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**EVALUATION OF RT_{NDT} USE, AND CHEMICAL COMPOSITION
OF CORE REGION ELECTROSLAG WELDS
FOR QUAD CITIES UNITS 1 AND 2**

by

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(See Section 4.0 for document signatures.)

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ABSTRACT

This document contains FTI's best estimate of the initial RT_{NDT} , initial Charpy V-notch upper-shelf energy (CvUSE), and chemical composition (copper, nickel and phosphorus) values for the longitudinal electroslag welds within the core region of Quad Cities Units 1 and 2. Based on a review of existing weld procedure qualifications (PQs) and surveillance weld data, initial RT_{NDT} is estimated to be 23.1°F, with a standard deviation of 13.0°F. The initial CvUSE for the electroslag welds is estimated to be 105.4 ft-lbs, with a standard deviation of 16.1 ft-lbs. The electroslag welds are estimated to contain 0.190 weight percent (w/o) copper, 0.311 w/o nickel, and 0.013 w/o phosphorus (with standard deviations of 0.048, 0.051, and 0.003 w/o, respectively). A chemistry factor of 114.43 is calculated based on the copper and nickel contents for the electroslag welds at Quad Cities Units 1 and 2.

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1. INTRODUCTION

This document presents FTI's (Framatome Technologies, Inc.) best assessment of the initial (i.e., beginning of life) reference temperature (RT_{NDT}) value, the initial Charpy V-notch upper-shelf energy (CvUSE) value, and the chemical composition of electroslog welds in the Quad Cities Units 1 and 2 reactor vessels. In particular, the electroslog welds of interest are longitudinal welds among the plates comprising the Mark 57 (Mk-57) and Mk-58 shell courses. The Mk-57 and Mk-58 shell courses are within the core region. Figure 1-1 illustrates the arrangement of these shell courses in the reactor vessels of Quad Cities Units 1 and 2.

This assessment is a result of the collection and compilation of weld PQs and other data pertinent to the fabrication of the Quad Cities reactor vessels, as well as other boiling water reactor (BWR) vessels fabricated in the same time frame. This document does not include information with regard to chemical composition or Charpy impact data on specific shell courses or non-electroslog welds.

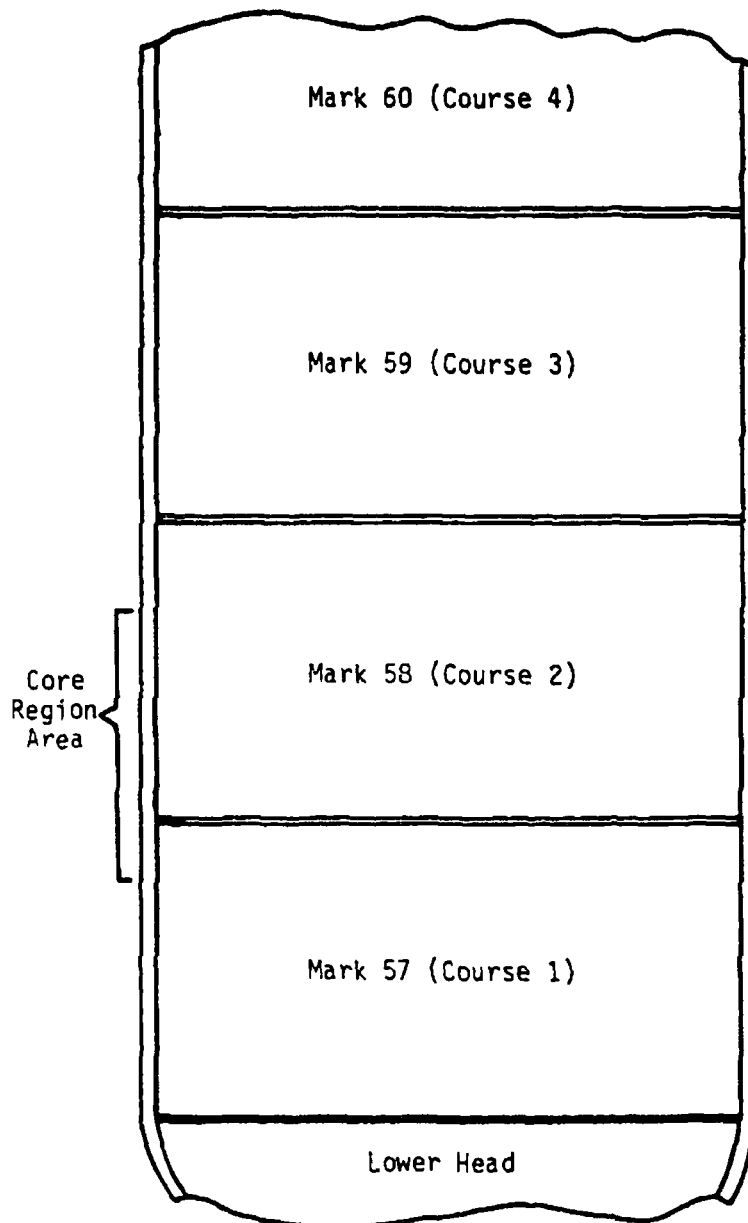
The following list identifies the number of electroslog (ES) welds in each of the two shell courses of the Quad Cities Units 1 and 2 reactor vessels.

<u>Unit ID</u>	<u>Shell Course</u>	<u>No. of ES welds</u>
Quad Cities 1	Mk-57	4
	Mk-58	4
Quad Cities 2	Mk-57	3
	Mk-58	3

All longitudinal welds within the individual shell courses of Units 1 and 2 are electroslog welds. [Note: The Mk-57 and Mk-58 shell courses of the Quad Cities Unit 1 reactor vessel were fabricated using three individual plates, one of which was initially in two sections; thus, each of these two shell courses has four longitudinal welds.]

FIGURE 1-1.

QUAD CITIES REACTOR VESSEL
SHELL COURSE ARRANGEMENT IN CORE REGION



2. FABRICATION HISTORY

The plate material supplied for fabrication of the Quad Cities Units 1 and 2 reactor vessels was ASME SA-302, Grade B¹ high strength alloy carbon steel (modified to Code Case 1339²) provided by Lukens Steel. During fabrication, the individual plates in each shell course were rolled to contour; then, the plates were welded together with longitudinal seams using electroslag and submerged arc welding processes. Figures 2-1 and 2-2 and Figures 2-3 and 2-4 illustrate the plate and weld layouts for the Mk-57 and Mk-58 shell courses of Quad Cities Units 1 and 2, respectively. All electroslag welds of interest were made using Hi-Mn-Mo filler wire with Linde #124 flux.

Following assembly of each shell section, the following heat treatment was performed:

- Heat to 1675-1725°F, hold for 6.5 hours; brine quench
- Heat to 1600-1650°F, hold for 6.5 hours; brine quench
- Heat to 1175-1225°F, hold for 6.5 hours; liquid quench

The two core region shell courses (Mk-57 and -58) were fabricated by Babcock & Wilcox (B&W) for Quad Cities Unit 1 and Unit 2. The circumferential weld joining the Mk-57 shell course to the Mk-58 shell course of the Quad Cities Unit 1 reactor vessel was completed by B&W; the circumferential weld for the Quad Cities Unit 2 reactor vessel was completed by Chicago Bridge & Iron, Company (CB&I).

Although an extensive records search was completed,^a very little information could be located with regard to either the specific weld materials or test results for the ES weld consumables used on the longitudinal weld seams of the core region shell courses of the Quad Cities reactor vessels. Therefore, applicable test data for weld PQs -- performed in the general time frame that the electroslag longitudinal welds in both Quad Cities units were fabricated -- have

^a Records were searched at the FTI facilities in Lynchburg, Virginia, as well as the Babcock & Wilcox facilities in Mt. Vernon, Indiana, and Barberton, Ohio, to locate all available documentation.

been included as one source of typical RT_{NDT} data for this type of weld. Copies of the weld PQs of interest are included in the Appendix. It is believed that the weld PQs included in the Appendix are the only weld PQs that are applicable to the core region shell courses welded by the electroslag welding process for the two Quad Cities units.

FIGURE 2-1.

QUAD CITIES UNIT 1
PLATE AND WELD LAYOUT FOR MK-57 SHELL COURSE

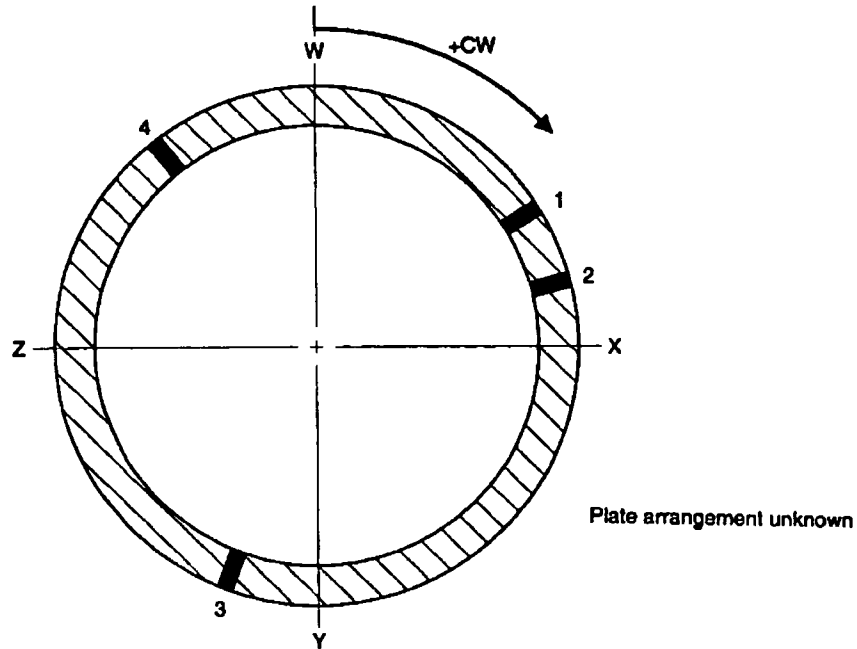


TABLE 2-1.

QUAD CITIES UNIT 1
PLATE AND WELD IDENTIFICATION FOR MK-57 SHELL COURSE

<u>ID</u>	<u>Location</u>	<u>Wire or Plate Heat No.</u>	<u>Flux Lot No.</u>	<u>Fab.'d by</u>
Long. seam 1 (ES)	55°	U*	U*	B&W
Long. seam 2 (ES)	77°	U*	U*	B&W
Long. seam 3 (ES)	197°	U*	U*	B&W
Long. seam 4 (ES)	317°	U*	U*	B&W
6-122-1	--	B5524-1	--	--
6-122-2	--	A0610-1	--	--
6-122-11	--	C1485-2	--	--
Mk-57 to Mk-58 circ. weld (SA)	--	72445 406L44	8688 8688	B&W

ES: Electroslag weld

SA: Submerged arc weld

U: Unidentified

*: Records indicated that the electroslag welds for Mk-57 were performed using the following weld wire/flux lot combinations: 0L0794/8467, 37C065/8445, 35A320/3496, and 36A168/3496. However, data for specific longitudinal seams are not identified.

FIGURE 2-2.

