MISSISSIPPI POWER & LIGHT COMPANY
Helping Build Mississippi
P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

August 21, 1981

NUCLEAR PRODUCTION DEPARTMENT

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
File 0260/0862
Transmittal of Proposed FSAR
Changes and Responses to NRC
Questions
AECM-81/273

References: Materials Engineering Branch Questions 251.1-9, 252.1.

In response to your request for additional information, Mississippi Power & Light Company is submitting the enclosed materials updating information pertaining to the above referenced items.

This information represents changes to the Grand Gulf Nuclear Station Final Safety Analysis Report (FSAR).

These proposed FSAR changes will be incorporated into the next available amendment to the FSAR. If you have any questions or require further information, please contact this office.

Yours truly,

L. F. Dale
Manager of Nuclear Services

JHS/JGC/JDR:ad
Attachments:
1. Question & Response 251.1
2. Question & Response 251.2
3. Question & Response 251.3
4. Question & Response 251.4
5. Question & Response 251.5
6. Question & Response 251.6
7. Question & Response 251.7
8. Question & Response 251.8
9. Question & Response 251.9
10. Question & Response 252.1
11. Revised FSAR Section 5.3

B001
S
1/1
Acceptance Dist
SEND Drawings to:
PM

cc: (See Next Page)

cc: Mr. N. L. Stampley
Mr. R. B. McGehee
Mr. T. B. Conner
Mr. G. B. Rogers

Mr. Victor Stello, Jr., Director
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

251.1 Provide CVN impact test data for the reactor vessel nozzles, flanges and shell regions near discontinuities. The data must include orientation, test temperature, energy absorbed (ft-lb), specimen lateral expansion (in mils), and RT_{NDT}.

RESPONSE

A. Grand Gulf 1 Reactor Vessel
Beltline Plate and Weld Information

1. The Grand Gulf 1 vessel was procured to meet the requirements of the ASME Code Section III, 1971 Edition with Winter 1972 Addenda. Thus, it is in compliance with the toughness testing requirements of 10CFR50 Appendix G.

2. To provide for consideration of the effects of neutron fluence on beltline toughness and of surveillance program requirements, beltline material data are given in the following attachments:

   a) Table 5.3-1 - Beltline plate toughness

   b) Table 5.3-2 - Beltline weld toughness

   c) Table 5.3-3 - Estimated effect of neutron fluence on beltline RT_{NDT} values.

   d) Figures 121.1-1 and -5 - from Amendment 31 of the FSAR define the beltline location and the location of plates and weld seams in the beltline.

B. Grand Gulf 1 Reactor Vessel
Non-Beltline Information

1. As stated for the beltline material, the Grand Gulf 1 vessel was procured to the requirements of the ASME Code Section III, 1971 Edition with Winter 1972 Addenda, which are consistent with the toughness testing requirements of 10CFR50 Appendix G.

2. A review of Quality Assurance Records (Documented Deviations, from the vendor CBIN) reveals deviations from the below listed fracture toughness purchase requirement limits:

   a) RT_{NDT} no greater than +10°F for the shell course, head, and closure flange.

   b) RT_{NDT} no greater than -20°F for nozzle forgings.

   c) RT_{NDT} no greater than -20°F for low alloy weld metal used to join base or weld materials requiring impact testing.

3. The use of these specification limits and the beltline data to establish vessel operating limits is described in the FSAR paragraph 5.3.2.

4. Vessel main closure studs meet the Charpy requirement of 45 ft-lb and 25 mils at +10°F.

C. Grand Gulf 1
Other Ferritic Reactor Coolant Pressure
Boundary Materials (NSSS)

The subject materials were impact tested and are in compliance with 10CFR50 Appendix G. Specific components, applicable code requirements, and impact test temperatures are the following:

1. Main Steam Pipe - ASME III, 1974 and Summer 1974 Addenda, +60°F.

2. Main Steam Isolation Valve - ASME III, 1974 +60°F.

3. Safety Relief Valve (8"x10") - ASME III, 1974 and Summer 1976 Addenda, +60°F.

4. HPCS Isolation Valve - ASME III, 1971 and Winter 1973 Addenda, +40°F.

5. Flued Head - ASME III, 1974 and Summer 1974, +60°F.

See also revised section 5.3.

GG
FSAR

251.2 Define the specimen orientation (longitudinal or transverse) for the CVN impact tests results submitted in response to Question 121.2.

RESPONSE

For the Unit 1 pressure vessel, see new Table 5.3-1.

Similar information for the Unit 2 pressure vessel will be provided in a later amendment.

GG
FSAR

251.3 To demonstrate compliance with Paragraph III.B.3 of Appendix G, 10 CFR Part 50, provide data as to how often the supplier calibrated his test machines, and indicate whether records have been maintained.

RESPONSE

The calibration of temperature instruments and CVN impact test machines used in impact testing complies with Paragraph NB-2360 of the ASME Code as required by 10 CFR 50, Appendix G, III.B.3.

GG
FSAR

251.4 Identify the weld filler metal, heat number, flux type, lot of flux, welding process, and RT_{NDT} for all welds in the reactor pressure vessel. Additionally, submit the chemical composition for all the core beltline region welds. Each weld (e.g., AB, AC, etc. in Figures 121.1-2 and -3) must have its own identification.

RESPONSE

For beltline region welds, see new Tables 5.3-2 and 5.3-3. The above information for non-beltline region welds has not been provided. See the response to Question 251.1 for the acceptance criteria applied to non-beltline materials.

GG
FSAR

251.5 Provide the CVN impact data and define the RT_{NDT} values for all base materials outside the core beltline region. This also applies to the top and bottom heads.

RESPONSE

See the response to Question 251.1 for the acceptance criteria applied to all non-beltline region materials.

GG
FSAR

251.6 No data has been provided to demonstrate that the impact properties for the ferritic valve and bolting materials in the reactor coolant pressure boundary meet the requirements of Paragraph IV.A.3 of Appendix G. Supply the actual test data so that compliance with the paragraph can be demonstrated. If no data exist for the actual materials at Grand Gulf Units 1 and 2, data from the literature for similar materials and/or analyses can be used to demonstrate compliance with Paragraph IV.A.3 of Appendix G.

RESPONSE

BOP

Ferritic valves employed in the reactor coolant pressure boundary (RCPB) (Class 1) were surveyed to identify the limiting component. Maximum member thickness was used as the criteria.

The limiting component identified is the feedwater outboard containment isolation check valve supplied by Atwood & Morrill. The pressure boundary parts consist of the body, cover, and disc. The data contained in the certified material test report have been summarized in Table 251.6-1. This report is attached for your review and includes affirmation by the supplier of compliance with Article NB 2000 of ASME Section III for the materials and constructions of this component. Fracture toughness data for all other ferritic valves in the RCPB is available for review at the Grand Gulf Nuclear Station.

All bolting materials for Class 1 application are 1" diameter or less and are exempt from impact testing.

NSSS

See the response to Question 251.1. The certified material test report for the main steam isolation valve is attached for your review.

GG
FSAR

TABLE 251.6-1

MATERIALS DATA OF COMPONENTS OF FEEDWATER
OUTBOARD CONTAINMENT ISOLATION VALVE

Valve Component	Thickness	Material	Heat Treatment*	Physical Tests	Heat Number
Body	2 19/64"	SA-352 Gr. LCB	1200°F ± 25°F PWHT	Yield - 61,500 psi Tensile - 81,500 psi Elong. - 30% Reduction of Area - 62.7%	F8063
Cover	5"	SA-350 Gr. LF-2	1650°F @ 6 hrs Air Cooled	Yield - 44,000 psi Ultimate Tensile - 77,500 psi Elong. - 32% Reduction of Area - 60.5%	214903
Disc	4"	SA-352 Gr. LCB	1200°F ± 25°F PWHT	Yield - 66,000 psi Tensile - 90,000 psi Elong. - 28% Reduction of Area - 61.5%	F8095

*For a full description of the heat treatment, see the attached certified material test report.

FORM NPV-1 MANUFACTURERS' DATA REPORT FOR NUCLEAR PUMPS OR VALVES
(As Required by the Provisions of the ASME Code, Section III, Div. 1)

1 Manufactured by Atwood & Morrill Co., Inc., Salem, Mass. (Name and Address of Manufacturer)

2 Manufactured for Bechtel Power Corporation (Name and Address of Purchaser or Owner)

3 Location of Installation Grand Gulf Nuclear Station, Port Gibson, Mississippi (Name and Address)

4 Pump or Valve Valve

5 Nominal Inlet Size 24" (inch) Outlet Size 24"

	(a) Model No., Series No. or Type	(b) Manufacturers' Serial No.	(c) Canadian Registration No.	(d) Drawing No.	(e) Class	(f) Nat'l. Bd. No.	(g) Year Built
(1)	24" Check Valve	1-13615	N/A	13615-01-H Rev.3	1	N/A	1976
(2)							
(3)							
(4)							
(5)							
(6)							
(7)							
(8)							
(9)							

6 Feedwater Check Valve
(Brief description of service for which equipment was designed)

7 Design Conditions 1700 (Pressure) psi 450 (Temperature) °F or Valve Pressure Class 1 (1)

8 Working Pressure 1930 psi at 100°F

9 Pressure Retaining Pieces

Mark No.	Material Spec. No.	Manufacturer	Remarks
Castings			
Body	SA352 Gr. LCB	Quaker Alloy	S/N 1-13615
Disc	SA352 Gr. LCB	Quaker Alloy	S/N 1-13615
Stuffing Box	SA352 Gr. LCB	Quaker Alloy	S/N 1-13615
Stuffing Box	SA352 Gr. LCB	Quaker Alloy	S/N 3-13615
Power Key	SA350 Gr. LF-2	Cann & Saul	S/N 1-13615
Power Key	SB564	Cann & Saul	S/N 1-13615

(1) Power operated valves only

Sheets in form of lists, sketches or drawings may be used provided (1) size is 8-1/2" x 11", (2) information in items 1 through 5 on this data report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded at top of this form.

This form (E00037) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

Q1B21-F032A

5

FORM NPV-1 MANUFACTURERS' DATA REPORT FOR NUCLEAR PUMPS OR VALVES*

(As Required by the Provisions of the ASME Code, Section III, Div. 1) Q1B21-F032A

1. Manufactured by Atwood & Morrill Co., Inc., Salem, Mass.
(Name and Address of Manufacturer)
2. Manufactured for Bechtel Power Corporation
(Name and Address of Purchaser or Owner)
3. Location of Installation Grand Gulf Nuclear Station, Port Gibson, Mississippi
(Name and Address)
4. Pump or Valve Valve Nominal Inlet Size 24" (inch) Outlet Size 24"

	(a) Model No., Series No. or Type	(b) Manufacturers' Serial No.	(c) Canadian Registration No.	(d) Drawing No.	(e) Class	(f) Nat'l. Bd. No.	(g) Year Built
(1)	24" Check Valve	1-13615	N/A	13615-01-H Rev.3	1	N/A	1976
(3)							
(4)							
(5)							
(6)							
(7)							
(8)							
(9)							
(10)							

5. Feedwater Check Valve
(Brief description of service for which equipment was designed)

6. Design Conditions 1700 (Pressure) psi 450 (Temperature) °F or Valve Pressure Class 1 (1)
7. Cold Working Pressure 1930 psi at 100°F.
8. Pressure Retaining Pieces

Mark No.	Material Spec. No.	Manufacturer	Remarks
(a) Castings			
Body RT# P811	SA352 Gr. LCB	Quaker Alloy	S/N 1-13615
Disc RT# P892	SA352 Gr. LCB	Quaker Alloy	S/N 1-13615
Stuffing Box	SA352 Gr. LCB	Quaker Alloy	S/N 1-13615
Stuffing Box	SA352 Gr. LCB	Quaker Alloy	S/N 3-13615
(b) Forgings			
Cover	SA350 Gr. LF-2	Cann & Saul	S/N 1-13615
Load Key	SB564	Cann & Saul	S/N 1-13615

(1) For manually operated valves only.

* Supplemental sheets in form of lists, sketches or drawings may be used provided (1) size is 8-1/2" x 11", (2) information in items 1, 2 and 5 on this data report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded at top of this form.

FORM NPV-1 (Back)

Mark No.	Material Spec. No.	Manufacturer	Remarks
(c) Bolting			
Cover Studs	SA193 Gr.B7	Jos. Dyson & Sons	Ht.# 52208
Cover Nuts	SA194 Gr.2H	Jos. Dyson & Sons	Ht.# 26210
(d) Other Parts			
* Pipe	SA106 Gr.B	Braman Dow	S/N 1-13615
	SA106 Gr.B	Braman Dow	S/N 3-13615
* Pipe Cap	SA105	Braman Dow	S/N 1-13615
	SA105	Braman Dow	S/N 3-13615
* Note: These items comply with the Code for material construction and workmanship, but are not included as far as design is concerned.			

9. Hydrostatic test 2900 psi.
Disc Hydro 2250

CERTIFICATE OF COMPLIANCE

We certify that the statements made in this report are correct and that this pump, or valve, conforms to the rules of construction of the ASME Code for Nuclear Power Plant Components. Section III, Div. 1., Edition 1974, Addenda Summer 1974 (Date), Code Case No. N/A N/A

Signed Atwood & Morrill Co., Inc. (Manufacturer) by Quality Control Manager

Our ASME Certificate of Authorization No. N812 to use the N (N) (NPV) symbol expires 5/7/77 (Date)

CERTIFICATION OF DESIGN

Design information on file at Bechtel Corporation

Stress analysis report (Class 1 only) on file at Atwood & Morrill Co., Inc., Salem, Mass.

Design specifications certified by (1) Jitendra K. Parikh

PE State Mississippi Reg. No. 6539

Stress analysis certified by (1) John J. Cowley

PE State Mass. Reg. No. 23160

(1) Signature not required. List name only.

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Massachusetts and employed by H.S.B. I. & I. Co. of Hartford, Conn. have inspected the pump, or valve, described in this Data Report on 9 SEPT 1976, and state that to the best of my knowledge and belief, the Manufacturer has constructed this pump, or valve, in accordance with the ASME Code, Section III.

By signing this certificate, neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the equipment described in this Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 9 SEPT 1976

Gerard F. Corrazzo (Inspector)

Commissions Mass. 1264, Ohio Commission (Nat'l Bd., State, Prov. and No.)

Ref: 13615-01-001
Body for 24"-900#
S/N 1-13615

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.
MYERSTOWN, PENNA. 17067

MATERIAL TEST REPORT

CUSTOMER ORDER NO	PATTERN NO	QUAKER ALLOY DESIGNATION	SPECIFICATION	SHOP ORDER NUMBER	DATE SHIPPED
AM1734	16435-30228-606	Q60	ASME SA352 GR.LCB		6-15-76

CUSTOMER: Atwood & Morrill Co.

HEAT NO	C	Mn	Si	P	S	Cr	Ni	Mo			YIELD PSI	TENSILE PSI	ELONG %	RED of AREA %	CSTG. SER.#	R.T. SER.#	PCS SHIPPED
F8063	.18	.89	.36	.015	.018						61,500	81,500	30.0	62.7	F8063-1	P811	1
		Charpy Impact V Notch Plus 50°F								90-87-65		foot pounds					
										65-70-51		lateral expansion					
										60-50-50		% Ductile Fracture					

REMARKS

CHEMICAL & PHYSICAL
REPORT CHECKED
BY DF Sharp
DATE 8/13/76
ATWOOD & MORRILL CO. INC.

A&M Q.C. A 6-11-76

Rejected by Radiography Corp 6/14/76

8-27-76

STATE OF PENNSYLVANIA, COUNTY OF LEBANON, SS
SWORN TO AND SUBSCRIBED BEFORE ME

THIS DAY OF 19

"I CERTIFY THE ABOVE INFORMATION IS CORRECT"
QUAKER ALLOY CASTING CO.

BY R. Rumpf METALLURGIST

QUAKER ALLOY CASTING CO., MIDDLETOWN, PA.

CUSTOMER Atwood & MOrrill PURCHASE ORDER AM1734 CONTRACT NO.

SHOP ORDER D818-05 Q DESIGNATION Q60 PATTERN NO. 16435-30228-606

MATERIAL SPEC. & GRADE ASME SA352 GR.LCB DESCRIPTION body SIZE 24"

HEAT NO. F20163 CASTING SERIAL NO. F20163 1 R.T. SERIAL NO. P711 A & M

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION & Bechtel

23

CERTIFIED MATERIAL TEST REPORT

The records enclosed in this folder comprise the certified material test report for the subject material.

APPROVED
DATE 8/17/76
BY W. Sullivan
ATWOOD & MORRILL CO., INC.

AFFIRMATION

We certify that the contents of this report are correct and accurate and that all test results and operations performed by Quaker Alloy Casting Company or our subcontractors are in compliance with the material specification and appropriate material requirements of the ASME Code 1974 Edition through Summer 1974 Addenda, Section III, as stipulated in the procurement documents. All requirements of the material specification and all special requirements of Art. NB2000 Sect.III 1974 and 1974 Sujmer addenda have been met.

Paul L Patterson — 6-11-76
Quaker Alloy Casting Company — Date

A&M Q.C.S A 6-11-76

REVIEWED

JUN 14 1976

Bechtel Corp

QA1 Rev. 2
11/11/75

QUAKER ALLOY CASTING CO.

PAGE 1 OF 2

CASTING REPAIR WELDING REPORT

2.25.76 (DATE) | 25 (CONTRACT NO.)

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NUMBER
Atwood + Morrill.	AM1734	D818-05

PATTERN NO.	MATERIAL SPEC.	GRADE	HEAT NUMBER
16435 30222.66	ASME SA352	LCB	F8063

CASTING SERIAL NO.	R.T. SERIAL NO.	WELDING PROCEDURE QAP	REV.	& ADD	REV.
F8063-1	P811	WLP 10) 1/2	0		

FILLER METAL	FILLER METAL LOT NUMBER
E7018	28603 (9014J-030)

APPROVED TO WELD

1. Lisa Springborn (QUAKER ALLOY CASTING CO.) — 2.25.76 (DATE)
2. _____ DATE
3. _____ DATE
4. _____ DATE

WELDERS

1. R Achenbach — 2.25.76 (DATE)
2. _____ DATE
3. _____ DATE
4. _____ DATE

DISCONTINUITIES DESCRIBED HEREIN HAVE BEEN REVEALED BY THE FOLLOWING METHODS:

☐ RADIOGRAPHY ☐ MAGNETIC PARTICLE ☐ LIQUID PENETRANT ☐ ULTRASONIC ☑ DIMENSIONAL ☐ VISUAL

MT-301/AS-1 Rev.0 & Add.1 Rev.0

EXAMINATION OF AREA PREPARED FOR WELDING QAP	REV.	& ADD	REV.	EXAMINATION OF AREA APPROVED BY	DATE
MT/F301 MT/D301	0 0	1 1	0 0	Ronald L. Schuler L2	2-25-76

INSPECTION REQUIREMENTS	PREHEAT TEMP.	INTERPASS TEMP.	POST WELD HEAT TREATMENT
☐ RT ☑ MT ☐ PT ☐ UT ☑ VISUAL	60°F min	60°F min	1200°F ± 25° AWHT

ROOT LAYER EXAMINATION — DATE: _____

INTERMEDIATE EXAMINATION — DATE: _____

NONDESTRUCTIVE EXAMINATION OF COMPLETED WELD REPAIRS

1. VISUAL EXAMINATION: Satisfactory RJ 22 SB — DATE 6.7.76
2. MAGNETIC PARTICLE EXAMINATION: MT/F301 Rev.0 & Add.1 Rev.0 / MT/D301 Rev.0 & Add.1 Rev.0 / MT-301/AS-1 Rev.0 & Add.1 Rev.0 RJ 22 SB — DATE 6.7.76
3. LIQUID PENETRANT EXAMINATION: n/a — DATE _____
4. RADIOGRAPHIC EXAMINATION: See RT Report — DATE _____
5. ULTRASONIC EXAMINATION: n/a — DATE _____

REMARKS:

REVIEWED

JUN 14 1976

M. J. Lewis
Bechtel Corp

APPROVED BY:

1. S Bates (QUAKER ALLOY CASTING CO.) — DATE 6.10.76
2. J. E. Fallon Level II (A&M Q.C. & Dept.) — 6-11-76
3. _____ DATE _____
4. _____ DATE _____

FORM 150-1 REV. A

QUAKER ALLOY CASTING CO.

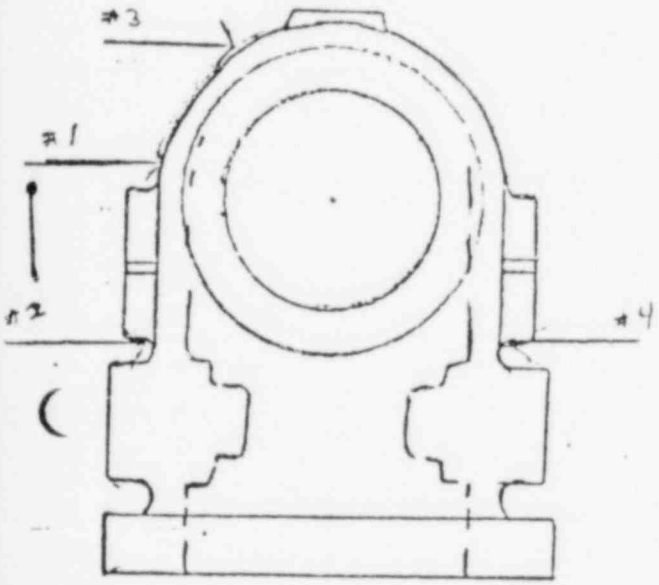
WELD REPAIR CHART

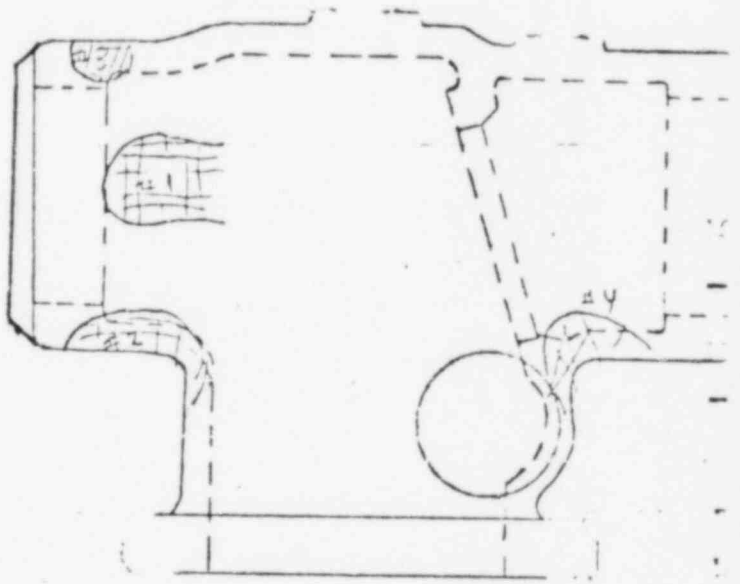
2-25-76 DATE | CONTRACT NO.

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NO.
A Twood & Morrill Co. Inc.	AM-1734	D318-05

PATTERN NO.	HEAT NUMBER	CASTING SERIAL NO.	R.T. SERIAL NO.
1.6435-30228-606	F-8063	F-8063-1	P811

VIEW: P.S.





SIZE AND CLASSIFICATION OF DISCONTINUITY

REPAIR NO.	DISCONTINUITY	SIZE	REMARKS	REPAIR NO.	DISCONTINUITY	SIZE	REMARKS
#1	F	9 x 8½ x 4" DEEP	BUILDUP				
#2	"	8 x 2½ x 1½ " "	"				
#3	"	2 x 2 x 2½ "	"				
#4	"	8½ x 8½ x 2"	"				
						REVIEWED	
						JUN 14 1976	
						M Doctrel Corp	

CLASS OF DISCONTINUITY
A. POROSITY B. INCLUSIONS C. SHRINK D. LINEAR E. INSERTS F. DIMENSIONAL CORRECTION

A&M Q.C.B A

6-11-76

Form 156-2 Rev. A

Nuclear

CASTING REPAIR WELDING REPORT

2-27-76 (DATE) | 7 (CONTRACT NO.)

CUSTOMER	CUSTOMER P.O. NUMBER	SHOP ORDER NUMBER
Atwood - Morrill	AM1734	0318-05-

PATTERN NO.	MATERIAL SPEC.	GRADE	HEAT NUMBER
(16435. 30228-606	SA352 ASME	LCB	F8063

CASTING SERIAL NO.	R.T. SERIAL NO.	WELDING PROCEDURE QAP.	REV.	& ADD —	REV.
F8063-1	P811	WP(P-10)-1/2	0		

FILLER METAL	FILLER METAL LOT NUMBER
E7018	0298829 { 90143-020 28603 }

APPROVED TO WELD

1. LeRoy Reed, QUAKER ALLOY CASTING CO. — 2-27-76 (DATE)
2. _____ — _____ (DATE)
3. _____ — _____ (DATE)
4. _____ — _____ (DATE)

WELDERS

1. R. Geasey — 3/1/76 (DATE) 3/2/76 (DATE)
2. R. Achenbach — 3/1/76 (DATE) 3/2/76 (DATE)
3. R. Blatt — 3/1/76 (DATE)
4. _____ — _____ (DATE)

DISCONTINUITIES DESCRIBED HEREIN HAVE BEEN REVEALED BY THE FOLLOWING METHODS:

☐ RADIOGRAPHY ☐ MAGNETIC PARTICLE ☐ LIQUID PENETRANT ☐ ULTRASONIC ☐ DIMENSIONAL ☑ VISUAL

EXAMINATION OF AREA PREPARED FOR WELDING MT-301 AS-1 Rev0 + add 1 Rev0

QAP	REV.	& ADD	REV.	EXAMINATION OF AREA APPROVED BY	DATE
MT1F301 MT1D301	0 0	1	0	Harry R. Lipe L2	2-27-76

INSPECTION REQUIREMENTS	PREHEAT TEMP.	INTERPASS TEMP.	POST WELD HEAT TREATMENT
☑ MT ☑ MT ☐ PT ☐ UT ☑ VISUAL	60°F MIN	400°F min	1200°F ± 25° FURN HT

LAYER EXAMINATION — DATE: _____

INTERMEDIATE EXAMINATION — DATE: _____

NONDESTRUCTIVE EXAMINATION OF COMPLETED WELD REPAIRS

1. VISUAL EXAMINATION Satisfactory RJ L2 SB — DATE 6 7 76
2. MAGNETIC PARTICLE EXAMINATION MT1F301 Rev0 + add 1 Rev0 / MT1D301 + Rev0 + add 1 Rev0 / MT-301 1AS-1 Rev0 + add 1 Rev0 RJ 1250 — DATE 6 7 76
3. LIQUID PENETRANT EXAMINATION N/A — DATE _____
4. RADIOGRAPHIC EXAMINATION See RT Report — DATE _____
5. ULTRASONIC EXAMINATION N/A — DATE _____

REMARKS:

REVIEWED

JUN 14 1976

M J Lewis
Bechtel Corp

APPROVED BY:

1. S Bate — DATE 6 10 76
   QUAKER ALLOY CASTING CO.
2. [illegible] Level II (A&M QC 8) — DATE 6-11-76
3. _____ — DATE _____
4. _____ — DATE _____

FORM 156-1 REV. A

WELD REPAIR CHART

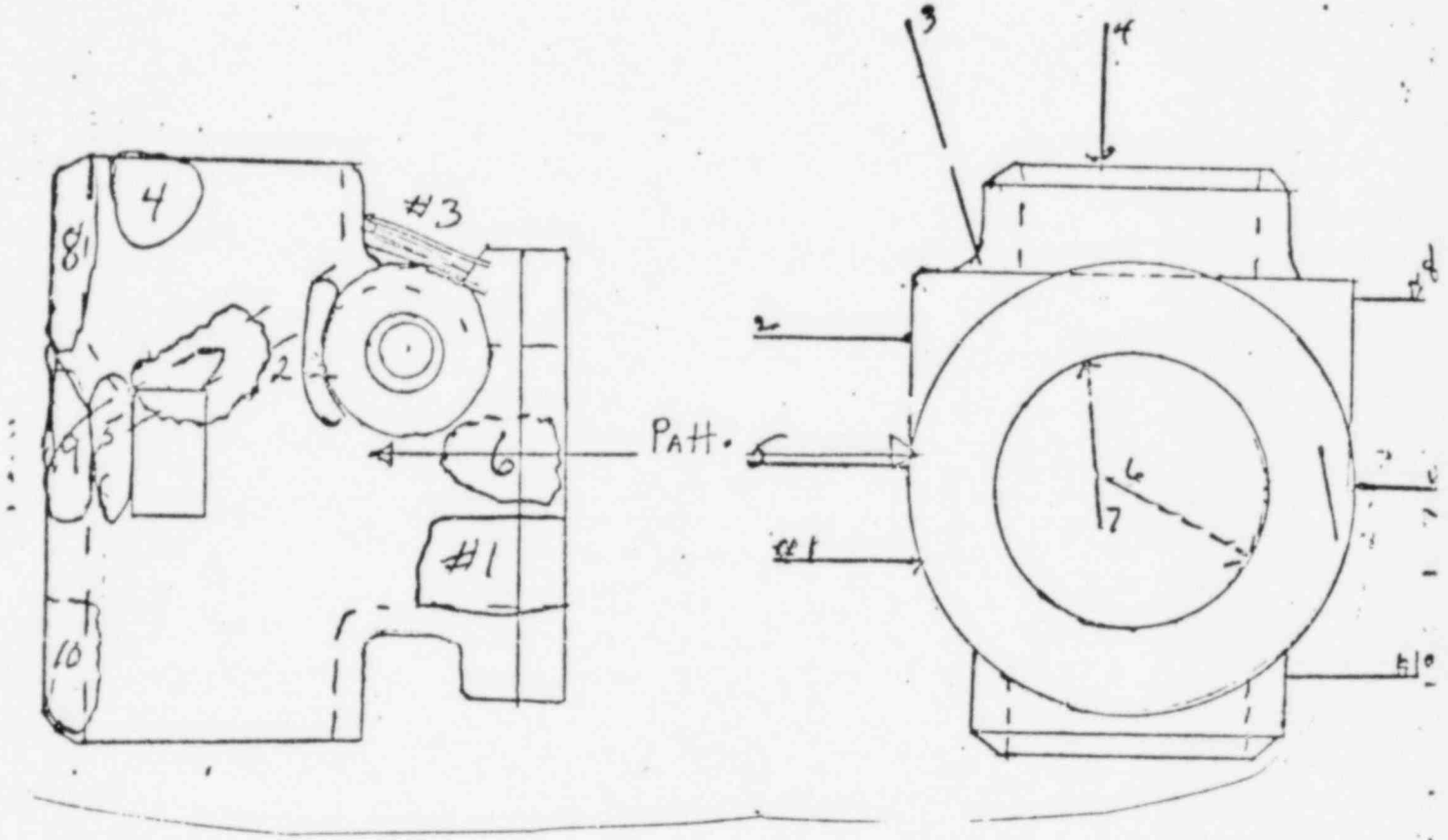
2-27-76 DATE

CONTRACT NO. C

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NO.
A Twood. Mark: 11	AM 1734	D315.05

I ERN NO.	HEAT NUMBER	CASTING SERIAL NO.	R.T. SERIAL NO.
C 16435.30227-606	F8063	F8063-1	P311

VIEW: PATT side



SIZE AND CLASSIFICATION OF DISCONTINUITY

REPAIR NO.	DISCONTINUITY	SIZE	REMARKS	REPAIR NO.	DISCONTINUITY	SIZE	REMARKS
#1	B-C	10 x 10 x 1/2 Deep	MAJOR				
#2	B-C	6 x 1 x 1/4 Deep	" "				
#3	B-C	10 x 6 x 1/4 Build up	" "				
#4	B-C	7 x 7 x 1/4 Deep	" "				
#5	B-C	7 x 6 x 1/4 Deep	" "				
#6	B-C	9 x 5 x 1/2 Deep	" "				
#7	B-C	13 x 20 x 1/2 Deep	" "				
#8	B-C	9 x 5 x 1/4 Deep	" "				
#9	B-C	11 x 6 x 1/4 Deep	" "				
#10	B-C	17 x 7 x 1/4 Deep	" "				

REVIEWED

JUN 14 1976

Bechtel Corp

CLASS OF DISCONTINUITY
A. POROSITY
B. INCLUSIONS
C. SHRINK
D. LINEAR
E. INSERTS
F. DIMENSIONAL CORRECTION

A&M QC.8 A

6-11-76

Form 136-2 Rev. A

CASTING REPAIR WELDING REPORT

DATE 3.16.76 | CONTRACT NO. 26

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NUMBER
Atwood + Morrill	AM1734	D815-05

PATTERN NO.	MATERIAL SPEC.	GRADE	HEAT NUMBER
16425-30328.606	ASME SA352	LCB	F8063

CASTING SERIAL NO.	R.T. SERIAL NO.	WELDING PROCEDURE QAP.	REV.	& ADD —	REV.
F80631	P311	W(P-10) ½	0		

FILLER METAL	FILLER METAL LOT NUMBER
E-7018	286C3 (9D143 030) 029B809

APPROVED TO WELD

1. Leroy Rich (QUAKER ALLOY CASTING CO.)	DATE 3 16 76	3.	DATE
2.	DATE	4.	DATE

WELDERS

1. B Bats	DATE 3.16.76	3.	DATE
2. M Thom.	DATE 3.16.76	4.	DATE

DISCONTINUITIES DESCRIBED HEREIN HAVE BEEN REVEALED BY THE FOLLOWING METHODS:

☐ RADIOGRAPHY ☐ MAGNETIC PARTICLE ☐ LIQUID PENETRANT ☐ ULTRASONIC ☐ DIMENSIONAL ☑ VISUAL

MT/F301 Rev.0 & Add.1 Rev.0

EXAMINATION OF AREA PREPARED FOR WELDING QAP:	REV.	& ADD	REV.	EXAMINATION OF AREA APPROVED BY
MT/D301	0	1	0	JE Bats L2 DATE 3 16 76

INSPECTION REQUIREMENTS: MT-301/AS-1 Rev.0 & Add.1 Rev.0

☑ RT	☑ MT	☐ PT	☐ UT	☑ VISUAL	60°F MIN	60°F MIN	POST WELD HEAT TREATMENT: 1200°F ± 25° PWHT

LAYER EXAMINATION — DATE:

INTERMEDIATE EXAMINATION — DATE:

NONDESTRUCTIVE EXAMINATION OF COMPLETED WELD REPAIRS

1. VISUAL EXAMINATION	Satisfactory RJ L2 SB	DATE	6.7.76
2. MAGNETIC PARTICLE EXAMINATION	MT/F301 Rev.0 & Add.1 Rev.0 MT/D301 Rev.0 & Add.1 Rev.0 RJ L2 SB MT-301/AS-1 Rev.0 & Add.1 Rev.0	DATE	6.7.76
3. LIQUID PENETRANT EXAMINATION	n/a	DATE	
4. RADIOGRAPHIC EXAMINATION	See RT Report	DATE	
5. ULTRASONIC EXAMINATION	n/a	DATE	

REMARKS:

REVIEWED

JUN 14 1976

M [signature] Buchtel Corp

APPROVED BY:

1. S Bats (QUAKER ALLOY CASTING CO.) DATE 6/10/76
2. [signature] Level II (A & M Q.C. B) DATE 6-11-76
3. DATE
4. DATE

FORM 156-1 REV. A

QUAKER ALLOY CASTING CO.

