.10 (Reactor Vessel - Welds in CRD Housing), applies to the Quad Cities CRD housing welds. Therefore, the welds should be included in the ISI program.

The licensee stated that they agreed that Table IWB-2500-1 applied to the CRD welds, but their interpretation was that the exemption of IWB-1220 also applied. The staff stated that IWB-1220 does not apply, because the CRD housing is considered part of the reactor vessel. The staff has discussed the issue with members of the applicable Code committee. Also, the staff is aware that PWRs and at least some BWRs (e.g., Fermi) include the welds in their ISI programs. The licensee may, of course, pursue a Code interpretation.

The licensee stated that they understood the staff's position and would evaluate their options and let us know as soon as they decide a course of action.

QUAD CITIES CRD HOUSING WELDS
CODE OF RECORD AND DESIGN SPECIFICATIONS

ADDITIONAL INFORMATION 11/01/02

Purpose:

To provide design information to support use of ASME Section XI 1989 Edition, Subsection IWB-1220 "Components Exempt from Examination" to exempt Category B-O CRD Housing welds from volumetric or surface examination.

Basis:

The design specifications for both: (1) the Quad Cities reactor vessel (i.e., General Electric Specification 21A1113, Revision 1, dated September 20, 1966), and (2) the control rod drive housing (i.e., General Electric Control Rod Drive Housing Design Specification 919D260, dated December 9, 1969) were evaluated to determine the basis for exempting the CRD housing welds from volumetric or surface examination. Specific details from the two design specifications are discussed below.

Reactor Vessel Design Specification

The design code of record for the Quad Cities Vessels is ASME Section III 1965 including Summer 1965 addendum as described in UFSAR section 5.3 Reactor Vessels.

The applicable Design Specification for the vessel is General Electric Specification 21A1113, revision 1, dated September 20, 1966, page 3 of 34 section 5.1.6 presents information on control rod drive penetration nozzles on drawing 886D485. Drawing 886D485 depicts the control rod drive penetration nozzle (stub tube) installation as being an integral part of the vessel. The vessel design specification does not include a glossary or definition section.

CRD Housing Design Specification

General Electric Control Rod Drive Housing Design Specification 919D260, dated December 9, 1969 defines the functions, design requirements and operating conditions to provide a complete basis for design, construction and inspection in accordance with the ASME BPV Code Section III. Section 5.2 page 5 of this specification provides the construction and inspection requirements of the control rod drive housings by referring to drawing 919D260.

Note[1] from drawing 919D260, for the control rod drive housing welds (this corresponds to the attached simplified drawing welds CRDH 3 and 4) require inspection in accordance with ASME BPV Section III 1965 Edition, Paragraph N-462.2(a) (i.e., Category B welds).

ASME Code, Section III, 1965 Edition

Section N-460, "Design of Welded Construction," subsection N-461, "Welded Joint Category," paragraph (b) defines Category B as "Circumferential welded joints within the main shell, communicating chambers,[1] nozzles, or transitions in diameter including joints between the transition and a cylinder at either the large or small end; circumferential welded joints connecting formed heads other than hemispherical to main shells, to transitions in diameter, to nozzles, or to communicating chambers.[1]"

Footnote[1]: Communicating chambers are defined as appurtenances to the vessel which intersect the shell or heads of a vessel and form an integral part of the pressure containing enclosure, e.g., sumps.

Conclusion:

The control rod drive housing welds as described in the design specifications for inspection of welds are considered communicating chambers and are appurtenances to the vessel. Therefore, the welds are not part of the reactor vessel, and ASME Section XI 1989 Edition, Subsection IWB 1220 "Components Exempt from Examination" Category B-O Housing welds may be invoked.

Attachments:

1. UFSAR Section 5.3.1 "Reactor Vessel Materials," page 5.3-1
2. RPV design specification 211A1113, Revision 1, dated September 20, 1966 (Table of Contents and page 3 of 34)
3. CRD housing specification 919D260, dated December 9, 1969 (page 5)
4. CRD Simplified Drawing entitled "CRD Penetration and CRD Housing"
5. ASME Code, Section III, 1965 Edition (cover sheet and pages 46-47)
6. Drawing 886D485 "Reactor Vessel" (**NOTE**: PDF is partial drawing)
7. Drawing 919D260 "Control Rod Drive Housing" (**NOTE**: PDF is partial drawing)

5.3 REACTOR VESSELS

This section presents pertinent data on the Quad Cities reactor pressure vessels (RPVs). Unless otherwise noted, the information presented applies to both Unit 1 and Unit 2 RPVs.