QUAD CITIES UNIT 1
PLATE AND WELD LAYOUT FOR MK-58 SHELL COURSE

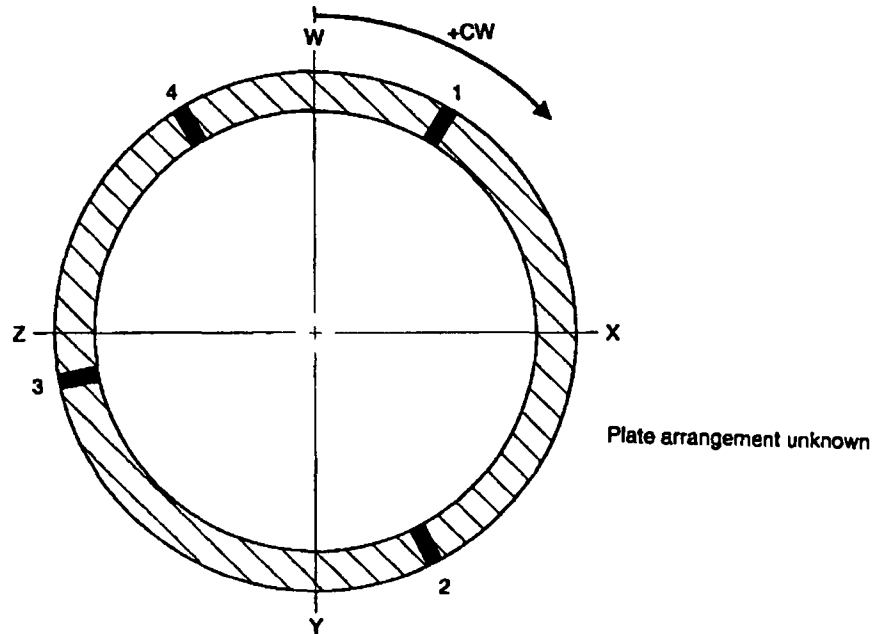


TABLE 2-2.

QUAD CITIES UNIT 1
PLATE AND WELD IDENTIFICATION FOR MK-58 SHELL COURSE

<u>ID</u>	<u>Location</u>	<u>Wire or Plate</u> <u>Heat No.</u>	<u>Flux</u> <u>Lot No.</u>	<u>Fab'd</u> <u>by</u>
Long. seam 1 (ES)	22°	U*	U*	B&W
Long. seam 2 (ES)	141°	U*	U*	B&W
Long. seam 3 (ES)	261°	U*	U*	B&W
Long. seam 4 (ES)	323°	U*	U*	B&W
6-122-4	--	C1505-2	--	---
6-122-6	--	C1498-2	--	---
6-122-13	--	A0931-1	--	---
Mk-57 to Mk-58	--	72445	8688	B&W
circ. weld (SA)	--	406L44	8688	

ES: Electroslag weld

SA: Submerged arc weld

U: Unidentified

*: Records indicated that the electroslag welds for Mk-57 were performed using the following weld wire/flux lot combinations: 0L0794/8467, 37C065/8445, 35A320/3496, and 36A168/3496. However, data for specific longitudinal seams are not identified.

FIGURE 2-3.

QUAD CITIES UNIT 2
PLATE AND WELD LAYOUT FOR MK-57 SHELL COURSE

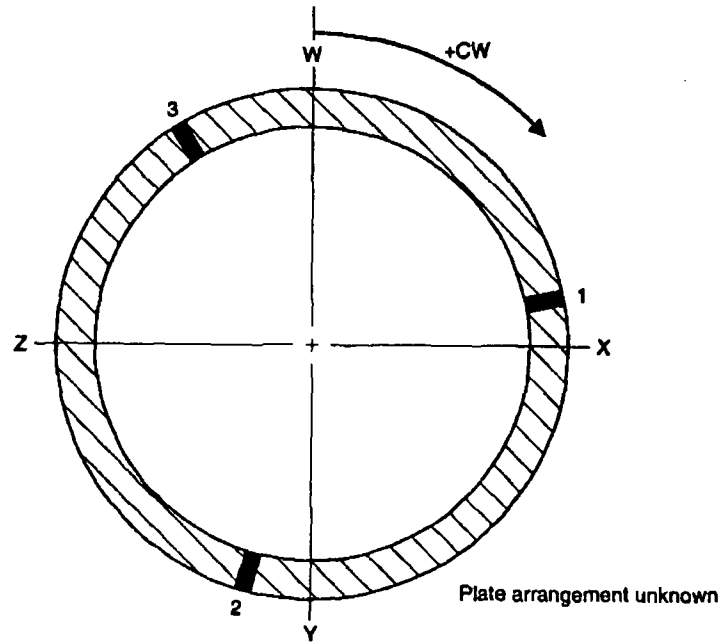


TABLE 2-3.

QUAD CITIES UNIT 2
PLATE AND WELD IDENTIFICATION FOR MK-57 SHELL COURSE

<u>ID</u>	<u>Location</u>	<u>Wire or Plate Heat No.</u>	<u>Flux Lot No.</u>	<u>Fab.'d by</u>
Long. seam 1 (ES)	77°	U	U	B&W
Long. seam 2 (ES)	197°	U	U	B&W
Long. seam 3 (ES)	317°	U	U	B&W
6-122-8	--	C1516-2	--	---
6-122-10	--	C1501-2	--	---
6-122-14	--	C1722-2	--	---
Mk-57 to Mk-58 circ. weld (SA)	--	S-3986	3870	CB&I

ES: Electroslag weld

SA: Submerged arc weld

U: Unidentified

FIGURE 2-4.

QUAD CITIES UNIT 2
PLATE AND WELD LAYOUT FOR MK-58 SHELL COURSE

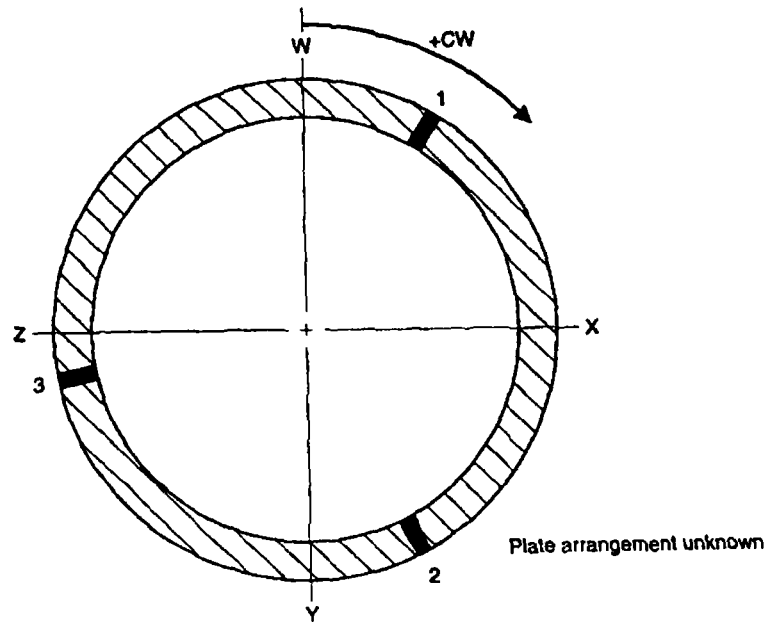


TABLE 2-4.

QUAD CITIES UNIT 2
PLATE AND WELD IDENTIFICATION FOR MK-58 SHELL COURSE

<u>ID</u>	<u>Location</u>	<u>Wire or Plate Heat No.</u>	<u>Flux Lot No.</u>	<u>Fab.'d by</u>
Long. seam 1 (ES)	22°	U	U	B&W
Long. seam 2 (ES)	142°	U	U	B&W
Long. seam 3 (ES)	262°	U	U	B&W
6-139-16	--	C2753-2	--	--
6-139-22	--	C2868-1	--	--
6-139-25	--	C3307-2	--	--
Mk-57 to Mk-58 circ. weld (SA)	--	S-3986	3870	CB&I

ES: Electroslag weld

SA: Submerged arc weld

U: Unidentified

3. RT_{NDT}, CvUSE, AND CHEMICAL COMPOSITION

Both mechanical property and chemical composition data are lacking on electrosag welds for Quad Cities Units 1 and 2. For this reason, the available data discussed in this report are based primarily on weld PQs and known weld wire chemistry data. Weld PQs contain mechanical properties and, usually, chemical composition data as well. While this data cannot represent actual reactor vessel welds exactly, the procedures, consumables (i.e., weld wire and flux), and thickness of the welded plates are similar to the actual welds. Generally, weld amperage, voltage, and oscillation speeds are equivalent or similar for the PQs. Although the welding procedures are similar, an accumulated thermal history is not available for the beltline reactor vessel welds at Quad Cities Unit 1. For Unit 2, however, CB&I has reported that the Mk-57 and Mk-58 shell courses received the following accumulated post weld heat treatment:^a

Mk-57	27 hours, 56 minutes
Mk-58	44 hours, 22 minutes.

Stress relief heat treatments were completed at temperatures in the range of 1100 to 1150°F.

3.1 RT_{NDT} Determination

The electrosag weld PQs included in this document contain Charpy impact data as well as respective stress relief times implemented for each weld PQ. As shown by the data in Table I below, stress relief heat treatments were typically performed for either 18 or 30 hours; one weld PQ had a stress relief time of 42 hours. The weld PQs for the electrosag welds in Quad Cities Units 1 and 2 used a RACO (Reid Avery Company) Hi-Mn-Mo weld wire and a Linde #124 flux; therefore, only data from weld PQs using this same RACO wire/flux combination are included. The Charpy V-notch impact data are reported for tests completed at 10°F using a load of 240 ft-lbs.

^a As reported in Attachment B to the CECo response to Generic Letter 92-01 for Dresden Units 2 and 3 and Quad Cities Units 1 and 2.³

TABLE I

Charpy V-Notch Impact Data for Electroslag Weld PQs

<u>Weld PQ</u>	<u>Charpy Data</u>	<u>Drop Wt. T_{NDT} (°F)</u>	<u>Stress Relief Time</u>
PQ-1092-C	38 33 41	--	18
PQ-1138-A	52 30 50 (Surf)	--	18
	30 53 36 (1/4T)	10	
PQ-1300	39 42 43	--	30
PQ-1309-A	60 50 35	--	18
PQ-1309-B	58 36 44	--	18
PQ-1667	47 39 27	--	30
PQ-1822	36 70 42	30	30
	64 45		
PQ-1851	84 71 57	10	30
PQ-1928	30 33 33	25	30
PQ-1929	80 40 55	50	30
PQ-1930	10 72 70	30	30
	75 16 14		
	39		
PQ-1931	47 24 33	20	30
	57 50		
PQ-2563	59 47 49 (Surf)	--	42
	27 34 32 (1/4T)	10	

From a statistical standpoint, the above Charpy data are sufficiently close with regard to Charpy impact behavior that the values can be considered as one group of data. Therefore, all drop weight data identified above are equally weighted in the calculation for initial RT_{NDT} discussed below.

No drop weight specimens were tested for the Quad Cities Units 1 and 2 surveillance electroslag weld metals, nor were any tested for the electroslag welds at other plants fabricated using the same RACO weld/flux combination as the Quad Cities units. The surveillance electroslag weld Charpy impact data that are available, however, are shown below in Table IIA.

TABLE IIA

Charpy V-Notch Data for Surveillance Electroslag Weld Metal⁴⁻¹¹

<u>Plant ID</u>	<u>I_{CV30}</u>	<u>I_{CV50}</u>	<u>I_{35MLE}</u>	<u>USE</u>
Quad Cities Unit 1	10°F	35°F	25°F	>100 ft-lbs
Quad Cities Unit 2	-30°F	20°F	- 5°F	125 ft-lbs
Browns Ferry Unit 1	8°F	33°F	20°F	93 ft-lbs
Browns Ferry Unit 2	-10°F	10°F	- 2°F	116 ft-lbs
Browns Ferry Unit 3	-31°F	-21°F	-27°F	124 ft-lbs
Dresden Unit 2	-10°F	40°F	5°F	101 ft-lbs
Dresden Unit 3	40°F	110°F	65°F	70 ft-lbs
Peach Bottom Unit 2	4°F	43°F	27°F	110 ft-lbs
Peach Bottom Unit 3	2°F	47°F	34°F	110 ft-lbs

[* Conservatively estimated based on data from Capsule No. 8,⁹ since value was not determined for unirradiated ESW surveillance material.]