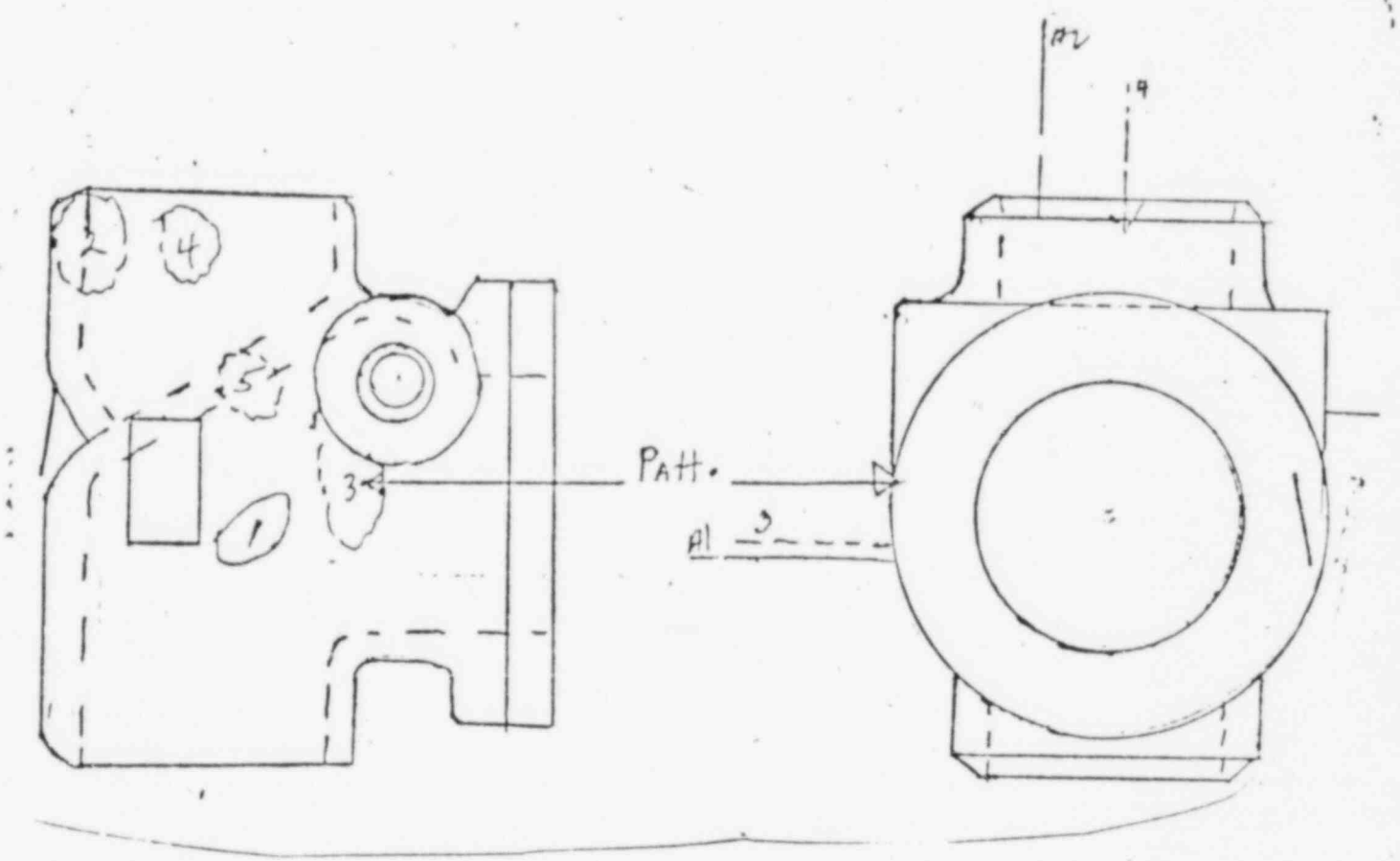
WELD REPAIR CHART

DATE	CONTRACT NO.
3-16-76	30

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NO.
ATwood. MORRIll	AM 1734	D815-03

PATTERN NO.	HEAT NUMBER	CASTING SERIAL NO.	N.T. SERIAL NO.
6435-30228-606	F8063	F8063-1	P811

VIEW: PATT Side



SIZE AND CLASSIFICATION OF DISCONTINUITY

REPAIR NO	DISCONTINUITY	SIZE	REMARKS	REPAIR NO.	DISCONTINUITY	SIZE	REMARKS
#1	B-E	5"15x½ Deep	MAJOR				
#2	B-C	9"7x½ " "	"				
#3	B-E	7x3x1 " "	"				
#4	B-C	4x6x½ " "	"				
#5	B-C	4"4x½ " "	"				

REVIEWED

JUN 14 1976

M Dodge Corp

CLASS OF DISCONTINUITY

A. POROSITY
B. INCLUSIONS
C. SHRINK
D. LINEAR
E. INSERTS
F. DIMENSIONAL CORRECTION

AMM D.C.B A

6-11-76

Form 156-2 Rev. A

QUAKER ALLOY CASTING CO.

WELD REPAIR CHART

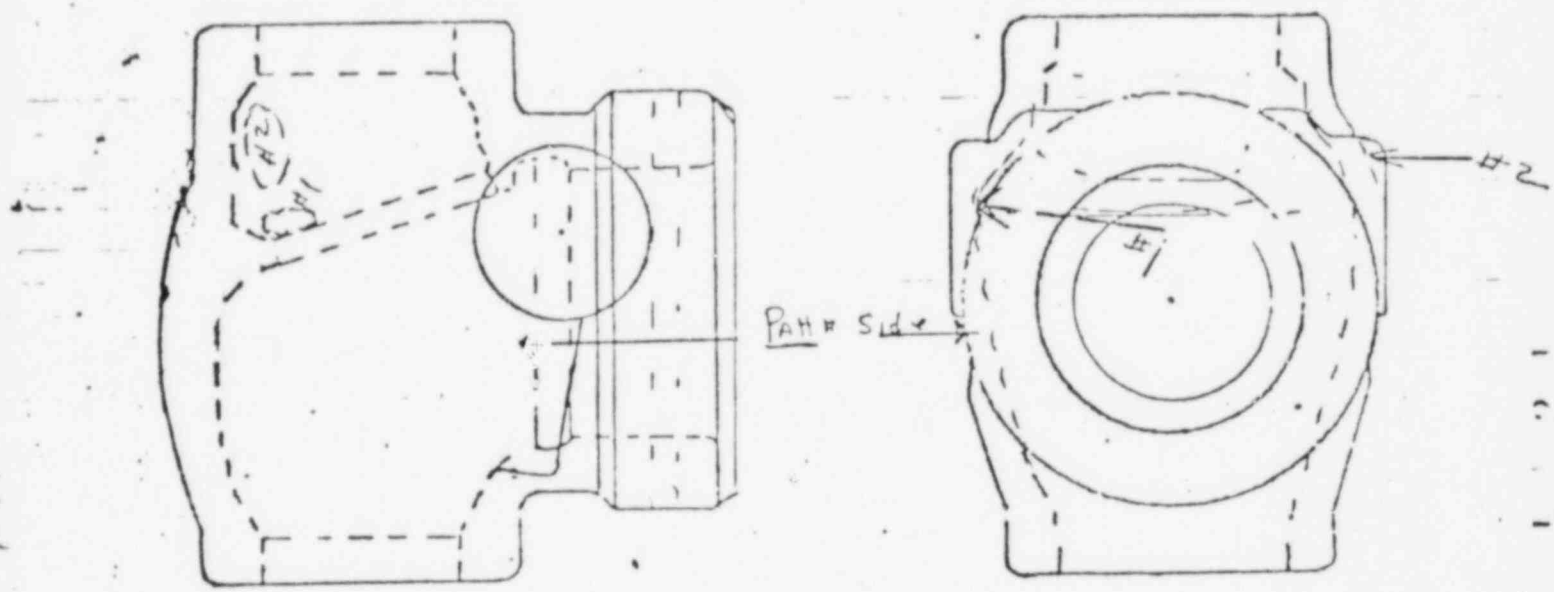
PAGE 2 OF 2 — 37

DATE	CONTRACT NO.
5-17-76	

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NO.
A Twood & Morrill Co. Inc	AM 1734	D318-05

PATTERN NO.	HEAT NUMBER	CASTING SERIAL NO.	R.T. SERIAL NO.
16435-30228-606	F8063	F8063-1	P811

VIEW:



SIZE AND CLASSIFICATION OF DISCONTINUITY

REPAIR NO.	DISCONTINUITY	SIZE	REMARKS	REPAIR NO.	DISCONTINUITY	SIZE	REMARKS
1	B-C	2DIA X 1 DEEP	MAJOR				
2	B-C	2 x 5 1/2 x 2 DEEP	MAJOR				

REVIEWED

JUN 14 1976

Bechtel Corp

CLASS OF DISCONTINUITY
A. POROSITY
B. INCLUSIONS
C. SHRINK
D. LINEAR
E. INSERTS
F. DIMENSIONAL CORRECTION

A&M O.C.S A

6-14-76

Form 156-2 Rev. A

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.

STAINLESS, SPECIAL ALLOY
AND CARBON STEEL CASTINGS

MYERSTOWN, PENNA.
17067

R.T. s/u P-811

9-10-75

AMENDMENT TO AIRCO CORPORATION

CERTIFICATION FOR LOT 029B829 OF FILLER MATERIAL

STRESS RELIEVED AT 1350°F FOR 8 HOURS

Yield	58,500
Tensile	70,500
Elongation	26.0
Reduction of Area	74.0

"V" NOTCH CHARPY IMPACT MINUS 20°F

Foot pounds	120	112	120	110	120
Mils Lateral Expansion	99	77	101	82	100
% Ductile Fracture	99	80	99	81	91

We certify the contents of this document and the attached Airco Laboratory Test Report is in compliance with Section III of the ASME Boiler and Pressure Vessel Code 1974 Edition.

TEST CONDUCTED BY QUAKER ALLOY CASTING COMPANY

Mark M. Landis

A&W Q.C.B A 6-11-76

REVIEWED

JUN 14 1976

M [illegible] Corp

AIRCO LABORATORY TEST REPORT

R.T. s/u P. 811

QA 6

TO: Quaker Alloy Casting Co.
Myerstown, Pa.

Q70 ACTUAL

DATE: August 14, 1975

AIRCO ORDER NO.: J 633081

CUSTOMER ORDER NO.: 1674 Order #34708

SFA 5.1 ASME Section III-71 NB2400

POUNDS	SIZE	TYPE	HEAT	LOT NO.
20,000	3/16	E7018	494S4561	029BS29

Actual CHEMICAL ANALYSIS OF Weld Deposit

C	Mn	P	S	Si	Ni	Cr	Mo	V	Cu
.066	1.21	.014	.021	.45	.057	.044	.069	.005	.048

1.21
.057
.048
.069
.005
.395

Actual PHYSICAL PROPERTIES OF Weld Deposit

TENSILE STRENGTH PSI	YIELD STRENGTH PSI	ELONGATION % IN 2"	REDUCTION IN AREA %	
82,450	72,700	28.0	72.3	As Welded
74,800	61,100	32.0	76.0	*Stress Relieved

REVISED JUN 14 1976

*Stress Relieved at 1150°F for 8 hours.

ADDITIONAL TEST RESULTS

X-ray results satisfactory to paragraph 8.1.1 of AWS SFA 5.1-69

Fillet Weld Usability Test satisfactory to paragraph 8.1.4 of AWS SFA 5.1-69

"We certify the above material has been tested in accordance with the listed specification and is in conformance with all requirements. We further certify that the above material was manufactured in compliance with Section III, ASME Boiler and Pressure Vessel Code."

STATE OF Maryland

COUNTY OF Baltimore

SUBSCRIBED AND SWORN TO BEFORE ME THIS 14th DAY

August 1975

Gladys Hall

NOTARY PUBLIC

A&M Q.C.B A 6-11-71

I certify the chemical analysis and physical or mechanical test results reported above meet the specifications on the described material and are correct as contained in the records of the Company.

R. Sallozzo

D. C. Nenstiel

D. C. Nenstiel

QUAKER ALLOY CASTING CO.
A DIVISION OF HARSCO CORP.
STAINLESS, SPECIAL ALLOY
AND CARBON STEEL CASTINGS
MYERSTOWN, PENNA.
17067

35

R.T. s/w P-811

1-19-76

AMENDMENT TO HOBART CORPORATION

CERTIFICATION FOR LOT 28603 SERIAL 90143-020 OF FILLER MATERIAL

STRESS RELIEVED AT 1350°F FOR 16 HOURS

Yield	57,000
Tensile	72,500
Elongation	29.5
Reduction of Area	76.4

"V" NOTCH CHARPY IMPACT MINUS 20°F

Foot pound	13	96	120	120
Lat. Expansion	15	79	102	100
% Shear	20	80	99	99

TESTS CONDUCTED BY QUAKER ALLOY CASTING COMPANY

REVIEWED

JUN 14 197

R. [illegible]

M [illegible]
Bechtel Corp.

We certify the contents of the document and the attached Hobart test report for lot 28603 Serial 90143-020 is in compliance with Section III of the ASME Boiler and Pressure Vessel Code 1974 Edition.

A&M QC 8 A

6-11-76

FILLER METAL CERTIFICATE
HOBART BROTHERS COMPANY

K.V. 2/2 F-311

No. Copies Req: 3

36

QA S

Ref: 35220

Type: LH-718

Diameter: 7/32"

Serial No.: 90143-020

Quantity:

To: Quaker Casting Company
722 South Cherry Street
Myerstown, Pennsylvania

The above filler metal complies with the following specification and requirements as noted:

AWS A5.1-69; ASTM _____, Class E-7018

MIL - _____

Others ASME SFA 5.1 Type 7018 Section III Specifications.

Chemical Analysis of:
( ) Filler Metal
( ) Typical Weld Metal
(X) Actual Weld Metal

Mechanical Properties:
( ) Typical (X) Actual
(X) As Welded ( ) Stressed Relieved @ _____

Carbon .038	Phosphorous .017	Tensile Strength, PSI	75,000
Manganese .60	Sulfur .012	Yield Point, PSI	66,000
Silicon .30	Molybedenum .014	Elongation in 2"	30.5%
Chromium .038	Columbium	Reduction of Area	72.4%
Nickel .009	Aluminum	Charpy V-Notch Impact @ -20 F.	114, 178, 85, 69, 119
Copper .054	Magnesium		
Vanadium .018		X-ray	Conforms
		Fillet	Conforms

Remarks:

	Mils Lateral Expansion	Percent Shear Fracture
1.	0.084	69%
2.	0.095	91%
3.	0.073	59%
4.	0.058	56%
5.	0.086	72%

~~REVISED~~

JUN 14 1976

STATE OF OHIO
COUNTY OF MIAMI

HARRIETT E. WILSON, Notary Public
In and for Miami County, Ohio
My Commission Expires Aug. 7, 1980

Subscribed and sworn to before me this 14th day of October 1975

Harriett E. Wilson
NOTARY PUBLIC

The undersigned certifies that the above is correct to the best of his knowledge and belief.

By R.E. Osgood
R.E. Osgood-Quality Control Dept.

HOBART BROTHERS COMPANY

A&M 6-11-76

J-20247

QUAKER ALLOY CASTING CO., MYERSTOWN, PA.

CUSTOMER Atwood & MOrrill PURCHASE ORDER AM1734 CONTRACT NO.

SHOP ORDER D818-05 Q DESIGNATION Q60 PATTERN NO. 16435-30228-605

MATERIAL SPEC. & GRADE ASME SA352 GR.LCB DESCRIPTION body SIZE 24"

HEAT NO. F3063 CASTING SERIAL NO. F3063 \ R.T. SERIAL NO. P811 A & M

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION & Bechtel

HEAT TREATMENT RECORD

PROCESS*	N	Harden	temper	PWHT
PROCEDURE	Rev.1 QAP-HT(P-1Q)-1	QAP-HT(P-1Q)-1 Rev.1		Rev.0 QAP-W(P-1Q)1/2
DATE	12-31-75	1-12-76	1-13-76	5-25-76
FURNACE	Flynn & Drefinn	Flynn & Drefinn	Gas Machine	Gas Machine
CHARGE NO.	FD1214	FD1225	GM1678	GM1817
CHARGE TEMP.	105°F	165°F	165°F	150°F
TIME TO EQUIL. TEMP.	3 Hrs. 15 Min.	2 Hrs. 15 Min.	20 Min.	30 Min.
HOLDING TEMP. (RANGE)	1690°-1700°F	1630°-1640°F	1200°F	1200°F
TIME AT TEMP.	6 Hrs. 10 Min.	6 Hrs. 30 Min.	6 Hrs.	6 HRs. 15 Min.
COOLING DATA	Air.	*	Air	Air

*FURNACE COOL - 1440°-1450°F - 1 Hr. 10 Min.
FURANCE COOL - 1420°-1430°F - 45 Min.

REMARKS WATER QUENCH

ACTUAL HEAT TREAT CHARTS ARE RETAINED IN FILE FOR THE ABOVE.

*N = Normalize or homogenize
Q = Quench or harden
T = Temper
SA = Solution Anneal
PWHT = Post Weld Heat Treat (Stress relieve)

PREPARED BY S. Betos
Quaker Alloy Casting Company
Q.C.Clerk

TITLE

DATE 6-9-76

A&M Q.C.B A

REVIEWED

JUN 14 1976

Bechtel Corp

Form 212
10/23/75

QUAKER ALLOY CASTING CO.

PAGE 1 OF 1

NUCLEAR CASTING REPAIR WELDING REPORT

DATE 06/22/76 | CONTRACT NO. 49

CUSTOMER	CUSTOMER P.O NUMBER	SHOP ORDER NUMBER
Atwood + Morrill	AM-5244	D818-05

ERN NO.	MATERIAL SPEC.	GRADE	HEAT NUMBER
16435-30228-606	ASME SA352	LCB	F8063

CASTING SERIAL NO.	R.T. SERIAL NO.	WELDING PROCEDURE QAP.	REV.	& ADD	REV.
F8063-1	P811	W(P-10) 1/2	0		

FILLER METAL	FILLER METAL LOT NUMBER
E70:8	C503M1AF

APPROVED TO WELD

1. Rod Soliday (QUAKER ALLOY CASTING CO.) 06/22/76 (DATE)
2. _____ DATE
3. _____ DATE
4. _____ DATE

WELDERS

1. R. Mohn 6-22-76 (DATE)
2. _____ DATE
3. _____ DATE
4. _____ DATE

DISCONTINUITIES DESCRIBED HEREIN HAVE BEEN REVEALED BY THE FOLLOWING METHODS:

☐ RADIOGRAPHY ☐ MAGNETIC PARTICLE ☐ LIQUID PENETRANT ☐ ULTRASONIC ☑ DIMENSIONAL ☐ VISUAL

EXAMINATION OF AREA PREPARED FOR WELDING QAP-MT-301/AS-1 Rev. 0 & Add.1 Rev. 0 AREA APPROVED BY

QAP	REV.	& ADD	REV.
MT/D-301	0	1	0
MT/F-301	0	1	0

DATE 06/22/76

INSPECTION REQUIREMENTS: ☐ RT ☑ MT ☐ PT ☐ UT ☑ VISUAL

PREHEAT TEMP.	INTERPASS TEMP.	POST WELD HEAT TREATMENT
60°F MIN	600°F min	1200°F Min. PWHT

ROOT LAYER EXAMINATION DATE:

INTERMEDIATE EXAMINATION DATE:

NONDESTRUCTIVE EXAMINATION OF COMPLETED WELD REPAIRS

1. VISUAL EXAMINATION Satisfactory Warren W. Warren Level II DATE 6-28-76
   QAP-MT-301/AS-1 Revision 0 & Add.1 Rev. 0 W. W. W. Level II
2. MAGNETIC PARTICLE EXAMINATION QAP-MT/D-301 Rev. 0 & Add.1 Rev. 0 DATE 6-28-76
   QAP-MT/F-301 Rev. 0 & Add.1 Rev. 0
3. LIQUID PENETRANT EXAMINATION N/A DATE
4. RADIOGRAPHIC EXAMINATION See RT Report DATE
5. ULTRASONIC EXAMINATION N/A DATE

REMARKS:

REVIEWED

JUN 28 1976

M J T Jones
Bechtel Corp.

APPROVED BY:

1. T Miller (QUALITY ALLOY CASTING CO.) DATE 6-28-76
2. W. E. Fallon Level II (A&M) DATE 6-28-76
3. _____ DATE
4. _____ DATE

FORM QA-1 REV. A

QUAKER ALLOY CASTINGS CO.

WELD REPAIR CHART

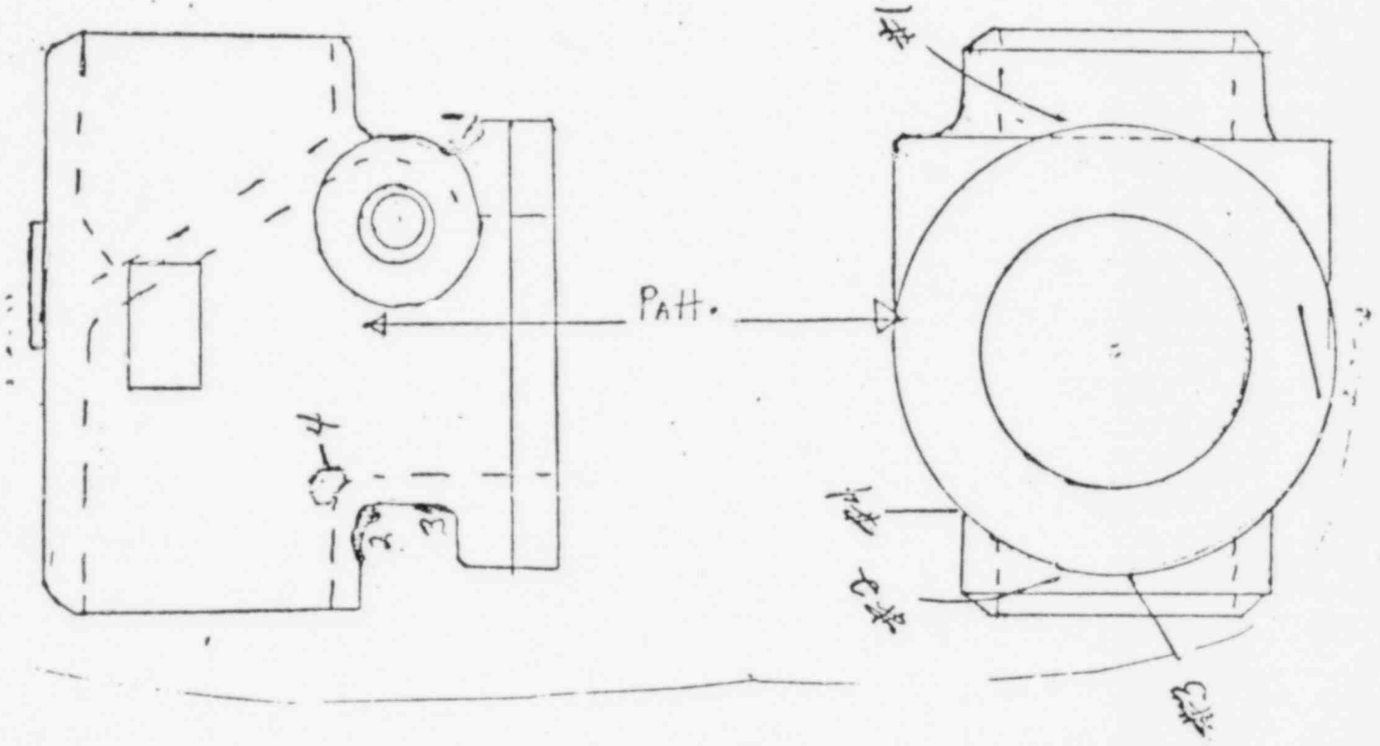
PAGE ___ OF ___

DATE	CONTRACT NO.
6-22-76	50

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NO.
Atwood + Morrill Co., Inc	AM-5244	D818-05

PATTERN NO.	HEAT NUMBER	CASTING SERIAL NO.	R.T. SERIAL NO.
1745-30222-008	F-8063	F8063-1	P-811

VIEW:



SIZE AND CLASSIFICATION OF DISCONTINUITY

REPAIR NO.	DISCONTINUITY	SIZE	REMARKS	REPAIR NO.	DISCONTINUITY	SIZE	REMARKS
1	F	14" x 8" x 1½" Build up	Major				
2	"	7" x 3½" x ¼" "	"				
3	"	12" x 9" x 3½" "	"				
4	"	1½" x 3" x ¼" "	"				

REVIEWED

JUN 28 1976

Bechtel Corp.

CLASS OF DISCONTINUITY
A. POROSITY
B. INCLUSIONS
C. SHRINK
D. LINEAR
E. INSERTS
F. DIMENSIONAL CORRECTION

6-28-76

QUAKER ALLOY CASTING CO.
A DIVISION OF HARSCO CORP.
STAINLESS, SPECIAL ALLOY
AND CARBON STEEL CASTINGS
MYERSTOWN, PENNA.
17067

R.T. s/n P-811

5

5-30-75

AMENDMENT TO CHEMTRON CORPORATION

CERTIFICATION FOR LOT C503M1AF OF FILLER MATERIAL

STRESS RELIEVED AT 1350°F FOR 8 HOURS

Yield	63,000
Tensile	73,500
Elongation	29.0
Reduction of Area	75.4

"V" NOTCH CHARPY IMPACT MINUS 20°F

Foot-pound	Lat. Expansion	% Shear
120	99	99
120	104	99
120	101	99
120	110	99

TESTS CONDUCTED BY QUAKER ALLOY CASTING COMPANY

Wm Landis

We certify the contents of the document, and the attached Chemetron test report for lot C503M1AF is in compliance with Section III of the ASME Boiler and Pressure Vessel Code 1974 Edition.

6-28-76

REVIEWED

JUN 28 1976

M

CHEMETRON CORPORATION
WELDING PRODUCTS DIVISION

R.T. s/w P-811

Certificate of Analysis

QA 6

ACTUAL Q70

Service Tool Supply
955 Rear Harrisburg Ave.
Lancaster, PA 17604

Customer Order No. 14250

Order No. 66225

Shipped

This material conforms to Specification AWS A 5.1-69 SFA5.1-72 SEC. III BoilerCod
Test No. 661
X-Ray Satisfactory
Control No. EED030
Type E 7018

Trade Name:	Atom Arc 7018
Diameter Size:	3/16"
	7,650 lb.
Lot Number:	C503M1AF
Heat Number:	401S0321
Carbon	.05
Manganese	1.19
Chromium	.02
Nickel	.03
Silicon	.45
Columbium	
Tantalum	
Molybdenum	.04
Tungsten	
Copper	.03
Titanium	
Phosphorus	.009
Sulphur	.013
Vanadium	.02
Iron	
Ferrite	

Moisture @ 1800°F. 0.2%
Concentricity 3%
Type Steel A-285

Test No.	Full	Split	Volts	Amps
Tensiles & Impacts	2	5	24	200

Test Results:	AS Welded	Stress Relieved 15 hrs. @ 1150°F.
Yield	66,000	59,000
Tensile	76,000	70,500
Elongation	32%	33%
Red. of Area	76.5%	78.3%

Charpy V-Notch Impacts Tested @ -20°F.

Impacts	111-132-140-196-211	107-155-215-239-240
Lat.Exp.	82-83-92-93-94	84-96-74-80-85
% Shear	40-50-50-100-100	40-75-100-1[illegible]-10

Fillet : OK Horizontal 1

REVIEWED

JUN 28 1976

Dechtel Corp

State of Penna.)
County of York) SS

Subscribed and sworn to before me
this 9th day of December 19 75

SEAL

Notary Public

My commission expires: 8-21-78

6-28-76

The undersigned certifies that this report is correct and that no significant change has been made in any of the elements described in the qualification approval.

CHEMETRON CORPORATION
WELDING PRODUCTS DIVISION

BY R. W. Boyer
R. W. Boyer

QUAKER ALLOY CASTING CO., MYERSTOWN, PA.

CUSTOMER Atwood & Morrill Co. PURCHASE ORDER AM-5244 CONTRACT NO. _____

SHOP ORDER D818-05 Q DESIGNATION Q60 PATTERN NO. 16435-30228-606

MATERIAL SPEC. & GRADE ASME SA352 Gr. LCB DESCRIPTION Body SIZE _____

HEAT NO. F8063 CASTING SERIAL NO. F8063-1 R.T. SERIAL NO. P811

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION A&M/Bechtel

HEAT TREATMENT RECORD

PROCESS*	PWHT		
PROCEDURE	QPW(P-10)-1/2 Rev 0		
DATE	6-23-76		
FURNACE	Gas Machine		
CHARGE NO.	GM-1856		
CHARGE TEMP.	160°F		
TIME TO EQUIL. TEMP.	20 min		
HOLDING TEMP. (RANGE)	1200°F		
TIME AT TEMP.	5 Hrs 5 min		
COOLING DATA	Air		

REMARKS _____

ACTUAL HEAT TREAT CHARTS ARE RETAINED IN FILE FOR THE ABOVE.