5.3.1 Reactor Vessel Materials

5.3-1 The RPV materials and fabrication methods conform to the ASME Boiler and Pressure Vessel Code (ASME Code) 1965 Edition and the Summer 1965 Addendum as referenced in Section3.2.8.4. Inservice inspection (ISI) techniques conform to ASME Section XI with approved exceptions as noted in Section 5.2.4.

5.3.1.1 Material Specifications

Reactor vessel material specifications are discussed in Section 5.2.3.1. Additional information on RPV materials is contained in Section 5.3.3.2.

5.3.1.2 Special Processes Used for Manufacturing and Fabrication

5.3-2 The Quad Cities Unit 1 RPV was fabricated entirely in the United States by Babcock & Wilcox (B&W). The Unit 2 RPV was fabricated by several different vendors, including one in Holland, as noted in the following paragraphs.

5.3-2a Fabrication work on the Unit 2 bottom head assembly and lower shell course was performed by the Rotterdam Dockyard Company (RDM) in Rotterdam, Holland. These two pieces were seam-welded together and returned to the United States as a fully completed subassembly including control rod drive (CRD) stub tubes, shroud support skirt, and vessel support skirt.

The CRD stub tube material is Inconel SB167, Code Case 1336, Paragraph 1. The stub tubes were joined to the vessel bottom by a weld on the Inconel-clad surface which makes a full penetration of the stub tube wall as specified in Figure N-462.4(e) of the ASME Code, 1965, Section III. The toe of this weld was removed by the finished counterbore.

All work on Unit 2 was performed and documented in accordance with ASME Section III. The procedures required by the attachment to the National Board of Boiler and Pressure Vessel Inspectors' letter of July 24, 1968, were implemented by providing the Illinois State Board of Boiler Rules with the required documentation. This documentation included copies of all welder qualification test reports and performance test reports for each welder.

All other components of the Unit 2 core internals and primary system were of domestic manufacture. For example, B&W completed the circumferential seam weld which attached the upper shell course to the RPV flange.

GENERAL ELECTRIC

ATOMIC POWER EQUIPMENT DEPT.
P.O. BOX 254
175 CURTNER AVENUE
SAN JOSE, CALIFORNIA

PROJECT: QUAD-CITIES

SPECIFICATION AND REV. NO. 21A1113, Revision 1 — 9-20-66 DATE

SPECIFICATION TITLE REACTOR PRESSURE VESSEL

TABLE OF CONTENTS

ISSUED BY

PRODUCTION AND CONTROL

TITLE
REACTOR PRESSURE VESSEL

5.0 DESIGN REQUIREMENTS

5.1 Operating Conditions

5.1.1 Internal Pressure

Design Pressure:	1250 psig at bottom of the reactor vessel
Normal Operating Pressure:	1000 psig at top of reactor vessel

5.1.2 Temperature

Design Temperature:	575°F
Normal Operating Temp.:	546°F

5.1.3 Reactor Core and Internal Weight

The weight of the reactor core and internal structure, centers of gravity and distribution of loadings are shown on Drawing 886D485.

5.1.4 Water Weight

The weight of water contained in the vessel for various conditions of operation are presented on Drawing 886D485.

5.1.5 Pipe Reactions

The Buyer shall provide the Seller with the pipe reactions which the connecting piping will apply to all nozzles with a nominal size larger than the reactor vessel wall thickness and those nozzles which in addition are subjected to significant thermal cycling. The reactions will be limited by the Buyer such that the combined stresses due to pipe reactions and design pressure in the vessel shell at the nozzle attachment will not exceed the design stress allowed by the ASME Code, Section III. These pipe reactions shall be used in the detailed stress analysis required by the Code and performed by the Seller. This analysis shall include the thin section of the nozzle in the vicinity of the weld preparation for connecting piping, any bi-metal weld and shall take into account the nozzle cladding.