The following Charpy impact data are also available for electroslag welds tested for the Peach Bottom Unit 2 surveillance program to determine an initial RT_{NDT} value representative of the electroslag welds:

TABLE IIB

Electroslag Weld Test Data¹⁰

<u>Test Weld ID</u>	<u>I_{CV50}</u>	<u>Test Weld ID</u>	<u>I_{CV50}</u>
1	18.8	6	-20.7
2	3.0	7	15.9
3	31.7	8	12.5
4	32.1	9	18.9
5	26.7		

As defined in the ASME Code, Paragraph NB-2331,¹² the RT_{NDT} is established in accordance with the following requirements:

1. Determine a temperature, T_{NDT}, that is at or above the nil-ductility transition temperature by drop weight tests.

2. At a temperature not greater than $T_{NDT} + 60^{\circ}\text{F}$, each Charpy specimen shall exhibit at least 50 ft-lbs absorbed energy and at least 35 mils lateral expansion. If these requirements are met, T_{NDT} is the RT_{NDT} .
3. If the requirements of 2. are not met, additional Charpy tests shall be performed (in groups of three specimens) to determine the temperature, T_{CV} , at which they are met. Then, RT_{NDT} is $(T_{CV} - 60^{\circ}\text{F})$. RT_{NDT} is the greater of T_{NDT} and $(T_{CV} - 60^{\circ}\text{F})$.
4. When a Charpy test has not been performed at $T_{NDT} + 60^{\circ}\text{F}$, or when a Charpy test is performed at $T_{NDT} + 60^{\circ}\text{F}$ and the specimens do not exhibit a minimum of 50 ft-lb absorbed energy and 35 mils lateral expansion, a temperature representing these minimum requirements may be obtained from a full Charpy curve developed from the minimum of Charpy data of all tests performed.

Using the weld PQ T_{NDT} data and the available surveillance Charpy impact data for the electroslag welds, the RT_{NDT} is controlled by the T_{NDT} requirement. Based on these data, the initial RT_{NDT} for the electroslag welds in Quad Cities Units 1 and 2 is calculated using the T_{NDT} data reported in the weld PQs. The T_{NDT} values range from 10 to 50°F . Taking the mean of these values results in an estimated initial RT_{NDT} value of 23.1°F for the electroslag welds, with a standard deviation (σ_1) of 13.0°F .

3.2 CvUSE Determination

The initial CvUSE data for electroslag welds were obtained from available surveillance data and are presented in Table IIA. The unirradiated CvUSE values range from 70 to 125 ft-lbs. Taking the mean of these values results in an estimated initial CvUSE value of 105.4 ft-lbs for the electroslag welds, with a standard deviation of 16.1 ft-lbs.

3.3 Weld Compositions (Cu, Ni, and P)

Electroslag weld chemical composition data (in weight percent [w/o]) are available from three different sources: weld PQs, weld wire compositions, and surveillance capsule specimens.

As shown in Tables III through VI, each group is similar in its own respect. In evaluating the data, the average weld compositions (and standard deviations) were calculated using only the data from the weld PQs and surveillance capsule specimens since this weld data is believed to be more representative of the actual (longitudinal) electrosag welds located in the reactor vessel shell courses. The weld wire composition data were not included in these calculations.

TABLE III

Procedure Qualification Chemical Composition Data

<u>Weld PQ</u>	<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>Cu</u>
PQ-1092-C	0.20	1.28	0.017	0.018	0.18	0.08	0.31	0.53	0.24
PQ-1138-A	0.19	1.50	0.017	0.027	0.19	0.09	0.35	0.55	0.25
PQ-1300	0.18	1.26	0.015	0.017	0.16	0.11	0.33	0.51	0.30
PQ-1309-A	0.18	1.34	0.012	0.017	0.14	0.10	0.30	0.47	0.22
PQ-1309-B	0.17	1.31	0.015	0.015	0.14	0.12	0.29	0.51	0.23
PQ-1667	0.19	1.41	0.019	0.015	0.07	0.06	0.25	0.57	0.20
PQ-1822	0.19	1.40	0.015	0.015	0.14	0.09	0.27	0.54	0.23
PQ-1851	0.18	1.49	0.014	0.011	0.15	0.06	0.36	0.49	0.18
PQ-1928	0.19	1.49	0.016	0.014	0.16	0.06	0.38	0.55	0.19
PQ-1929	0.18	1.50	0.016	0.013	0.17	0.08	0.30	0.48	0.20
PQ-1930	0.16	1.52	0.012	0.014	0.15	0.07	0.26	0.51	0.20
PQ-1931	0.20	1.52	0.015	0.021	0.12	0.05	0.38	0.59	0.19

TABLE IV

Weld Consumables Chemical Composition Data

<u>Wire ID</u>	<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>Cu</u>
W-8349	0.14	1.79	0.010	0.012	0.04	--	--	0.47	--
34A167	0.14	1.76	0.010	0.014	0.04	--	--	0.49	--
36A168	0.12	1.70	0.010	0.019	0.03	--	--	0.52	--

TABLE V

Surveillance and Beltline Weld Chemical Composition Data¹³⁻¹⁷

<u>Specimen & Plant ID</u>	<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>Cu</u>
MA1 QC1 ^{a,13a}	0.17	1.56	0.011	0.017	0.19	0.06	0.28	0.45	0.17
TD1 QC2 ^{b,13}	0.18	1.75	0.011	0.013	0.17	0.09	0.20	0.49	0.18
MA4 QC1 ^{a,14}	0.158	--	0.012	0.006	0.05	0.063	0.25	0.45	0.136
	--	--	--	--	--	--	0.26	--	0.19
MAD QC1 ^{a,14}	0.236	--	0.012	0.004	0.08	0.063	0.26	0.45	0.138
	--	--	--	--	--	--	0.38	--	0.19
M7L QC1 ^{a,14}	--	--	--	--	--	--	0.30	--	0.20
MBU QC1 ^{a,14}	--	--	--	--	--	--	0.33	--	0.24
M6D QC1 ^{a,14}	--	--	--	--	--	--	0.39	--	0.16
MDC QC1 ^{a,14}	--	--	--	--	--	--	0.40	--	0.21
MD4 QC1 ^{a,14}	--	--	--	--	--	--	0.33	--	0.19
MBY QC1 ^{a,14}	--	--	--	--	--	--	0.40	--	0.21
TAE QC2 ^{b,15}	0.209	--	0.008	0.017	0.115	0.079	0.313	0.503	0.129
							0.32		0.14
TAT QC2 ^{b,15}	0.216	--	0.008	0.018	0.126	0.091	0.359	0.522	0.122
							0.33		0.16
TBP QC2 ^{b,15}	--	--	--	--	--	--	0.34	--	0.16
TB1 QC2 ^{b,15}	--	--	--	--	--	--	0.37	--	0.17
T6K QC2 ^{b,15}	--	--	--	--	--	--	0.39	--	0.17
TBM QC2 ^{b,15}	--	--	--	--	--	--	0.37	--	0.17
T72 QC2 ^{b,15}	--	--	--	--	--	--	0.41	--	0.20
TAP QC2 ^{b,15}	--	--	--	--	--	--	0.32	--	0.12

* Number designates reference from which data was taken.

TABLE V (cont.)

<u>Specimen & Plant ID</u>	<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>Cu</u>
ESW Weld D3 ^{c,18}	0.21	1.78	0.011	0.015	0.32	0.07	0.30	0.51	0.20
KAE D3 ^{c,17}	0.220	--	0.009	0.016	0.176	0.064	0.332	0.550	0.191
	--	--	--	--	--	--	--	--	0.29
KAL D3 ^{c,17}	0.197	--	0.008	0.019	0.144	0.056	0.282	0.520	0.171
	--	--	--	--	--	--	0.33	--	0.18
K6L D3 ^{c,17}	--	--	--	--	--	--	0.41	--	0.24
K6A D3 ^{c,17}	--	--	--	--	--	--	0.38	--	0.23
KBM D3 ^{c,17}	--	--	--	--	--	--	0.36	--	0.22
K6T D3 ^{c,17}	--	--	--	--	--	--	0.38	--	0.19
KAJ D3 ^{c,17}	--	--	--	--	--	--	0.34	--	0.21
KAD D3 ^{c,17}	--	--	--	--	--	--	0.34	--	0.21
Peach Bottom 2,3 ^{d,*}	0.17	1.41	0.015	0.013	0.09	0.05	0.21	0.53	0.21

^a Quad Cities Unit 1

^b Quad Cities Unit 2

^c Dresden Unit 3.

^d Beltline weld data

^{*} Based on nine electroslag weld prolongations from the Peach Bottom Unit 2 reactor vessel; all were made from the same weld heat.

It should be noted that the data taken from References 14, 15, and 17 were not included in these calculations as individual data points; instead, the mean values of these data were determined and included in the calculations for Quad Cities Units 1 and 2. Additional data is listed below for the surveillance electroslag welds for Browns Ferry Units 1, 2, and 3 and Peach Bottom Units 2 and 3.

TABLE VI

Surveillance Electroslag Weld Data^{8,10,11}

<u>Plant ID</u>	<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>Cu</u>
Browns Ferry 1	--	--	0.012	--	--	--	0.30	--	0.10
Browns Ferry 2	--	--	0.010	--	--	--	0.33	--	0.20
Browns Ferry 3	--	--	0.011	--	--	--	0.28	--	0.11
Peach Bottom 2	--	1.43	0.010	--	--	0.08	0.32	0.49	0.09
Peach Bottom 3	--	1.46	0.012	--	--	0.08	0.32	0.49	0.10
Peach Bottom 3	--	1.55	0.009	--	0.19	--	0.40	0.50	0.11
Peach Bottom 3	--	1.57	0.009	--	0.19	--	0.41	0.51	0.11

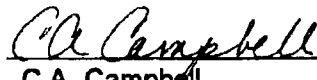
The compositional data for the weld PQs; the surveillance weld data for Dresden Unit 3 and Quad Cities Units 1 and 2; and the beltline and surveillance weld data for the Browns Ferry and Peach Bottom units were averaged to determine estimated values for copper, nickel, and phosphorus contents for the ES welds at Quad Cities Units 1 and 2. The results are as follows:

<u>Element</u>	<u>Content</u> <u>(w/o)</u>	<u>Std. Deviation</u> <u>w/o</u>
Copper	0.190	0.048
Nickel	0.311	0.051
Phosphorus	0.013	0.003


Applying these best estimate chemistry values to the Position C.1 procedures of Regulatory Guide 1.99, Revision 2,¹⁸ a chemistry factor of 114.43 is calculated for the Quad Cities Units 1 and 2 longitudinal electroslag welds.

4. CERTIFICATION

This report provides justifiable estimates for initial RT_{NOT} and chemical composition (copper, nickel, and phosphorus) for the longitudinal electrosag welds in the core region of the Quad Cities Units 1 and 2 reactor vessels.

 1/10/96
C.A. Campbell Date
Materials and Structural Analysis

This report was reviewed and was found to be an accurate assessment of the work reported.

 1/15/96
M.J. DeVan Date
Materials and Structural Analysis

Verification of independent review.

 1-15-96
K.E. Moore, Manager Date
Materials and Structural Analysis

The document has been approved for release.

 1/15/96
D.L. Howell, Program Manager Date

5. REFERENCES

1. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section II, "Material Specifications, Part A: Ferrous Materials," American Society of Mechanical Engineers, New York, New York.
2. ASME Boiler and Pressure Vessel Code, "Code Cases," American Society of Mechanical Engineers, New York, New York.
3. Letter and Attachments from Marcia A. Jackson, Commonwealth Edison Company, to Dr. Thomas E. Murley, U.S.NRC, Subject: Dresden Station Units 2 and 3, NRC Docket Numbers 50-237/249; Quad Cities Station Units 1 and 2, NRC Docket Numbers 50-254/265; LaSalle County Station Units 1 and 2, NRC Docket Numbers 50-373/374. (Response to Generic Letter 92-01.) Dated July 1, 1992.
4. Yanichko, S.E., et al., "Analysis of the Third Capsule from the Commonwealth Edison Company Quad Cities Unit 1 Nuclear Plant Reactor Vessel Radiation Surveillance Program," WCAP-9920, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, August 1981.
5. Perrin, J.S., et al., "Quad Cities Nuclear Plant Unit No. 2 Reactor Pressure Vessel Surveillance Program: Capsule Basket No. 12 and Capsule Basket No. 13, Battelle Columbus Laboratories, Columbus, Ohio, September 19, 1975.
6. "Browns Ferry Core Region Materials Information (Units 1, 2, and 3)," BAW-1845, Babcock & Wilcox Utility Power Generation Division, Lynchburg, Virginia, August 1984.^a
7. Rieger, G.F., and G.H. Henderson, "Dresden Nuclear Power Station Unit One and Unit Two Mechanical Properties of Irradiated Reactor Vessel Material Surveillance

^a Report available from Framatome Technologies, Inc., Lynchburg, Virginia.