REVIEWED

JUN 28 1976

M J Elmi
Bechtel Corp

*N = Normalize or homogenize
Q = Quench or harden
T = Temper
SA = Solution Anneal
PWHT = Post Weld Heat Treat (Stress relieve)

PREPARED BY Miller
Quaker Alloy Casting Company

TITLE QC Supv

DATE 6-28-76

A&M QCS A 6-28-76

Form 212
10/23/75

R&R NUCLEAR

CASTING REPAIR WELDING REPORT

DATE 7/12/76 | CONTRACT NO. 57

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NUMBER
Atwood	A15387	13615

PATTERN NO.	MATERIAL SPEC.	GRADE	HEAT NUMBER
16435-30228-606	ASME SA 352	LCB	F8063

CASTING SERIAL NO.	R.T. SERIAL NO.	WELDING PROCEDURE QAP	REV.	& ADD	REV.
F8063-1	P811	WP-Q 1½	0		

FILLER METAL	FILLER METAL LOT NUMBER
E7018	C503 M1AF

APPROVED TO WELD

1. H. Snavely, QUAKER ALLOY CASTING CO. — 7/12/76 DATE
2. _____ DATE
3. _____ DATE
4. _____ DATE

WELDERS

1. J Smith — 7-12-76 DATE
2. _____ DATE
3. _____ DATE
4. _____ DATE

DISCONTINUITIES DESCRIBED HEREIN HAVE BEEN REVEALED BY THE FOLLOWING METHODS:

☐ RADIOGRAPHY ☐ MAGNETIC PARTICLE ☐ LIQUID PENETRANT ☐ ULTRASONIC ☑ DIMENSIONAL ☐ VISUAL

EXAMINATION OF AREA PREPARED FOR WELDING QAP	REV.	& ADD	REV.	EXAMINATION OF AREA APPROVED BY	DATE
MT 301/AS-1	0	1		QE Bates	7/12/76
MT/T 301	0	1			
MT/D 301	0	1			

INSPECTION REQUIREMENTS	PREHEAT TEMP.	INTERPASS TEMP.	POST WELD HEAT TREATMENT
☐ RT ☑ MT ☐ PT ☐ UT ☑ VISUAL	60°F MIN	60°F MIN	1200°F ±25° PWHT

FINAL LAYER EXAMINATION — DATE:

INTERMEDIATE EXAMINATION — DATE:

NONDESTRUCTIVE EXAMINATION OF COMPLETED WELD REPAIRS

1. VISUAL EXAMINATION: Satisfactory — QEB 1.2 — DATE 7.19.76
2. MAGNETIC PARTICLE EXAMINATION: MT/T 301 Rev 0 + ACC 1; MT/D 301 Rev 0 + ACC 1; MT-301/AS 1 Rev 0 + ACC 1 — QEB 1.2 — DATE 7.19.76
3. LIQUID PENETRANT EXAMINATION: NA — DATE
4. RADIOGRAPHIC EXAMINATION: See RT Report — DATE
5. ULTRASONIC EXAMINATION: NA — DATE

REMARKS:

Bechtel 7/22/76 J.H. Slaven

APPROVED BY:

1. S Bates, QUAKER ALLOY CASTING CO. — DATE 7-21-76
2. [illegible] Level II — DATE 7-21-76
3. _____ DATE
4. _____ DATE

ASME Q.C.8

FORM 120-1 REV. A

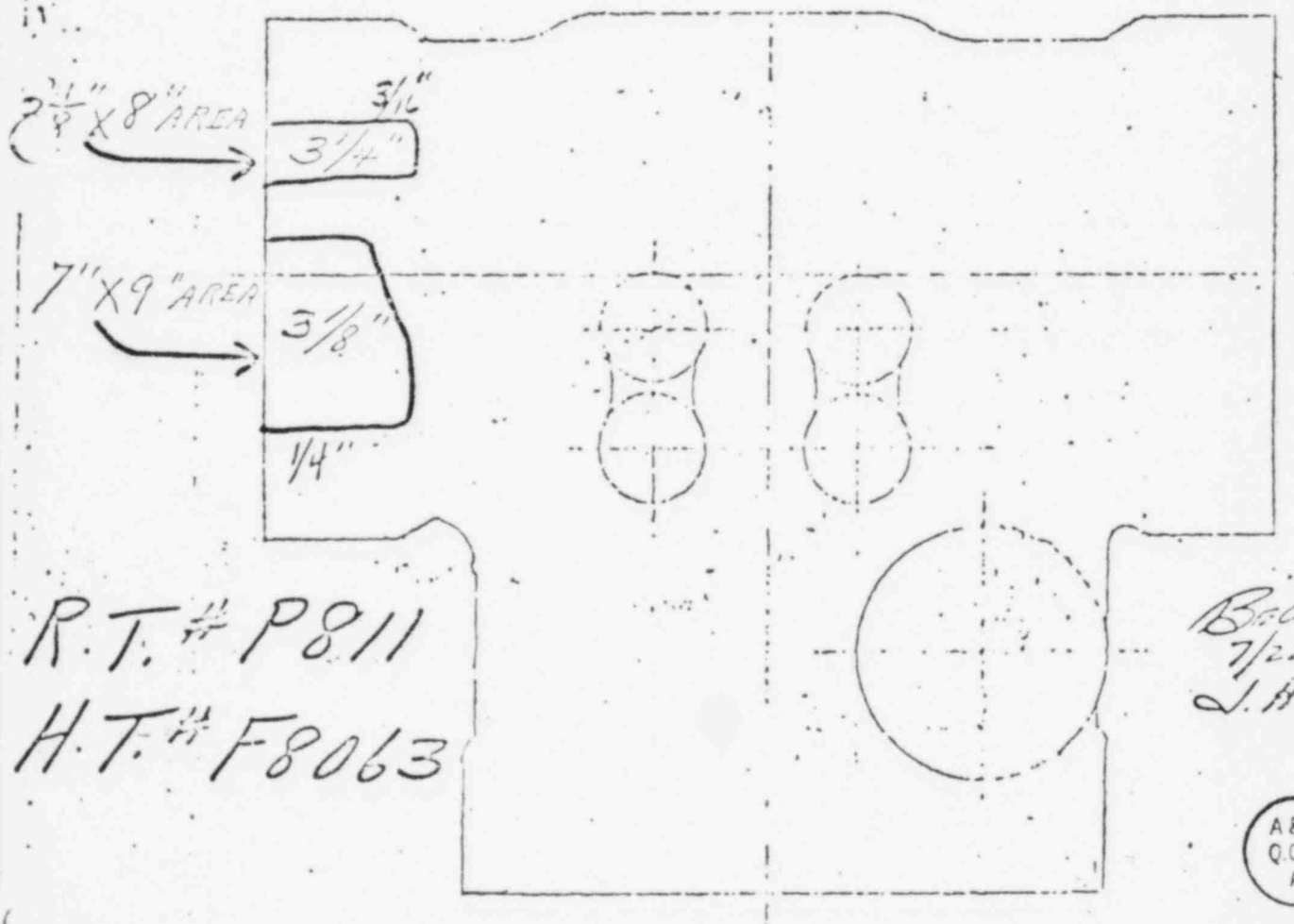
ATWOOD & MORRILL CO.
SALEM, MASS.

DATE: 5/8

S.O. # 13615-01
(4" 900# W.E. SWING CHECK

CAST. DWG. 30222-606-11 REV. 3
R.M. DWG. PS 1262-F REV. 1
A&M P.O. # 1734
VENDOR. QUAKER ALLOY INC.
MIL SA 352 L.C.B.
PATTERN. # 16435

3 5/16" MIN. WALL IS 3 1/4" THICK IN AN AREA 3 1/8" X
AND 3 1/8" THICK IN AN AREA 7" X 9".



R.T. # P811
H.T. # F8063

Bashed
7/22/76
J. H. Stem

A&M Q.C. 5 A

(A&M Q.C. 8 A) 7-21-76

QUAKER ALLOY CASTING CO., FRIEDENSTOWN, PA.

CUSTOMER Atwood and Morrill PURCHASE ORDER AM-5387 CONTRACT NO. 16

SHOP ORDER D818-05 Q DESIGNATION Q60 PATTERN NO. 16435-30228-606

MATERIAL SPEC. & GRADE ASME SA352 GR.LCB DESCRIPTION body SIZE 24"

HEAT NO. F80163 CASTING SERIAL NO. F80163 1 R.T. SERIAL NO. P811

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION Atwood & Bechtel

HEAT TREATMENT RECORD

PROCESS*	PWHT		
PROCEDURE	ONPW (P10) ½ hrs		
DATE	7.15.76		
FURNACE	Ajax		
CHARGE NO.	GM1769		
CHARGE TEMP.	240°F		
TIME TO EQUIL. TEMP.	45 min.		
HOLDING TEMP. (RANGE)	1200°F		
TIME AT TEMP.	6 hrs 10 min		
COOLING DATA	Air		

REMARKS

ACTUAL HEAT TREAT CHARTS ARE RETAINED IN FILE FOR THE ABOVE.

*N = Normalize or homogenize
Q = Quench or harden
T = Temper
SA = Solution Anneal
PWHT = Post Weld Heat Treat (Stress relieve)

A&M Q.C.8 7.21.76

Bechtel 7/20/76 L. H. Starr

PREPARED BY S Bates
Quaker Alloy Casting Company

TITLE Clerk

DATE 7.19.76

Form 212
10/23/75

CABOT
STELLITE DIVISION
CABOT CORPORATION
13808 E. IMPERIAL HWY., NORWALK, CAL. 90650

NORWALK FACILITY
TELEPHONE 213 921-4455

70

SUBURBAN WELDERS SUPPLY CO., INC.
72 Nickerson Road
Ashland, Mass. 01721

Date: July 21, 1976
Certification No.: 721-A
Customer Order No.: P.O. 22405
S. O. No.: 2-08124

Item	Material	Heat No.	Weigh
1.	1/4 HAYNES STELLITE 21 Ctd.	102M	610#

Chemical Analysis - Weight Percent

Heat No.	Cr	W	Fe	C	Si	Co	Ni	Mn	~~V~~B	Mo	P	S
102M**	26.37	.06	.28	.25	.58	Bal	2.57	.59	*.007	5.32	.01	*.02

Mesh Size - Percent Retained on U.S. Std. Screen

* Less Than ** HARDNESS Rc 25.8

This material meets the marking requirements of ASME Boiler and Pressure Vessel Code, Section III, paragraph NA-3766.6, paragraph b (Welding and Brazing Materials Identification).

7CC: Customer
1CC: Lab
2CC: File

L. Peterson Bedford Corp 9-21-76

STELLITE DIVISION
CABOT CORPORATION

J. E. REDMAN
MANAGER, QUALITY CONTROL

CHEMICAL & ~~PHYSICAL~~
REPORT CHECKED
BY W. Frame
DATE 8-5-76
ATWOOD & MORRILL CO. INC.

STOODY COMPANY
WHITTIER, CALIFORNIA

Ref. 5415

PRODUCT CERTIFICATION

x: Atwood & Morrill Company, Inc.

285 Canal Street

Salem, MA 01970

Date June 10, 1975

Certification No. 1469-75

ustomer
. O. No. AM 25777 Item No. 1

toody Product Name 3/16" Stoody E309 Mo-16 Stainless Electrodes

Specification ASME SFA 5.4

S.O. 15844 Wt. 2110 lbs

ot No. 7267

CHEMICAL ANALYSIS – PERCENT BY WEIGHT

Actual Chemical Analysis of Undiluted All-Weldmetal Deposit

C	Mn	Si	Cr	Ni	Mo	Cb+Ta	P	S
.08	1.79	0.31	23.42	12.40	2.17	0.01	0.013	0.018
		Co	V	Ti	Cu			
		0.03	0.02	0.01	0.03			

Ferrite per Schaeffler Diagram 10% Ferrite Number 11

emarks: Mechanical Properties: Ultimate Tensile Strength 89900 psi
Elongation 33%

We hereby certify that the above material was manufactured in compliance with Para. NA4112, NB2130, NB2140, NB2152, and NB2400, Sect. III, 1974 (including addenda through Winter 1974 inclusive) Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code.

Each container and package is identified in accordance with NB2152 requirements showing ASME Section IIC-Specification and Classification, Heat and Lot Number, Stoody Company name and trade designation, size and net weight. Each electrode is identified by Specification classification.

METALLURGY
ATWOOD & MORRIL
approved for use

APPROVED
DATE 6/12/75
BY W. Lebo
ATWOOD & MORRILL CO., INC.

STOODY COMPANY

Frank Ordway, Supervisor
Quality Assurance

P.O. 2863

Middlesex Welding Supply
2 Ridge Ave.
Cambriadge, MASS. 02140

APPROVED
DATE 2-1-76
BY
ATWOOD & MORRILL CO., INC.

1/12/76
DATE

458-886
AIRCO ORDER NO.

C6344
CUSTOMER ORDER NO.

ECIFICATION: ASME SFA 5.1, Group#F-4 ASME SEction III, 1974 Edition including denda thru Summer 1975.

WEIGHT (LBS)	SIZE	TYPE	HEAT NO.	LOT NO.
550	1/8	E7018	411T2271	026B2

CHEMICAL & PHYSICAL REPORT CHECKED
2/1/76

ICAL ANALYSIS is (1) Actual Weld Metal ☒ (2) Typical Weld Metal ☐ (3) Mill Check Analysis ☐ (4) Actual Ship Analysis ☐

C	Mn	P	S	Si	Ni	Cr	Mo	Cb	V	Cu				
.068	.66	.015	.014	.48	.049	.041	.11	---	.004	⩽.01				

MECHANICAL PROPERTIES (1) Actual Weld Metal ☒ (2) Typical Weld Metal ☐

TENSILE P.S.I.	YIELD P.S.I.	% EL.	% R.A.	OTHER
80,710	70,620	30.0	77.6	As Welded
73,775	60,650	35.0	75.9	Stress Relieved at 1150°F for 8 hours.

ADDITIONAL TESTS

X-ray results satisfactory to paragraph 8.1.1 of AWS SFA 5.1-69

Fillet Weld Usability Test satisfactory to paragraph 8.1.4 of AWS SFA 5.1

The above material meets the paragraphs of NB2130, NB 2150 NB2400, NB41? of the ASME Section III, 1974 including addenda through Summer 1975. Weld deposits fall within Weld Metal Analysis No. A-1 in accordance with Section IX, 1974 paragraph Q.W. 430, 431, 432, 440, and 441.

and Subscribed before me this 12th
January 19 76

Notary Public

ommission Expires 7/1/78

I certify the chemical analysis and physical or mechanical test result reported above meet the specifications on the described material and are correct as contained in the records of the Company.

1/12/76
AUTHORIZED SIGNATURE DATE

G. G. Hall Quality Control Expediter
NAME TITLE

CERTIFICATE OF TEST - CHARPY V-NOTCH IMPACTS

13

1/12/76
DATE

458-836
ORDER NO.

C6344 -
CUSTOMER ORDER NO.

Impacts in accordance with SA 370
Section III of the ASME Code including Addenda thru Summer 1975.

TYPE	DIAMETER	LOT NO.	HEAT NO.
E7018	1/8"	026B2	411T2271

TEST TEMPERATURE -20°F

As-Welded

Specimen No.	Energy (ft-lb)	Lateral Expansion (Mils)	Shear (%)
1	129	84	70
2	131	81	80
3	109	75	70
4	151*	85	70
5	103*	71	70
Average	123		

Stress Relieved at 1150°F for 8 hours.

Specimen No.	Energy (ft-lb)	Lateral Expansion (Mils)	Shear (%)
1	124	79	60
2	112	73	60
3	106*	80	50
4	163*	87	90
5	125	79	50
Average	120		

Peterson Backhill Corp 4-21-76

G. G. Hall 1/12/76
AUTHORIZED SIGNATURE DATE
G. G. Hall
Quality Control Expediter

*The extreme lowest and highest values were disregarded for computing average.
The specimen failed to fracture at 240 ft-lb the maximum reading for our instrument.

S/N 1 - 13C15

Ref: 13615-01-002

DISC for 24" S/N 1

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.
MYERSTOWN, PENNA. 17067

MATERIAL TEST REPORT

CUSTOMER ORDER NO.	PATTERN NO.	QUAKER ALLOY DESIGNATION	SPECIFICATION	SHOP ORDER NUMBER	DATE SHIPPED
AM1734	16659-30545-601	Q60	ASME SA352 GR.LCB (74)		6.11.76

CUSTOMER: Atwood and Morrill

HEAT NO	C	Mn	Si	P	S	Cr	Ni	Mo			YIELD PSI	TENSILE PSI	ELONG %	RED. of AREA %	CSTG. SER.#	R.T. SER.#	PCS SHIPPED
F8095	.23	.90	.49	.021	.011						66,000	90,000	28.0	61.5	F8095-5	P892	1
	Charpy Impact V Notch Plus 50°F									79-80-81		foot pounds					
										57-54-59		lateral expansion					
										99-99-99		% Ductile Fracture					

REMARKS

CHEMICAL & PHYSICAL REPORT CHECKED

BY D.E. Sharp

DATE 6/17/76

ATWOOD & MORRILL CO. INC.

APPROVED
DATE 6/18/76
BY N. Lull
ATWOOD & MORRILL CO. INC.

A&M QC.8 A 6-3-76

J. Peterson Bechtel Corp 8-6-76

Received J.E. Lull Co 6/11/76

STATE OF PENNSYLVANIA, COUNTY OF LEBANON, SS
SWORN TO AND SUBSCRIBED BEFORE ME

Wfd 6-23-76.

THIS DAY OF 19

"I CERTIFY THE ABOVE INFORMATION IS CORRECT"
QUAKER ALLOY CASTING CO.

BY B Sattazahn
METALLURGIST

76

QUAKER ALLOY CASTING CO., MYERSTOWN, PA. SIN 1-13615

CUSTOMER Atwood & Morrill PURCHASE ORDER AM1734 CONTRACT NO. _____

SHOP ORDER D818-05 Q DESIGNATION Q60 PATTERN NO. 16659-30545-601

MATERIAL SPEC. & GRADE ASME SA352 GR.LCB DESCRIPTION disc SIZE _____

HEAT NO. F8095 CASTING SERIAL NO. F8095-5 R.T. SERIAL NO. P812

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION _____

77

CERTIFIED MATERIAL TEST REPORT

The records enclosed in this folder comprise the certified material test report for the subject material.

AFFIRMATION

We certify that the contents of this report are correct and accurate and that all test results and operations performed by Quaker Alloy Casting Company or our subcontractors are in compliance with the material specification and appropriate material requirements of the ASME Code 1974 Edition through 1974 Summer Addenda, Section III, as stipulated in the procurement documents. All requirements of the material spec. and all special requirements of NB2000 have been met.

Paul R Strongosky
Quaker Alloy Casting Company

5-27-76
Date

A&M Q.C. 8 A

6-3-76

L Peterson
Bechtel Corp
8-6-76

REVIEWED
JUN 11 1976
Bechtel Corp

QA1 Rev. 2
11/11/75

CASTING REPAIR WELDING REPORT

3.26.76 (DATE) | CONTRACT NO. | 42

USTOMER: Atwood & Morrill	CUSTOMER P/O NUMBER: AM1734	SHOP ORDER NUMBER: D818 05	
D.: 16659-30545-601	MATERIAL SPEC.: ASME SA352	GRADE: LCB	HEAT NUMBER: F8095
ASTING SERIAL NO.: F8095.5	R.T. SERIAL NO.: P892	WELDING PROCEDURE QAP: W(P1Q) 1/2 REV.: 0	& ADD: — REV.:
LLER METAL: E7018	FILLER METAL LOT NUMBER: 029B233		

PPROVED TO WELD

1. Rob Salisbury (QUAKER ALLOY CASTING CO.) 3.26.76 (DATE)
2. _____ DATE
3. _____ DATE
4. _____ DATE

/ELDERS

1. Smith 3.26.76 (DATE)
2. _____ DATE
3. _____ DATE
4. _____ DATE

ISCONTINUITIES DESCRIBED HEREIN HAVE BEEN REVEALED BY THE FOLLOWING METHODS:

☑ RADIOGRAPHY ☐ MAGNETIC PARTICLE ☐ LIQUID PENETRANT ☐ ULTRASONIC ☐ DIMENSIONAL ☐ VISUAL

XAMINATION OF AREA PREPARED FOR WELDING: MT-301/AS-1 Revo +add1				EXAMINATION OF AREA APPROVED BY: Warren H Wagner LL DATE 3.26.76
AP.: mtd301	REV.: 0	& ADD: 1	REV.: —	

IEPECTION REQUIREMENTS: ☑ RT ☐ PT ☐ UT ☑ VISUAL	PREHEAT TEMP.: 60°F min	INTERPASS TEMP.: 60°F min	POST WELD HEAT TREATMENT: 1200°F ± 25° PWHT
C. AYER EXAMINATION: DATE:	INTERMEDIATE EXAMINATION: DATE:		

NONDESTRUCTIVE EXAMINATION OF COMPLETED WELD REPAIRS

1. VISUAL EXAMINATION: Satisfactory CF LL CF LL — DATE 5.10.76
2. MAGNETIC PARTICLE EXAMINATION: MT/D301 Revo +add1 / MT-301/AS-1 Revo +add1 — DATE 5.10.76
3. LIQUID PENETRANT EXAMINATION: NA — DATE
4. RADIOGRAPHIC EXAMINATION: See RT Report — DATE
5. ULTRASONIC EXAMINATION: NA — DATE

REMARKS:

REVIEWED
JUN 11 1976
M. Johnson Bechtel Corp

J. Peterson Bechtel Corp 8-6-76

APPROVED BY:

1. S Bates (QUALITY ALLOY CASTING CO.) DATE 5.27.76
2. A.F. Hallmark IV A&M Q.C. DATE 6-3-76
3. _____ DATE
4. _____ DATE

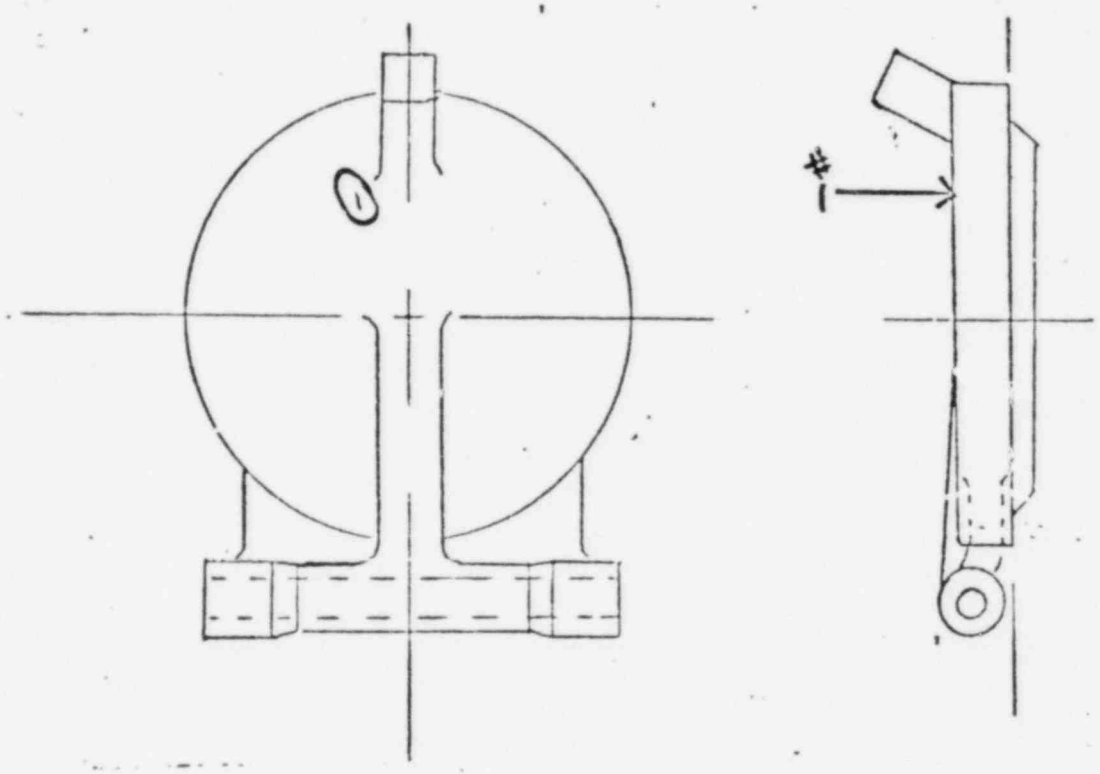
FORM [illegible] REV. A

WELD REPAIR CHART

DATE	CONTRACT NO.

CUSTOMER	CUSTOMER P/O NUMBER	SHOP ORDER NO.
Atwood + Morrill	AM-1734	0818-05

ITEM NO.	HEAT NUMBER	CASTING SERIAL NO.	B.C. SERIAL NO.
6 (59-305415-601	F8095	F8095-5	P892



SIZE AND CLASSIFICATION OF DISCONTINUITY

REPAIR NO.	DISCONTINUITY	SIZE	REMARKS	REPAIR NO.	DISCONTINUITY	SIZE	REMARKS
1	B+C	2" x 1 1/4" x 1" Deep	Major				

REVIEWED
J. Peterson
Bechtel Corp
6-6-76
JUN 11 1976
M.G. [illegible] Steel Corp

CLASS OF DISCONTINUITY
A. POROSITY
B. INCLUSIONS
C. SHRINK
D. LINEAR
E. INSERTS
F. DIMENSIONAL CORRECTION

A&M Q.C. 8 A

6-3-76

Form 156-2 Rev. A

QUAKER ALLOY CASTING CO., MIDDLETOWN, PA.

STOMER Atwood & Morrill PURCHASE ORDER AM1734 CONTRACT NO.

OP ORDER D818-05 Q DESIGNATION Q60-1 PATTERN NO. 16659-30545.601

AL SPEC. & GRADE ASME SA352 GR.LCB DESCRIPTION d-sc SIZE

AT NO. F8095 CASTING SERIAL NO. F8095-5 R.T. SERIAL NO. P892

CISAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION

HEAT TREATMENT RECORD

PROCESS*	N	HARDEN	TEMPER	PWHT
PROCEDURE	Rev.1 QAP-HT(P-10)-1	Rev.1 QAP-HT(P-10)-1		Rev.0 QAP-W(P-10) 1/2
DATE	1-7-76	1-27-76	1-29-76	3-29-76
FURNACE	Flynn & drefinn	Flynn & Drefinn	Gas Machine	Gas Machine
CHARGE NO.	FD1219	FD1243	GM1700	GM1776
CHARGE TEMP.	190°F	205°F	260°F	250°F
TIME TO EQUIL. TEMP.	3 hrs. 5min.	1 Hr.40Min.	40 Min.	30 Min.
ING TEMP. (RANGE)	1690°-1700°F	1630°-1650°F	1190°-1200°F	1200°F
TIME AT TEMP.	4 Hrs. 25 min.	4 Hrs. 5 Min.	4 Hrs. 5 Min.	6 Hrs. 5 Min.
COOLING DATA	Air	*	Air	Air

*FURNACE COOL 1450°-1460°-1 hr. 5 min.
1420°-1435°-35 Min.

REMARKS Water quench

ACTUAL HEAT TREAT CHARTS ARE RETAINED IN FILE FOR THE ABOVE.

*N = Normalize or homogenize
Q = Quench or harden
T = Temper
SA = Solution Anneal
PWHT = Post Weld Heat Treat (Stress relieve)

PREPARED BY S. Bates
Quaker Alloy Casting Company
TITLE Q.C.Clerk
DATE 5-27-76

A&M Q.C. 8 A 6-3-76 REVIEWED

JUN 11 1976

M [illegible] Bechtel Corp

J Peterson Bechtel Corp 8-6-76

Form 212
10/23/75

QUAKER ALLOY CASTING CO.
A DIVISION OF HARSCO CORP.
STAINLESS, SPECIAL ALLOY
AND CARBON STEEL CASTINGS
MYERSTOWN, PENNA.
17067

R.T. s/n P-892

9-25-75

AMENDMENT TO AIRCO CORPORATION

CERTIFICATION FOR LOT 029B833 OF FILLER MATERIAL

STRESS RELIEVED AT 1350°F FOR 8 HOURS

Yield	58,500
Tensile	70,500
Elongation	25.0
Reduction of Area	76.8

"V" NOTCH CHARPY IMPACT MINUS 20°F

Foot-Pounds	56	94	100	90
Mils Lateral Expansion	34	82	80	72
% Ductile Fracture	40	70	60	50

TESTS CONDUCTED BY QUAKER ALLOY CASTING COMPANY

Mark M. Landis

WE CERTIFY THE CONTENTS OF THIS DOCUMENT, AND THE ATTACHED AIRCO TEST REPORT FOR LOT 029B833 IS IN COMPLIANCE WITH SECTION III OF THE ASME BOILER & PRESSURE VESSEL CODE 1974 EDITION.

J. J. Peters
Bechtel Corp
8-6-76

M&M Q.C.8 A 6-3-76

REVIEWED
JUN 11 1976
M J. J. Peters
Bechtel Corp

Quaker Alloy Casting Co.
Myerstown, Pa.

QTC ACTUAL (QA 6)

DATE August 27, 1975

AIRCO ORDER NO. J-633081-A

FICATION: SFA 5.1

S 5.1-69 ASME SECTION III -71 NB 2400

CUSTOMER ORDER NO. 1674 Order #34708

POUNDS	SIZE	TYPE	HEAT	LOT NO.
5,000	5/32"	CA 7018	N-12686	029B833

Actual CHEMICAL ANALYSIS OF Weld Deposit

C	Mn	P	S	Si	Ni	Cr	Mo	V	Cu
.057	.97	.014	.020	.27	.048	.057	.076	.004	.034

Actual PHYSICAL PROPERTIES OF Weld Deposit

TENSILE STRENGTH PSI	YIELD STRENGTH PSI	ELONGATION % IN 2"	REDUCTION IN AREA %	
76,700	65,200	28.0	52.5	As-Welded
70,300	58,300	37.0	77.1	*Stress Relieved

*Stress 1150°F for 8 hours

.97
.048
.057
.076
.004
1.155

ADDITIONAL TEST RESULTS

X-Ray results satisfactory to Paragraph 8.1.1 of AWS 5.1-69 SFA 5.1

Fillet Weld Usability Test satisfactory to Paragraph 8.1.4 of AWS 5.1-69 SFA 5.1

"We certify the above material has been tested in accordance with the listed specification and is in conformance with all requirements. We further certify that the above material was manufactured in compliance with Section III, ASME Boiler and Pressure Vessel Code".

J. Peterson Bechtel Corp 8-6-76

E OF Maryland

TY OF Baltimore

CRIBED AND SWORN TO BEFORE ME THIS 27th DAY

19

NOTARY PUBLIC BALTIMORE COUNTY, MARYLAND

OMMISSION EXPIRES July 1, 1978

I certify the chemical analysis and physical or mechanical test results reported above meet the specifications on the described material and are correct as contained in the records of the Company.

R Sattazahn

G. G. Hall
Quality Control Expeditor

A & M Q.C.S. A

6-3-76

JUN 11 1976

POLY CAST, INC.

800 RICKETT ROAD · P.O. BOX 237
BRIGHTON, MICHIGAN 48116
TELEPHONE 313-229-2934

№ 10194

Ref: 5458

APPROVED
DATE 2/22/76
BY W. Sullivan
EDWARD J. MORRILL CO., INC.

SOLD TO • ATWOOD & MORRILL
285 Canal Street
Salem, Mass. 01970

SHIP TO • SAME

INVOICE DATE
2/20/76
SHIPPING DATE
2/20/76
CARRIER
Interstate

CUSTOMER ORDER NO.	DATE	DATE ENTERED	SALESMAN
3219	12/23/75		N/A

FREIGHT PREPAID	FREIGHT COLLECT	FORM	TERMS NET - 30 DAYS
	XXX	Welding Rod	XXX

STATUS OF ORDER	COMPLETE	PARTIAL
	XXX	

LBS. ORDERED	DESCRIPTION	PRICE PER LB.	NET LBS. SHIPPED	PRICE EXTENSION
500#	3/16" dia. x 14" long Poly Cast No. 21 PC-21-MOD-118 Nuclear Gas Quality This material meets AWS A5.13-70 Class RCoCr-X and conforms to ARticle NB-2000, Section III, ASME Boiler & Pressure Vessel Code and complies with the marking requirements for welding materials of Section III, 1974, thru summer 1975, addenda of ASME Boiler & Pressure Vessel Code, para. NA3766.6(B) Color Code: Red		552#	

CHEMICAL ANALYSIS

HEAT NO.	C	Mn	Si	P	S	Ni	Cr	W	Mo	Fe	Co	Others
PC-21-MOD-118	.22	.30	.70	.015	.018	2.06	27.5	.08	5.11	.84	BAL.	∠.50

Certification of quality assurance tests to follow.
Usability Tests Performed.
Poly Cast, Inc. certifies that the content of this report is correct and accurate.

We hereby certify that the foregoing data is a true copy of the data resulting from tests performed in our laboratory or of the data furnished us by the laboratory performing the tests.

DATE February 20, 1976
Subscribed to and sworn before me

J. Peterson Bechtel Corp 4-21-76

WILLIAM R. GALL
Notary Public, Washtenaw Co., Mich.
My Commission Expires Dec. 1, 1979

NOTARY PUBLIC
Acting in Livingston Co., Mich.

POLY CAST, INC.

AUTHORIZED AGENT
Stephen J. Barkovich

ALL CLAIMS MUST BE MADE WITHIN 30 DAYS. PRICES SUBJECT TO CHANGE WITHOUT NOTICE

We hereby certify that these goods were produced in compliance with all applicable requirements of Section 6, 7 and 12 of the Fair Labor Standards Act of 1938, as amended and all regulations and orders of the administrator of the Wage and Hour Division issued under Section 14 thereof. Shipments under $500

WHITTIER, CALIFORNIA

PRODUCT CERTIFICATION

Atwood & Morrill Company, Inc.

285 Canal Street

Salem, MA 01970

Date June 10, 1975

Certification No. 1469-75

Customer P.O. No. AM 25777 Item No. 1

Stoody Product Name 3/16" Stoody E309 Mo-16 Stainless Electrodes

Specification ASME SFA 5.4

S.O. 15844 Wt. 2110 lbs

Lot No. 7267

CHEMICAL ANALYSIS – PERCENT BY WEIGHT

Actual Chemical Analysis of Undiluted All-Weldmetal Deposit

C	Mn	Si	Cr	Ni	Mo	Cb+Ta	P	S
08	1.79	0.31	23.42	12.40	2.17	0.01	0.013	0.018
		Co	V	Ti	Cu			
		0.03	0.02	0.01	0.03			

Ferrite per Schaeffler Diagram 10% Ferrite Number 11

Remarks: Mechanical Properties: Ultimate Tensile Strength 89900 psi

Elongation 33%

We hereby certify that the above material was manufactured in compliance with Para. NA4112, NB2130, NB2140, NB2152, and NB2400, Sect. III, 1974 (including addenda through Winter 1974 inclusive) Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code.