5.1.6 Control Rod Drive Weight and Reaction

The momentary reactions which are suddenly applied to each control Rod drive housing in the vessel bottom head are presented on Drawing 886D485.

5.2 The construction and inspection of the drive housings must be in accordance with all of the requirements given by the Drawing 919N260 C1, C2, C3 or C4 and associated drawings, specifications, processes, and procedures.

6.0 DESCRIPTION OF APPLICATION

The control rod drive housings are installed through vertical penetrations in the lower head of the reactor pressure vessel and are welded to stub tubes inside the vessel. The design, fabrication and inspection requirements for the attachment are covered by the reactor vessel design specification for each plant. The portion of each housing which is above the weld to the stub tube is not covered by the ASME Boiler and Pressure Vessel Code, since failure could not release primary reactor water to the atmosphere surrounding the housing. The portion of the housing which is below the weld to the stub tube contains the reactor pressure and supports the weight of the control rod drive and the control rod.

The control rod drives which meet the requirements of Specification 257HA331 are bolted to the flange located at the lower end of each housing. The drive is sealed to the housing by metallic "O" rings per Drawing 159A2816 P1 and P2 for the two ports and primary seal respectively. Two dowel pin holes are located in the housing flange face to properly orient the control rod drive installation.

A thermal sleeve per Drawing 117C1435 G1 is installed between the inside diameter of each drive housing and outside diameter of each control rod drive. A keyway must be provided at the inside diameter of the drive housing flange to allow for the installation of the key which permits axial movement due to thermal expansion differences, between the housing and thermal sleeve, but prevents rotation of the thermal sleeve which could unlock it from the control rod guide tube base. The purpose of the thermal sleeve is to reduce the temperature gradient and resulting thermal stresses across the housing wall, particularly at the weld of the housing to the stub tube.

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ASME BOILER AND PRESSURE VESSEL CODE

1965

Section III

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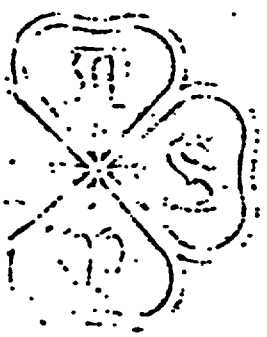

NUCLEAR VESSELS

ASME BOILER AND PRESSURE VESSEL CODE SECTION III

Rules for Construction of

NUCLEAR VESSELS

1965 Edition

REPORT OF SUBCOMMITTEE OF BOILER AND PRESSURE VESSEL COMMITTEE

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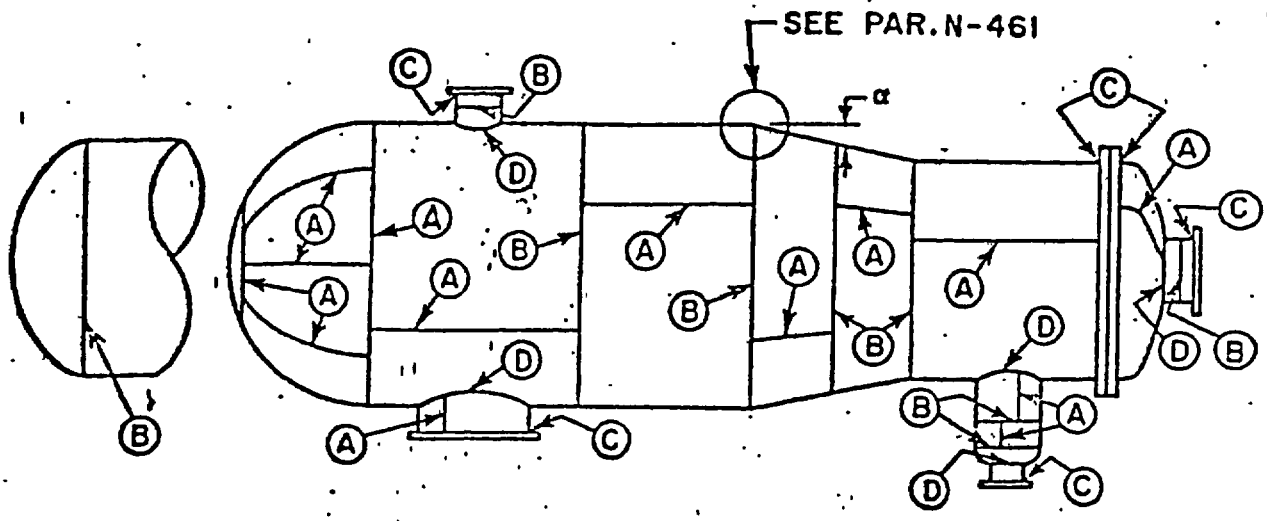