Specimens," NEDC 12585, Vallecitos Nuclear Center, General Electric Company, Pleasanton, California, May 1975.

8. Perrin, J.S., et al., "Dresden Nuclear Plant Reactor Pressure Vessel Surveillance Program: Unit No. 2 Neutron Dosimeter Monitor, Unit No. 2 Capsule Basket Assembly No. 2, and Unit No. 3 Capsule Basket Assembly No. 12," BCL-585-3, Battelle Columbus Laboratories, Columbus, Ohio, September 15, 1977.
9. Norris, E.B., "Dresden Nuclear Power Station Unit 2 Reactor Vessel Irradiation Surveillance Program Analysis of Capsule No. 8," SwRI Project No. 06-6901-002, Southwest Research Institute, San Antonio, Texas, March 1983.
10. Branlund, B.J., "Peach Bottom Atomic Power Station Unit 2 Vessel Surveillance Materials Testing and Fracture Toughness Analysis," SASR 88-24, DRF B13-01445-1 Rev. 1, General Electric, December 1991.
11. Caine, T.A., "Peach Bottom Atomic Power Station, Unit 3 Vessel Surveillance Materials Testing and Fracture Toughness Analysis," SASR 90-50, DRF B11-00494, General Electric, June 1990.
12. ASME Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components," Division 1 -- Subsection NB, American Society of Mechanical Engineers, New York, New York.
13. Perrin, J.S., and L.M. Lowry, "Quad Cities Nuclear Plant Unit No. 1 and Unit No. 2 Reactor Pressure Vessel Surveillance Programs: Unirradiated Mechanical Properties," Battelle Columbus Laboratories, Columbus, Ohio, February 15, 1975.
14. Norris, E.B., "Quad Cities Nuclear Power Station Unit 1 Reactor Vessel Irradiation Surveillance Program -- Analysis of Capsule No. 8," SwRI-7857, Southwest Research Institute, San Antonio, Texas, August 1984.
15. Norris, E.B., "Quad Cities Nuclear Power Station Unit 2 Reactor Vessel Irradiation Surveillance Program -- Analysis of Capsule No. 18," SwRI-7484-002/1, Southwest Research Institute, San Antonio, Texas, March 1984.
16. Yanichko, S.E., et al., "Analysis of the Fourth Capsule From the Commonwealth Edison Company Dresden Unit 3 Nuclear Plant Reactor Vessel Radiation Surveillance

Program," WCAP-10030, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, January 1982.

17. Norris, E.B., "Dresden Nuclear Power Station Unit 3 Reactor Vessel Irradiation Surveillance Program Analysis of Capsule No. 18," SwRI-7484-003/1, Southwest Research Institute, San Antonio, Texas, February 1984.
18. U.S. Nuclear Regulatory Commission, Radiation Damage to Reactor Vessel Material, Regulatory Guide 1.99, Revision 2, May 1988.

APPENDIX
Electroslag Procedure
Qualifications

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

RECORD OF PROCEDURE OR OPERATOR QUALIFICATION TEST QCD 2E4-122

JOB NO. 610-098 Initial Application		DATE 10-14-65		PROCEDURE NO. PQ-1092C-2		W-182-3 WS-40																	
WELDING PROCESS Electroslag		SINGLE PASS <input checked="" type="checkbox"/> Double Electrode		MULTIPLE PASS		MULTIPLE ARC																	
MATERIAL SPECIFICATION P-3 (A-302-B Mod)																							
PLATE <input checked="" type="checkbox"/>	PIPE <input type="checkbox"/>	METAL THICKNESS 6-1/4"		FILLER METAL GROUP NO. Roid Avery HI-Mn-Mo		WELD CLASSIFICATION NO. Pressure																	
BACKING STRIP USED <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		PRE HEAT TEMPERATURE 70°F Min.		INTER PASS TEMPERATURE Not Applicable		FLUX NAME OR COMPOSITION Linde #124 20 X 150																	
WELD CHARACTERISTICS (VMA) (A.C. OR D.C.) Alternating Current 48-52 Volts 600 Amps																							
GAS FLOW RATE Not Applicable		POSITION OF PLATE OR PIPE Vertical		ULTRASONIC TEST Acceptable/No Defects		LIQUID PENETRANT Not Applicable																	
MAGNETIC PARTICLE Acceptable/No Defects		RADIOGRAPH No		MACRO EXAMINATION Not Required		MICRO EXAMINATION Not Required																	
SIZE OF ELECTRODE 1/8" Dia.		INERT GAS COMPOSITION Not Applicable		TRAVEL SPEED INCHES PER MIN. Oscillation Speed 48"/Min. Dwell Time 5 Sec.																			
WELDER'S NAME R. Reese		CLOCK NO. 6136		SYMBOL None																			
REMARKS Procedure qualification for welding P-3 material in the vertical position by electroslag process using 1/8" Dia. (RACO) HI-Mn-Mo filler wire with Linde #124 flux. (Groove Configuration Attached)																							
WELD CHEMICAL ANALYSIS																							
<table border="1"> <tr> <td>MN</td> <td>SI</td> <td>P</td> <td>S</td> <td>CR</td> <td>NI</td> <td>MO</td> <td>CU</td> </tr> <tr> <td colspan="8">Not Required</td> </tr> </table>								MN	SI	P	S	CR	NI	MO	CU	Not Required							
MN	SI	P	S	CR	NI	MO	CU																
Not Required																							
REDUCED SECTION TENSILE (TRANSVERSE TO WELD)																							
SPECIMEN NO.	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STRENGTH PSI	FRACTURE OR LOCATION																	
	WIDTH	THICK.																					
			See Attached Sketch																				
SIDE BEND TEST				FREE BEND TEST																			
Four Side Bends - Acceptable (No Defects)				Not Required																			
ALL WELD METAL TENSILE																							
SPECIMEN NO.	DIA.	AREA SQ. IN.	YIELD POINT PSI.	TENS. STR. PSI	ELONG % IN 2"	RED AREA %																	
Not Required																							
HARPY IMPACT TESTS																							
TYPE		OR		FT. LBS. ENERGY LOAD																			
SPECIMEN NO.	FT. LBS.		SPECIMEN NO.		FT. LBS.																		
	See Attached Sketch																						

WE CERTIFY THAT THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED WELDED, AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF ASME, U.S.C.G., ABS, USN MIL-STD-278 OR NAVSHIPS 280-1800-1.

D. 10-28-65 SIGNED

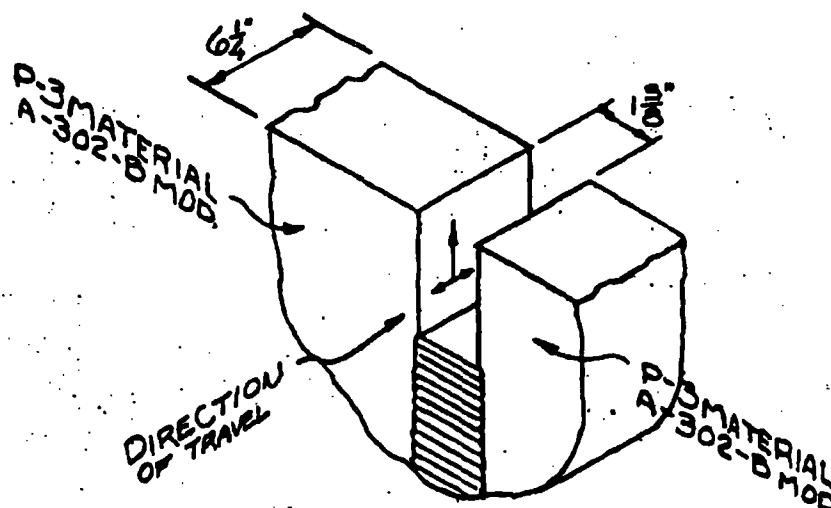
WITNESSED C. Zenon, D.C.A.S.O

BABCOCK & WILCOX COMPANY

BY Paul E. Campbell

PQ-1092C-2

Code #235



ELECTROSLAG DOUBLE ELECTRODE WELD A.C.
48-52 VOLTS 600 AMPS OSCILLATION SPEED 48"/MIN. DWELL TIME 5S
1/8" DIA. (RACO) HI-MN-MO FILLER WIRE-LINDE #12A FLUX

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NR	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS	ULT. TENSILE STRENGTH PSI	FRACTURE
	WIDTH	THICK				
PQ1092C-2	1.000"	3.060"	3.060"	284,500	92,960	WELD
PQ1092C-2	1.000"	2.732"	2.732	251,000	91,880	WELD
PQ1092C-2	1.007"	2.829"	2.848	266,000	93,400	WELD
PQ1092C-2	1.006"	3.092"	3.092	285,000	92,170	WELD

CHARPY V-NOTCH IMPACTS @ +10°F 240 FT LBS

LOCATION	FT LBS	FT LBS	FT LBS
BASE METAL	60.0	70.0	63.0
HEAT AFFECTED ZONE	40.0	52.0	70.0
WELD METAL	38.0	33.0	41.0

HEAT TREATMENT

PRELIMINARY QUENCH 6 1/2 HOURS @ 1675°-1725°F BRINE QUENCH
FINAL QUENCH 6 1/2 HOURS @ 1600°-1650°F BRINE QUENCH
TEMPER 6 1/2 HOURS @ 1175°-1225°F WATER QUENCH
STRESS RELIEF 18 HRS @ 1100°-1150°F FURNACE COOL

PQ 1092 C-2
WELDED IN VERTICAL POSITION.
DATE 11-2-65

1-30356

RECORD OF TEST RESULTS

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

JECT		CUSTOMER General Electric Atomic Power Equipment Department
ASME Code Weld Test Plate (Electro Slag)		CUSTOMER ORDER NO. 205-55501
IT NO.	ASSOCIATED PROCESS QUALIFICATION NO.	B&W CONTRACT NO.
PQ-1138-A	PQ-1092 C-2	610-0098

DESCRIPTION OF TEST Postweld - Heat Treatment - Preliminary Quench 1750-1800°F. HOLD 6-1/2 hours.
Quench to below 400°F. Final Quench 1600-1650°F. HOLD 6-1/2 hours. Brine Quench to below
1175-1225°F. HOLD 6-1/2 hours. Water Quench to below 400°F. Stress Relieve
1150°F. HOLD 18 hours. Furnace cool to below 600°F.