Each container and package is identified in accordance with NB2152 requirements showing ASME Section IIC Specification and Classification, Heat and Lot Number, Stoody Company name and trade designation, size and net weight. Each electrode is identified by Specification classification.

METALLURGY
ATWOOD & MORRILL
approved for use
6-27-75

APPROVED
DATE 6/25/75
BY W. Sullivan
ATWOOD & MORRILL CO., INC.

STOODY COMPANY

Frank Ordway, Supervisor
Quality Assurance

Form T-14

CANN & SAUL STEEL CO.

ROYERSFORD, PA. 19468

Report of Physical Tests and/or Chemical Compositions

RECEIVED MAY 20 '76 ATWOOD & MORRILL CO.

9

Date 5/12/76

Customer's Order No. AM-3525 Ref. #13615-01-013(2) 13615-06-013(2) S/N 1 + S/N 2 - 13615

Cann & Saul Order No. 37714

LOAD KEYS

Customer Atwood & Morrill Co., Inc.

Address 285 Canal St. Salem, Mass. 01970

Attention Purchasing Dept.

CHEMICAL COMPOSITIONS

	HEAT NO.	C	MN	P	S	SI	CR	NI	Fe DSX	Al DSX	Ti	Cu
(Ladle)	NX8224	.09	.43	.007	.011	.20	15.13	75.33	8.46	.34	.24	.36
(Check)		.08	.48	.007	.004	.31	14.96	74.70	8.37	.22	.36	.37

Lab. No.	B	Co	Mg
	.005	.004	.06
	.004	.05	.013

PHYSICAL TESTS

CUT FROM	TEST NUMBER	GAUGE	YIELD PT. LBS.	YIELD PER Square In Lbs.	BROKE AT LBS.	ULTIMATE TENSILE LBS.	ELONG %	REDUCED AREA	Reduction %	B.H.N.
			YS	YS .2%						
Forg-ing	37714 1	.505	10,500	52,500	19,500	97,500	35.0	.082	56.5	

CHEMICAL & PHYSICAL REPORT CHECKED

BY C. Shaw

DATE 6/8/76

ATWOOD & MORRILL CO. INC.

OTHER TESTS

Sonic C&S Proc. A388, Rev. 21B(6/11/75) Acceptable.

We certify that the contents of this report are accurate and correct and that all operations by our company or subcontractors are in compliance with the requirements of materials specification and the ASME Code, Section III 1974 Edition with 1974 Summer Addenda.

Customer's Specifications: ASME SB-564

Inconel 600 B.H.N.

XXX	35,000	YS .2%
T.	80,000	
E.	30	
R.	--	

THE ABOVE TESTS COVER THE FOLLOWING MATERIAL:

4 - Load Key Forgings per Dwg. 22897-C, Rev. 1 for Dwg. 30836-706-7942.
Forgings serialized #1 thru 4

A&M & Bechtel

Inspection

Inspector

A&M QC.8 A 5-12-76

APPROVED DATE 6/8/76 BY W. Sullivan ATWOOD & MORRILL CO.

CANN & SAUL STEEL CO.

End of Test

J Peterson Bechtel Corp 8-6-76

VERIFIED A+M ACCEPTANCE SFC ANE 7-30-76

13615-01 Stuffing Box 24"

5/11/1

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.
MYERSTOWN, PENNA. 17067

MATERIAL TEST REPORT

CUSTOMER ORDER NO	PATTERN NO	QUAKER ALLOY DESIGNATION	SPECIFICATION	SHOP ORDER NUMBER	DATE SHIPPED
AM1734	16446-1-30626-804	Q60	ASME SA352 GR.LCB		6.24-7

CUSTOMER: Atwood and Morrill

APPROVED
BY J. J. [illegible]
DATE 7-2-76
ATWOOD & MORRILL CO. INC.

HEAT NO	C	Mn	Si	P	S	Cr	Ni	Mo			YIELD P.S.I.	TENSILE P.S.I.	ELONG %	RED of AREA %	CSTG. SER.#	R.T. SER.#	PC SHIP
A9478	.19	.65	.47	.015	.014						42,000	75,000	29.0	47.0	A9478-2	P2187	1
		Charpy Impact V Notch Plus 50°F							99-93-96			foot pounds					
									70-71-70			lateral expansion					
									90-90-90			% Ductile Fracture					

REMARKS

6-23-76

L. Peterson Bechtel 5-6-76

Bechtel Corp 6/22/76

CHEMICAL & PHYSICAL REPORT CHECKED
BY W. Trainer
DATE 6-30-76
ATWOOD & MORRILL CO. INC.

STATE OF PENNSYLVANIA, COUNTY OF LEBANON, S.S.
SWORN TO AND SUBSCRIBED BEFORE ME

THIS DAY OF 19

ANI 7-19-76 QC

"I CERTIFY THE ABOVE INFORMATION IS CORRECT"
QUAKER ALLOY CASTING CO.

BY B. Sattazahn METALLURGIST

101

CUSTOMER Atwood and Morrill PURCHASE ORDER AM1734 CONTRACT NO. 102

SHOP ORDER D813-05 Q DESIGNATION Q60 PATTERN NO. 16446-1-30626-804

MATERIAL SPEC. & GRADE ASME SA352 GR.LCB DESCRIPTION stuffing box SIZE

HEAT NO. A9478 CASTING SERIAL NO. A9478 2 R.T. SERIAL NO. P2187

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION Atwood & Bechtc

CERTIFIED MATERIAL TEST REPORT

The records enclosed in this folder comprise the certified material test report for the subject material.

APPROVED
BY [signature]
DATE 7-2-76
ATWOOD & MORRILL CO. INC.

AFFIRMATION

We certify that the contents of this report are correct and accurate and that all test results and operations performed by Quaker Alloy Casting Company or our sub-contractors are in compliance with the material specification and appropriate material requirements of the ASME Code 1974 Edition through 1974 Summer Addenda, Section III, as stipulated in the procurement documents. All requirements of the material spec. and all special requirements of Art.NB2000 Sect.III 1974 and 1974 Summer addenda have been met.

Paul R Settanni — 6-23-76
Quaker Alloy Casting Company — Date

A&M QC.S A 6-23-76

REVIEWED
JUN 23 1976

QA1 Rev. 2
11/11/75

L. Peterson Bechtel Corp 8-6-76

[signature]
Bechtel Corp.

13615 stuffing Box 24"
S/N 3

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.
MYERSTOWN, PENNA. 17067

MATERIAL TEST REPORT

CUSTOMER ORDER NO	PATTERN NO	QUAKER ALLOY DESIGNATION	SPECIFICATION	SHOP ORDER NUMBER	DATE SHIPPED
AM1734	16446-1-30626-804	Q60	ASME SA352 GR.LCB		6.24.76

CUSTOMER: Atwood and Morrill

APPROVED
BY R. Jos. Dupault
DATE 7-2-76
ATWOOD & MORRILL CO. INC.

HEAT NO	C	Mn	Si	P	S	Cr	Ni	Mo			YIELD P.S.I.	TENSILE P.S.I.	ELONG %	RED. of AREA %	CSTG. SER.#	R.T. SER.#	PCS SHIPP
A9022	.21	.68	.35	.015	.013						53,500	83,000	32.0	67.4	A9022-5	P1179	1
		Charpy Impact V Notch Plus 50°F							108-94-103	foot pounds							
									65-62-60	lateral expansion							
									70-70-70	% ductile Fracture							

REMARKS

A&M Q.C.8 6-23-76

L. Peterson Bechtel Corp. 8-6-76

Raymond J. Lee Bechtel Corp 6/24/76

CHEMICAL & PHYSICAL REPORT CHECKED
BY W. Frame
DATE 6-30-76
ATWOOD & MORRILL CO. INC.

STATE OF PENNSYLVANIA, COUNTY OF LEBANON, SS
SWORN TO AND SUBSCRIBED BEFORE ME

THIS DAY OF 19

ANI 7-19-76 GCC

"I CERTIFY THE ABOVE INFORMATION IS CORRECT"
QUAKER ALLOY CASTING CO.

BY B Sattazahn METALLURGIST

110

AIRCO QUALITY CONFORMANCE REPORT PRTD. IN U.S.A.

Master

P.O. 2863

IP
D (

Middlesex Welding Supply
2 Rindge Ave.
Cambriadge, MASS. 02140

APPROVED
DATE 3-1-76
BY
ATWOOD & M.O. RILL CO., INC.

1/12/76
DATE

458-886
AIRCO ORDER NO.

C6344
CUSTOMER ORDER NO.

PECIFICATION: ASME SFA 5.1, Group#F-4 ASME SEction III, 1974 Edition including ddenda thru Summer 1975.

M	WEIGHT (LBS)	SIZE	TYPE	HEAT NO.	LOT NO.
	550	1/8	E7018	411T2271	026B2

CHEMICAL & PHYS. DEPT.
REPORT CHECKED
E.T. Hardy
3/1/76

HICAL ANALYSIS is (1) Actual Weld Metal ☒ (2) Typical Weld Metal ☐ (3) Mill Check Analysis ☐ (4) Actual Wire Analysis ☐

C	Mn	P	S	Si	Ni	Cr	Mo	Cb	V	Cu			
.068	.66	.015	.014	.48	.049	.041	.11	---	.004	/.01			

MECHANICAL PROPERTIES (1) Actual Weld Metal ☒ (2) Typical Weld Metal ☐

M	TENSILE P.S.I.	YIELD P.S.I.	% EL.	% R.A.	OTHER
	80,710	70,620	30.0	77.6	As Welded
	73,775	60,650	35.0	75.9	Stress Relieved at 1150°F for 8 hours.

ADDITIONAL TESTS

X-ray results satisfactory to paragraph 8.1.1 of AWS SFA 5.1-69

Fillet Weld Usability Test satisfactory to paragraph 8.1.4 of AWS SFA 5.

The above material meets the paragraphs of NB2130, NB 2150 NB2400, NB41 of the ASME Section III, 1974 including addenda through Summer 1975. Weld deposits fall within Weld Metal Analysis No. A-1 in accordance wit Section IX, 1974 paragraph Q.W. 430, 431, 432, 440, and 441.

rn and Subscribed before me this 12th
o. January 19 76

Commission Expires 7/1/78

I certify the chemical analysis and physical or mechanical test result reported above meet the specifications on the described material and are correct as contained in the records of the Company.

Linde Div. Union Carbide Corp. 1-21-76

G. G. Hall 1/12/76
AUTHORIZED SIGNATURE DATE

G. G. Hall Quality Control Expediter

CERTIFICATE OF TEST - CHARPY V-NOTCH IMPACTS

121

1/12/76
DATE

458-886
ORDER NO.

C6344-
CUSTOMER ORDER NO.

Impacts in accordance with SA 370
Section III of the ASME Code including Addenda thru Summer 1975.

TYPE	DIAMETER	LOT NO.	HEAT NO.
E7018	1/8"	026B2	411T2271

TEST TEMPERATURE -20°F

As-Welded

Specimen No.	Energy (ft-lb)	Lateral Expansion (Mils)	Shear (%)
1	129	84	70
2	131	81	80
3	109	75	70
4	151*	85	70
5	103*	71	70
Average	123		

Stress Relieved at 1150°F for 8 hours.

Specimen No.	Energy (ft-lb)	Lateral Expansion (Mils)	Shear (%)
1	124	79	60
2	112	73	60
3	106*	80	50
4	163*	87	90
5	125	79	50
Average	120		

J. Peters
Bechtel Corp
9-21-76

G. G. Hall 1/12/76
AUTHORIZED SIGNATURE DATE

G. G. Hall
Quality Control Expediter

The extreme lowest and highest values were disregarded for computing average.
The specimen failed to fracture at 240 ft-lb the maximum reading for our instrument.

Atwood & Morrill Co.
P.O. M 3815

18 pcs 1/2" Sch 160, 6" long
4 pcs 1/2" " 2-1/2" long

SHARON TUBE COMPANY, SHARON, PENNA.
Cold Draw Department

13615 A-106

Braman Dow PIPE
N910

Report of CHEMICAL and PHYSICAL Tests for Charles F. Cuyon, Inc. February 17 1976

5089-75 Harrison, New Jersey

Customer Order No. P-15073

DESCRIPTION	LOT NO.	HEAT NUMBER	CHEMICAL ANALYSIS C	Mn	P	S	Si		HARDNESS		YIELD PSI	ULTIMATE PSI	ELONGATION IN _ IN	PERCENT	
1/2" Blk. Schedule 160	1	E10594	.22	.77	.007	.013	.18		74	Rb	51530	65590	2	40.0	C
	2	J07172	.22	.73	.007	.023	.16		73		50100	72530		40.0	

APPROVED
DATE 8/26/76
BY [illegible]
[illegible] PIPE CO., INC.

We certify that the contents of this report are correct and accurate and that all operations performed by our company are in compliance with the requirements of materials specifications and the ASME Code, Section III, 1974 Edition with Summer 1974 addenda, with the exception of performing the Eddy Current and Ultrasonic Testing.

CHEMICAL & PHYSICAL REPORT CHECKED
BY C.U. Frauen
DATE 8-26-76
[illegible] Co., Inc.

Cold Drawn Stress Relieved Carbon Steel Seamless Pressure Pipe Meeting the Requirements of ASTM A-106 Grades A & B and ASME SA-106 Grades A & B; Each Length of Pipe Hydrostatically Tested to 2500 P.S.I.

APPROVED
BY: J Garry DATE 2-27-7
[illegible] ON & ORS INC

STATE OF PENNSYLVANIA, } ss
COUNTY OF MERCER }

Subscribed and sworn to before me this 27th day February, A. D., 1976

L. Patton Bechtel Corp 8-26-76

Robin E. McGinnis, Notary Public
My commission expires October 4, 1978

W. D. Perrine, being duly sworn according to law, deposes and says that the figures set forth above are correct, as contained in the records of the Company.

W. D. Perrine

W.D.P. 8-26-76

123

Custome

Braman Dow & Co.
239 Causeway Street
Boston, Massachusetts 02114

FEB 13

Ship to: Them

CERTIFICATION of MATERIAL WITH FULL TRACEABILITY

Def. 13615-

PIPE CAPS

Customer P.O. Number: N
Tag Number:
Vogt Invoice: 234489

We certify that the Vogt products identified below were manufactured in full accordance with the specifications listed and are marked with a Vogt Code which is traceable to the original mill heat.

APPROVED
DATE 8/26/76
BY
ATWOOD & MORRILL CO. INC.

(1) S.O. Item Numbers | Description

Item 1 - 20 - 1/2" #SW-4001 6000# SW Cap

Item 01 - S/O 1 Thru 4-13615
03 C-13315
04 F-13615
05 8 Thru 11-13615

Atwood & Morrill Co. P.O. AM 3815

20 pcs 1/2" Sch 160 6000# FS SW Caps

06 12 Thru 15-13315
08 17-13615
10 19 Thru 22-13615

S.O.(1) Item No.	Vogt Code No.	Material Producer	Heat Number	Chemical Analyses of Material Used in the Manufacture of Above Items								Mechanical Property Data From Representative Test Pieces Heat Treated with the Above Items					Heat Treat	Spec
				C	MN	P	S	SI	CR	NI	MO	YIELD STRENGTH	ULTIMATE STRENGTH	ELONG	R A	BHN		
1	CKP	U.S.Steel	L64415	.30	.80	.009	.017	.22				53190	85257	29	54	156	NR	A-234-WPB*

CHEMICAL & PHYSICAL REPORT CHECKED
8-26-76
ATWOOD & MORRILL CO. INC.

a. Certifications to ASTM specifications are acceptable for ASME Code use. See ASME ... n 2, Foreword, last paragraph

(1) S.O.: Shop Order
A: Annealed
N: Normalized
NT: Normalized & Tempered
QT: Quenched & Tempered
SA: Solution Annealed
NR: Not Required

*Forgings marked WPB. Machined from bar stock with chemical and mechanical properties complying with A-105-73.

HENRY VOGT MACHINE CO., INC.

By: Elizabeth L...
Title: Asst. to Chief Metallurgist
Date: February 17, 1976

L Peterson Bechtel Corp 8.27.76

Vgt 8-26-76

Henry Vogt Machine Co.
P.O. ... - Louisville, Ky. 40201
502-634-9411

131

JOS. DYSON & SONS INC.//DEPENDABLE DIVISION

POST OFFICE BOX 4078
CLEVELAND, OHIO 44137
TELEPHONE 216 941-4300

DATE SHIPPED	DEPENDABLE ORDER NUMBER	CUSTOMER ORDER NUMBER
6-27-76	M2391-1-8N	AM 3831

Atwood & Morrill
285 Canal Street
Salem, Mass. 01970

RECEIVED
JUN 21 1976

REVISED CERTIFICATION 6/16/76

Description:
ITEM 2: 160 Pcs. 1 1/2-8 x 9 3/4 TBE Studs per DWG. SK 3730
ITEM 4: 160 Pcs. 1 1/2-8 Hvy Hex Nuts
ITEM 5: 192 Pcs. 7/8-9 x 4 TFL Studs per DWG SK 3729
ITEM 6: 192 Pcs. 7/8-9 Hvy Hex Nuts

Specification: ASME Sec. III Cl. I S74 Addenda SA 540 B23 Cl 5 SA 193 B7 SA 194 2

ITEM	HEAT	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V				
2.	40215	.39	.82	.012	.020	.30		1.73	.88	.22		TRACE D-59			
4.	83642	.40	.72	.010	.010	.29		1.70	.74	.22		TRACE D-58			
5.	52208	.45	.96	.012	.028	.26		.22	.96	.15		TRACE D-61			
6.	26210	.43	.81	.015	.024	.18						TRACE D-60			

ITEM	TENSILE STRENGTH PSI	YIELD PSI	ELONG. PERCENT IN 2"	PER CENT RED. AREA	HARDNESS	BEND TEST	CHARPY	MIN. TEMP
2.	133,500	119,250	21.5	64.4	BHN 269		+50°F OK	850°F
4.	131,500	117,750	23.5	65.9	BHN 262		+50°F OK	850°F
5.	144,425	120,925	19.0	62.3	BHN 293			1100°F
6.	PROOF LOAD	59,650	SATISFACTORY		RC 31 RB 90			850°F

Items 2 and 4 magnetic particle inspected and acceptable to approved procedures.

"We certify that the contents of this report are correct and accurate and that all operations performed by our company or subcontractors are in compliance with the requirements of materials specification and the ASME Code, Section III, 1974 Edition with Summer 1974 addenda."

MILLS LATERAL EXP TRACE D-58
.056
.045
.051

MILLS LATERAL EXP TRACE D-59
.055
.053
.056

L. Peluso Penfield Corp 8-26-76

APPROVED
DATE 7/20/76
BY N. J. [illegible] INC
ATWOOD & MORRILL

Mfg. 8-26-76

CHEMICAL & PHYSICAL REPORT CHECKED
BY D. Eikup
DATE 6/24/76
ATWOOD & MORRILL CO. INC.

THE ABOVE TESTS CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS LISTED

CERTIFICATE NOTARIZED ONLY WHEN REQUIRED

I, _____, a Notary Public do hereby certify that this affidavit was subscribed and sworn to before me by a duly authorized agent of Jos. Dyson & Sons, Inc., this _____ day of _____

We hereby certify that the foregoing data is a true copy of the data furnished us by the producing mill or the data resulting from tests performed

DEPENDABLE DIVISION
JOS. DYSON & SONS INC.
BY _____
AUTHORIZED AGENT

MY COMMISSION EXPIRES

NOTARY PUBLIC

FORM C101

CANN & SAUL STEEL CO.

ROYERSFORD PA. 19468

90

Report of Physical Tests and/or Chemical Compositions

6/17/76

	Customer's Order No.	Cann & Saul Order No.
Customer: Atwood & Morrill Co., Inc.	AM-3525	37713
Address: 285 Canal St. Salem, Mass. 01970	Ref. #13615-01-014	S/N 1 + 2-13615-
	13615-06-014	S/N 10+11-13615-
	COVERS	

Attention: Purchasing Dept.

CHEMICAL COMPOSITIONS

HEAT NO.	C	MN	P	S	SI	CR	NI	MO	CB
214903	.24	1.22	.012	.027	.28	(Ladle)			
	.24	1.14	.009	.031	.26	(Check)			

Lab. No.

PHYSICAL TESTS

CUT FROM	TEST NUMBER	GAUGE	YIELD PT. LBS.	YIELD PER Square In Lbs.	BROKE AT LBS.	ULTIMATE TENSILE LBS.	ELONG %	REDUCED AREA	Reduction %	B.H.N.
Forging	37713 1	.505	8,800	44,000	15,500	77,500	32.0	.079	60.5	
Charpy Impacts "V" Notch	32 52 46 Mils lateral expansion @ +50°F									

CHEMICAL & PHYSICAL REPORT CHECKED

BY D C Sharp

DATE 6/30/76

ATWOOD & MORRILL CO. INC.

OTHER TESTS

Sonic A388, Rev. 21B(6/11/75) Acceptable

We certify that the contents of this report are correct and accurate and that all operations performed by our company or subcontractors are in compliance with the materials specification and the ASME Code, Section III 1974 Edition and S74 Addenda.

Customer's Specifications: ASME SA350- Gr. LF-2

Charpy "V" Impact 25 Mils Lat. Exp. @ +50°F

25/30 Carbon B.H.N.

Y. P. 36,000
T. 70,000
E. 22%
R. 30%

THE ABOVE TESTS COVER THE FOLLOWING MATERIAL:

4 - Cover Forgings per Dwg. 24148-B, Rev. 0 for Dwg. 30841-601-2967
Forgings serialized #1 thru 4

A&M QC 1 A 6/4/76

A&M
Inspection

G. Walker Level II 6/4/76
Inspector

APPROVED
DATE 7-15-76
BY
ATWOOD & MORRILL CO., INC.

F. Peterson Bechtel Corp 8-6-76

CANN & SAUL STEEL CO.

M E Baltusavich
End of Tests

AAI 7-16-76

SEE APERTURE CARDS

APERTURE CARD NO# 01-02

AVAILIBILITY ✓ PDR ___ CF ___ HOLD ___

NUMBERS OF PAGES. 2

FORM NPV-1 MANUFACTURERS' DATA REPORT FOR NUCLEAR PUMPS OR VALVES*

As Required by the Provisions of the ASME Code Rules

1. Manufactured by Atwood & Morrill Co., Inc. Salem, Mass. (Name & Address of Manufacturer) Order No. 13561-01

2. Manufactured for General Electric Co. San Jose, California (Name and Address) Order No. 205-AF775

3. Owner Mississippi Power & Light Co.

4. Location of Plant Port Gibson, Mississippi

5. Pump or Valve Identification S/N 7-561 28" - 575# Main Steam Isolation Valve

For service in Main Steam Piping System (Brief description of service for which equipment was designed)

(a) Drawing No. 13561-01-H Rev. 5 Prepared by Robert Knox

(b) National Board No. N/A

6. Design Conditions 1375 (Pressure) psi 586 (Temperature) °F

7. The material, design, construction, and workmanship complies with ASME Code Section III, Class 1

Edition 1974, Addenda Date N/A, Case No. N/A

Mark No.	Material Spec. No.	Manufacturer	Remarks
(a) Castings			
Body	SA216-WCB	Quaker Alloy	S/N 7-561
RT # N1555			
(b) Forgings			
Poppet	SA 105 (QT)	Cann & Saul	S/N 4-561
Cover	SA 105 (QT)	Cann & Saul	S/N 5-561

*Supplemental sheets in form of lists, sketches or drawings may be used provided (1) size is 8½" x 11", (2) information in items 1, 2, 5a and 5b on this data report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded at top of this form.

Mark No.	Material Spec. No.	Manufacturer	Remarks
(c) Bolting			
Cover Studs (18)	SA540, Gr.B23 Class 5	Jos. Dyson & Sons	Ht.#114188
Cover Nuts (18)	SA540, Gr.B23 Class 5	Jos. Dyson & Sons	Ht.#5P7751
(d) Other Parts			
* 3/4" Nipples (2)	SA106, Gr.B	U.S. Steel	S/N 5-561
* 45° Elbow	SA105	Vogt Mach. Co.	S/N 5-561

* NOTE: These items conply with the Code for material contruction and workmanship, but are not included as far as design is concerned.

8. Hydrostatic test Body 2175 Poppet 1450 psi.

CERTIFICATION OF DESIGN

Design information on file at General Electric Co. San Jose, California

Stress analysis report on file at Atwood & Morrill Co., Inc. Salem, Mass.

Design specifications certified by Clyde T. Nish (1) Prof. Eng. State Calif. Reg. No. 15587

Stress analysis report certified by Herbert Cook (1) Prof. Eng. State Mass. Reg. No. 10981

(1) Signature not required. List name only.

We certify that the statements made in this report are correct.

Date Dec. 16 19 75 Signed Atwood & Morrill Co., Inc. (Manufacturer) By [signature] Quality Control Manager

Certificate of Authorization No. N812 expires May 7, 1977

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State of Province of Massachusetts and employed by Hartford Steam Boiler Insp. & Ins. Co. of Hartford, Conn. have inspected the equipment described in this Data Report on Dec. 16, 19 75, and state that to the best of my knowledge and belief, the Manufacturer has constructed this equipment in accordance with the applicable Subsections of ASME Code, Section III.

By signing this certificate, neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the equipment described in this Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Dec. 16 19 75

[signature] (Inspector) John Paul Jones Commissions Mass. 755 (National Board, State, Province and No.)

CANN & SAUL STEEL CO.

S/N 7R-561

ROYERSFORD, PA. 19468

Report of Physical Tests and/or Chemical Compositions

Date 11-17-75

Customer Atwood & Morrill Co.
235 Canal St.
Address Salem, Mass. 01970

Attention Purch. Dept.

Customer's Order No. All-25353
Ref. #13561-01-221 STEM
G.E. #205-AF-775

Cann & Saul Order No. 34063

CHEMICAL COMPOSITIONS

HEAT NO.	C	MN	P	S	SI	CR	NI	MO	CB & Ta		Cu
74504	.04	.32	.018	.012	.67	16.13	4.16		.23		3.3

Lab. No.

PHYSICAL TESTS

CUT FROM	TEST NUMBER		GAUGE	YIELD PT. LBS.	YIELD PER Square In Lbs.	BROKE AT LBS.	ULTIMATE TENSILE LBS.	ELONG %	REDUCED AREA	Reduction %	B.H.N.
Forg-ing	34063	1	.505	Ys 29,600	YS.2% 148,000	31,500	157,500	19.0	.084	58.0	
Charpy Impacts:- "V" Notch				108.0 64	110.0 63	108.0 64	ft. lbs. @ Room Temp. mils lateral expansion				

CHEMICAL & PHYSICAL REPORT CHECKED

BY [signature]

OTHER TESTS

DATE 11/19/75

Brinell:-321/352
Sonic to C&S Proc. A388,Rev. 20(4-11-75):-Acceptable
Heat Treat to C&S H.T.Proc. 1900/1100(5-15-75)
We certify that the contents of this report are correct and accurate and that all operations performed by our company or subcontractors are in compliance with the requirements of materials specification and the ASME Code,Sec. III-'77 Edition.

ATWOOD & MORRILL CO. INC.

Customer's Specifications: ASME SA-564,Gr. 630, Cd. 1100
Charpy "V" Impacts 25'# @ R.T. Min.

17/4 PH BHN. 311 Min.

Y. 115,000 YS.2%
T. 140,000
E. 14%
R. 45%

THE ABOVE TESTS COVER THE FOLLOWING MATERIAL:

1 - Valve Stem Forging per Dwg. 21320-D,Rev. 1 for Code 15215-644-0582.
Forging serialized #9

GE & A&M
Inspection

Reviewed By R.E.C. Date 11/25/75
R. E. Clemps, Quality Control Representative
General Electric Co. - BWR Projects Dept.

APPROVED
DATE 11/24/75
ATWOOD & MORRILL CO. INC.

CANN & SAUL STEEL CO.

C. Bruen
Eng. of Tests

NUCLEAR ENERGY DIVISION

PRODUCT QUALITY CERTIFICATION

CUSTOMER/PROJECT		PRODUCT NAME	MPL NO.
Grand Gulf I		28" Main Steam Isolation Valve	B21-F022
G. E. PURCHASE ORDER NO.	REV	PURCHASE ORDER ITEM(S) NO.	QUANTITY
205-[illegible]F775	12	1 (one)	1 (one)

SUPPLIER'S CERTIFICATION

THIS IS TO CERTIFY THAT THE PRODUCTS IDENTIFIED HEREIN HAVE BEEN MANUFACTURED UNDER A CONTROLLED QUALITY ASSURANCE PROGRAM AND ARE IN CONFORMANCE WITH THE PROCUREMENT QUALITY REQUIREMENTS INCLUDING APPLICABLE CODES, STANDARDS AND SPECIFICATIONS AS IDENTIFIED IN THE ABOVE-REFERENCED DOCUMENTS; UNLESS NOTED BELOW. ANY SUPPORTING DOCUMENTATION WILL BE FORWARDED OR RETAINED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS.

SIGNED: [signature] DATE: 12-17-75

TITLE: Quality Control Manager ORGANIZATION: Atwood & Morrill Co. Inc.

GE QUALITY ASSURANCE CERTIFICATION

THIS IS TO CERTIFY THAT EVIDENCE SUPPORTING THE ABOVE SUPPLIER'S CERTIFICATION STATEMENT HAS BEEN REVIEWED AND NO PRODUCT NONCOMFORMANCES FROM PROCUREMENT QUALITY REQUIREMENTS HAVE BEEN FOUND UNLESS NOTED BELOW.

SIGNED [signature] DATE: 12-18-75

TITLE: GE QA REPRESENTATIVE ORGANIZATION: B.W.R.P.D.

NONCONFORMANCES FROM PROCUREMENT QUALITY REQUIREMENTS:

REMARKS/EQUIPMENT SERIAL NUMBERS:

Valve Serial Number 7-561

NUTS

Atwood and Morrill Co.
285 Canal Street
Salem, Massachusetts 01970

P.O. AM-25931
Heat No. 5P7751
Code A-51
Brisch Code 21838-7

99 Pcs. Hex Nuts for 26" and 28" Main Steam Isolation Valves
2-1/4" - 8 ANSI Standard Heavy

SPECIFICATION: SA-540 B-23, Class 5

HEAT NO. 5P7751 CODE NO. A-51

LADLE ANALYSIS: C-.39 Mn-.73 Phos-.012 Sul-.014 Sil-.22 Cr-.83 Ni-1.77 Mo--

CHECK ANALYSIS: C-.42 Mn-.80 Phos-.013 Sul-.013 Sil-.24 Cr-.83 Ni-1.65 Mo-.25

MECHANICAL TESTS:

	TENSILE	YIELD	ELONG	RED	BHN
	148,000	131,500	19.0	58.8	286
	151,000	134,500	20.0	58.1	286

CHARPY IMPACT TEST AT +60°F PER SA-370 45 Ft/Lbs.

	FT/LBS.	LAT. EXPANSION (IN.)	% DUC. FRACTURE AREA
	65.5	.042	100%
	66.5	.044	100%
	65.0	.042	100%
Ave.	65.5		
	64.0	.043	100%
	62.0	.039	100%
	62.5	.039	100%
Ave.	63.0		

Meets Mechanical requirements of ASME SA-540 Gr. B-23, Class 5, and ASME Section III, Sub Section NB-2333

HEAT TREAT DATA:

Heated to 1550°F 3 Hrs. at Heat - Oil Quenched →
Tempered at 1100°F 3 Hrs. at Heat - Air Cooled
Per Procedure HTN-573 Rev. 2, dated 6-12-75.

-Continued-

CHEMICAL & PHYSICAL REPORT CHECKED

APPROVED
DATE 12/4/75
BY
ATWOOD & MORRILL CO. INC.

Reviewed By: QEC Date: 12-10-75
R. E. Clompa, Quality Control Representative
General Electric Co. - BWR Projects Dept.

DATE 12/22/75
ATWOOD & MORRILL CO. INC.

(P) A.I. 12-4-75

Atwood and Morrill Co.
285 Canal Street
Salem, Massachusetts 01970

S.O. N-572
Dwg. # 3730
Brisch Code 34285-2
3276
Code A-88
Heat No. 114188

40 Pcs. Studs for 26" and 28" Main Steam Isolation Valves
2-1/4" - 8 UN3A x 13-1/4" Long S.E. 3-1/2" N.E. 3-1/2"
Per Sketch # 3730

SPECIFICATIONS: Alloy Steel Bolting Material for Special application
ASME SA-540 Gr. B-23, Class 5

HEAT NUMBER: 114188
CODE A-88

LADLE ANALYSIS C-.42 Mn-.81 Phos-.009 Sul-.008 Sil-.34 Cr-.81 Ni-1.75 Mo-.28

CHECK ANALYSIS C-.42 Mn-.81 Phos-.014 Sul-.006 Sil-.27 Cr-.82 Ni-1.74 Mo-.26

MECHANICAL TESTS:

	TENSILE	YIELD	ELONG	RED	BHN
	153,000	135,750	19.0	54.9	302
	151,750	134,000	20.0	55.5	293

CHARPY V-NOTCH IMPACT TEST PER SA-370 Specification at +60°F 45 ft/lbs.