FIG. N-461 ILLUSTRATION OF WELDED JOINT LOCATIONS TYPICAL OF CATEGORIES A, B, C, AND D

N-460 DESIGN OF WELDED CONSTRUCTION

N-461 Welded Joint Category — The term "Category" as used herein defines the location of a joint in a vessel, but not the type of joint. The categories established by this paragraph are for use elsewhere in this Section of the Code in specifying special requirements regarding joint type and degree of inspection for certain welded pressure-joints. Since these special requirements, which are based on service, material, and thickness, do not apply to every welded joint, only those joints to which special requirements apply are included in the categories. The special requirements will apply to joints of a given category only when specifically so stated. The joints included in each category are designated as joints of categories A, B, C, and D. Fig. N-461 illustrates typical joint locations included in each category.

(a) Category A — Longitudinal welded joints within the main shell, communicating chambers,[1] transitions in diameter, or nozzles; any welded joint within a sphere, within a formed or flat head, or within the side plates[2] of a flat sided vessel; circumferential welded joints connecting hemispherical heads to main shells, to transitions in diameters, to nozzles, or to communicating chambers.[1]

(b) Category B — Circumferential welded joints within the main shell, communicating chambers,[1] nozzles, or transitions in diameter, including joints between the transition and a cylinder at either the large or small end; circumferential welded joints connecting formed heads other than hemispherical to main shells, to transitions in diameter, to nozzles, or to communicating chambers.[1]

(c) Category C — Welded joints connecting flanges, Van Stone laps, tube sheets, or flat heads to main shell, to formed heads, to transitions in diameter, to nozzles, or to communicating chambers[1]; any welded joint connecting one side plate to another side plate of a flat sided vessel.

(d) Category D — Welded joints connecting communicating chambers[1] or nozzles to main shells, to spheres, to transitions in diameter, to heads, or to flat sided vessels, and those joints connecting nozzles to communicating chambers[1] (for nozzles at the small end of a transition in diameter, see Category B).

N-462 Permissible Types of Welded Joints

N-462.1 Joints of Category A — All welded joints of Category A as defined in N-461 shall be fully radiographed in accordance with N-624 and shall be full penetration welds between plates or other elements that lie approximately in the same plane (double-welded butt joints). Joints made with consumable inserts or gas backup or with metal backing strips that are later removed are acceptable as full-penetration-welded provided the back face of such joints meets the requirements of N-526.

N-462.2 Joints of Category B — All welded joints of Category B as defined in N-461 shall be in accordance with the following and shall be fully radiographed in accordance with N-624:

(a) Full penetration welded joints between plates or other elements that lie approximately in the same plane (double-welded butt joints). Joints made with consumable inserts or gas backup or with metal backing strips which are later removed

[1] Communicating chambers are defined as appurtenances to the vessel which intersect the shell or heads of a vessel and form an integral part of the pressure containing enclosure, e.g., sumps.

[2] Side plates of a flat sided vessel are defined as any of the flat plates forming an integral part of the pressure containing enclosure.

are acceptable as full-penetration-welded provided the back face of such joints meets the requirements of N-526.

(b) Full penetration welded joints in which the edges to be joined are prepared with opposing lips to form an integral backing strip, and full penetration welded joints with metal backing strips which are not later removed are acceptable as full penetration-welded, except that the suitability for cyclic operation must be analyzed by the method of N-415 using a fatigue-strength reduction factor of not less than 2. When used, backing strips shall be continuous and any splices shall be butt-welded.

(c) Full penetration-welded joints between plates or other elements that have an offset angle not greater than 30 deg, provided such welded joints are rounded on both sides to a radius of not less than three times the base metal thickness, and provided the joint can be radiographed to the standards of N-624.