WELD CHEMICAL ANALYSIS									
C	Mn	Si	P	S	Cr	Ni	Mo	Cu	
	1.50	.19	.017	.027	.09	.35	.55	.25	
BASE METAL CHEMICAL ANALYSIS									
C	Mn	Si	P	S	Cr	Ni	Mo	Cu	
	1.37	.28	.015	.020	.14	.69	.51	.24	

ND TEST: TYPE Side NUMBER 4 RESULTS Satisfactory

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMAN NO.	WIDTH	THICKNESS	AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STRENGTH PSI	LOCATION OF FRACTURE
1138-A	1.001"	2.934"	2.936 sq "	252,000	85,820	Weld
1138-A	1.001"	2.944"	2.947 sq "	262,000	88,900	Weld
1138-A	1.000"	2.682"	2.682 sq "	244,500	91,160	Weld
1138-A	1.000"	2.850"	2.850 sq "	250,000	87,700	Weld

WELD METAL TENSILE

SPECIMAN NO.	DIAMETER	AREA SQ. IN.	YIELD POINT PSI	TENSILE STRENGTH PSI	E LONG % IN. 2"	RED AREA %
1138-A	.505"	.2 sq in	66,500	87,500	25.0	60.6
1138-A	.504"	.2 sq in	66,500	87,000	25.5	60.7

HARDY IMPACT TESTS

LOCATION	TYPE V-Notch	AT	+10	OF	240	FT. LBS. ENERGY LOAD.
Weld Surface			52.0, 30.0, 50.0		.044, .031, .041	
Weld 1/4 T			30.0, 53.0, 36.0		.023, .046, .029	
1/4 T Base Metal			64.0, 58.0, 70.0		.042, .041, .053	
1/4 T HAZ			76.0, 68.0, 76.0		.052, .047, .051	

DROP WEIGHT IMPACT TESTS

LOCATION	HEIGHT	WEIGHT
Weld	1/4"	60#
Weld 1/4 T	1/4"	60#
Weld 1/4 T	1/4"	60#

TEMPERATURE °F

+20	+10	0	-20	-40	-50	-60	-70	-80
FF	FF	F	F					
FF			FF	FF	FF	F		
FF			FF			FF	FF	F

F = FAILURE

FF = NO FAILURE

DATE January 24, 1966

WITNESSED

BY

Paul E. Campbell

THE BABCOCK & WILCOX COMPANY

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

RECORD OF PROCEDURE OR OPERATOR QUALIFICATION TEST QCD 2E4-122

TEST JOB NO. 610-0111 INITIAL APPLICATION		DATE 5-26-66		PROCEDURE NO. PQ-1300		WS-40	
WELDING PROCESS Electroslag		SINGLE Pass		MULTIPLE PASS		MULTIPLE ARC	
		<input checked="" type="checkbox"/> Double Arc					
MATERIAL SPECIFICATION P-3 (SA-302, Grade B)							
PLATE <input checked="" type="checkbox"/>	PIPE <input type="checkbox"/>	METAL THICKNESS 6-3/8"		FILLER METAL GROUP NO. RACO Hi-Mn-Mo		WELD CLASSIFICATION NO. Pressure	
IS BACKING STRIP USED <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		PRE HEAT TEMPERATURE 70°F. MIN.		INTER PASS TEMPERATURE Not Applicable		FLUX NAME OR COMPOSITION LINDE #124	
WELD CHARACTERISTICS (V&A) (A.C. OR D.C.) Alternating Current 48-52 Volts 575-625 Amps							
GAS FLOW RATE Not Applicable		POSITION OF PLATE OR PIPE Vertical		ULTRASONIC TEST Acceptable/No Defects		LIQUID PENETRANT Not Applicable	
MAGNETIC PARTICLE Acceptable/No Defects		RADIOGRAPH No Acceptable/Defects		MACRO EXAMINATION Acceptable		MICRO EXAMINATION Not Required	
SIZE OF ELECTRODE 1/8" Diameter		INERT GAS COMPOSITION Not Applicable		TRAVEL SPEED INCHES PER MIN. Not Applicable Oscillation 48"/MIN. Dwell Time 5 sec			
WELDERS NAME R. Reese		CLOCK NO. -----		SYMBOL -----			
REMARKS Procedure qualification for welding P-3 material in the vertical position by Electroslag process using 1/8" Dia. (RACO Hi-Mn-Mo Filler Wire with LINDE #124 Flux. See Reverse Side for Groove Configuration.							
WELD CHEMICAL ANALYSIS							
	MN	SI	P	S	CR	NI	MO
	1.26	.16	.015	.017	.11	.33	.51
REDUCED SECTION TENSILE (TRANSVERSE TO WELD)							
SPECIMEN NO.	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STRENGTH PSI	FRACTURE OR LOCATION	
	WIDTH	THICK.					
			See Reverse Side				
SIDE BEND TEST				FREE BEND TEST			
Four Side Bends - Acceptable/No Defects				Not Applicable			
ALL WELD METAL TENSILE							
SPECIMEN NO.	DIA.	AREA-SQ. IN.	YIELD POINT PSI.	TENS. STR. PSI	ELONG % IN 2"	RED AREA %	
			Not Required				
CHARPY IMPACT TESTS		TYPE V-Notch @ 10 of 240		FT. LBS. ENERGY LOAD			
LOCATION		FT. LBS.		LOCATION		FT. LBS.	
Heat Affected Zone		104.0, 76.0, 114.0		Weld Metal		39.0, 42.0, 43.0	
Base Metal		94.0, 76.0, 82.0					

WE CERTIFY THAT THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED, AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF ASME, U.S.C.G., ABS, USN MIL-STD-278 OR NAVSHIPS 250-1500-1.

October 17, 1966 SIGNED

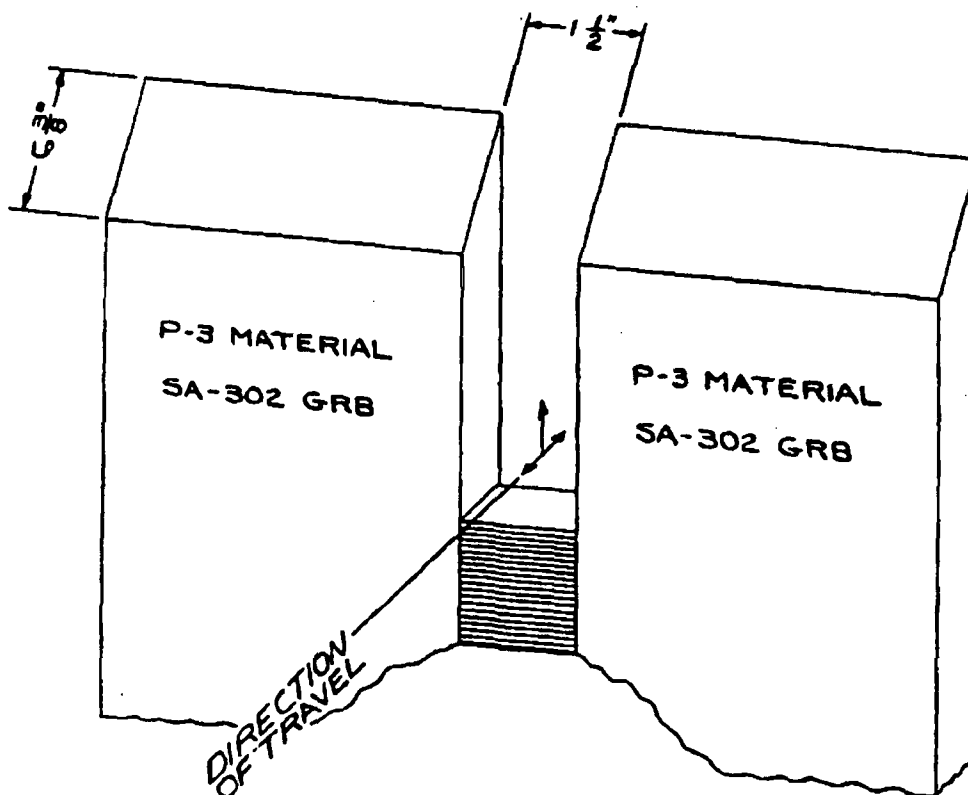
WITNESSED R. Remark, D. C. A. S. O.

PQ-1300
235

BABCOCK & WILCOX COMPANY

BY

Paul E Campbell



ELECTROSLAG WELD A.C. 48-52 VOLTS 575-625 AMPS
 48"/MIN OSCILLATION SPEED 5 SEC DWELL TIME
 1/8 DIA (RACO) HI-MN-MO FILLER WIRE WITH LINDE #124 FLUX

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STR. P.S.I.	FRACTURE
	WIDTH	THICK.				
PQ 1300	1.007"	3.175"	3.197"	266,000	83,200	WELD
PQ 1300	1.001"	2.785"	2.788"	237,000	84,980	WELD
PQ 1300	.992"	2.956"	2.932"	236,000	80,500	WELD
PQ 1300	1.008"	3.937"	3.968"	332,000	83,660	WELD

HEAT TREATMENT

6 1/2 HRS @ 1675°-1725°F - BRINE QUENCH
 6 1/2 HRS @ 1600°-1650°F - BRINE QUENCH
 6 1/2 HRS @ 1175°-1225°F - LIQUID QUENCH
 30 HRS @ 1100°-1150°F - FURNACE COOL

PQ 1300
 WELD IN VERTICAL POSITION
 10-22-GG

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

RECORD OF PROCEDURE OR OPERATOR QUALIFICATION TEST QCD 2E4-122

ASSOCIATED JOB NO. 610-0098 INITIAL APPLICATION		DATE 6-7-66		PROCEDURE NO. PQ-1309-A	
WELDING PROCESS Electroslag and Automatic Submerged Arc		SINGLE PASS <input checked="" type="checkbox"/> Double Arc		MULTIPLE PASS <input type="checkbox"/> MULTIPLE ARC <input type="checkbox"/>	
MATERIAL SPECIFICATION P-3 (A-302-B)					
PLATE <input checked="" type="checkbox"/>	PIPE <input type="checkbox"/>	METAL THICKNESS 6-1/4"	FILLER METAL GROUP NO. RACO HI-Mn-Mo & ASW Mn-Mo-Ni		WELD CLASSIFICATION NO. Pressure
IS BACKING STRIP USED <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		PRE HEAT TEMPERATURE ES 70°F MIN-ASA 300°F MIN.	INTER PASS TEMPERATURE ASA - Not Applicable		FLUX NAME OR COMPOSITION Electroslag LINDE # Auto Sub Arc LINDE #
WELD CHARACTERISTICS (VBA) (A.C. OR D.C.) Electroslag 48-52 Volts 600 Amps Alternating Current Automatic Submerged Arc 30-34 Volts 450-500 Amps					
GAS FLOW RATE Not Applicable		POSITION OF PLATE OR PIPE ES-Vertical ASA-Flat		ULTRASONIC TEST Acceptable/No Defects	
MAGNETIC PARTICLE Acceptable/No Defects		RADIOGRAPH Acceptable/Defects	MACRO EXAMINATION Not Required	MICRO EXAMINATION Not Required	LIQUID PENETRANT Not Applicable
SIZE OF ELECTRODE 1/8" Diameter		INERT GAS COMPOSITION Not Applicable		TRAVEL SPEED INCHES PER MIN. ASA - 10" - 12" /MIN. ES Oscillation 48"/MIN. Dwell Time 5 sec.	
WELDERS NAME R. Reese - T. Starnes - V. Clonts		CLOCK NO. 6136 - 6376 - 6149		SYMBOL None - YS - U-11	
REMARKS Procedure qualification for welding P-3 material by Combination Electroslag and Automatic merged Arc process. Electroslag weld in the vertical position using 1/8"Dia. (RACO)HI-Mn-Mo Filler Wire with LINDE #124 Flux. Auto Sub Arc in the flat position using 1/8"Dia. (ASW)Mn-Mo-Ni Filler with LINDE #80 Flux.					
WELD CHEMICAL ANALYSIS See Reverse Side-Groove Configuration					
C	MN	SI	P	S	CR
See Reverse Side					

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)						
SPECIMEN NO.	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STRENGTH PSI	FRACTURE OR LOCATION
	WIDTH	THICK.				
			See Reverse Side			

SIDE BEND TEST	FREE BEND TEST
Four Side Bends - Acceptable/No Defects	Not Required

ALL WELD METAL TENSILE						
SPECIMEN NO.	DIA.	AREA SQ. IN.	YIELD POINT PSI.	TENS. STR. PSI	ELONG % IN 2"	RED AREA
			Not Required			

CHARPY IMPACT TESTS		TYPE V-Notch @ +10 of 240 FT. LBS. ENERGY LOAD			
SPECIMEN NO.	FT. LBS.	SPECIMEN NO.	FT. LBS.		
				See Reverse Side	

WE CERTIFY THAT THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED WELDED, AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF ASME, U.S.C.G., ABS, USN MIL-STD-278 OR NAVSHIPS 250-1500-1.