	FT.LBS.	LAT. EXPANSION (IN.)	% DUC. FRACTURE AREA
	61.5	.036	100
	61.5	.039	100
	47.0	.030	100
Ave.	56.5		
	62.0	.040	100
	62.5	.040	100
	61.5	.038	100
Ave.	62.0		

Reviewed By: REC Date: 12-10-75
R. E. Ciampa, Quality Control Representative
General Electric Co. - BWR Projects Dept.

HEAT TREAT DATA:
Heated to 1550°F 2-1/2 Hrs. at Heat - Oil Quenched
Tempered 1160°F 3 Hrs. at Heat - Air Cooled

Per Procedure H.T.N.-572, Rev. 2, dated 6-12-75

APPROVED
DATE 12.4.75
BY
ATWOOD & MORRILL CO. INC.

-Continued-

CHEMICAL & PHYSICAL
REPORT CHECKED
BY
DATE 12/2/75
ATWOOD & MORRILL CO. INC.

A.I. 12-4-75

Form T-14

CANN & SAUL STEEL CO.

Thru 6: 581

ROYERSFORD, PA. 19468

Report of Physical Tests and/or Chemical Compositions

REVISED COPY

Date 11-6-75

Customer's Order No. AM-25353
Ref. #13561-01-211 COVER
G.E. 205-AF-775

Cann & Saul Order No. 34061

Customer Atwood & Morrill Co.
Address 285 Canal St. Salem, Mass. 01970

Attention Purch. Dept.

CHEMICAL COMPOSITIONS

HEAT NO.	C	MN	P	S	SI	CR	NI	MO	CB		
632202	.26	.94	.023	.015	.20						

PHYSICAL TESTS

Lab. No.

CUT FROM	TEST NUMBER	GAUGE	YIELD PT. LBS.	YIELD PER Square In Lbs.	BROKE AT LBS.	ULTIMATE TENSILE LBS.	ELONG %	REDUCED AREA	Reduction %	B.H.N.
			YS	YS.2%						
Forg-ing	34061 1	.505	10,000	50,000	16,000	80,000	24.0	.134	32.0	
	Charpy Impacts:- "V" Notch		58 64	54 Mils lateral expansion @ 60°F						
			66 74	65 Ft. Lbs.						
			20 20	20 Percent Shear						

CHEMICAL & PHYSICAL REPORT CHECKED

BY [signature]

DATE 11/10/75

ATWOOD & MORRILL CO. INC.

OTHER TESTS

Brinell:-143/160
Sonic A388, Rev. 20(4-11-75):-Acceptable
Mag. Part, BAFV #12, Rev. 1(5-7-75):-Acceptable for A&M Info
Heat Treat to C.S H.T.Proc. #5B(10-25-74)& Addendum.
We certify that the contents of this report are correct and accurate and that all operations performed by our company or subcontractors are in compliance with the requirements of materials specification and the ASME Code Sec. III 1974 Edition.

Customer's Specification: ASME SA-105 (QT)
Charpy "V" Impact 25 mils lat. exp. @ 60°F

BHN. 187 Max.

MIN. 36,000 YS.2%
T. 70,000
E. 22%
R. 30%

THE ABOVE TESTS COVER THE FOLLOWING MATERIAL:

4 - Cover Forgings per Dwg. 3086-1-405-D, Rev. C for Code 30861-405-2974.

Forgings serialized #5 thru 8

Reviewed By [signature] Date: 11/10/75
R. E. Cleaver, Quality Control Representative
General Electric Co. - DWR Projects Dept.

CANN & SAUL STEEL CO.

G.E. & A&M

Inspection APPROVED

By [signature] End of Tests

C Brown

CANN & SAUL STEEL CO. THRU 6-5-61

ROYERSFORD, PA. 19468

Report of Physical Tests and/or Chemical Compositions

Date 11-6-75 REVISED COPY

Customer Atwood & Morrill Co.

Address 295 Canal St. Salem, Mass. 01970

Customer's Order No. AM-25353 Ref. #13561-01-002 GE 205-AF-775

Cann & Saul Order No. 34059 APPETS

Attention Purch. Dept.

CHEMICAL COMPOSITIONS

HEAT NO.	C	MN	P	S	SI	CR	NI	MO	CB
632202	.26	.94	.023	.015	.20				

Lab. No.

PHYSICAL TESTS

CUT FROM	TEST NUMBER	GAUGE	YIELD PT. LBS.	YIELD PER Square In Lbs.	BROKE AT LBS.	ULTIMATE TENSILE LBS.	ELONG %	REDUCED AREA	Reduction %	B.H.N.
			YS	YS.2%						
Forg-ing	34059 1	.505	9,500	47,500	14,500	72,500	35.0	.058	71.0	
	Charpy Impacts:- "V" Notch		52 63 57 Mils lateral expansion @ 60°F							
			65 78 72 Ft. lbs.							
			30 30 30 Percent shear							

CHEMICAL & PHYSICAL REPORT CHECKED

BY E. L. Sharp

DATE 11/10/75

ATWOOD & MORRILL CO. INC.

OTHER TESTS

Brinell:170/174
Sonic A388, Rev. 20(4-11-75):-Acceptable
Mag. Part. B&PV #12, Rev. 1(5-7-75):- Acceptable
We certify that the contents of this report are correct and accurate and that all operations performed by our company or subcontractors are in compliance with the requirements of materials specification and the ASME Code, Sec. III 1974 Edition.

Customer's Specifications: ASME SA-105 (QT)
Charpy "V" Impact 25 Mils Lat. Exp. @ 60°F
BHN. 197 Max.

YS 36,000 YS.2%
T. 70,000
E. 22%
R. 30%

THE ABOVE TESTS COVER THE FOLLOWING MATERIAL:

5 - Poppet Forgings per Dwg. 30521-808-D, Rev. 1 for Code 30521-807-2974.
Forgings serialized #2 thru 6

Reviewed By REC. Date: 11-14-75
R. E. Ciampa, Quality Control Representative
General Electric Co. - BWR Projects Dept.

G.E. & A&M
Inspection

APPROVED
BY
DATE 11/10/75
ATWOOD & MORRILL CO. INC.

CANN & SAUL STEEL CO.

C Bruno
Eng. of Tests

VJL 11-14-75

Ref: 13561-0
Body for 28"-575#

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.
MYERSTOWN, PENNA. 17067

MATERIAL TEST REPORT

S/N 7-561

205AF775

CUSTOMER ORDER NO	PATTERN NO.	QUAKER ALLOY DESIGNATION	SPECIFICATION	SHOP ORDER NUMBER	DATE SHIPPED
~~AM25338~~	~~16728-30147-101~~	Q70	ASME SA216 GR.WCB (74)	[illegible]	10-31-75

CUSTOMER: Atwood and Morrill

APPROVED
BY R.A. Dupuit
DATE 11/25/75
ATWOOD & MORRILL CO. INC.

HEAT NO.	C	Mn	Si	P	S	Cr	Ni	Mo			YILD P.S.I.	TENSILE P.S.I.	ELONG. %	RED. of AREA %	CSTG. CER.#	R.T. SER.#	IN.
F6445	.25	.75	.50	.017	.014						49,500	83,000	27.0	45.3	F6445-2	N1555	1
				Charpy Impact V Notch Plus					60°F	32-33-30 foot pounds							
										29-30-27 lateral expansion							
										40-40-40 % Ductile Fracture							

REMARKS:

Reviewed By: R.E.C Date: 11/25/75
R. E. Clampa, Quality Control Representative
General Electric Co. - BWR Projects Dept.

CHEMICAL & PHYSICAL
REPORT CHECKED
BY S.F. Harp
DATE 11/24/75
ATWOOD & MORRILL CO. INC.

VJL 11-24-75

STATE OF PENNSYLVANIA, COUNTY OF LEBANON, S.S.
SWORN TO AND SUBSCRIBED BEFORE ME

THIS DAY OF 19

"I CERTIFY THE ABOVE INFORMATION IS CORRECT"
QUAKER ALLOY CASTING CO.
BY [signature]
METALLURGIST

Ref. 1356-01

Body for 28"-575#

QUAKER ALLOY CASTING CO.

A DIVISION OF HARSCO CORP.
MYERSTOWN, PENNA. 17067

MATERIAL TEST REPORT

N/N 8-561

205AF77.

CUSTOMER ORDER NO.	PATTERN NO.	QUAKER ALLOY DESIGNATION	SPECIFICATION	SHOP ORDER NUMBER	DATE SHIPPED
AM25338	16728-30147-101	Q70	ASME SA216 GR.WCB (74)		10-31-75

CUSTOMER: Atwood & Morrill

APPROVED
BY R.D. Arnault
DATE 11/24/75
ATWOOD & MORRILL CO. INC.

HEAT NO.	C	Mn	Si	P	S	Cr	Ni	Mo			YIELD P.S.I.	TENSILE P.S.I.	ELONG. %	RED. of AREA %	CSTG. SER.#	R.T. SER.#	PCS. SHIPPED
3360	.26	.86	.46	.020	.016						40,500	76,000	32.0	60.7	F6360-1	N1563	1
				CHarpy Impact V Notch Plus 60°F							30-30-35	foot pounds					
											32-32-35	lateral expansion					
											40-40-40	% Ductile Fracture					

REMARKS:

Reviewed By: R.E.C Date: 11/25/75
R. E. Ciampa, Quality Control Representative
General Electric Co. - BWR Projects Dept.

CHEMICAL & PHYSICAL REPORT CHECKED
BY D.F. Sharp
DATE 11/24/75
ATWOOD & MORRILL CO. INC.

VJL 11-24-75

STATE OF PENNSYLVANIA, COUNTY OF LEBANON, S.S.
SWORN TO AND SUBSCRIBED BEFORE ME

DAY OF 19

V. Smith - Authorized Inspector

"I CERTIFY THE ABOVE INFORMATION IS CORRECT"
QUAKER ALLOY CASTING CO.
BY Thomas Landis
METALLURGIST

QUAKER ALLOY CASTING CO., MYERSTOWN, PA.

CUSTOMER Atwood & Morrill Co. PURCHASE ORDER AM-25338 CONTRACT NO. 205AF775

SHOP ORDER D220-01 Q DESIGNATION Q70 PATTERN NO. 16728-30147-101

MATERIAL SPEC. & GRADE ASME SA216 Gr. WCB DESCRIPTION Body SIZE 28"

HEAT NO. F6360 CASTING SERIAL NO. F6360-1 R.T. SERIAL NO. N1563

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION A&M - GE

CERTIFIED MATERIAL TEST REPORT

The records enclosed in this folder comprise the certified material test report for the subject material.

AFFIRMATION

We certify that the contents of this report are correct and accurate and that all test results and operations performed by Quaker Alloy Casting Company or our subcontractors are in compliance with the material specification and appropriate material requirements of the ASME Code 1974 through W'0 Addenda, Section III, as stipulated in the procurement documents.

Mark M. Fralic 10-31-75

Quaker Alloy Casting Company Date

Reviewed By: [illegible] Date: 11/25/75
R. E. Gianna, Quality Control Representative
General Electric Co. - BWR Projects Dept.

QA1 Rev. 2
11/11/75

APPROVED
DATE 11/24/75
[illegible]
ATWOOD & MORRILL CO. INC.

CUSTOMER Atwood & Morrill Co. PURCHASE ORDER M-25138 CONTRACT NO. 95A5775

SHOP ORDER D220-01 Q DESIGNATION Q70 PATTERN NO. 16728-30147-101

MATERIAL SPEC. & GRADE ASME SA216 Gr. WCB DESCRIPTION Body SIZE 28"

HEAT NO. F6364 CASTING SERIAL NO. F6360-1 R.T. SERIAL NO. N1563

NUCLEAR CLASS 1 PCS. COVERED ON THIS REPORT 1 SOURCE INSPECTION AGM - GE

HEAT TREATMENT RECORD

PROCESS*	N	T	P.W.H.T.
PROCEDURE	per WPS-1 Rev F	per WPS-1 Rev F	per WPS-1 Rev F
DATE	5-15-75	5-15-75	10-21-75
FURNACE	Lynn Electric	Gas Machine	Gas Machine
CHARGE NO.	F6364	GM 1396	GM 1465
CHARGE TEMP.	535°F	160°F	175°F
TIME TO EQUIL. TEMP.	3 Hrs 5 min	1 Hr 50 min	45 min
HOLDING TEMP. (RANGE)	1640° - 1700°F	1350°F	1175° - 1200°F
TIME AT TEMP.	5 Hr 55 min	5 Hr 55 min	6 Hrs
COOLING DATA	Air	Air	Air

REMARKS

ACTUAL HEAT TREAT CHARTS ARE RETAINED IN FILE FOR THE ABOVE.

*N = Normalize or Homogenize
Q = Quench or Harden
T = Temper
SA = Solution Anneal
PWHT = Post Weld Heat Treat (Stress relieve)

PREPARED BY [illegible]
Quaker Alloy Castings Co., Inc.

TITLE QC Supervisor

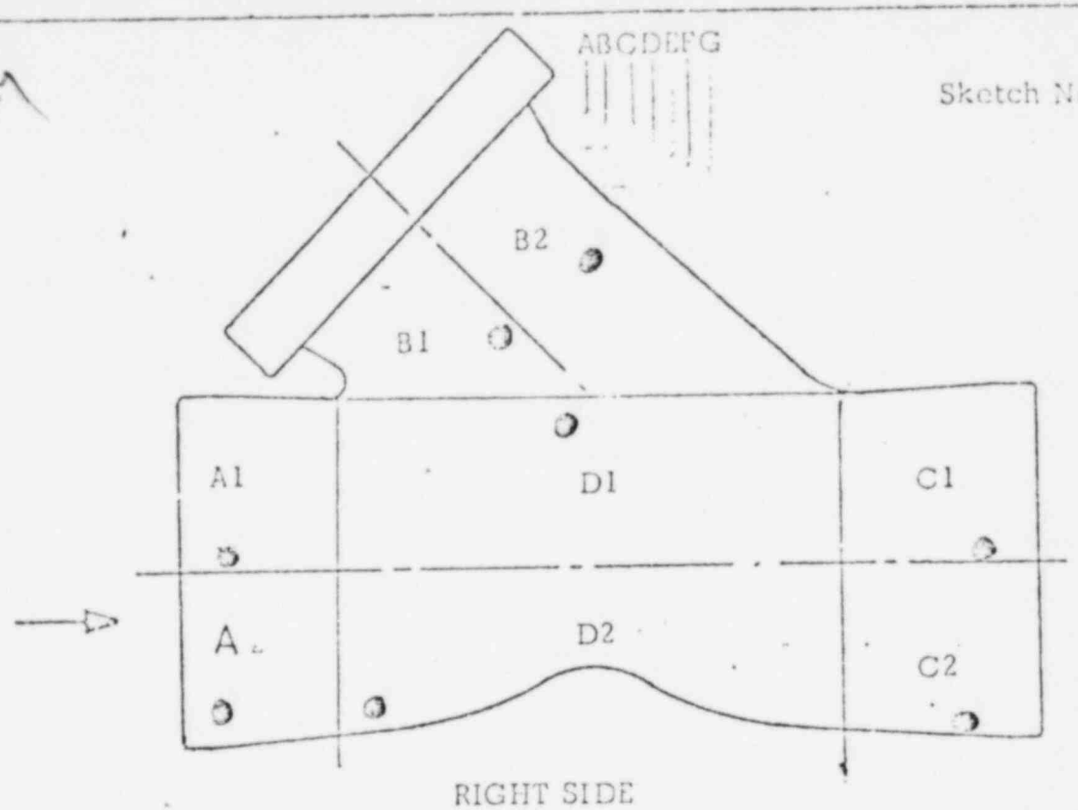
DATE 10-31-75

ASME QC-1 A 10-31-75

Form 212
10/23/75

Body

Sketch No. 1



RIGHT SIDE

Item No. 01 Proc. No. 603-13561-00 Rev. 2

A&M S.O.No. 13561 Dim.Req.Dwg. 1 15/16 Min. inches

Method of Meas CALIPER + SCALE Dwg. No. 13561-01-H Rev. 5

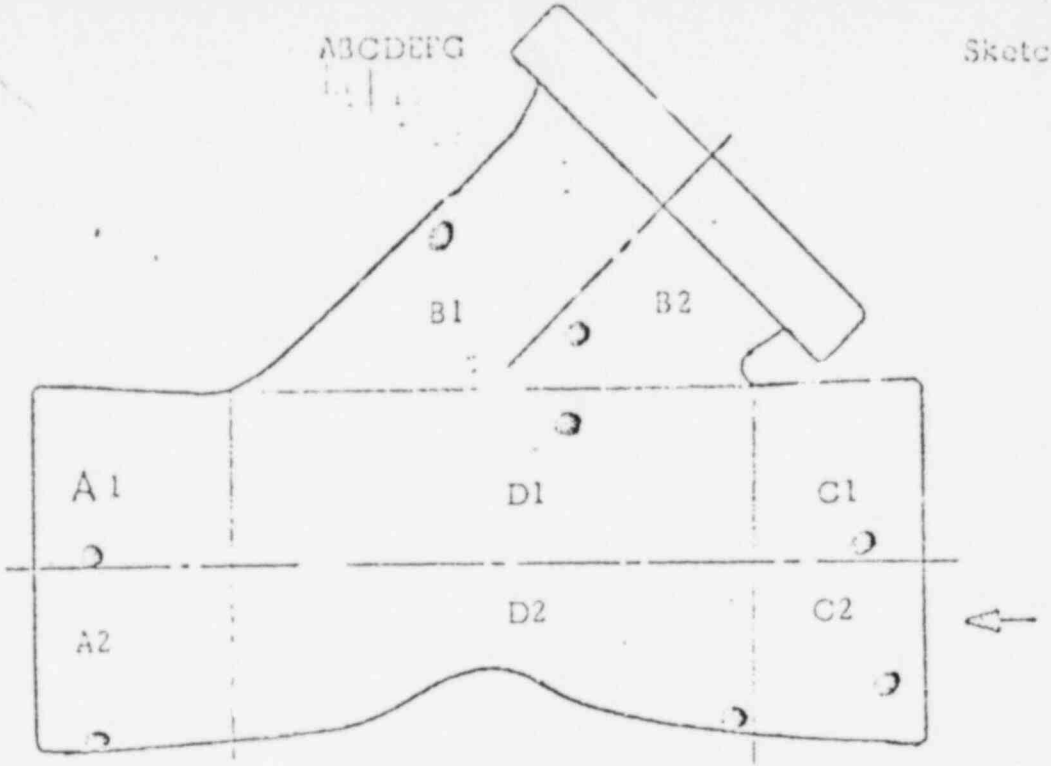
A&M Insp. A&M Q.C. 3 A 12-11-75 Cust. Insp. INSPD 12-11-75

Location of minimum dimensions shall be shown for each zone.

Required Zone Dimensions	A1	A2	B1	B2	C1	C2	D1	D2
Actual Dimensions	2 3/16"	2 1/8"	2 1/8"	2 1/16"	2 1/4"	2 1/16"	2 1/8"	2 7/16"
Required Band Dimension		A	B	C	D	E	F	G
Code Calculated Dimension		3 1/8"	3"	2 7/8"	2 3/4"	2 5/8"	2 7/16"	2 5/16"
Actual Dimensions		N/A	3 3/4"	3 1/2"	3 5/16"	3 1/8"	3"	2 11/16"

ABCDEFG

Sketch No. 2



LEFT SIDE

Item No. 01 Proc. No. 603-13561-00 Rev. 2

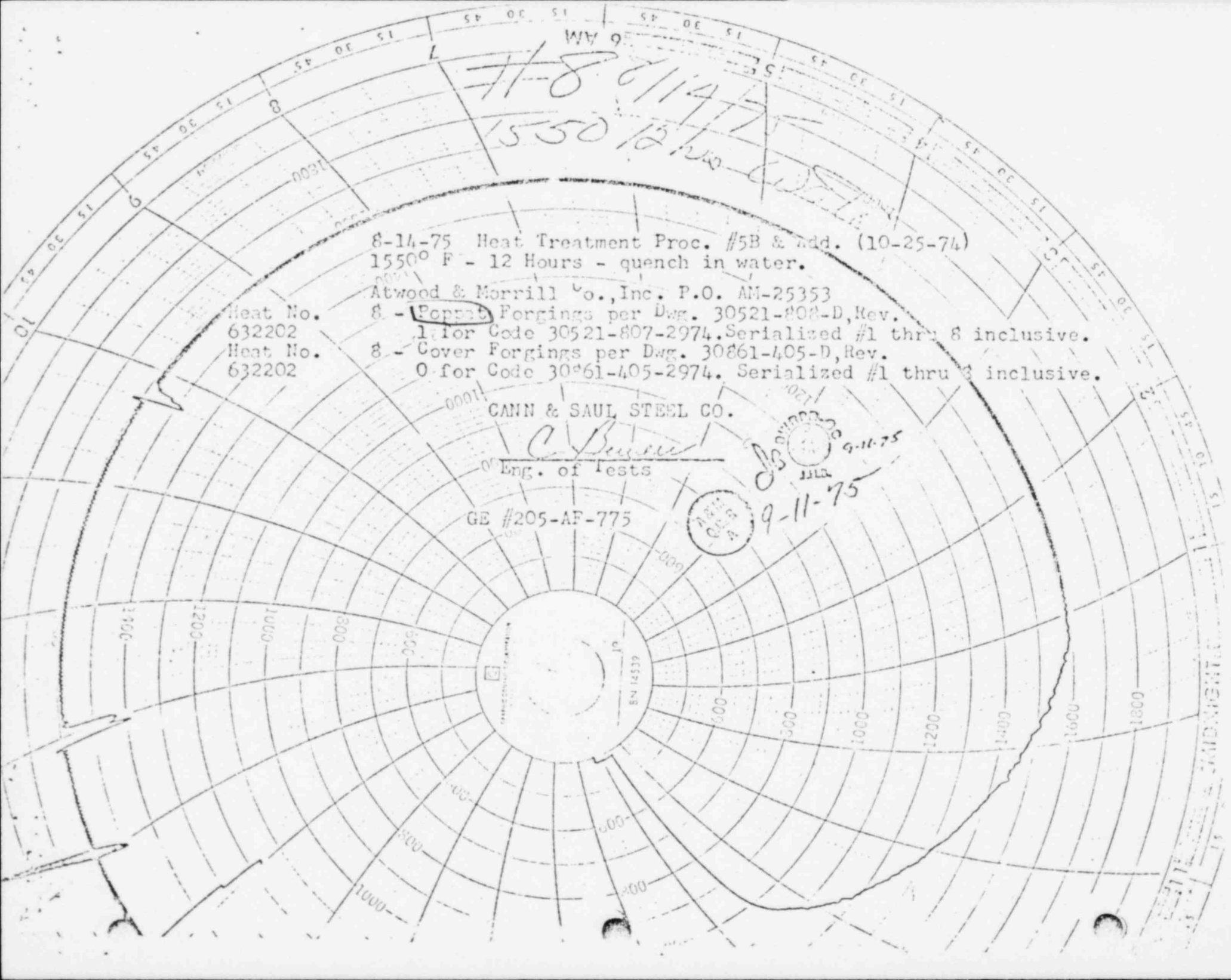
A&M S.O.No. 13561 Dim. Req. Dwg. 1 15/16" MIN.

Method of Meas. CALIPER + SCALE Dwg. No. 13561-01-H Rev. 5

A&M Insp. 12-11-75 Cust. Insp. 12-11-75

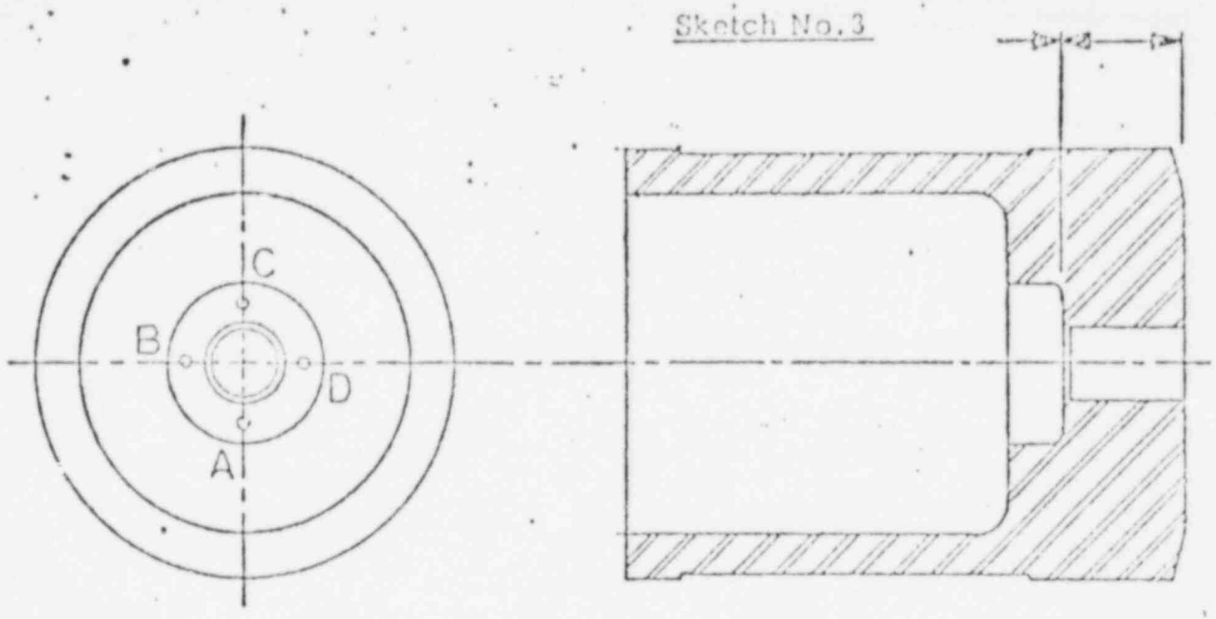
Location of minimum dimensions shall be shown for each zone.

Required Zone Dimensions	A1	A2	B1	B2	C1	C2	D1	D2
Actual Dimension	2 5/16	2 1/3	2 1/3	2 7/16	2 5/16	2 7/16	2 5/8	2 1/2
Required Band Dimension		A	B	C	D	E	F	G
Code Calculated Dimension		3 1/3	3"	2 7/8	2 1/16	2 1/3	2 7/16	2 5/16
Actual Dimension		N/A	3 15/16	3 2/3	3 11/16	3 1/16	3 3/16	3 1/4


8-14-75 Heat Treatment Proc. #5B & Add. (10-25-74)
1550° F - 12 Hours - quench in water.
Atwood & Morrill Co.,Inc. P.O. AM-25353
Heat No. 632202
8 - Poppet Forgings per Dwg. 30521-808-D,Rev. 1 for Code 30521-807-2974.Serialized #1 thru 8 inclusive.
Heat No. 632202
8 - Cover Forgings per Dwg. 30861-405-D,Rev. 0 for Code 30861-405-2974. Serialized #1 thru 8 inclusive.
CANN & SAUL STEEL CO.
Eng. of Tests
GE #205-AF-775
9-11-75


8-15-75 Heat Treatment Proc. #5B & Add.
(10-25-74)
1175° F - 12 Hours - cool slow in furnace.
Atwood & Morrill Co.,Inc. P.O. AM-25353
8 - Ponnet Forgings per Dwg. 30521-808-D,Rev. 1 for Code. 30521-807-2974.Serialized #1 thru 8 inclusive.
8 - Cover Forgings per Dwg. 30861-405-D,Rev. 0 for Code 30861-405-2974. Serialized #1 thru 8 inclusive.
CAMP & SAUL STEEL CO.
Engr. of Tests
GE #205-AF-775
9-11-75
9-11-75
Part No.
6532202
Part No.
6532202

Sketch No. 3



POPPET

S/N 3-561. C+S #3

A&M S.O.No. 13561 Proc. No. 603-13561-00 Rev. 2

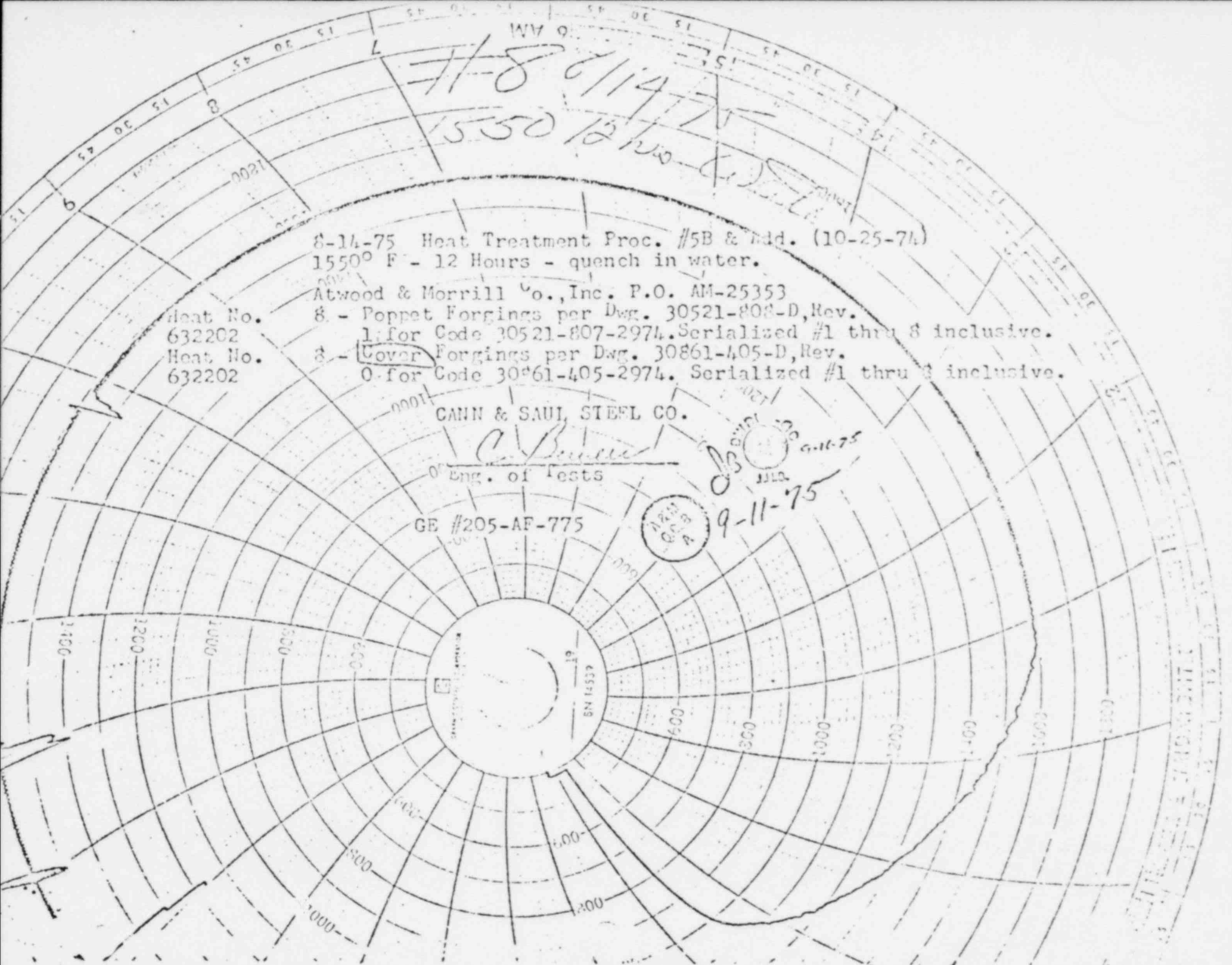
Item No. 01 Dim.Req.per Dwg. 6 1/3" MIN

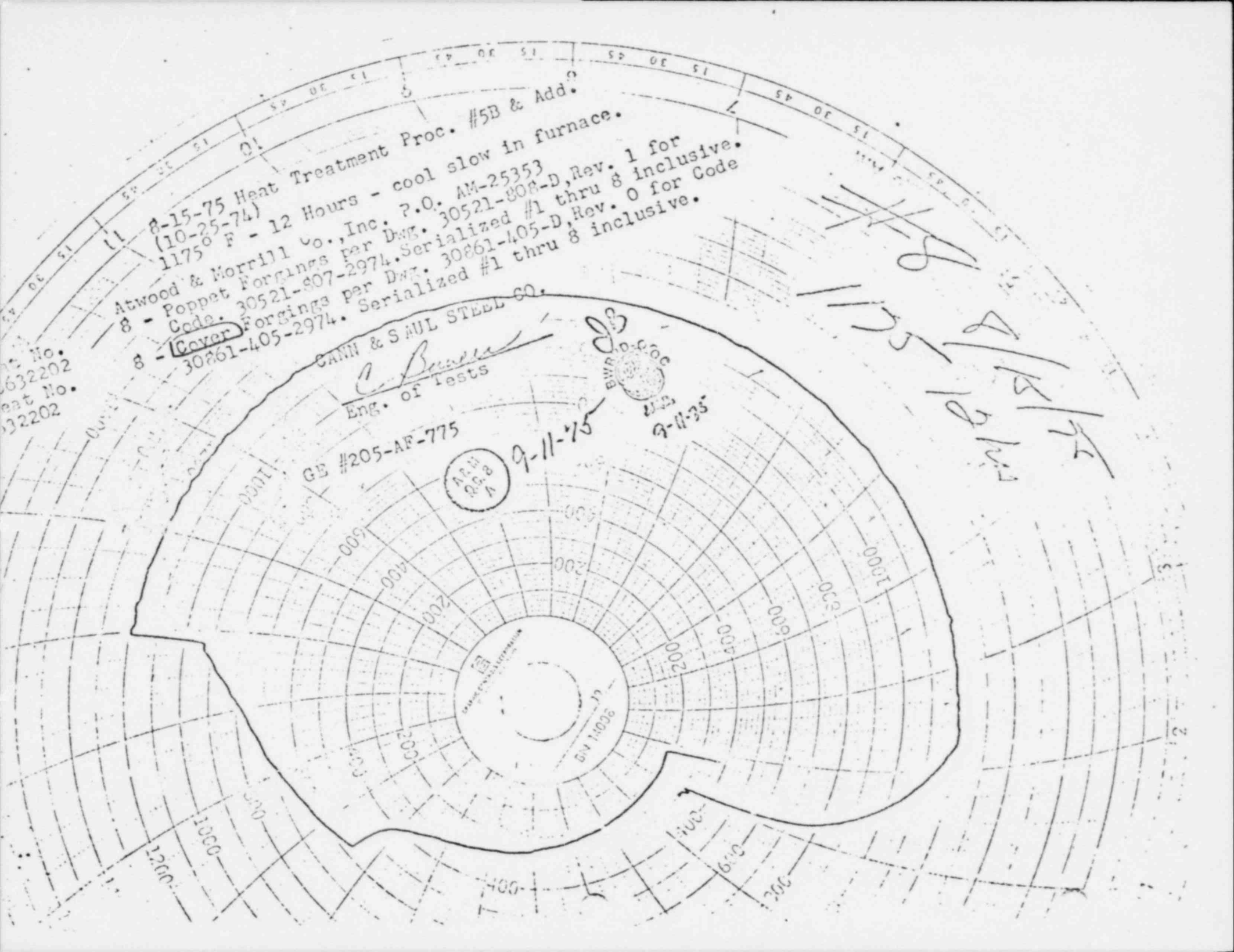
Heat No. 632202 Dwg. No. 13561-01-H Rev. 5

Measure 100% of the two surfaces and record actual A, B, C, & D.