N-462.3 Joints of Category C – All welded joints of Category C as defined in N-461 shall be in accordance with one of the following:

(a) Full penetration welds as defined in N-462.1 that are fully radiographed in accordance with N-624.

(b) Full penetration corner welds similar to Fig. N-462.3, Sketches (1), (2) and (3) that are radiographically examined in accordance with N-624. The radiography of these details requires special techniques[1], which may require multiple exposures, and these techniques shall be acceptable to the Inspector.

(c) Full penetration corner weld similar to Fig. N-462.3, Sketches (4), (5), and (6) that are radiographically examined in accordance with N-624. The radiography of these details requires special techniques[1], which may require multiple exposures, and these techniques shall be acceptable to the Inspector. In addition, the fusion zone and the parent metal beneath the attachment surface shall be ultrasonically inspected after welding in accordance with N-625 to verify freedom from lack of fusion and laminar defects.

N-462.4 Joints of Category D – All welded joints of Category D as defined in N-461 shall be in accordance with one of the following:

(a) Butt Welded Attachments – Nozzles may be attached by full penetration butt welds through the wall of either the vessel or the nozzle as shown in Fig. N-462.4*(a)*. The butt weld shall be so located that it can be radiographically examined in accordance with N-624.

(b) Full Penetration Corner Welded Attachments – Nozzles may be attached by full penetration welds through the wall of either the vessel or the nozzle as shown in Fig. N-462.4*(b)*.

(1) Nozzles attached in accordance with Fig. N-462.4*(b)*, Sketch (6) shall be examined by radiography in accordance with N-624. The radiography of this detail requires special techniques[1], which may require multiple exposures, and these techniques shall be acceptable to the Inspector.

(2) Nozzles attached in accordance with Fig. N-462.4*(b)*, Sketches (1), (2), (3), (4), (5) and (7) shall be examined by radiography in accordance with N-624. The radiography of these details require special techniques[1], which may require multiple exposures, and these techniques shall be acceptable to the Inspector. In addition, the weld, the fusion zone, and the parent metal beneath the attachment surface shall be ultrasonically inspected after welding in accordance with N-625 to assure freedom from lack of fusion and laminar defects.

(c) Attachment of Connections Using Deposited Weld Metal as Compensation.

(1) Built-up weld deposits may be applied to either the vessel or the nozzle wall provided:

(a) the deposited weld is radiographically examined before assembly in accordance with N-624,