PQ-1309-A

275

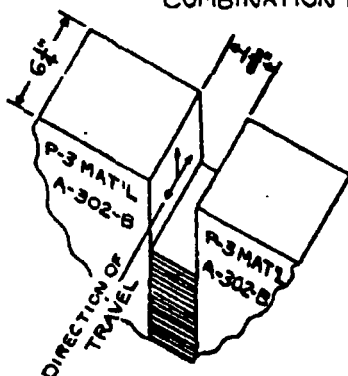
June 23, 1966 SIGNED

WITNESSED R. Y. Brown, G. E. APED

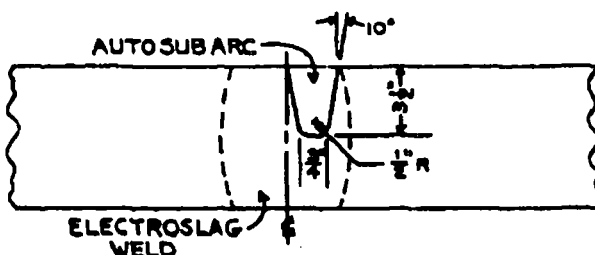
A-7

BY *Paul E. Campbell*
BABCOCK & WILCOX COMPANY

COMBINATION ELECTROSLAG & AUTO SUB ARC WELD



DOUBLE ARC ELECTROSLAG WELD
A.C. 48-52 VOLTS 600 AMPS
OSCILLATION SPEED 48"/MIN DWELL TIME 5 SEC
1/8" DIA (RACO) HI-MN-MO FILLER WIRE
LINDE #124 FLUX



AUTOMATIC SUBMERGED ARC WELD
A.C. 30-34 VOLTS 450-500 AMPS 10"-12"/MIN TRAVEL SPEED
1/8" DIA (AMERICAN STEEL & WIRE) MN-MO-NI FILLER WIRE-LINDE #80 FLUX

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT TENSILE STRENGTH LBS./SQ. IN.	FRACTURE
	WIDTH	THICK				
PQ1309A	1.000"	2.980"	2.980	253,000	84,900	SLAG WELD
PQ1309A	1.000"	2.510"	2.510	217,500	86,660	SLAG WELD
PQ1309A	1.001"	3.009"	3.010	255,000	84,720	SLAG WELD
PQ1309A	.998"	2.506"	2.501	220,000	87,960	SLAG WELD

CHARPY U-NOTCH IMPACTS @ +10°F 240 FT. LBS. ENERGY LOAD

LOCATION	FT. LBS.	FT. LBS.	FT. LBS.
AUTO SUB ARC WELD	33.0	42.0	34.0
HEAT AFFECTED ZONE OF SUBARC IN ELECTROSLAG WELD	93.0	90.0	87.0
BASE METAL	89.0	80.0	95.0
ELECTROSLAG WELD	60.0	50.0	35.0

CHEMICAL ANALYSIS

	C.	MN.	P.	S.	SI.	CR.	NI.	MO.	CU.
ELECTROSLAG WELD	.18	1.34	.012	.017	.14	.10	.30	.47	.22
BASE METAL	.18	1.14	.012	.018	.25	.15	.57	.48	.20
AUTO SUB ARC WELD	.08	1.65	.015	.016	.46	.07	.48	.43	.19

HEAT TREATMENT PRIOR TO SUBARC WELD 1 HR/IN @ 1675°-1725°F BRINE QUENCH
HEAT TREATMENT PRIOR TO SUBARC WELD 1 HR/IN @ 1600°-1650°F BRINE QUENCH
HEAT TREATMENT PRIOR TO SUBARC WELD 1 HR/IN @ 1175°-1200°F LIQUID QUENCH
FINAL STRESS RELIEF, AFTER WELDING 18 HRS @ 1100°-1150°F FURNACE COOL

PQ1309A
ELECTROSLAG WELD IN VERTICAL POSITION
AUTO SUB ARC WELD IN FLAT POSITION
DATE 6-29-66 CHEMISTRY REVISED 7-22-66

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

3RD OF PROCEDURE OR OPERATOR QUALIFICATION TEST QCD 2E4-122

ASSC TED JOB NO. 610-0098 INITIAL APPLICATION		DATE 6-8-66	PROCEDURE NO. PQ-1309-B			
WELDING PROCESS Electroslag and Manual Metal Arc		SINGLE	MULTIPLE PASS	MULTIPLE ARC		
MATERIAL SPECIFICATION P-3 (A-302-B)						
PLATE <input checked="" type="checkbox"/>	PIPE <input type="checkbox"/>	METAL THICKNESS 6-1/4"	FILLER METAL GROUP NO. RACO Hi-Mn-Mo & B&W 8015	WELD CLASSIFICATION NO. Procedure		
IS BACKING STRIP USED <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		PRE HEAT TEMPERATURE Electroslag 700° F MIN M.M.A. 300° F MIN	INTER PASS TEMPERATURE Electroslag Not Applicable M.M.A. 500° F MAX	FLUX NAME OR COMPOSITION E.S. LINDE # 124		
WELD CHARACTERISTICS Electroslag-Alternating Current 48-52 Volts 600 Amps Manual Metal Arc-Direct Current Reverse Polarity 22-26 Volts 185-265 Amps (See Reverse Side)						
GAS FLOW RATE Not Applicable		POSITION OF PLATE OR PIPE Vertical	ULTRASONIC TEST Acceptable/No Defects	LIQUID PENETRANT Not Applicable		
MAGNETIC PARTICLE Acceptable/No Defects		RADIOGRAPH No Acceptable/Defects Not Required	MACRO EXAMINATION Not Required	MICRO EXAMINATION Not Required		
SIZE OF ELECTRODE 1/8", 5/32", & 3/16" Dia		INERT GAS COMPOSITION Not Applicable		TRAVEL SPEED INCHES PER MIN. E.S. Oscillation 48"/MIN In all Time		
WELDERS NAME R. Reese - E. Sylvester D. Sinnett - U. Palinkas - G. Thompson		CLOCK NO. 6136 - 6188 6125 - 6092 - 6276	SYMBOL None - HU HU - BZ - US			
REMARKS Procedure qualification for welding P-3 material by combination Electroslag and Manual Metal Arc process in the vertical position. Electroslag using 1/8" Dia. (RACO) Hi-Mn-Mo Filler Wire with LINDE #124 Flux. Manual Metal Arc using 5/32" & 3/16" Dia. (B&W) 8015 Electrodes. See Reverse Side for Configuration.						
WELD CHEMICAL ANALYSIS						
MN	SI	P	S	CR		
			See Reverse Side			
REDUCED SECTION TENSILE (TRANSVERSE TO WELD)						
SPECIMEN NO.	DIMENSIONS WIDTH THICK.		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STRENGTH PSI	FRACTURE OR LOCAT
			See Reverse Side			
SIDE BEND TEST			FREE BEND TEST			
Four Side Bends - Acceptable/No Defects			Not Required			
ALL WELD METAL TENSILE						
SPECIMEN NO.	DIA.	AREA SQ. IN.	YIELD POINT PSI.	TENS. STR. PSI	ELONG % IN 2"	RED AREA
			Not Required			
CHARPY IMPACT TESTS		TYPE V-NOTCH @ +10° OF 240° FT. LBS. ENERGY LOAD				
SPECIMEN NO.	FT. LBS.		SPECIMEN NO.		FT. LBS.	
			See Reverse Side			

WE CERTIFY THAT THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED WELDED, AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF ASME, U.S.C.G., ABS, USN MIL-STD-278 OR NAVSHIPS 250-1800-1.

June 30, 1966 SIGNED

WITNESSED W. J. Titterington, Sr., G.E.

PQ-1309-B

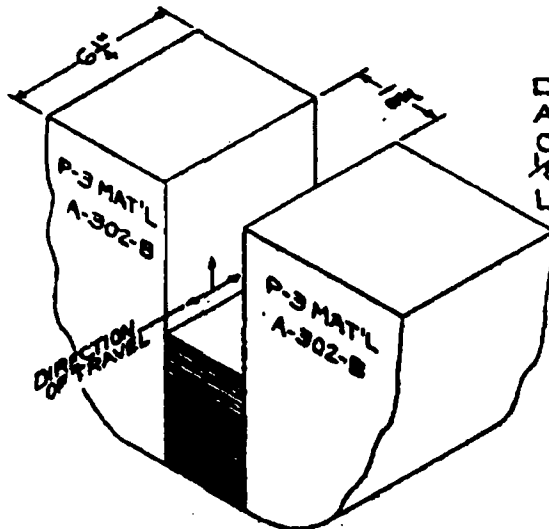
275

BABCOCK & WILCOX COMPANY

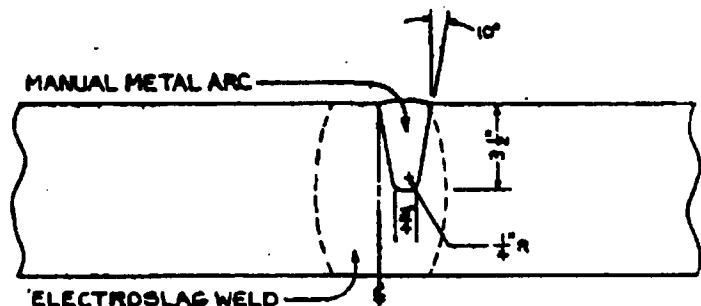
BY

Paul E Campbell

COMBINATION ELECTROSLAG + MANUAL METAL ARC WELD



DOUBLE ARC ELECTROSLAG WELD
A.C. 48-52 VOLTS 600 AMPS
OSCILLATION SPEED 48"/MIN DWELL TIME 5 SEC
1/8" DIA (RACO) HI-MN-MO FILLER WIRE
LINDE #124 FLUX



MANUAL METAL ARC DCRP
5/32" DIA (B+W) 8015 ELECTRODES 22-24 VOLTS 185-195 AMPS
3/16" DIA (B+W) 8015 ELECTRODES 24-26 VOLTS 250-265 AMPS

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT TENSILE STRENGTH P.S.I.	FRACTURE
	WIDTH	THICK.				
PQ1309B	1.000"	3.010"	3.010	249,000	82,720	M.M.A. WELD
PQ1309B	1.002"	2.783"	2.788	230,000	82,500	SLAG WELD
PQ1309B	1.002"	2.736"	2.742	228,000	83,150	SLAG WELD
PQ1309B	1.003"	2.784"	2.793	228,000	81,640	SLAG WELD

CHARPY V-NOTCH IMPACTS @ +10°F 240 FT. LBS. ENERGY LOAD

LOCATION	FT. LBS.	FT. LBS.	FT. LBS.
MANUAL METAL ARC WELD	97.0	91.0	96.0
HEAT AFFECTED ZONE OF M.M.A.	47.0	95.0	74.0
ELECTROSLAG WELD	98.0	53.0	95.0
BASE METAL	58.0	36.0	44.0

CHEMICAL ANALYSIS

	C	MN	P	S	SI	SR	NI	MO	CU
ELECTROSLAG WELD	.17	1.31	.015	.015	.14	.12	.29	.51	.23
MANUAL METAL ARC WELD	.06	.94	.011	.020	.27	.04	.73	.59	.01
BASE PLATE	.19	1.12	.011	.016	.23	.15	.57	.48	.20

HEAT TREATMENT PRIOR TO M.M.A. WELD 1 HR/IN @ 1675°-1725°F BRINE QUENCH
HEAT TREATMENT PRIOR TO M.M.A. WELD 1 HR/IN @ 1600°-1650°F BRINE QUENCH
HEAT TREATMENT PRIOR TO M.M.A. WELD 1 HR/IN @ 1175°-1200°F LIQUID QUENCH
FINAL STRESS RELIEF 18 HRS @ 1100°-1150°F FURNACE COOL
(AFTER WELDING)