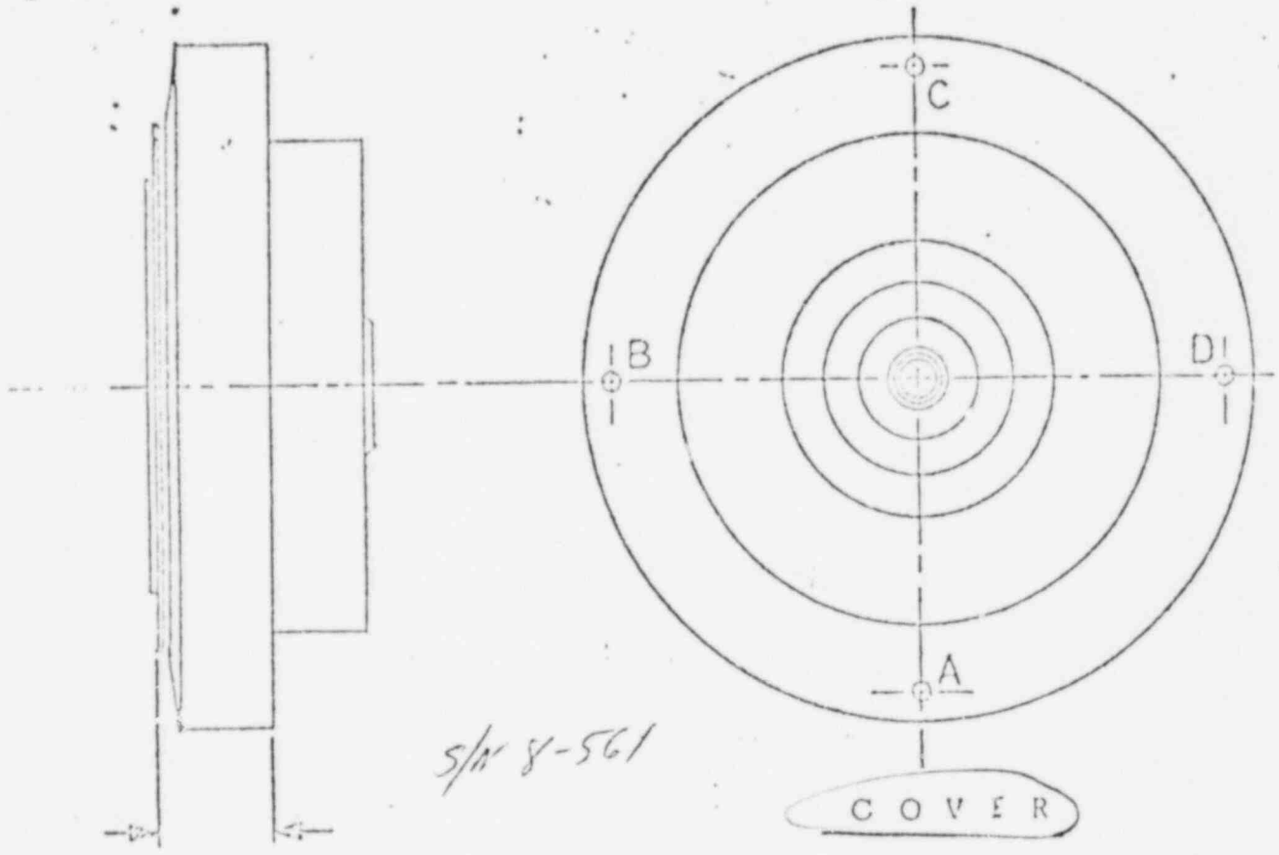
	Actual Dimension			
Required Dimension	A	B	C	D
Actual Dimension	6 5/16	6 5/16	6 5/16	6 5/16

A&M Inspection performed by QUALITY A 12-10-75 Cust. Insp. 12-10-75


8-14-75 Heat Treatment Proc. #5B & Add. (10-25-74)
1550° F - 12 Hours - quench in water.
Atwood & Morrill Co.,Inc. P.O. AM-25353
8 - Poppet Forgings per Dwg. 30521-808-D,Rev.
1 for Code 30521-807-2974.Serialized #1 thru 8 inclusive.
8 - Cover Forgings per Dwg. 30861-405-D,Rev.
0 for Code 30861-405-2974. Serialized #1 thru 8 inclusive.
Heat No.
632202
Heat No.
632202
CANN & SAUL STEEL CO.
Dept. of Tests
GE #205-AF-775
9-11-75


8-15-75 Heat Treatment Proc. #5B & Add.
(10-25-74)
1175° F - 12 Hours - cool slow in furnace.
Atwood & Morrill Co., Inc. P.O. AM-25353
8 - Poppet Forgings per Dwg. 30521-808-D, Rev. 1 for
Code. 30521-807-2974. Serialized #1 thru 8 inclusive.
8 - Cover Forgings per Dwg. 30861-405-D, Rev. 0 for Code
30861-405-2974. Serialized #1 thru 8 inclusive.
CANN & SAUL STEEL CO.
Eng. of Tests
GE #205-AF-775
9-11-75
9-11-75
8
1175 8/15/75
No.
632202
eat No.
32202

Sketch No. 4



S/N 8-561

A&M S.O.No. 13561 Proc. No. 603-13561 Rev 2

Item No. 01 Dim.Req.per Dwg. 5 15/16

Method . Caliper Dwg. No. 13561-01-4 Rev 5

Measure 100% of the two surfaces and record actual A, B, C & D.

	Dimension			
Required Dimension	A	B	C	D
Actual Dimension	6 1/4	6 1/8	6 1/4	6 1/8

A&I Insp.Signature [signature] A&M QC II Inst.Insp. [signature] QC 12-10-75

GC
FSAR

251.7 Insufficient data has been supplied to demonstrate that the weld metals 5P6214B, 627260 and 401S0371 have a minimum upper shelf energy of 75 ft-lb as required by Paragraph IV.B of Appendix G. Provide additional data, information from the literature, and/or analyses to demonstrate that an acceptable margin of safety is assured for normal operation in the upper shelf temperature region. The additional data should be from tests of similar welds; that is, those having the same weld wire, flux and thermal treatments as the four identified beltline welds.

RESPONSE

Heat numbers 5P6214B and 627260 apply to weld materials used on the Unit 1 vessel. An additional heat number applicable to the Unit 1 vessel is 626677. Additional information on these materials have been provided in Tables 5.3-2 and 5.3-3. See also revised Section 5.3. The same information will be provided for the Unit 2 vessel in a later amendment.

GG
FSAR

251.8 The materials surveillance program uses three specimen capsules that should contain reactor vessel steel specimens of the limiting base material, weld metal and heat-affected zone material. To help demonstrate compliance with Appendix H, 10 CFR Part 50, provide a table that includes the following information for each specimen:

(1) Actual surveillance material;

(2) Origin of each surveillance specimen (base metal: heat number, plate identification number; weld metal: weld wire, heat of filler material, production welding conditions, and plate material used to make weld specimens);

(3) Test specimen and type;

(4) Fabrication history of each test specimen;

(5) Chemical composition of each test specimen.

Provide the location, lead factor and withdrawal time for each specimen capsule calculated with respect to the vessel inner wall. The above information should be submitted in tabular form as illustrated in Enclosure 1.

RESPONSE

Grand Gulf 1
RPV Surveillance Specimens

Surveillance specimen materials are identified, with properties, in Tables 5.3-1, 5.3-2 and 5.3-3. It can be seen in Table 5.3-3 that all beltline materials are quite resistant to radiation degradation of toughness. All weld materials (3) in the #2 shell longitudinal seams were used to fabricate the surveillance weld specimens, thus including limiting materials. The exact predicted limiting plate was not used, but is only 9°F different in end-of-life RT_{NDT} from the limiting plate (Table 5.3-3). This is not considered significant, especially because of the insensitivity of these materials to neutron radiation damage. Heat Affected Zone (HAZ) specimens were taken from the HAZ of the weldment fabricated from the materials indicated in Table 5.3-3.

The CBIN weld procedure used to prepare the surveillance specimens is shown as Attachment 251.8-1. This is the beltline weld procedure. No tandem wire Submerged Arc welding was performed, as verified with CBIN.

Specimen orientations, locations in test plate, and quantities are in compliance with ASTM E-185-73 as required by 10CFR50 Appendix H.

Further details of the surveillance program are included in paragraph 5.3.1.6 of the Grand Gulf FSAR.

ATTACHMENT 251.8-1

GRAND GULF I SURVEILLANCE SPECIMEN WELD PROCEDURE

CBI NUCLEAR COMPANY

CHICAGO BRIDGE & IRON CO.

WELD PROCEDURE SPECIFICATION

Low Alloy SMA & SA Grooves & Buildup

CUSTOMER General Electric Company
PRODUCT NUCLEAR VESSELS (Class 1)
DESCRIPTION Shielded Metal Arc and Submerged Arc Welding of ASME P12B Subgroup 1 Material

PROCEDURE NUMBER WPS 322.2T4R6
PAGE NO. 1 OF 3
DATE 2-17-69
REVISION NO 8(7-23-74)PJO

REFERENCE SPECIFICATIONS
General WPS 800 Latest Revision
General WPS 820 Latest Revision

PROCEDURE QUALIFICATION

NO.	POSITION	THICKNESS RANGE
1890(SMA)	V	3/16" to 8"
1891(SMA)	H	3/16" to 8"
1892(SMA)	CH,F	3/16" to 8"
1893(SA-1)	F	3/16" to 8"
2200(SA-2)	F	3/16" to 8"

POST HEAT TREATMENT -
Procedure qualified with 50 hrs. at 1150°F +25°/-50°F.
Postweld heat treatment of the weldment shall be in accordance with a CB&I approved procedure.

BASE METAL -
ASME SA-533 Gr B Class 1 or SA-508 Class 2
ASME Group No. P12B Subgroup I

FILLER METAL - ASME
Shielded Metal Arc
Specification - SFA-5.5
Classification - E8018-G
Analysis - A3 (except Ni 0.50 to 1.25)
Usability - F4
Trade Name - Alloy Rods E8018NM
Submerged Arc
See Adjacent Column.

ELECTRICAL CHARACTERISTICS -
See Adjacent Column.

SHIELDING GAS - None

BACKUP GAS - None

FLUX - Linde 124

PREHEAT REQUIREMENTS:

Minimum preheat of 300°F shall be applied uniformly to the full thickness of the weld joint and adjacent base material for a minimum distance of "T" or "6", whichever is least, where "T" is the material thickness.

Maintain 300°F min. preheat temp. until start of postweld heat treatment except for longitudinal and circumferential shell and head seams, preheat may be dropped to 250°F min. 8 hours after completion of welding. All runoff tabs and flux dams must be removed prior to dropping preheat below 300°F.

INTERPASS TEMPERATURE REQUIREMENTS:

The interpass temperature shall not exceed 500°F maximum.

FILLER METAL:

Submerged Arc
Specification - N.A.
Classification - N.A.
Analysis - A3 (except Ni 0.50 to 1.25)
Usability - F6
Trade Name - CBI 1NMM (1% Nickel) or equal

ELECTRICAL CHARACTERISTICS:

SMA - DCRP

Submerged Arc
Tandem Wire
Lead Wire DCRP
Trail Wire AC
Single Wire - DCRP

GG
FSAR

251.9 To demonstrate compliance with Paragraph IV.A.3 of Appendix G, 10 CFR Part 50, identify all ferritic piping in the reactor coolant pressure boundary by component part, ASME material designation, fracture toughness requirements, and fracture toughness test results.

RESPONSE

BOP

Ferritic piping employed in the reactor coolant pressure boundary (RCPB) (Class 1) was surveyed to identify the limiting case using maximum wall thickness as the criteria. Feedwater system piping was identified as the limiting case. The material test report for a representative pipe spool used at Grand Gulf is attached for your review. This report includes stated compliance with ASME Section III as required by Appendix G to 10 CFR 50. A brief data summary from that report is provided below. Fracture toughness data on all other ferritic piping in the RCPB is available for review at the Grand Gulf Nuclear Station.

Pipe Spool Number	Wall Thickness	Size	Material	Test Temperature	Heat Number
Q1B21G030-5-8	1.219"	24"	SA-106 Grade C	+50°F	L2505

NSSS

See the response to Question 251.1.

CAPITOL PIPE CERTIFICATE OF COMPLIANCE 74

ASME QUALITY SYSTEM CERTIFICATE (MATERIALS) NUMBER N-936

EXPIRATION DATE: JANUARY 6, 1978

Q-251-9 & 252.1

SPOOL NO. Q1 B21-6030-5-8
Main Feedwater Piping

MATERIALS: 24" SCH 80 SMLS ASME SA-106 GR-C.

HEAT NO: L-2505

MANUFACTURER: CAMERON IRON WORKS, INC.

This Certification affirms that the content of the attached report (s) is correct and accurate and that all test results and operations performed are in compliance with the below Listed Specifications:

1) ASME Code Section II 1971 Edition including addenda through Summer 1973.

2) ASME Code Section III 1971 Edition including addenda through Summer 1973 for Class 1 Materials.

REFERENCE:
TEXAS PIPE BENDING CO. P.O.# N-1788-54
CAPITOL S.O.# HN-5491-A
ITEM# 9

Sworn to and subscribed before me this ... day of ... 19...

Murray Herbert Feldman

Brian Kirkpatrick RPS
QUALITY ASSURANCE

Chas. C. Patton
Date 6-3-76

Charles Lassiter
Rec'd 6-3-76

Cameron IRON WORKS, INC.

P. O. BOX 1212 HOUSTON, TEXAS 77001

R. Reichardt UT-12
CIW INSPECTOR: C. Jones UT-13 DATE: 3-23-76
SNT-TC-1A Level II

ULTRASONIC EXAMINATION REPORT

CUSTOMER: Capitol Pipe U.T. PROCEDURE: PU-33 Rev. A PART NO.: 86-5576-240-215

SPECIFICATION: ASME SA106 Gr. C & ASME SEC. III MATERIAL: A-106
1971 Edition thru Summer '73 Addenda) Cl. 1 Components plus
INSTRUMENT: Ultrasonoscope Series 10 Check analysis per Para. 9
METHOD: Contact TECHNIQUE: Pulse Echo COUPLANT: Water
OVERLAP: 10% SCANNING SPEED (MAX.) 80' 1 minute
INDEXING: Automatic Helical Scan
SCANNING: Pipe rotated on rolls with search units in fixed position

SERIAL #	HEAT #	LENGTH	MIN. WALL UT		O.D.
25553	L 2505	22' 0 1/4"	1.067	13	21.000
25554	L 2773	34' 8 1/4"	"	13	"
25555	"	34' 8 1/4"	"	12	"

These are the only serial # for this job on my
other two serial # for
Job N-1788-75

LONGITUDINAL MODE

SURFACE SCANNED	SEARCH UNIT	REFERENCE STANDARD	STANDARDIZATION

SHEAR MODE

SURFACE SCANNED	SEARCH UNIT	REFERENCE STANDARD	STANDARDIZATION
O.D. 2 shear wave circ. direcitons	Branson 2.25 MHZ 1"x1"Z @45° (2)	5% I.D. & O.D. NOTCHES	80% on O.D. NOTCH

REPORTABLE INDICATIONS

IND. #	DISTANCE FROM END "A"	CIRCUM. LENGTH	AXIAL LENGTH	DEPTH FROM OD	CLOCK POSITION	INDICATION AMPLITUDE	LOSS OF B. R.	REMARKS

Texas Pipe Bending
P.O.# N-1788-54
S.O.# HN-5491-A

Ch# H-78522
Item# 9

RESULTS: [ ] REPORTABLE INDICATIONS RESOLVED ARE INCLUDED IN THIS REPORT. [ ] ACCEPT [ ] REJECT

[X] NO REPORTABLE INDICATIONS AND NO REPORTABLE LOSS OF BACK REFLECTION WERE NOTED.

[X] THE PARTS WERE TESTED IN ACCORDANCE WITH THE ABOVE PROCEDURE AND FOUND TO BE ACCEPTABLE.

Cameron's

IRON WORKS, I

P. O. BOX 1212
HOUSTON, TEXAS 77

SOLD TO
CAPITOL PIPE & STEEL PRODUCTS, INC.
301 City Line Avenue
Bala-Cynwyd, Pa 19004

Date 26 March 1976

Customer Order No.	C.I.W. Sales Order No.	
D-75512-00	F-5576	ASME-SA106-Gr. C & ASME-Section III (1971 Editi thru Summer '73 Addenda) Class 1 Components plu Ck. Analysis per Para. 9 & Additional Impact re ments per Cust. P.O.

Description of Material: O.D. 24" × I.D. ____ × WALL SCH. 80

C.I.W. Part No. 86-5576-240-215

ASME QUALITY SYSTEM CERTIFICATE (MATERIALS) NO. N-1261 EXPIRES 10-27-78.

CHEMICAL ANALYSIS

Heat No.	Location or Serial No.	C	MN	P	S	SI	CR	NI	MO
L 2505		.24	.97	.010	.016	.29			
	Check Anal.	.23	.96	.008	.017	.28			
L 2773		.25	.92	.007	.012	.24			
	Check Anal.	.25	.93	.006	.009	.24			
	Check Anal.	.23	.90	.006	.012	.25			

Texas Pipe Bending
P.O.# N-1788-54
S.O.# HN-5491-A

Ch# H-78522
Item# 9

MECHANICAL PROPERTIES

Quantity or Serial No.	Heat No.	Test Loc.	Tensile PSI	.2 % Offset Yield PSI	% Elong. In. 2"	% Red. Area	Macro Etch	Bend Test	Flattening Test	Specimen Size	Test Lot
1	L 2505	Trans.	78,600	51,400	29.3	57.3			OK	.505	67
2	L 2773	Trans.	78,400	44,700	28.5	54.7			OK	.505	67

Reviewed for Purchase Order Compliance

By D Lindsey Date 4-2-76

Heat#	Test Lot#
L 2505	674
2773	674

V-Notch Charpy Impact tests at +50°F.:

Ft.lbs.	Lat. Exp.	D/F
81.0	.064	75%
86.0	.059	75
86.0	.061	80
83.0	.065	75
94.0	.070	80
84.0	.057	75

Forg.Ser.#	Heat#	Test Lot#
#25553	L 2505	674
25554	L 2773	674
25555	L 2773	674

Charles S. Watkins
Date 6-3-76

Each length of pipe 100% ultrasonically examined in accordance with approved C.I.W. Procedure PU-33 Rev. 'A' and found acceptable.

Hydrostatic Test: Each length of pipe hydrostatically tested at 2400 psi for 5 sec. and found accepta

Heat Treatment:
1650°F., held 1 hr. at temp., Air cooled.

Subscribed and Sworn to before me this 26th Day of March 1976

G. A. TOUCHTON
Notary Public In And For Harris County, Texas
My Commission Expires June 1, 1977.

I certify these tests to be correct as contained in the record of the company.

Metallurgical Representative H. G. WRIGHT,

GG
FSAR

252.1 We have assessed the ferritic materials in the Grand Gulf Units 1 and 2 containment system that constitute the containment pressure boundary to determine if the material fracture toughness is in compliance with the requirements of General Criterion 51, "Fracture Prevention of Containment Pressure Boundary."

GDC-51 requires that under operating, maintenance, testing and postulated accident conditions, (1) the ferritic materials of the containment pressure boundary behave in a nonbrittle manner, and (2) the probability of rapidly propagating fracture is minimized.

The Grand Gulf primary containment is a reinforced concrete structure with a thin steel liner on the inside surface which serves as a leaktight membrane. The ferritic materials of the containment pressure boundary which were considered in our assessment were those applied in the fabrication of the equipment hatch, personnel airlocks, penetrations and piping system components, including the isolation valves required to isolate the system. These components are the parts of the containment system which are not backed by concrete and must sustain loads.

The Grand Gulf containment pressure boundary is comprised of ASME Code Class 1, 2 and MC components. In late 1979, we reviewed the fracture toughness requirements of the ferritic materials of Class MC, Class 2 and Class 1 components which typically constitute the containment pressure boundary. Based on this review we determined that the fracture toughness requirements contained in ASME Code Editions and Addenda typical of those used in the design of the Grand Gulf Units 1 and 2 containment may not ensure compliance with GDC-51 for all areas of the containment pressure boundary. We initiated a program to review fracture toughness requirements for containment pressure boundary materials for the purpose of defining those fracture toughness criteria that most appropriately address the requirements of GDC-51. Prior to completion of this study, we have elected to apply in our licensing reviews the criteria identified in the Summer 1977 Addenda of Section III of the ASME Code for Class 2 components. These criteria were selected to ensure that uniform fracture toughness requirements, consistent with the containment safety function, are applied to all components in the containment pressure boundary. Accordingly, we have reviewed the Class 1, 2, and MC components in the Grand Gulf containment pressure boundary according to the fracture toughness requirements of the Summer 1977 Addenda of Section III for Class 2 components. However, in order to complete our review, we require additional information because the FSAR does not provide the information necessary to characterize the fracture toughness of the reactor containment

GG
FSAR

pressure boundary within the context of GDC-51. We request, therefore, that the following information be provided by the applicant:

(1) Lowest Service Metal Temperature

The lowest service metal temperature within the context of the effective NE 2300 and GDC-51.

(2) Penetrations

(a) Listing of all containment hot and cold pipe penetrations and related supplemental information which identifies penetration assembly sleeve, process pipe and end closure materials by specification, final heat treat condition, nominal OD and schedule, wall or section thickness.

(b) Full size assembly and detail drawings showing as-built configurations and dimensioning of hot and cold pipe penetrations.

(c) Fracture toughness data relating to the materials of those parts of penetration assemblies which perform the containment function and provide a pressure boundary under the conditions cited by GDC-51.

(3) Equipment Hatch and Personnel Access Airlock

(a) Full size assembly drawing and detail drawings which identify and dimension those parts which constitute parts of the containment pressure boundary.

(b) Supplemental information related to item 3(a) above which identifies materials of the parts of interest by specification, final heat treat condition and section thickness.

(c) Fracture toughness data relating to the materials of those parts which perform the containment function and provide a pressure boundary under the conditions cited by GDC-51.

(4) Main Steam - Main Feedwater - Auxiliary Feedwater System

(a) Full size piping diagrams and related pipeline list, pipe design tables which identify these systems by line designators and pipe size, schedule or wall and material by specification and grade and which identify valves by number, type and valve pressure boundary materials by specification, grade and final heat treat condition.

GG
FEAR

(b) Fracture toughness data relating to the material of those parts of the main steam-main feedwater and auxiliary feedwater systems which perform the containment function and provide a pressure boundary under the conditions cited by GDC-51.

(c) Graphic legend information relating to the piping diagrams addressed in item 4(a).

(5) Should the fracture toughness data requested under items 2(c), 3(c) and 4(c) above be unavailable, the applicant is requested to provide the following information for the materials of interest.

1. Seamless Pipe

   (a) Billet heating temperature prior to piercing
   (b) In-process reheat temperatures
   (c) Stock wall thickness prior to final sizing
   (d) Reheat temperature prior to final sizing
   (e) Pipe final heat treatment or pipe assembly heat treatment

2. Seamless Ells

   (a) Stock heating temperature prior to hot forming
   (b) In-process reheat temperatures
   (c) Ell final heat treatment or pipe assembly heat treatment

3. Welded Pipe

   (a) Metallurgical heat treat condition of plate stock as entered into fabrication
   (b) Plate stock heating temperature prior to hot forming
   (c) In-process reheat temperatures
   (d) Pipe final heat treatment or pipe assembly heat treatment

4. Welded Ells

   (a) Metallurgical heat treat condition of stock as entered into fabrication
   (b) Stock heating temperature prior to hot forming
   (c) In-process reheat temperatures
   (d) In-process heat treatments
   (e) Ell final heat treatment or pipe assembly heat treatment

GG
FSAR

5. Valves

(a) Final metallurgical heat treat condition of the material of those parts which constitute parts of the pressure boundary.
(b) In-process postweld repair heat treatments of the material of those parts which constitute parts of the pressure boundary.

RESPONSE

1. The Lowest Service Metal Temperature (LSMT), which could be experienced by containment boundary materials is +60°F. This value is conservative with respect to NE 2300 and GDC-51. This LSMT does not apply to the Disc of the Outboard Feedwater Check Valve. The LSMT for this valve is currently being evaluated and will be provided in a later amendment.

2. Materials of all penetration sleeves have been reviewed and found to be either ASTM 516 Grade 70 or ASTM A333. Evaluation of the remaining parts of the penetration assemblies for the most limiting components is given in the response to item 4 of this question. Actual fracture toughness data for each material of the penetration sleeves are attached for your review.

   Fracture toughness data (certified material test reports) and detail drawings for all penetration assemblies are available for review at the Grand Gulf Nuclear Station.

3. The equipment hatch and personnel airlocks drawings have been reviewed to determine the maximum thickness of the containment boundary parts. Each opening is fabricated of ASTM A516 Grade 70 material. The maximum thickness dimension is 4½ inches which is the thickness of the seal block. Actual fracture toughness data for the seal block are attached for your review.

   Fracture toughness data and detail drawings for other parts of the equipment hatch and for the personnel airlocks are available for review at the Grand Gulf Nuclear Station. The containment boundary parts of the personnel blocks are bounded by the equipment hatch seal block.

4. Piping diagrams and graphic legends for the main steam and main feedwater systems are available for review at the Grand Gulf Nuclear Station. Fracture toughness data relating to the material of those parts of the main feedwater system which perform the containment function are attached for your review.

GG
FSAR

The penetration sleeve is addressed in the response to Item (2) of this question and is bounded by the main steamline penetrations.

5. The fracture toughness data requested in this question is available for review at the Grand Gulf Nuclear Station.

PURCHASER:

HAHN & CLAY
R. G. JEFFRIES
5100 CLINTON DRIVE
HOUSTON, TEXAS 77020

LUKENS STEEL COMPANY

COATESVILLE, PA. 19320

TEST CERTIFICATE

DATE: 10/31/75 FILE NO. 34HB-01-01

CONSIGNEE:

Equipment Hatch

MILL ORDER NO.	CUSTOMER P.O.	
66928 2	1874	102875 RH

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS AND SPECIFICATION(S):

SA-516 GR. 70 ASME CODE SEC 2 & 3 SUB NE 1974 EDITION N-1160 8/4/78

Revised Copy: 12-11-75 R. A. Lilius

BEND TEST HOMOGENEITY TEST

CHEMICAL ANALYSIS

MELT NO.	C	MN	P	S	CU	SI	NI	CR	MO	V	TI	AL	B		
C5744	.25	.95	.007	.020		.21									7-8

L. R. Wiley
Bechtel Corp.
3/1/76

Piece #6
Drw 93770

Please destroy other test reports ~~xxxxxxxx~~ previously sent.
revised copy.
Reason: Revised stress relieved ~~x~~ statement.
Customer Request.

PHYSICAL PROPERTIES

MELT NO.	SLAB NO.	YIELD PSI X100	TENSILE PSI X100	% ELONG IN 2"	% R.A.	BHN	IMPACTS LO- 50 F			Fracture Appearance % Shear	DESCRIPTION
C5744	3	510 561	747 780	30 30			77	58	40	50-50-50	2- 5" x 76 x 185
							Lateral Expansion in Inches				
							.060	.054	.038		

Plates and tests heated to 1625°F./1675°F., held 1/2 hr. per inch min., and water quenched., then tempered 1220°F., held 1/2 hr. per inch min., and water quenched.

Tests stress relieved by heating within a rate of 100°F. per hr. to 1100°F./1150°F., held 1 hr. per inch , and furnace ~~xx~~ cooled within a rate of 100°F. per hr. to 800°F.

REFERENCE ONLY

PURCHASER: LEC

Chicago Bridge & Iron Co.
Pur. Dept.
Greenville, Pa. 16125

LUKENS STEEL COMPANY
COATESVILLE, PA. 19320

TEST CERTIFICATE

AFFI:

DATE: 5-2-75 FILE NO 1540-03-06

CONSIGNEE:

MILL ORDER NO.	CUSTOMER P.O.	
79213-1	73-7341U-19	MP 5175 JW

Penetration sleeves

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS AND SPECIFICATION(S).

CB&I MS-6042 Rev. 0 1974 QAS 345 Rev. 0 SA-516 Gr. 70 ASME Code Section 2 & 3 Cl. MC 1971 Edition Thru Summer 1973 Addenda

BEND TEST O.K. HOMOGENEITY TEST

CHEMICAL ANALYSIS

MELT NO.	C	MN	P	S	CU	SI	NI	CR	MO	V	TI	AL	B		Grain Size
X7847	24	95	011	030		22							0015		7-8

#5

RECEIVED
MAY -8 1975
C
SMK

PHYSICAL PROPERTIES

MELT NO.	SLAB NO.	YIELD PSI X100	TENSILE PSI X100	% ELONG IN 2"	% R.A.	BHN	IMPACTS Long. V-Notch -10°F.			Fracture Appearance % Shear	DESCRIPTION
X7847	6	600	815	28			70	70	64	60-60-60	1- 3-1/16" x 80 x 228
		570	790	28							
					Lateral Expansion in Inches		.058	.060	.054		

Plate and tests heated to 1625°F./1675°F., held 1/2 hr. per inch min., and water quenched, then tempered 1240°F., held 1/2 hr. per inch min., and water quenched.

Tests stress relieved by heating within a rate of 131°F. per hr. to 1150°F. held 15 hrs. and furnace cooled within a rate of 163°F. per hr. to 600°F.

Affirmed and subscribed before me this ____ day of MAY 2 1975

Phillip A. Romanshin Jr.

Notary Public

My Commission Expires April 1, 1976

REFERENCE ONLY

237

We hereby certify the above information is correct.