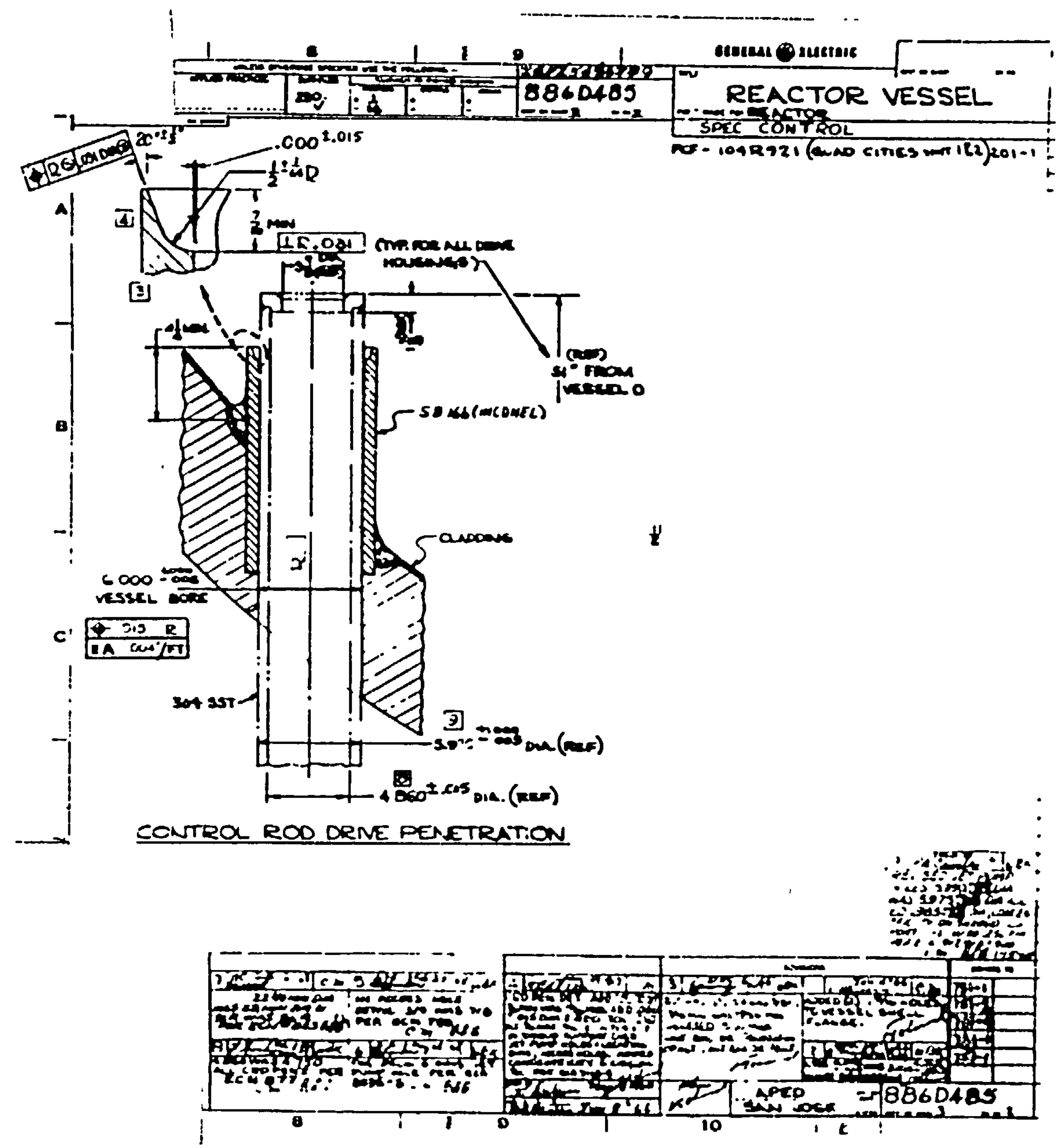
(b) the deposit satisfies the impact requirements of Table N-332, and

(c) the coefficients of thermal expansion of the base metal, the weld metal, and the connection do not differ by more than 15 per cent of the lowest coefficient involved.

Nozzles may then be attached by full penetration welds through the wall of either the vessel or the nozzle as shown in Fig. N-462.4*(c)*. This weld attachment shall be so located that it can be examined by radiography in accordance with N-624. Prior to fabricating the vessel, the manufacturer shall demonstrate to the satisfaction of the Inspector the adequacy of the radiographic technique[1] which is to be used in fabrication. Whenever a weld is attached to a plate surface as in Fig. N-462.4*(c)*, the weld, the fusion zone, and the parent metal beneath the attachment surface shall be ultrasonically examined after Step 1 in Fig. N-462.4*(c)* in accordance with N-625 to insure freedom from lack of fusion and laminar defects.

(2) The inner corners of finished openings in which the nozzle necks do not extend beyond the inner surface of the part penetrated, shall be rounded to a radius of ¼ the required thickness of

[1] See ASTM Specification E94-62T, Recommended Practice for Radiographic Testing.