PQ 1309B
WELDED IN VERTICAL POSITION
DATE 7-8-66

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

CONTRACT NO. A.S.M.E.
SPECIFICATION NO. _____

OF PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-QC 2E4-122

WELDING PROCESS Double Electroslag	QUALIFICATION POSITION Vertical	METAL THICKNESS 6 1/2 IN.	SINGLE PASS <input checked="" type="checkbox"/>	MULTIPLE <input checked="" type="checkbox"/>
MATERIAL SPECIFICATION P-3 (SA-302-B) and electroslag weld metal (plus Mn-Mo base material)		SINGLE ARC <input checked="" type="checkbox"/>	MULTIPLE <input checked="" type="checkbox"/>	
HEAT TREATMENT See reverse side		MACRO. EXAM. N.R.	MICRO. EX. N.R.	
FLUX NAME OR COMPOSITION Linde #124	PREHEAT TEMPERATURE NONE °, MIN.	INTERPASS TEMPERATURE NONE °, MAX.	WELDER Cissna	McFarland
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION N.A.		FILLER METAL GROUP NO. RACO - H1-Mn-Mo	SHIELDING GAS N.A.	CUP SIZE N.A.
AMPS, VOLTS, CURRENT, POLARITY Alternating current - 48-52 Volts 590-600 Amps		TORCH GAS FLOW RATE N.A.		
SIZE OF ELECTRODE, IN. DIA. 1/8	ELECTRODE EXT. BEYOND CUP IN. N.A.	TRAVEL SPEED IPM N.A.	WIRE FEED IPM N.A.	OSCILLATION 48 ipm
LIQUID PENETRANT N.A.	MAGNETIC PARTICLE Acceptable	RADIOGRAPH Acceptable	ULTRASONIC TEST Acceptable	
REMARKS: Procedure Qualification for welding P-3 material in the vertical position by the electroslag process using 1/8" dia. (RACO) H1-Mn-Mo filler wire with Linde #124 flux. See reverse side for groove configuration.				

CHEMICAL ANALYSIS - S E NO. 59703

LOCATION	C	MN	P	S	SI	CR	NI	MO	FE	CU	CO	TA	TI
	.19	1.41	.019	.015	.07	.06	.25	.57		.20			

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH PSI	FRACTURE LOCATION
	WIDTH	THICKNESS				
PG-1667	.995	2.465	2.453	221,000	90,100	Weld
PG-1667	1.000	2.342	2.342	208,500	89,020	Weld
PG-1667	.995	2.590	2.577	228,000	88,470	Weld
PG-1667	1.000	2.660	2.660	233,000	87,600	Weld

BEND TEST

Four side bends - Acceptable (No defects)

ALL WELD METAL TENSILE

SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG % IN 2"	RED AREA %
			N.R.			

TYPE CHARPY V-NOTCH	IMPACT TEST AT	240 FT. LBS. ENERGY LOAD
USE METAL	57, 69, 77 FT. LBS.	
ELD METAL	47, 39, 27 FT. LBS.	
EAT AFFECTED ZONE	44, 44, 35 FT. LBS.	

WE CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

N.R. = NOT REQUIRED N.A. = NOT APPLICABLE

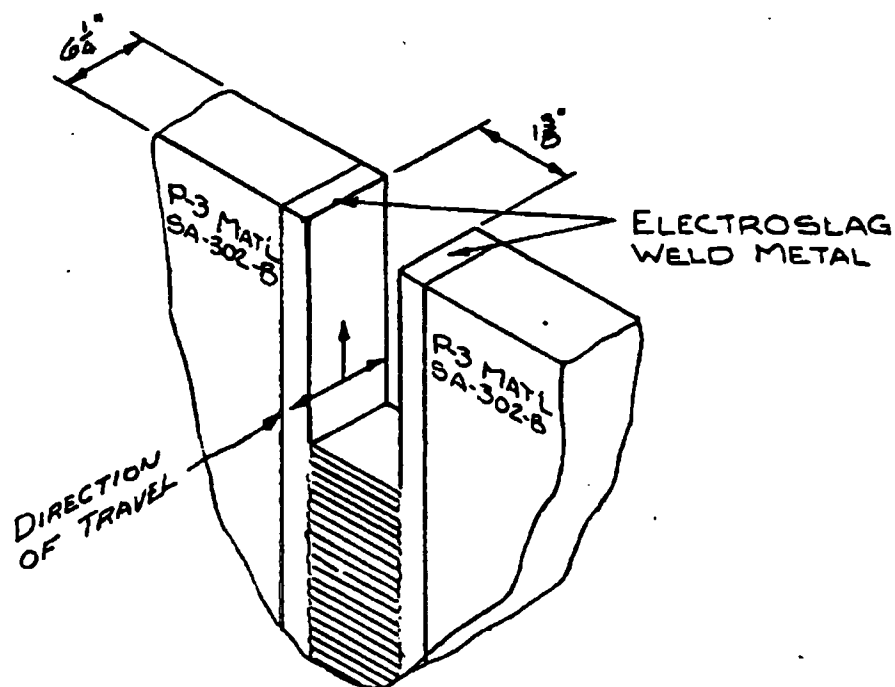
WITNESSED _____

A-11

DATE Sept. 22, 1967

MTV-9
PO 1667
BY Paul E Campbell
BABCOCK & WILCOX COMPANY 235

DOUBLE ELECTROSLAG (A.C.)



$\frac{1}{8}$ " DIA (RACO) HI-MN-MO FILLER WIRE

LINDE *124 FLUX

48-52 VOLTS 590-600 AMPS

48 IPM OSCILLATION 5 SEC. DWELL TIME

HEAT TREATMENT AFTER WELDING

$6\frac{1}{2}$ HRS @ 1675° - 1725° F - BRINE QUENCH

$6\frac{1}{2}$ HRS @ 1600° - 1650° F - BRINE QUENCH

$6\frac{1}{2}$ HRS @ 1180° - 1200° F - WATER QUENCH

30 HRS @ 1100° - 1150° F - FURNACE COOL

PQ 1667

MTV-9

WELDED IN VERTICAL POSITION

DATE 10-18-67

A-12

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

CONTRACT NO. 847-008136-02
SPECIFICATION NO. WS-40

501-4

WORD OF PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-QC 2E4-122

SHIPS 1500-1	ASME SECTION 3	ASME SECTION 8	OTHER	PLATE X	PIPE	SINGLE PASS X	MULTIPLE PASS
WELDING PROCESS Electroslag		QUALIFICATION POSITION Vertical		METAL THICKNESS 6-3/8 IN.		SINGLE LAYER NA	MULTIPLE LAY NA
SERIAL SPECIFICATION P-3 (SA-302-B)						SINGLE ARC	MULTIPLE ARC * 2
POST TREATMENT See reverse side						MACRO. EXAM. **	MICRO. EXAM. NR
FILLER METAL OR COMPOSITION Linde 124		PREHEAT TEMPERATURE 60 °F MIN.		INTERPASS TEMPERATURE NA °F MAX.		WELDER Pierson 5702 Miller 5701	
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION None		FILLER METAL GROUP NO. A-2		SHIELDING GAS NA		CUP SIZE NA	TORCH GAS FLOW RATE NA
PS, VOLTS, CURRENT, POLARITY Alternating current 46-48 volts, 550-600 amps							
SIZE OF ELECTRODE, IN. DIA. 1/8		ELECTRODE EXT. BEYOND CUP IN. NA		TRAVEL SPEED IPM NA		WIRE FEED IPM NA	WELDING POSITION 4-5 CY/PM
SIZE OF FILLER WIRE, IN. DIA. NA		MAGNETIC PARTICLE Acceptable		RADIOGRAPH Acceptable		ULTRASONIC TEST Acceptable	

MARKS: Procedure qualification for welding P-3 material in the vertical position by the electroslag process using 1/8" dia. (RACO) Hi-Mn-Mo fillerwire with Linde 124 flux. See reverse for additional information & groove configuration.

CHEMICAL ANALYSIS - S E NO. 65179

LOCATION	C	MN	P	S	SI	CR	NI	MO	FE	CU	CS	CO	TA	TI	VL
Weld	.19	1.40	.015	.015	.14	.09	.27	.54		.23					
Base	.24	1.26	.016	.019	.23	.14	.69	.51		.16					

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH PSI	FRACTURE LOCATION
	WIDTH	THICKNESS				
PQ-1822	.993	2.895	2.875	255,000	88,690	Weld
PQ-1822	.993	2.802	2.782	249,000	89,510	Weld

BEND TEST

Four side bends (split into 20) - Acceptable (No defects)

ALL WELD METAL TENSILE

SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG % IN 2"	RED AREA %
Q-1822 (AT)	.504		66,000	88,000	25.0	64.6
Q-1822 (AT)	.504		66,000	85,500	26.5	64.1
Q-1822 (AT)	.505		65,000	85,500	27.0	67.0
Q-1822 (AT)	.505		63,750	85,500	29.0	67.9

TYPE CHARPY	IMPACT TEST AT	FT. LBS.	FT. LBS. ENERGY LOAD
SE METAL			
LD METAL	See Reverse Side		
AT AFFECTED ZONE			

WE CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

N.R. = NOT REQUIRED N.A. = NOT APPLICABLE

* Electrode spacing 4"

** One transverse & one longitudinal macro - Acceptable

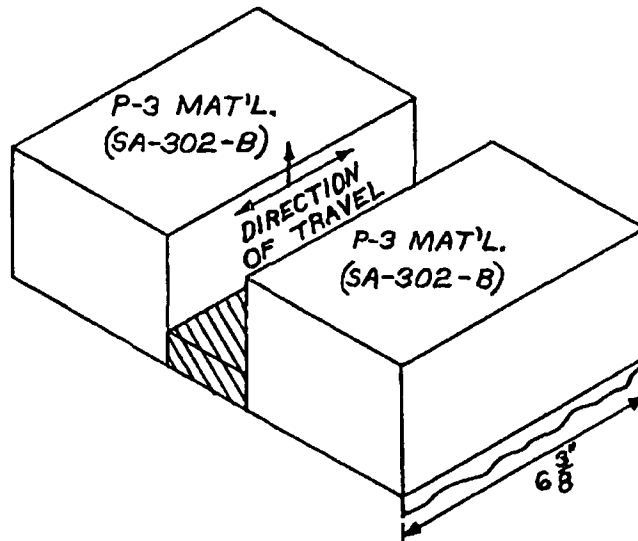
WITNESSED

A-13

DATE July 30, 1968

BY F. J. Muffet
BABCOCK & WILCOX COMPANY

PQ 1822



HEAT TREATMENT

$6\frac{1}{2}$ HRS. @ 1675° – 1725° F — BRINE QUENCH
 $6\frac{1}{2}$ HRS. @ 1600° – 1650° F — BRINE QUENCH
 $6\frac{1}{2}$ HRS. @ 1175° – 1225° F — LIQUID QUENCH
 30 HRS. @ 1100° – 1150° F — FURANCE COOL

DROP WEIGHTS

TEMP.	WELD	BASE	HEAT AFFECTED ZONE
+50°	NF NF		
+40°	NF NF		
+30°	NF F F		NF NF
+20°	F	NF NF	F NF
-10°		NF NF	
-20°		NF F	
-30°		F	
-40°		F	

CHARPY V-NOTCH IMPACTS — $\frac{1}{4}$ T

TEMP.	WELD FT. LBS.	BASE FT. LBS.	HEAT AFFECTED ZONE FT. LBS.
+10	36, 70, 42, 64, 45	56, 56, 56	66, 77, 60
+40	66, 56, 65		
-20	25, 36, 43		
-50	8, 35	32	

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

CONTRACT NO. 610-0127
SPECIFICATION NO. W-57

RECORD OF PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-OC 2E4-122

NAVSHIPS 150-1500-1	ASME SECTION 3	ASME SECTION 4	OTHER	PLATE	PIPE	SINGLE PASS	MULTIPLE PASS
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
WELDING PROCESS Electroslag		QUALIFICATION POSITION Vertical		METAL THICKNESS 6-3/8 in.		SINGLE LAYER NA	MULTIPLE LAY NA
MATERIAL SPECIFICATION P-3 (SA-302-B)						SINGLE ARC	MULTIPLE ARC
HEAT TREATMENT See reverse side						MACRO. EXAM. 5-Acceptable	MICRO. EXAM. NR
FLUX NAME OR COMPOSITION Linde 124	PREHEAT TEMPERATURE 70 °, MIN.	INTERPASS TEMPERATURE NA °, MAX.	WELDER Pierston		Miller		
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION None		FILLER METAL GROUP NO. A-2	SHIELDING GAS NA	CUP SIZE NA	TORCH GAS FLOW RATE	NA	
AMPS, VOLTS, CURRENT, POLARITY Alternating current 48 volts, 550-600 amps							
SIZE OF ELECTRODE, IN. DIA.	ELECTRODE EXT. BEYOND CUP IN.	TRAVEL SPEED IPM	WIRE FEED IPM	OSCILLATION	DWELL TIME SEC.		
SIZE OF FILLER WIRE, IN. DIA. 1/8	NA	NA	NA	40" /PM			
LIQUID PENETRANT NA	MAGNETIC PARTICLE Acceptable *	RADIOGRAPH Acceptable	ULTRASONIC TEST Acceptable				
REMARKS: Procedure qualification for welding P-3 material in the vertical position by the electroslag process using 1/8" dia. (Raco) Hi-Mn-Mo filler wire with Linde 124 flux. See reverse side for groove configuration.							