SUPERVISOR-TESTING L. A. Klinc

PURCHASER: Eb

6 Chicago Bridge & Iron Co.
Purch. Dept.
Greenville, Pa. 16125

LUKENS STEEL COMPANY
COATESVILLE, PA. 19320

TEST CERTIFICATE

MILL ORDER NO.	CUSTOMER P.O.	
79213-1	73-7341U-19	DP 11774 BT

AFFI:
DATE: 11-11-74
CONSIGNEE:
FILE NO. 1540-03-05

Penetration Sleeves

THIS MATERIAL HAS BEEN MANUFACTURED AND TESTED IN ACCORDANCE WITH PURCHASE ORDER REQUIREMENTS AND SPECIFICATION(S):

CB&I MS-6042 Rev.0 1974 QAS 345 Rev.0 SA-516 Gr.70 ASME Code Sec. 2&3 Cl.MC 1971 Edit. thru Summer 1973 Addenda

BEND TEST O.K. HOMOGENEITY TEST

CHEMICAL ANALYSIS

MELT NO.	C	MN	P	S	CU	SI	NI	CR	MO	V	TI	AL	B	Grain Size
T8631	23	91	008	030		23								7-8

CBI CONTRACT NO. 73-7341-U
BECHTEL SUBCONTRACT NO. 9645-C-151.0
GRAND GULF NUCLEAR STATION – UNIT #1
PORT GIBSON, MISSISSIPPI

PHYSICAL PROPERTIES

MELT NO.	SLAB NO.	YIELD PSI X100	TENSILE PSI X100	% ELONG IN 2"	% R.A.	BHN	IMPACTS Long. V-Notch -10°F.			Fracture Appearance % Shear	DESCRIPTION
T8631 #6	5	544	767	26			53	39	54	50-50-50	1- 3-1/16" x 80 x 228
		530	755	26			Lateral Expansion in Inches				
							.046	.036	.048		
T8631 #7 & #8	6	455	773	28			44	49	57	40-40-40	2- "
		602	781	26			Lateral Expansion in Inches				
							.043	.053	.042		

Plates and tests heated to 1625°F./1675°F. held 1/2 hr. per inch min. and water quenched then tempered 1240°F. held 1/2 hr.per inch min. and water quenched.

Tests stress relieved by heating within a rate of 131°F. per hr. to 1150°F. held 15 hrs. and furnace cooled within a rate of 163°F. per hr. to 600°F.

CERTIFIED

bff

L.J. McAnallen
Chemist
11-20-74

Affirmed and subscribed before me this 11 day of NOV 1 1 1974

Donald C. Poteet
Notary Public
My Commission Expires February 20, 1979

93

We hereby certify the above information is correct. 0 0 1 5 7 0

SUPERVISOR TESTING H. K. Kline

Penetration 54

ARMCO STEEL CORPORATION
AMBRIDGE WORKS, AMBRIDGE, PA.

Form No. 0021-5 (3/1/74)

REPORT OF TESTS

Customer: CAPITOL PIPE & STEEL PRODUCTS INC. Date: 3-16-74

Specification: ASTM A-333-72A / ASME SA-333 Armco Order No. 002448900-0170A

Material: SMLS. GR 1 AND GR 6 / STEEL PIPE Customer Order No. 64209

PHYSICAL TESTS (MATERIAL NORMALIZED AT 1650° F) STILL-AIR COOLED 80 MIN

Item	Heat Number	Identification	Yield Strength	Ultimate PSI	% Elongation In 2 Inch	Transverse Strip	Transverse Round	Hydro Test PSI
1	234099	12 3/4 x 1.312	48750	74000	36.0	X		7800
"	"	"	42500	73500	38.0	"		"

(463)

CHEMICAL ANALYSIS

Item	Heat Number	C	Mn	P	S	Si	Ni	Cr	Mo	V	Other
1	234099	.16	.94	.011	.017	.13					CHEM
"	"	.17	.95	.010	.018	.14					CHECK
"	"	.15	.93	.011	.017	.14					LADLE

Chicago Bridge & Irn
Capitol S.O.# RN-1016-A
P.O.# G-70983-7341/41 Ptl

Ch# P-19519

Item# 8

WE HEREBY CERTIFY THAT THIS IS A TRUE AND ORIGINAL MILL RECORD IN ACCORDANCE WITH SPECIFICATION

SIGNED [signature] DATE 10-9-74

IMPACT TESTS – Longitudinal X Transverse ____ Size 10x 10 MM.

Condition 1: Impact Test Normalizing Temperature 1650 °F at 80 Minutes Soak, Still Air Cooled.

Condition 2: Impact Test Normalizing Temperature 1650 °F at 80 Minutes Soak, Still Air Cooled and Stress Relieved at 1100 °F at 80 Minutes Soak, Furnace Cooled.

Condition 3: Impact Test Water Quenched & Tempered at Minimum Soak of one Hour Per Inch of Wall.

Item	Heat Number	FT/LB Impact Value of Set &			Avg.	% Ductile Fracture			Lateral Expansion			V-Notch Charpy Test Condition	V-Notch Charpy Test Temperature °F
1	234099	16	16	17 =	16	5%	5%	5%	.014	.010	.013	STR REL	-50°
"	"	23	16	15 =	18	5%	5%	5%	.018	.006	.006	Norm	-50°

CBI CONTRACT NO. 73-7341-U
BECHTEL SUBCONTRACT NO. 9645-C-151.0
GRAND GULF NUCLEAR STATION – UNIT #1
PORT GIBSON, MISSISSIPPI

Sworn to and subscribed before me this 18th day of March 1974

Rita Ferris
RITA FERRIS
Notary Public, Harmony Twp., Beaver Co.
Commission Expires December 8, 1975

REFERENCE OK
Bending Test ONLY
2 Longitudinal pcs 10-2-74

The chemical analyses and physical or mechanical tests reported above are correct as contained in the records of the corporation.

S. Mitelsky
Metallurgical Laboratory

#43

ESTABLISHED 1881
8[illegible] POPLAR STREET, PITTSBURGH, P[illegible] 15220
PLEASE REPLY TO
P. O. BOX 1646
PITTSBURGH, PA. 152

AREA CODE 412 TELEPHONE 922-4000

LABORATORY No. 742984

CLIENT'S No. L-66851
Rel. #17

ORDER No. PG-17500

REPORT No. 1

REPORT OF CHARPY IMPACT

DATE 2-22-74

REPORT TO: Capitol Pipe & Steel Products Inc.
Nuclear Products Division
730 Superior Avenue
Carnegie, Pennsylvania 15106

REPORT FOR: P.D.M. PN-9082A P12521
Cust. PO 148473 Add 12

MATERIAL INFORMATIO: TYPE ASTM A333/Gr. 6
SIZE 12" SCH. 160 HT. 234099

SPECIFICATION: ASTM A333 Gr. 6

Chicago Bridge & Iron
Capitol S.O.# RN-1024-A
P.O.# G80184-73024
Ch# P-18893
Item# 15

Material Identification	Test No.	Test	Results Ft. Lbs.
1	234099	Charpy Impact -30°F	28
2	234099	Charpy Impact -30°F	35
3	234099	Charpy Impact -30°F	28

	Lateral Expansion In.	Shear %	Cleavage %
1	.032	5	95
2	.033	5	95
3	.031	5	95

CBI CONTRACT NO. 73-7341-U
BECHTEL SUBCONTRACT NO. 9645-C-151.0
GRAND GULF NUCLEAR STATION – UNIT #1
PORT GIBSON, MISSISSIPPI

The above tests meet the impact requirements of ASTM A333 Gr. 6.

WE HEREBY CERTIFY THAT THIS IS A TRUE COPY OF THE ORIGINAL MILL TEST CERTIFICATE ON FILE WITH CAPITAL PIPE AND STEEL PRODUCTS, INC.

SIGNED [illegible] DATE 10-2-74

2-21-74
Date of Test

Earl Gallagher
Earl Gallagher, Manager
Physical Testing Department

REFERENCE ONLY

cc: 4- Client
cms

J Lopez Becerra 10-2-74

Metallurgical Laboratory

11-43

43

ESTABLISHED 1881
850 [illegible] PLAR STREET, PITTSBURGH, PA. [illegible]220
PLEASE REPLY TO: P. O. BOX 1640 PITTSBURGH, PA. 15230
AREA CODE 412 TELEPHONE 922-4000

CLIENT'S No. L-66351 Rel. #17

LABORATORY No. 742984
ORDER No. PG-17500
REPORT No. 1
DATE 2-22-74

REPORT OF CHARPY IMPACT

REPORT TO: Capitol Pipe & Steel Products Inc.
Nuclear Products Division
730 Superior Avenue
Carnegie, Pennsylvania 15106

REPORT FOR: C.B.&I. RN-1016-A P-19519
CUST. PO# G70983-7341/41 PT.1

MATERIAL INFORMATION: TYPE ASTM A333 Gr. 6
SIZE 12" SCH. 160 HT. 234099

SPECIFICATION: ASTM A333 Gr. 6

Material Identification	Heat No.	Test	Results Ft. Lbs.
1	234099	Charpy Impact -30°F	28
2	234099	Charpy Impact -30°F	35
3	234099	Charpy Impact -30°F	28

	Lateral Expansion In.	Shear %	Cleavage %
1	.032	5	95
2	.033	5	95
3	.031	5	95

The above tests meet the impact requirements of ASTM A333 Gr. 6.

RECEIVED
JUN 13 1975
GREENVILLE

Chicago Bridge & Irn
Capitol S.O.# RN-1016-A
P.O.# G-70983-7341/41 Ptl
Ch# P-19519
Item# 8

2-21-74
Date of Test

Earl Gallagher, Jr.
Physical Testing Department

REFERENCE

CBI CONTRACT NO. 73-7341-U
BECHTEL SUBCONTRACT NO. 8645-C-151.0
GRAND GULF NUCLEAR STATION – UNIT #1
PORT GIBSON, MISSISSIPPI

U-43

Doc. I.D. No. 9645-M-312.0-Q1B21G502B-16.0-10
17.1
17.2

19

ARMCO Machinery and Equipment Division
Armco Steel Corporation
Torrance, California

LABORATORY REPORT

CUSTOMER Bechtel Power Corporation
Port Gibson, Mississippi

CUSTOMER'S PURCHASE ORDER NO. 9645-M-312.0

NSCO SALES REGISTER NO. IPN-27970

DATE 5-20-77 BY D. A. Bender

SPECIFICATION NO. ASME-SA-508, Cl. 1 and Bechtel Spec. 9645-M-312.0 Rev. 11

PART NAME (1) Flued Head

APN 616
PART NO. 10

Customer's Equipment No. Q1B21G502-B

NSCO DRG. NO. 151016 -9

COUPON IDENTIFICATION	TENSILE TEST: PROOF STRESS P.S.I. / YIELD STRENGTH P.S.I. / YIELD POINT P.S.I.	X	ULTIMATE STRENGTH P.S.I.	ELONG. %	REDUCT. %	HARDNESS: BRINELL / ROCKWELL / SHORE	IMPACT TEST: LONG. / TRANS. / IZOD FT. LBS. / CHARPY FT. LBS.	BE TE
	LONGITUDINAL / TRANSVERSE	X						
522316-B1A	73,600		86,500	27.5	66.2		See Page 2	
522316-B1B	66,100		84,500	28.0	65.7		See Page 3	
REQUIRED	35,000		70,000 95,000	20.0	38.0			

HEAT NO.	CHEMICAL ANALYSIS: C.	MN.	SI.	P.	S.	CR.	VA.	NI.	MO.				A. S. T. M GRAIN SIZ
Ladle	.24	.80	.30	.019	.015		.036						
Product	.25	.80	.31	.016	.014		.03[illegible]						
REQUIRED MAX.	.35	.90	.35	.025	.025		.05						
REQUIRED MIN.		.40	.15										

NATIONAL SUPPLY COMPANY
ARMCO STEEL CORPORATION
TORRANCE, CALIFORNIA

Date 5-20-77

Customer Bechtel Power Corporation Customer Order No. 9645-M-312.0

MED Order No. IPN-27970 Heat No. 522316-B1A

"V" NOTCH CHARPY IMPACT TEST RESULTS @ +40°F APN 616

	Absorbed Energy	% Shear	Lateral Expansion	
	80.0 Ft.Lbs.	65	.050	in.
	70.0 Ft.Lbs.	65	.047	in.
	78.0 Ft.Lbs.	69	.047	in.
Required	20 Ft. Lbs. Avg	INFO	INFO	

21

NATIONAL SUPPLY COMPANY
ARMCO STEEL CORPORATION
TORRANCE, CALIFORNIA

Date 5-20-77

Customer Bechtel Power Corporation Customer Order No. 9645-M-312.0

MED Order No. IPN-27970 Heat No. 522316-B1B

"V" NOTCH CHARPY IMPACT TEST RESULTS @ +40°F APN 616

	Absorbed Energy	% Shear	Lateral Expansion
	61.0 Ft.Lbs.	53	.042 in.
	71.5 Ft.Lbs.	69	.049 in.
	69.5 Ft.Lbs.	65	.052 in.
Required	20 Ft. Lbs. Avg	INFO	INFO

HEAT TREATMENT

Austenitize

1550°F (11 Hrs.) Water Quench

Temper

1200°F (8 Hrs.) Furnace Cool

TEST LOCATION

The previous test results were obtained from a test prolongation in accordance with Armco drawing number 151016-9M.

BECHTEL
230

The chemical, physical, or mechanical tests reported above are correct as contained in the records of the Corporation.
ARMCO STEEL CORPORATION
David A. Bender
(signed)

David A. Bender

MACHINERY AND EQUIPMENT DIVISION
ARMCO STEEL CORPORATION
TORRANCE, CALIFORNIA

CUSTOMER: Bechtel Power Corporation DATE: 5-3-77

MAGNETIC PARTICLE EXAMINATION CERTIFICATION

PART NAME: (1) Flued Head

PART NO: 151016-10

ARMCO DWG. NO: 151016-9

HEAT NUMBER(S): 522316-B1 APN NO. 616

SALES ORDER NO: IPN-27970 CUSTOMER P.O. NO: 9645-M-312.0

DATE EXAMINED: 5-5-77 SURFACE FINISH: 250 RMS

TYPE OF MATERIAL: ASME-SA-508 Cl. 1

TYPE OF MAGNETIZATION: Longitudinal and Circular

EQUIPMENT USED: Special TAQ-1926

CURRENT USED: Direct Current DEMAGNETIZATION: Reverse Step-down D.C.

PARTICLES USED: MANUFACTURER Magnaflux Corporation

COLOR Red 9-C

WET 410-H Base Oil

DRY

SUSPENSION CONCENTRATION: 2.0 Solids per 100 Ml.

5.3 REACTOR VESSEL

5.3.1 Reactor Vessel Materials

5.3.1.1 Materials Specifications

The materials used in the reactor pressure vessel and appurtenances are shown in Table 5.2-4 together with the applicable specifications.

5.3.1.2 Special Processes Used for Manufacturing and Fabrication

The reactor pressure vessel is primarily constructed from low alloy, high strength steel plate and forgings. Plates are ordered to ASME SA533 Grade B, Class 1, and forgings to ASME SA508, Class 2. These materials are melted to fine grain practice and are supplied in the quenched and tempered condition. Further restrictions include a requirement for vacuum degassing to lower the hydrogen level and improve the cleanliness of the low alloy steels. Materials used in the core beltline region also specify limits of 0.12 percent maximum copper and 0.015 percent maximum phosphorus content in the base materials and weld materials.

Studs, nuts, and washers for the main closure flange are ordered to ASME SA 540, Grade 23 or Grade 24. Welding electrodes are low hydrogen type ordered to ASME SFA 5.5.

All plate, forgings, and bolting are 100 percent ultrasonically tested and surface examined by magnetic particle methods or liquid penetrant methods in accordance with ASME Code, Section III, subsection NB standards. Fracture toughness properties are also measured and controlled in accordance with subsection NB requirements.

All fabrication of the reactor pressure vessel is performed in accordance with buyer approved drawings, fabrication procedures, and test procedures. The shells and vessel heads are made from formed plates, and the flanges and nozzles from forgings. Welding performed to join these vessel components is in accordance with procedures qualified per ASME Code, Sections III and IX requirements. Weld test samples are required for each procedure for major vessel full penetration welds. Tensile and impact tests are performed to determine the properties of the base metal, heat affected zone, and weld metal.

Submerged arc and manual stick electrode welding processes are employed. Electroslag welding is not permitted. Preheat and interpass temperatures employed for welding of low alloy steel meet or exceed the requirements of ASME Code, Section III, subsection NA. Post weld heat treatment at 1100 F minimum is applied to all low alloy steel welds.

Radiographic examination is performed on all pressure containing welds in accordance with requirements of ASME Code, Section III, subsection NB 5320. In addition, all welds are given a supplemental ultrasonic examination.

The materials, fabrication procedures, and testing methods used in the construction of BWR reactor pressure vessels meet or exceed requirements of ASME Code Section III, Class I vessels.

5.3.1.3 Special Methods for Nondestructive Examination

The materials and welds on the reactor pressure vessel were examined in accordance with methods prescribed and met the acceptance requirements specified by ASME Code, Section III. In addition, the pressure retaining welds were ultrasonically examined to the requirements of ASME Code, Section XI, in Appendix I. See subsection 5.2.4 for details of the ISI program.

5.3.1.4 Special Controls for Ferritic and Austenitic Stainless Steels

5.3.1.4.1 Compliance With Regulatory Guides

5.3.1.4.1.1 Regulatory Guide 1.31, Control of Stainless Steel Welding

Controls on stainless steel welding are discussed in subsection 5.2.3.4.2.

5.3.1.4.1.2 Regulatory Guide 1.34, Control of Electroslag Weld Properties

Electroslag welding was not employed for the reactor pressure vessel fabrication.

5.3.1.4.1.3 Regulatory Guide 1.43, Control of Stainless Steel Weld Cladding of Low Alloy Steel Components

Reactor pressure vessel specifications require that all low alloy steel be produced to fine grain practice. The requirements of this regulatory guide are not applicable to BWR vessels.

5.3.1.4.1.4 Regulatory Guide 1.44, Control of the Use of Sensitized Stainless Steel

Controls to avoid severe sensitization are discussed in subsection 5.2.3.4.1.

5.3.1.4.1.5 Regulatory Guide 1.50, Control of Preheat Temperature for Welding Low Alloy Steel

Preheat controls are discussed in subsection 5.2.3.3.2.

5.3.1.4.1.6 Regulatory Guide 1.71, Welder Qualification for Areas of Limited Accessibility

Qualification for areas of limited accessibility is discussed in subsection 5.2.3.3.2.3.

5.3.1.4.1.7 Regulatory Guide 1.99, Effects of Residual Elements on Predicted Radiation Damage to Reactor Pressure Vessel Materials

Predictions for changes in transition temperature and upper shelf energy were made in accordance with the requirements of Regulatory Guide 1.99.

5.3.1.5 Fracture Toughness

5.3.1.5.1 Compliance with 10CFR50 Appendix G

Appendix G of 10CFR50 is interpreted for Class I RCPB components of the BWR/6 reactor design and complied with as discussed in 5.3.2 and below with the following exceptions:

1) The specific temperature limits for operation when the core is critical are based on a proposed modification of 10CFR50, Appendix G, Paragraph IV, A.2.C. The proposed modification and the justification for it, together with the results of an NRC review, are given in GE Licensing Topical Report NEDO-21778-A.

2) A minimum boltup and pressurization temperature of 70°F is called for, which is at least 60°F above the flange region RT_{NDT}. This exceeds the minimum RT_{NDT} temperature required by ASME Code Section III, Paragraph G-2222(c), Summer 1976 and later editions. A flange region flaw size less than 10% of the wall thickness can be detected at the outside surface of the flange to shell and head junctions where stresses due to boltup are most limiting.

5.3.1.5.1.1 Method of Compliance

The following items A through G are the interpretations and methods used to comply with Appendix G of 10CFR50. Item H reports the fracture toughness test results and the background information used as the basis to show compliance with 10CFR50, Appendix G.

A) Specimen Orientation for Original Qualification Versus Surveillance (Ref. Appendix G-III A)

The second sentence of G-III A is understood to be independent of the first sentence; that is, Charpy V-notch tests as defined in NB-2321.2 are to be conducted on both unirradiated and irradiated ferritic materials; however, the special beltline longitudinally oriented Charpy specimens required by the general reference NB-2300 and, specifically, NB-2322.2 (a) (6) are not to be included in the surveillance program, because the transverse specimens are limiting with regard to toughness.

B) Records and Procedures for Impact Testing (Ref. Appendices G-III B.4 and G-III B.5)

It is understood that G-III B.4 allows the component manufacturer the liberty of assigning to qualified sub-contractors, such as material suppliers, the actual preparation of written impact testing procedures. Personnel were qualified to written impact testing procedures. For the Grand Gulf 1 & 2 reactor pressure vessels, records were not sufficient to document full compliance to G-III B.5; however, there are sufficient records to document that the technical requirements are met.

C) Charpy-V Curves for the RPV Beltline (Ref. Appendices G-III C and H-III B)

It is understood that the orientation of impact test specimens for the G-III C1 requirements shall comply with the requirements of NB-2322(a)4 (transverse

specimen) for plate material as opposed to NB-2322(a) (6) (longitudinal specimen). This understanding of the general reference to NB-2322 in G-111 C1 results in meaningful and conservative beltline curves of unirradiated materials for comparison with the results of surveillance program testing of irradiated transverse base metal specimens and also allows this curve to comply with ASTM E-185-73.

It is understood that the number, type and locations of specimens necessary for the full curves of G-III C(1) are those required to comply with paragraphs 4.3 and 4.4 of ASTM E-185-73. This interpretation is considered necessary to assure that the adjusted reference temperature of irradiated base metal, heat-affected zone and weld metal called for in H-III B can be based on directly comparable data for the unirradiated reference temperature.

In regard to G-III C(2), for Grand Gulf 1, all beltline weld materials (3) and beltline plate material within 9°F of being limiting (adjusted reference temperature), were used for selection of surveillance specimen base material and weld material to provide a conservative adjusted reference temperature for the beltline material. The weld test plate for the surveillance program specimens had the principal working direction perpendicular to the weld seam to assure that heat affected zone specimens were parallel to the principal working direction in order to represent the longitudinal weld seams in the Grand Gulf beltline.

D) Alternative Procedures for the Calculation of Stress Intensity Factor (Ref. Appendices G-IV A.2(a) and G-IV A.2(b))

Stress Intensity Factors were calculated by the methods of Appendix G to Section III of the ASME Code. Discontinuity regions were evaluated, as well as shell and head areas, as part of the detailed thermal and stress analysis in the vessel stress report. Equivalent margins of safety to those required for shells and heads were demonstrated using a ¼T defect at all locations, with the exception of the main closure flange to head and shell discontinuity locations, there it was found that additional restriction on operating limits would be required for outside surface flaw size greater than 0.24 inches at the outside surface of the flange to shell joint (based on additional analyses made for BWR/6 reactor vessels). It has been demonstrated using a test mockup of these areas that smaller defects can be detected by the ultrasonic inservice examination procedures required at the adjacent weld joint. Since the stress intensity factor is greatest at the outside surface of the flange to shell and head joints a flaw can also be detected by outside surface examination techniques.

E) Fracture Toughness Margins in the Control of Reactivity (Ref. Appendix G-IV A 2.c)

Appendix G of the ASME Code Section III (1971 Edition with Addenda to and including Winter 1972 or later), "Protection Against Non-ductile Failure," was used in determining pressure/temperature limitations for all phases of plant operation. Additional, when the core is critical a 40°F temperature allowance is included in the reactor vessel operating pressure vs temperature limits to account for operational occurrences in the control of reactivity as described in GE BWR Licensing Topical Report NEDO-21778-A and the US Nuclear Regulatory Commission's acceptance basis which is included therein.

F) Bolting Materials (Reference Appendix G-IV A.4)

Bolting meets the 45 ft-lb and 25. mils lateral expansion requirements at 10°F for Grand Gulf Units 1 & 2.

G) Upper Shelf Energy for Beltline (Ref. Appendix G-IV B)

For the Grand Gulf 1 reactor pressure vessels all beltline materials comply with the requirement of 75 ft-lb minimum upper shelf Charpy V-notch energy (transverse direction).

H) Results of fracture toughness tests are reported in Tables 5.3-1 and 5.3-2.

5.3.1.6 Material surveillance

5.3.1.6.1 Compliance with Reactor Vessel Material Surveillance Program Requirements

The materials surveillance program monitors changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region resulting from their exposure to neutron irradiation and thermal environment.

Reactor vessel materials surveillance specimens are provided in accordance with requirements of ASTM-E-185-73 and 10CFR50, Appendix H except for material selection and HAZ orientation as indicated in 5.3.1.5.1.1.C. Materials for the program are selected to represent materials used in the reactor beltline region, as indicated in 5.3.1.5.1.1.A. Specimens are manufactured from a plate actually used in the beltline region and a weld typical of those in the beltline region and thus represent base metal, weld material, and the weld heat affected zone material. Surveillance specimen materials are identified with properties in Table 5.3-1, 5.3-2, and 5.3-3. The plate and weld are heat treated in a manner which simulates the actual heat treatment performed on the core region shell plates of the completed vessel.

Each in-reactor surveillance capsule contains 36 Charpy V-Notch specimens. The capsule loading consists of 12 specimens each of base metal, weld metal, and heat affected zone material. A set of out-of-reactor baseline Charpy V-Notch specimens and archive material are provided with the surveillance test specimens.

Three capsules are provided in accordance with the requirements of 10CFR50 Appendix H since the predicted end of life adjusted reference temperature of the reactor vessel steel is less that 100°F. The proposed withdrawal schedule is in accordance with 10CFR50, Appendix H.

First capsule - 10 years (one-fourth service life)
Second capsule - 30 years (three-fourths service life)
Third capsule - standby

Fracture toughness testing of irradiated capsule specimens will be in accordance with requirements of 10CFR50, Appendix H.

5.3.1.6.2 Neutron Flux and Fluence Calculations

A description of the methods of analysis is contained in subsections 4.1.4.5 and 4.3.2.8.

The peak fluence at ¼T depth of the vessel beltline material is 1.9×10^{18} n/cm² after 40 years of service. All predictions of radiation damage to the reactor vessel beltline material were made using peak fluence values.

5.3.1.6.3 Predicted Irradiation Effects on Vessel Beltline Materials

Estimated maximum changes to RT_{NDT} (initial reference temperature) and upper shelf fracture energy as a function of the end-of-life (EOL) fluence at the ¼T depth of the vessel beltline materials are listed on Table 5.3-3. The predicted peak EOL fluence at the ¼T depth of the vessel beltline is 1.9×10^{18} n/cm² after 40 years of service. Transition temperature changes and changes in upper shelf energy were calculated in accordance with the rules of Regulatory Guide 1.99. Reference temperatures were established in accordance with 10CFR50 Appendix G and NB-2330 of the ASME Code.

5.3.1.6.4 Positioning of Surveillance Capsules and Methods of Attachment (Ref. Appendix H.II C.3))

Surveillance specimen capsules are located at three azimuths at a common elevation in the core beltline region. The sealed capsules are not attached to the vessel but are in seal welded capsule holders. The capsule holders are mechanically retained by capsule holder brackets welded to the vessel cladding as shown in Figure 5.3-3. Since reactor vessel specifications require that all low alloy steel pressure vessel boundary material be produced to fine-grain practice, underclad cracking is of no concern. The capsule holder brackets allow the removal and reinsertion of capsule holders. These brackets are designed, fabricated and analyzed to the requirements of ASME Code, Section III. A positive spring loaded locking device is provided to retain the capsules in position throughout any anticipated event during the lifetime of the vessel.

In areas where brackets such as the surveillance specimen holder brackets are located, additional non-destructive examinations are performed on the vessel base metal and stainless steel weld deposited cladding or weld buildup pads during vessel manufacture. The base metal is ultrasonically examined by straight beam techniques to a depth at least equal to the thickness of the bracket being joined. The area examined is the area of the subsequent attachment weld plus a band around this area of width equal to at least half the thickness of the part joined. The required stainless steel weld deposited cladding is similarly examined. The full penetration welds are liquid penetrant examined to ASME Code, Section III standards. Cladding thickness is required to be at least 1/8".

The above requirements have been successfully applied to a variety of bracket designs which are attached to weld deposited stainless steel cladding or weld buildups in many operating BWR reactor pressure vessels.

Inservice inspection examinations of core beltline pressure retaining welds are performed from the outside surface of the reactor pressure vessel. If a bracket were located at or adjacent to a vessel shell weld, it would not interfere with the straight beam or half node angle beam inservice inspection ultrasonic examinations performed from the outside surface of the vessel.

5.3.1.6.5 Time and Number of Dosimetry Measurements

GE provides a separate neutron dosimeter so that fluence measurements may be made at the vessel ID during the first fuel cycle to verify the predicted fluence at an early date in plant operation. This measurement is made over this short period to avoid saturation of the dosimeters now available. Once the fluence-to-thermal power output is verified, no further dosimetry is considered necessary because of the linear relationship between fluence and power output. It will be possible, however, to install a new dosimeter, if required, during succeeding fuel cycles.

5.3.1.6.6 Lead Factor

The lead factor is the ratio of the flux greater than 1 MeV at the surveillance sample divided by the flux greater than 1 MeV at the point of greatest flux in the vessel. For Grand Gulf, this value is 0.8. This lead factor has arbitrarily been reduced by a factor of 2 in order to improve the probability that vessel fluxes estimated from surveillance data will not be underestimated. The lead factor then becomes 0.4.

5.3.1.7 Reactor Vessel Fasteners

The reactor vessel closure head (flange) is fastened to the reactor vessel shell flange by multiple sets of threaded studs and nuts. The lower end of each stud is installed in a hole threaded in the vessel shell flange. A nut and washer are installed on the upper end of each stud. The proper amount of preload can be applied to the studs by a sequential tensioning using hydraulic tensioners. The design and analysis of this area of the vessel is in full compliance with all requirements of ASME Code, Section III, Class I. The material for studs, nuts and washers is SA-540 Grade B23 or B24 in the 130,000 psi specified minimum yield strengths level.

Hardness tests are performed on all main closure bolting to demonstrate that heat treatment has been properly performed. A minimum of 45 ft-lbs Charpy V-Notch, C_v, energy and 25 mils lateral expansion is required at the lowest service temperature. The maximum reported ultimate tensile strength was below the 170,000 psi maximum specified in Regulatory Guide 1.65. Also, the Charpy impact test requirements of Appendix G-IV A.4 were satisfied at +10°F, compared to the requirement of 45 ft-lbs at 70°F. Studs, nuts, and washers are ultrasonically examined in accordance with Section III, NB-2585 and the following additional requirements:

a. Examination was performed after heat treatment and prior to machining threads.

b. Straight beam examination was performed on 100 percent of each stud. Reference standard for the radial scan was a ½" diameter flat bottom hole having a depth equal to 10 percent of the material thickness. For the end scan the standard of NB-2585 is used.

c. Nuts and washers were examined by angle beam from the outside circumference per ASME-SA-388 in both the axial and circumferential directions.

The surface examinations of NB-2583 are applied after heat treatment and threading.

There are no metal platings applied to closure studs, nuts, or washers. A phosphate coating was applied to threaded areas of studs and nuts and bearing areas of nuts and washers to assist in retaining lubricant on these surfaces.

5.3.2 Pressure/Temperature Limits

5.3.2.1 Limit Curves

The limit curves presented in Figures 5.3-4 and 5.3-4a are based on the requirements of 10CFR50, Appendix G with the modification to Paragraph IV.A.2.C per GE BWR Licensing Topical Report NEDO-21778-A. All the vessel shell and head areas remote from discontinuities plus the feedwater nozzles were evaluated, and the operating limit curves are based on the limiting location. The boltup limits for the flange and adjacent shell region are based on a minimum metal temperature of RT_{NDT} +60°F. The maximum through-wall temperature gradient from continuous heating or cooling of 100°F per hour was considered. The safety factors applied were as specified in ASME Code Appendix G and GE Licensing Topical Report NEDO-21778-A.

5.3.2.1.1 Temperature Limits for Boltup

A minimum temperature of 70°F is required for the closure studs for Grand Gulf Units 1 & 2. The flanges and adjacent shell are required to be warmed to minimum temperatures of 70°F before they are stressed by the full intended bolt preload (all bolts fully tightened). The fully preloaded boltup limits are shown on Figures 5.3-4 and 5.3-4a.

5.3.2.1.2 Temperature Limits for Preoperational System Hydrostatic Tests and ISI Hydrostatic or Leak Pressure Tests

Based on 10CFR50 Appendix G IV.A.2.d, which allows a reduced safety factor for tests prior to fuel loading, the preoperational system hydrostatic test at 1563 psig may be performed at a minimum temperature of 135°F for Unit 1 and (later)°F for Unit 2. The fracture toughness analysis for system pressure tests resulted in the curves labeled A in Figures 5.3-4 (Unit 1) and 5.3-4a (Unit 2). The curves labeled "core beltline" are based on an initial RT_{NDT} of 0°F for the plate material for Unit 1 and -10°F for the plate material for Unit 2.

The predicted shift in the RT_{NDT} from Figure 5.3B (based on the neutron fluence at ¼T of the vessel wall) must be added to the beltline curve to account for the effect of fast neutrons. Figures 5.3-4 and 5.3-4a show the beltline curves with an assumed 26°F shift (Unit 1) and 31°F shift (Unit 2) at the end of 40 years service (fluence of 1.9×10^{18} n/cm^2).