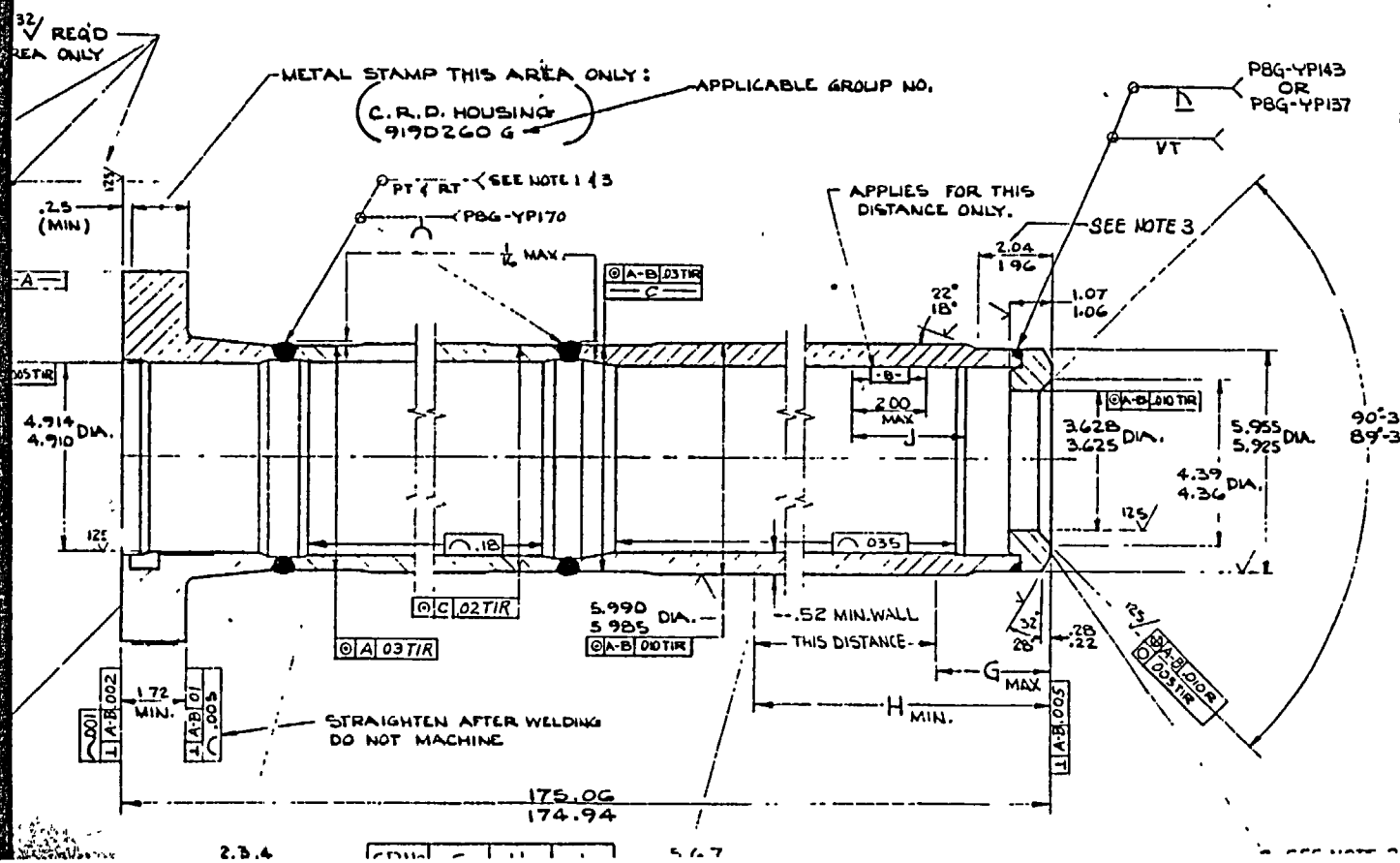
CONTROL ROD DRIVE PENETRATION

GENERAL ELECTRIC

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING —

APPLIED PRACTICES	SURFACES				SIZE	DRAWING NO.
145A5481	250	—	—	—		919D260

TITLE ASSEMBLY
CONTROL ROD DRIVE HOUSING
FIRST MADE FOR GEN. USE (REACTOR)
P.L. ISSUED



NOTES:

1. P8G-YP170 WELDING FABRICATION & INSPECTION SHALL BE IN ACCORDANCE WITH THE PROVISIONS OF THE A.S.M.E. BOILER CODE SECTION III, PAR. N-462.2(a)

2. CODE STAMPING SHALL BE IN ACCORDANCE WITH ARTICLE 8 OF SECTION III

3. LIQUID PENETRANT TEST ALL MACHINED SURFACES AND WELDS PER A.S.M.E BOILER CODE SECTION III ARTICLE 6 PAR. N-627 EXCEPT P8 & 2.04/1.96 DIMENSIONED AREA OF P5, 6, 7.

7 4. MATERIAL PROCESSING CONTROL PER P50YP107.