5.3.2.1.3 Operating Limits During Heatup, Cooldown and Core Operation

The fracture toughness analysis was done for the normal heatup or cooldown rate of 100°F/hour. The temperature gradients and thermal stress effects corresponding to this rate were included. The results of the analyses are a set of operating limits for non-nuclear heatup or cooldown shown as curves labeled B on Figures 5.3-4 and 5.3-4a. Curves labeled C on these figures

apply whenever the core is critical. The basis for the curves labeled C is described in GE BWR Licensing Topical Report NEDO-21778-A.

5.3.2.1.4 Reactor Vessel Annealing

In-place annealing of the reactor vessel because of radiation embrittlement is unnecessary because the predicted value in transition of adjusted reference temperature does not exceed 200°F (10CFR50, Appendix G, Paragraph IV.C).

For design purposes the adjusted reference temperature for BWR vessels is predicted using the procedures in Regulatory Guide 1.99, as shown in Figure 5.3-5.

5.3.2.2 Operating Procedures

By comparison of the pressure vs temperature limits in subsection 5.3.2.1 with intended normal operating procedures for the most severe upset transient, it is shown that the limits will not be exceeded during any foreseeable upset condition. Reactor operating procedures have been established such that actual transients will not be more severe than those for which the vessel design adequacy has been demonstrated. Of the design transients, the upset condition producing the most adverse temperature and pressure condition anywhere in the vessel heads and/or shell areas has a minimum fluid temperature of 250 F and a maximum pressure peak of 1180 psig. Scram automatically occurs with initiation of this event, prior to the reduction in fluid temperature, so the applicable operating limits are given by Figures 5.3-4 and 5.3-4a. For a temperature of 250 F, the maximum allowable pressure exceeds 1600 psig for the intended margin against nonductile failure. The maximum transient pressure of 1180 psig is therefore within the specified allowable limits.

5.3.3 Reactor Vessel Integ

The Units 1 and 2 reactor vessels were fabricated for General Electric's Nuclear Energy Division by CBI Nuclear Co. and were subject to the requirements of General Electric's Quality Assurance program.

The CBI Nuclear Co. has had extensive experience with GE reactor vessels and has been the primary supplier of GE domestic reactor vessels and some foreign vessels since the company was formed in 1972 from a merger agreement between Chicago Bridge and Iron Co. and General Electric. Prior experience by the Chicago Bridge and Iron Co. with GE reactor vessels dates back to 1966.

Assurance was made that measures were established requiring that purchased material, equipment, and services associated with the reactor vessels and appurtenances conform to the requirements of the subject purchase documents. These measures included provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished, inspection at the vendor source and examination of the completed reactor vessels.

General Electric provided inspection surveillance of the reactor vessel fabricator's inprocess manufacturing, fabrication, and testing operations in accordance with GE's Quality Assurance program and approved inspection procedures. The reactor vessel fabricator was responsible for the first level inspection of his manufacturing, fabrication, and testing activities and

General Electric is responsible for the first level of audit and surveillance inspection.

Adequate documentary evidence that the reactor vessel materials, manufacture, testing, and inspection conform to the specified quality assurance requirements contained in the procurement specification is available at the fabricator plant site.

A. Regulatory Guide 1.2
General Compliance or Alternate Approach Assessment:
For commitment, revision number, and scope see Section 1.8.

The Regulatory Guide states that potential reactor pressure vessel brittle fracture which may result from emergency core cooling system operation need not be reviewed in individual cases if no significant changes in presently approved core and pressure vessel designs are proposed. Should it be considered that the margin of safety against reactor pressure vessel brittle fracture due to emergency core cooling system operation is unacceptable, an engineering solution, such as annealing, could be applied to assure adequate recovery of the fracture toughness properties of the vessel material. This Regulatory Guide requires that available engineering solutions be outlined and requires that it be demonstrated that the design does not preclude their use.

The reactor pressure vessel employs no significant core or vessel design changes from previously approved BWR pressure vessels such as Browns Ferry, all units.

An investigation of the structural integrity of boiling water reactor pressure vessels during a design basis accident (DBA) has been conducted (refer to NEDO-10029, "An Analytical Study on Brittle Fracture of GE-BWR Vessel Subject to the Design Basis Accident") - It has been determined, based on methods of fracture mechanics, that no failure of the vessel by brittle fracture as a result of DBA will occur.

The investigation included:

(1) A comprehensive thermal analysis considering the effect of blowdown and the low-pressure coolant injection (LPCI) system reflooding.

(2) A stress analysis considering the effects of pressure, temperature, seismic load, jet load, dead weight, and residual stresses.

(3) The radiation effect on material toughness (NDTT shift and critical stress intensity).

(4) Methods for calculating crack tip stress intensity associated with a nonuniform stress field following the design basis accident.

This analysis incorporated very conservative assumptions in all areas (particularly in the areas of heat transfer, stress analysis, effects of radiation on material toughness, and crack tip stress intensity). Therefore, the results reported in NEDO-10029 provide an upper bound limit on brittle fracture failure mode studies. Because of the upper bound approach, it is concluded that catastrophic failure of the pressure vessel due to the DBA is shown to be impossible from a fracture mechanics point of view. In the case

studies, even if an acute flaw does form on the vessel inner wall, it will not propagate as the result of the DBA.

The criteria of 10CFR50 Appendix G are interpreted as establishing the requirements for annealing. Paragraph IV C of Appendix G, requires the vessels to be designed for annealing of the beltline only where the predicted value of adjusted RT_{NDT} exceeds 200°F as defined in paragraph NB-2331 of the ASME Section III Code. This predicted value is not exceeded, therefore design for annealing is not required.

For further discussion of fracture toughness of the reactor pressure vessel refer to Subsection 5.3.1.5.

5.3.3.1 Design

5.3.3.1.1 Description

5.3.3.1.1.1 Reactor Vessel

The reactor vessel shown in Figure 5.3-1 is a vertical, cylindrical pressure vessel of welded construction. The vessel is designed, fabricated, tested, inspected, and stamped in accordance with the ASME Code, Section III, Class 1 including the addenda in effect at the date of order placement, Unit 1, Winter 1972 and Unit 2, Winter 1972. Design of the reactor vessel and its support system meets seismic Category I equipment requirements. The materials used in the reactor pressure vessel are shown in Table 5.2-4.

The cylindrical shell and top and bottom heads of the reactor vessel are fabricated of low allow steel; the interior of which is clad with stainless steel weld overlay, except for the top head and nozzle weld zones.

In-place annealing of the reactor vessel is unnecessary because shifts in transition temperature caused by irradiation during the 40 year life can be accommodated by raising the minimum pressurization temperature, and the predicted value of adjusted reference temperature does not exceed 200 F. Radiation embrittlement is not a problem outside of the vessel beltline region because the irradiation in those areas is less than 1×10^{18} nvt with neutron energies in excess of 1 MeV.

Quality control methods used during the fabrication and assembly of the reactor vessel and appurtenances assure that design specifications are met.

The vessel top head is secured to the reactor vessel by studs and nuts. These nuts are tightened with a stud tensioner. The vessel flanges are sealed with two concentric metal seal rings designed to permit no detectable leakage through the inner or outer seal at any operating condition, including heating to operating pressure and temperature at a maximum rate of 100 F/hr in any one hour period. To detect seal failure, a vent tap is located between the two seal rings. A monitor line is attached to the tap to provide an indication of leakage from the inner seal ring seal.

5.3.3.1.1.2 Shroud Support

The shroud support is a circular plate welded to the vessel wall and to a cylinder supported by vertical stilt legs from the bottom head, peripheral

fuel elements, neutron sources, core plate, top guide, the steam separators, and the jet pump diffusers, and to support laterally the fuel assemblies. Design of the shroud support also accounts for pressure differentials across the shroud support plate, for the restraining effect of components attached to the support, and for earthquake loadings. The shroud support design is specified to meet appropriate ASME Code stress limits.

5.3.3.1.1.3 Protection of Closure Studs

The boiling water reactor does not use borated water for reactivity control. This subsection is therefore not applicable.

5.3.3.1.2 Safety Design Bases

Design of the reactor vessel and appurtenances meets the following safety design bases:

a. The reactor vessel and appurtenances will withstand adverse combinations of loading and forces resulting from operation under abnormal and accident conditions.

b. To minimize the possibility of brittle fracture of the nuclear system process barrier, the following are required:

   1. Impact properties at temperatures related to vessel operation have been specified for materials used in the reactor vessel.

   2. Expected shifts in transition temperature during design life as a result of environmental conditions, such as neutron flux, are considered in the design. Operational limitations assure that NDT temperature shifts are accounted for in reactor operation.

   3. Operational margins to be observed with regard to the transition temperature are specified for each mode of operation.

5.3.3.1.3 Power Generation Design Basis

The design of the reactor vessel and appurtenances meets the following power generator design basis:

a. The reactor vessel has been designed for a useful life of 40 years.

b. External and internal supports that are integral parts of the reactor vessel are located and designed so that stresses in the vessel and supports that result from reactions at these supports are within ASME Code limits.

c. Design of the reactor vessel and appurtenances allows for a suitable program of inspection and surveillance.

5.3.3.1.4 Reactor Vessel Design Data

Reactor vessel design data are contained in Table 5.2-3.

5.3.3.1.4.1 Vessel Support

The vessel supports are discussed in subsections 3.8.3.1.4 and 3.8.3.1.5

5.3.3.1.4.2 Control Rod Drive Housings

The control rod drive housings are inserted through the control rod drive penetrations in the reactor vessel bottom head and are welded to the reactor vessel. Each housing transmits loads to the bottom head of the reactor. These loads include the weights of a control rod, a control rod drive, a control rod guide tube, a four-lobed fuel support piece, and the four fuel assemblies that rest on the fuel support piece. The housings are fabricated of Type 304 austenitic stainless steel.

5.3.3.1.4.3 In-core Neutron Flux Monitor Housings

Each in-core neutron flux monitor housing is inserted through the in-core penetrations in the bottom head and is welded to the inner surface of the bottom head.

An in-core flux monitor guide tube is welded to the top of each housing and either a source range monitor/intermediate range monitor (SRM/IRM) drive unit or a local power range monitor (LPRM) is bolted to the seal ring flange at the bottom of the housing (Section 7.6).

5.3.3.1.4.4 Reactor Vessel Insulation

The reactor vessel insulation is of the reflective type and is constructed completely of metal. The outer surface temperature of the insulation is expected to be at 160 F and the heat transfer rate through the insulation is approximately 65 Btu/hr-ft^2 under normal operating conditions. The insulation consists of several self-contained assemblies latched together, each of which can be easily removed and replaced. The insulation assemblies are designed to remain in place and resist permanent damage during a safe shutdown earthquake.

The reactor top head insulation is supported from a structure secured on the bulkhead by means of temporary fasteners. During refueling, the support structure along with the top head insulation is removed. The support structure is designed as seismic Category I equipment. The insulation for the reactor vessel cylindrical surface is supported by brackets welded on the shield wall liner plate.

5.3.3.1.4.5 Reactor Vessel Nozzles

All piping connecting to the reactor vessel nozzles has been designed so it does not exceed the allowable loads on any nozzle.

The vessel top head nozzle is provided with a flange with large groove facing. The drain nozzle is of the full penetration weld design. The recirculation inlet nozzles are located as shown in Figure 5.3-1, feedwater inlet nozzles, core spray inlet nozzles, LPCI nozzles, and the control rod drive hydraulic system return nozzle all have thermal sleeves. Nozzles connecting to stainless steel piping have safe ends or extensions made of stainless steel. These safe ends or extensions were welded to the nozzles after the pressure vessel was heat treated to avoid furnace sensitization of the stainless steel. The material used is compatible with the material of the mating pipe.

The nozzle for the standby liquid control pipe is designed to minimize thermal shock effects on the reactor vessel, in the event that use of the standby liquid control system is required.

5.3.3.1.4.6 Materials and Inspections

The reactor vessels were designed and fabricated in accordance with the appropriate ASME Boiler and Pressure Vessel Code as defined in subsection 5.3.1. Table 5.2-4 defines the materials and specifications. Subsection 5.3.1.5.1 defines the compliance with reactor vessel material surveillance program requirements.

5.3.3.1.4.7 Reactor Vessel Schematic (BWR)

The reactor vessel schematic is contained in Figure 5.3-2. Trip system water levels are indicated as shown.

5.3.3.2 Materials of Construction

All materials used in the construction of the reactor pressure vessel conform to the requirements of ASME Code, Section II materials. The vessel heads, shells, flanges, and nozzles are fabricated from low alloy steel plate and forgings purchased in accordance with ASME specifications SA533 Grade B Class 1 and SA508 Class 2. Special requirements for the low alloy steel plate and forgings are discussed in subsection 5.3.1.2. Cladding employed on the interior surfaces of the vessel consists of austenitic stainless steel weld overlay.

These materials of construction were selected because they provide adequate strength, fracture toughness, fabricability, and compatibility with the BWR environment. Their suitability has been demonstrated by long term successful operating experience in reactor service.

5.3.3.3 Fabrication Methods

The reactor pressure vessel is a vertical, cylindrical pressure vessel of welded construction fabricated in accordance with ASME Code, Section III, Class 1 requirements. All fabrication of the reactor pressure vessel was performed in accordance with buyer-approved drawings, fabrication procedures, and test procedures. The shells and vessel heads were made from formed low alloy steel plates, and the flanges and nozzles from low alloy steel forgings. Welding performed to join these vessel components was in accordance with procedures qualified per ASME Code, Sections III and IX requirements. Weld test samples were required for each procedure for major vessel full penetration welds.

Submerged arc and manual stick electrode welding processes were employed. Electroslag welding was not permitted. Preheat and interpass temperatures employed for welding of low alloy steel met or exceeded the requirements of ASME Code, Section III, subsection NA. Post weld heat treatment of 1100 F minimum was applied to all alloy steel welds.

All previous BWR pressure vessels have employed similar fabrication methods. These vessels have operated for periods up to 16 years and their service history is excellent.

The vessel fabricator, CBI Nuclear Co., has had extensive experience with GE reactor vessels and has been the primary supplier for GE domestic reactor vessels and some foreign vessels since the company was formed in 1972 from a merger agreement between Chicago Bridge and Iron Co. and GE. Prior experience by the Chicago Bridge and Iron Co. with GE reactor vessels dates back to 1966.

5.3.3.4 Inspection Requirements

All plate, forgings, and bolting were 100 percent ultrasonically tested and surface examined by magnetic particle methods or liquid penetrant methods in accordance with ASME Code, Section III requirements. Welds on the reactor pressure vessel were examined in accordance with methods prescribed and met the acceptance requirements specified by ASME Code, Section III. In addition, the pressure retaining welds were ultrasonically examined using acceptance standards which were equivalent or more restrictive than required by ASME Code, Section XI.

5.3.3.5 Shipment and Installation

The completed reactor vessel is given a thorough cleaning and examination prior to shipment. The vessel is tightly sealed for shipment to prevent entry of dirt or moisture. Preparations for shipment are in accordance with detailed written procedures. On arrival at the reactor site, the reactor vessel is carefully examined for evidence of any contamination as a result of damage to shipping covers. Suitable measures are taken during installation to assure that vessel integrity is maintained; for example, access controls are applied to personnel entering the vessel, weather protection is provided, periodic cleanings are performed, and only approved miscellaneous materials are used during assembly.

5.3.3.6 Operating Conditions

Procedural controls on plant operation are implemented to hold thermal stresses within acceptable ranges. These restrictions on coolant temperature are:

a. The average rate of change of reactor coolant temperature during normal heatup and cooldown shall not exceed 100 F during any 1-hour period.

b. If the coolant temperature difference between the dome (inferred from P_{sat}) and the bottom head drain exceeds 145 F, neither reactor power level nor recirculation pump flow shall be increased.

c. The pump in an idle reactor recirculation loop shall not be started unless the coolant temperature in that loop is within 50 F of average reactor coolant temperature.

The limit regarding the normal rate of heatup and cooldown (item a.) assures that the vessel closure, closure studs, vessel support skirt, and control rod drive housing stresses and usage remain within acceptable limits. The limit regarding a vessel temperature limit on recirculating pump operation and power level increase restriction (item b) augments the item a. limit in further detail by assuring that the vessel bottom head region will not be warmed at an

excessive rate caused by rapid sweep out of cold coolant in the vessel lower head region by recirculating pump operation or natural circulation (cold coolant can accumulate as a result of control drive inleakage and/or low recirculation flow rate during startup or hot standby). The item c. limit further restricts operation of the recirculating pumps to avoid high thermal stress effects in the pumps and piping, while also minimizing thermal stresses on the vessel nozzles.

The above operational limits when maintained ensure that the stress limits within the reactor vessel and its components are within the thermal limits to which the vessel was designed for normal operating conditions. To maintain the integrity of the vessel in the event that these operational limits are exceeded the reactor vessel has also been designed to withstand a limited number of transients caused by operator error. Also, for abnormal operating conditions where safety systems or controls provide an automatic temperature and pressure response in the reactor vessel, the reactor vessel integrity is maintained since the severest anticipated transients have been included in the design conditions. Therefore, it is concluded that the vessel integrity will be maintained during the most severe postulated transients, since all such transients are evaluated in the design of the reactor vessel. The postulated transient for which the vessel has been designed is shown on Figure 5.2-5 and discussed in subsection 5.2.2.

5.3.3.7 Inservice Surveillance

Inservice inspection of the reactor pressure vessel will be in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, as discussed in subsection 5.2.4.

The materials surveillance program will monitor changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region resulting from their exposure to neutron irradiation and thermal environment. Specimens of actual reactor beltline material will be exposed in the reactor vessel and periodically withdrawn for impact testing. Operating procedures will be modified in accordance with test results to assure adequate brittle fracture control.

Material surveillance programs and inservice inspection programs are in accordance with applicable ASME Code requirements, and provide assurance that brittle fracture control and pressure vessel integrity will be maintained throughout the service lifetime of the reactor pressure vessel.

5.3.4 Reference

1. "Transient Pressure Rises Affecting Fracture Toughness Requirements for BWR's" (NEDO-21778-A) December 1978.

2. "An Analytical Study on Brittle Fracture of GE-BWR Vessel Subject to the Design Basis Accident" (NEDO-10029).

TABLE 5.3-1

Grand Gulf 1
Beltline Plate Toughness Data
(A-533 Grade B, Class 1 Plate - Lukens Steel Co.)

Plate	Heat#-Slab#	Dropweight NDT (Top/Bottom) °F	Charpy V-Notch Toughness (Top/Bottom) Orientation (L or T)	Charpy Test Temp. °F	Energy Ft-lb	Lat. Expansion Mils	% Shear
#2 shell 22-1-3	C2594-2	0/-20	T	+ 60	50,59,69/52,52,51	43,54,45/48,52,48	40,40,40/50,50,50
			L	+ 60	80,79,87	68,69,63	60,60,60
			T	+ 40	38,44,42	42,37,39	30,30,30
			T	+ 60	52,52,51	48,52,48	50,50,50
			L	+ 40	55,55,55	48,47,48	50,50,50
			T	+212	96,106,105	78,82,81	99,99,99
				+ 60	60,64,65	55,55,55	50,50,50
				+ 40	67,50,50	56,38,38	40,40,40
				0	28,16,17	26,17,19	20,20,20
				- 50	7,11, 5	7,13, 5	10,10,10
				-100	4, 3, 4	2, 4, 2	1, 1, 1
22-1-4	A1224-1*	-20/-20	T	+ 40	33,48,16/58,61,40	41,32,19/48,37,52	30,30,30/50,50,50
				+ 60	52,74,52/80,69,63	46,49,61/66,64,68	50,50,50/60,60,60
			L	+ 40	78,68,61/55,51,61	64,40,56/40,52,51	50,50,50/50,50,50
			T	+212	122,177,118	90,91,90	99,99,99
				+100	92, 97,117	78,85,76	80,80,80
				+ 70	62, 61, 59	59,62,54	60,60,60
				+ 50	56, 50, 61	53,44,50	50,50,50
				+ 10	37, 35, 47	32,41,35	30,30,30
				- 20	38, 37, 33	29,31,31	20,20,20
				- 70	10, 9, 3	9, 7,11	1, 1, 1

*This material is also in the reactor vessel surveillance program.

TABLE 5.3-1 - Continued

Grand Gulf 1
Beltline Plate Toughness Data
(SA-533 Grade B, Class 1 Plate - Lukens Steel Co.)

Plate	Heat#-Slab#	Dropweight NDT (Top/Bottom) °F	Charpy V-Notch Toughness (Top/Bottom)				
			Orientation (L or T)	Charpy Test Temp. °F	Energy Ft-Lb	Lat. Expansion Mils	% Shear
#2 shell							
22-1-1	C2593-2	-50/-30	T	+ 10	57,36,48	45,40,39	40,40,40
			L	+ 10	92,96,93	70,71,70	70,70,70
			T	+ 20	52,60,61	47,51,48	50,50,50
			T	+ 30	61,61,65	50,50,53	50,50,50
			L	+ 30	81,79,73	63,65,66	70,70,70
			T	+212	102,104,100	76,76,79	99,99,99
				+ 70	89, 63, 84	56,71,72	70,70,70
				+ 30	87, 58, 77	61,70,51	60,60,60
				0	46, 36, 42	33,37,39	30,30,30
				- 50	18, 36, 42	17,29,31	20,20,20
				-100	13, 4, 7	2, 9, 5	1, 1, 1
22-1-2	C2594-1	-10/-30	T	+ 50	56,50,62	48,43,53	40,40,40
			L	+ 50	69,71,68	57,62,60	50,50,50
			T	+ 30	53,86,60	63,47,49	50,50,50
			L	+ 30	75,79,68	69,71,68	70,70,70
			T	+212	108,94,98	79,76,76	99,99,99
				+150	90,96,99	77,80,74	90,90,90
				+ 70	85,61,75	51,62,63	70,70,70
				0	51,55,37	44,36,49	40,40 40
				- 10	37,36,39	35,33,31	30,30,30
				- 30	23,31,20	19,23,28	30,30,30
				- 50	20,23,11	16,11, 8	10,10,10

TABLE 5.3-2

Grand Gulf 1
Beltline Weld Toughness Data
Post Weld 1150°F for 50 hr. Typical

Weld Seam	Type	Heat #	Lot # or Flux #	Drop-weight NDT °F	Charpy Toughness			
					Charpy Temp, °F	Charpy Energy Ft-lbs	Lateral Expansion Mils	% Shear
#2 Shell Longitudinal Seams	E8018-G* (Trade Name Atom Arc 8018 NM)	627260	B322A27AE	- 40	- 40	23, 10, 16	15, 5,11	5, 5, 5
					- 10	23, 22	15,15	15, 15
					+ 20	48, 56	31,36	20, 30
					+ 30	52, 56, 51	36,37,35	30, 35, 45
					+ 40	51, 55	30,37	25, 35
					+ 70	83, 65	55,40	75, 65
					+100	101, 95	70,67	95, 95
					+150	115,108,140	75,74,71	100,100,100
	E8018-G* (Trade Name Atom Arc 8018 NM)	626677	C301A27AF	- 40	- 70	10,13	8,12	0, 0
					- 40	17,20,27	15,17,20	5, 5, 5
					- 20	27,29	24,26	10, 10
					0	43,22	33,21	20, 15
					+ 40	53,51,54	36,37,35	25, 25, 25
					+ 70	66,70	54,46	75, 75
					+100	83,89	61,69	90, 95
					+150	90,92,102	74,61,78	100,100,100
	INMM** (Single Wire, Trade Name Raco)	5P6214B	0331 (Linde 124)	- 50	- 70	22,13,11	17,10, 9	2, 2, 2
					- 50	42,13,34	34,11,26	15, 5, 10
					+ 10	56,50,54	45,41,46	25, 20, 30
					+ 40	76,66	66,52	75, 45
					+100	87,89	70,64	95, 90
					+120	96,90,88	68,61,71	100,100,100

* Shielded Metal Arc Weld
**Submerged Arc Weld

NOTE: All weld materials in Table 2 are also in the reactor vessel surveillance program.

Table 5.3-3 - Grand Gulf 1

Beltline Plate & Weld RT_{NDT} Values

(Peak End-of-Life (EOL) fluence = 1.9×10^{18} n/cm² (> 1MeV) at ¼T wall from vessel ID)

A. Plates - Beltline

Heat	Wt. % Cu	Wt. % P	ASME NB-2300 Start RT_{NDT} (°F)	Reg. Guide 1.99 Extrap ΔRT_{NDT} (°F)	Estimated EOL (RT_{NDT} (°F)	
C2593-2	0.04	0.012	-30	26	-4	
C2594-1	0.04	0.012	-10	26	+16	
C2594-2	0.04	0.012	0	26	+26	limiting plate
A1224-1*	0.04	0.007	0	17	+17	

B. Welds - Beltline

Heat/Lot	Wt. % Cu	Wt. % P	ASME NB-2300 Start RT_{NDT} (°F)	Reg. Guide 1.99 Extrap. ΔRT_{NDT} (°F)	Estimated EOL (RT_{NDT} (°F)	
627260/B322A27AE*	0.06	0.020	-30	44	+14	limiting weld
626677/C301A27AF*	0.01	0.015	-20	33	+13	
5P6214B/0331*	0.02	0.013	-50	26	-24	

*These materials are also in the reactor vessel surveillance program.

FIGURE 5.3-4 GRAND GULF UNIT 1

Minimum Temperatures Required Vs.
Reactor Pressure

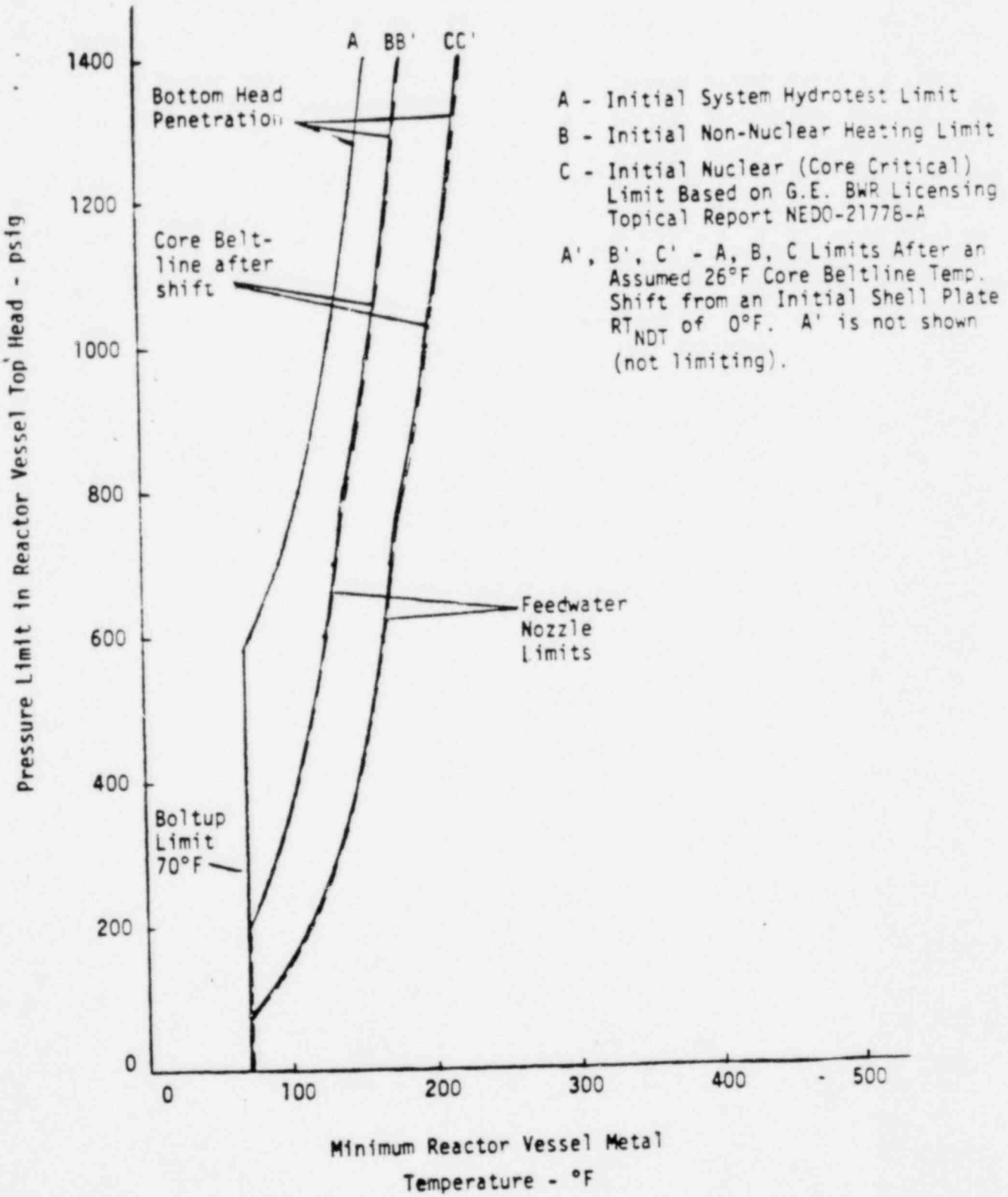
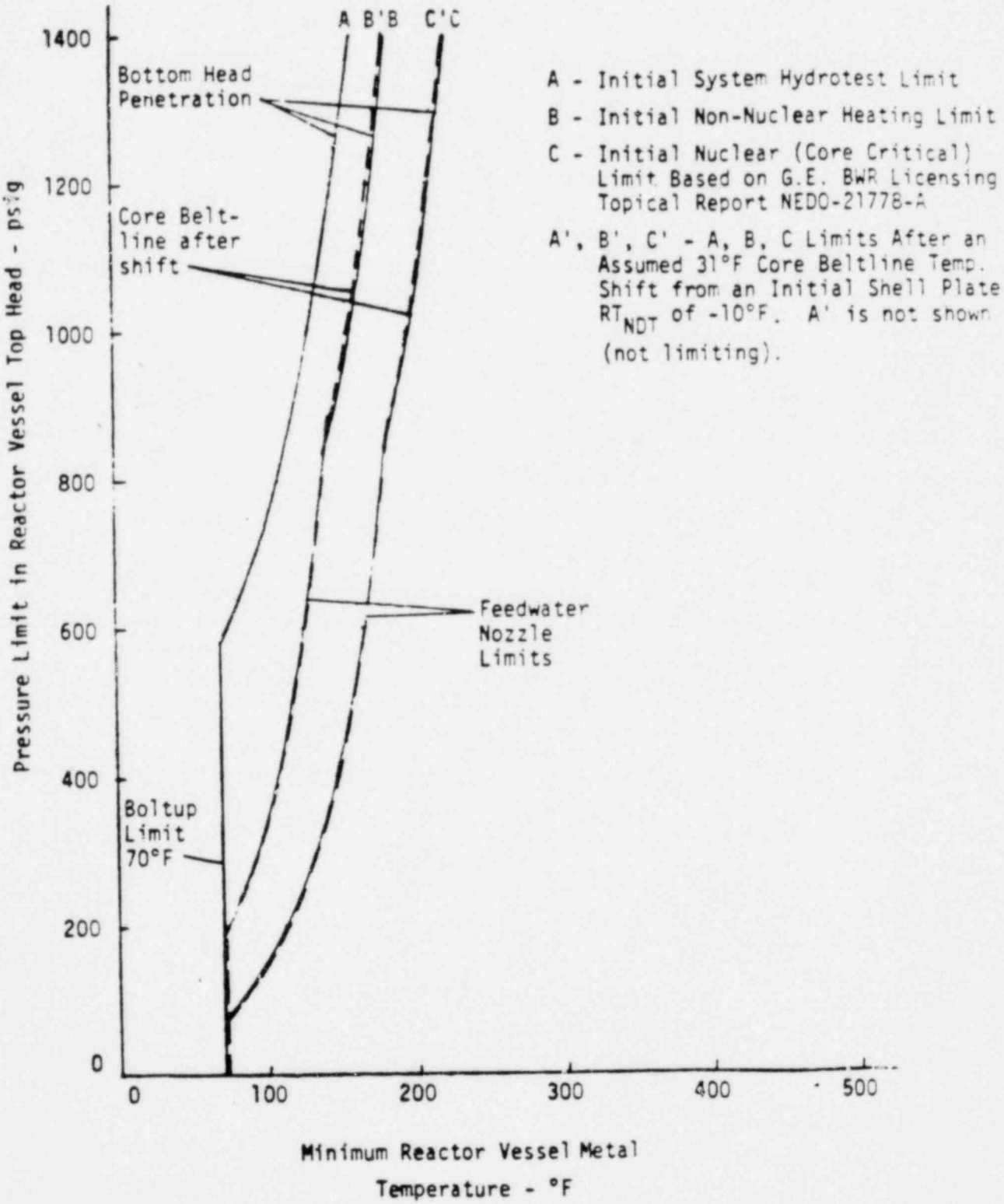


FIGURE 5.3-4a GRAND GULF UNIT 2

Minimum Temperatures Required Vs.
Reactor Pressure



GG
FSAR

Regulatory Guide 1.2 (December 1970)

Thermal Shock to Reactor Pressure Vessels

Project Position - Comply.

FSAR Subsection - 5.3.3