CHEMICAL ANALYSIS - S E NO. 65765

LOCATION	C	MN	P	S	SI	CR	NI	MO	FE	CU	CO	TA	TI	AL
V'd	.18	1.49	.014	.011	.15	.06	.36	.49		.18				
Base	.23	1.35	.013	.019	.25	.09	.62	.51		.08				

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH PSI	FRACTURE LOCATION
	WIDTH	THICKNESS				
PQ-1851	.878	2.765	2.428	206,500	85,050	Weld
PQ-1851	.871	3.122	2.719	224,500	82,560	Weld
PQ-1851	1.004	2.995	3.007	251,000	83,460	Weld
PQ-1851	1.006	2.852	2.859	240,000	83,940	Weld

BEND TEST

Four side bends (split into 16) - Acceptable (No defects)

ALL WELD METAL TENSILE

SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG % IN 2"	RED AREA %
PQ-1851	.505		61,750	83,000	30.0	65.6
PQ-1851	.505		63,000	83,500	30.0	69.7
PQ-1851	.505		60,000	82,000	29.0	69.0
PQ-1851	.505		59,500	81,250	29.0	67.9

TYPE CHAMFY	IMPACT TEST AT °F	FT. LBS. ENERGY LOAD
BASE METAL	FT. LBS.	FT. LBS.
WELD METAL	See reverse side	FT. LBS.
HEAT AFFECTED ZONE	FT. LBS.	FT. LBS.

WE CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

N.R. = NOT REQUIRED N.A. = NOT APPLICABLE

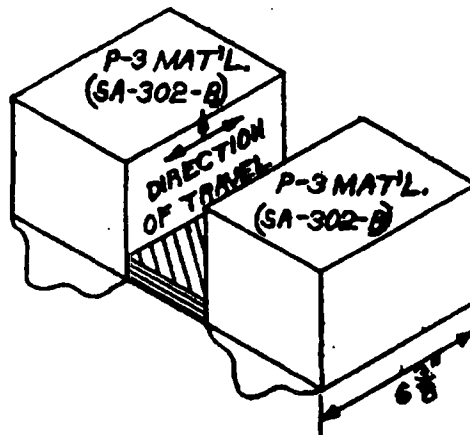
* Final surfaces

WITNESSED _____

A-15

DATE Oct. 15, 1968

PQ 1851
Paul E Campbell
BABCOCK & WILCOX COMPANY CN 23



HEAT TREATMENT AFTER WELDING

6 1/2 HRS. @ 1675°-1725°F — BRINE QUENCH

6 1/2 HRS. @ 1600°-1650°F — BRINE QUENCH

6 1/2 HRS. @ 1175°-1225°F — LIQUID QUENCH

30 HRS. @ 1100°-1150°F — FURNACE COOL

CHARPY V-NOTCH IMPACTS @ 240 FT. LBS.

LOCATION	0°F	+10°F	+40°F	-20°F	-30°F	-40°F
WELD METAL (±T)	55	84, 71, 57	79, 72, 81, 83	59, 39, 35	44	21
BASE METAL (±T)		74, 84, 81		55		
HEAT AFFECTED ZONE (±T)		79, 96, 64		64		

DROP WEIGHTS @ 3 FT./100 LBS.

HEAT AFFECTED ZONE (±T)		WELD METAL (±T)		BASE METAL (±T)	
+20°F	NF	-20°F	F	0°F	NF
0°F	NF	-10°F	F	0°F	NF
-20°F	F	0°F	F	0°F	NF
-10°F	NF	+10°F	F	0°F	NF
-10°F	NF	+20°F	NF	0°F	F
-20°F	F	+20°F	NF	+20°F	NF
-20°F	NF	-10°F	NF	+10°F	NF
-20°F	NF	-30°F	F	+10°F	NF

PQ 1851

DATE: 10-15-68

A-16

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

CONTRACT NO. ASME
SPECIFICATION NO. W-34.1-1

D OF PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-QC 2E4-122

NAVSHIPS 250-1500-1	ASME SECTION 3	ASME SECTION 8	OTHER	PLATE	PIPE	SINGLE PASS	MULTIPLE
WELDING PROCESS Electroslag	QUALIFICATION POSITION Vertical		METAL THICKNESS 6-3/8 IN.		SINGLE LAYER	MULTIPLE	
MATERIAL SPECIFICATION P-3 (SA-302-B)				SINGLE ARC		MULTIPLE	
HEAT TREATMENT See Reverse Side				MACRO. EXAM.		MICRO. EXAM.	
FLUX NAME OR COMPOSITION Linde 124	PREHEAT TEMPERATURE 70° MIN.	INTERPASS TEMPERATURE NA ° F MAX.	WELDER Flanston Miller SYMBOL CLOCK NO. 5702 5701				
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION None		FILLER METAL GROUP NO. A-2	SHIELDING GAS NA	CUP SIZE NA	TORCH GAS FLOW RATE NA		
AMPS, VOLTS, CURRENT, POLARITY Alternating Current 46-48 Volts 590-600 Amps							
SIZE OF ELECTRODE, IN. DIA.		ELECTRODE EXT. BEYOND CUP IN.	TRAVEL SPEED IPM	WIRE FEED IPM	OSCILLATION	DWELL TIME	
SIZE OF FILLER WIRE, IN. DIA. 1/8		NA*	NA	NA	NA	NA	
LIQUID PENETRANT NA		MAGNETIC PARTICLE Acceptable **	RADIOGRAPH Acceptable	ULTRASONIC TEST Acceptable			

REMARKS: Procedure qualification for welding P-3 mat'l in the vertical position by the electroslag process using 1/8" Dia (Raco) HiMnMo filler wire with Linde 124 flux. See reverse side for groove configuration.

CHEMICAL ANALYSIS - S E NO. 67501

LOCATION	C	MN	P	S	SI	CR	NI	NO	FE	CU	CO	TA	YI
Weld	.19	1.49	.016	.014	.16	.06	.38	.55		.19			
Base	.22	1.34	.013	.018	.25	.07	.62	.53		.11			

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH PSI	FRACTURE LOCATION
	WIDTH	THICKNESS				
PQ-1928	.995	3.141	3.125	250,500	83,300	Weld
PQ-1928	.995	3.150	3.134	252,000	83,500	Weld
PQ-1928	.996	2.790	2.779	242,500	87,270	Weld
PQ-1928	1.006	2.697	2.713	235,500	86,800	Weld

BEND TEST

Four side bends (split into 1b) - Acceptable (No Defects)

ALL WELD METAL TENSILE

SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG % IN 2"	RED AREA

TYPE CHARPY	IMPACT TEST AT	FT. LBS.	FT. LBS. ENERGY LOAD
BASE METAL			
WELD METAL	See Reverse Side		
HEAT AFFECTED ZONE			

WE CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

N.R. = NOT REQUIRED N.A. = NOT APPLICABLE

* 4" Electrode spacing
** Final surface

PQ 1928

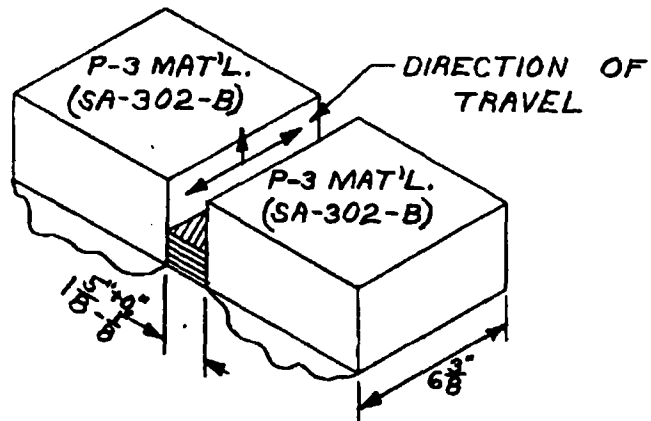
WITNESSED _____

A-17

DATE Dec. 10, 1968

BY F. J. Muffey
BABCOCK & WILCOX COMPANY

CN 235



HEAT TREATMENT AFTER WELDING

6 1/2 HRS. @ 1675°-1725°F—BRINE QUENCH

6 1/2 HRS. @ 1600°-1650°F—BRINE QUENCH

6 1/2 HRS. @ 1175°-1225°F—LIQUID QUENCH

30 HRS. @ 1100°-1150°F—FURNACE COOL

CHARPY V-NOTCH IMPACTS 240 FT. LBS. ENERGY LOAD

WELD METAL (1/2T)	
+10°F	30
+10°F	33
+10°F	33
0°F	18
0°F	26

BASE METAL (1/2T)	
-10°F	57
-10°F	39
-10°F	27
-20°F	52
-20°F	30
-20°F	38

HEAT AFFECTED ZONE (1/2T)	
+10°F	81
+10°F	81
+10°F	62
-20°F	41
-20°F	58
-20°F	35

DROP WEIGHTS

WELD METAL (1/2T)	
+20°F	NF
+20°F	F
+30°F	NF
+30°F	NF
+25°F	F
+25°F	NF
+25°F	F

BASE METAL (1/2T)	
+20°F	NF
+20°F	NF
+10°F	NF
+10°F	NF
-10°F	F
0°F	NF
0°F	NF
-10°F	F

HEAT AFFECTED ZONE (1/2T)	
+20°F	F
+30°F	NF
+30°F	NF
+25°F	NF
+25°F	F

PQ 1928

DATE: 12-10-68

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO

CONTRACT NO. ASME
SPECIFICATION NO. W-34

WDM 501-4

WELDING PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-QC 2E4-122

NAVSHIPS 250-1800-1	ASME SECTION 3	ASME SECTION	OTHER	PLATE	PIPE	SINGLE PASS	MULTIPLE
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
WELDING PROCESS Electroslag		QUALIFICATION POSITION Vertical		METAL THICKNESS 6-3/8 IN.		SINGLE LAYER	MULTIPLE
MATERIAL SPECIFICATION P-3 (SA-302-B)						SINGLE ARC	MULTIPLE
HEAT TREATMENT See reverse side						MACRO. EXAM. NR	MICRO. E NR
FLUX NAME OR COMPOSITION Linde 124	PREHEAT TEMPERATURE 70 °F MIN.	INTERPASS TEMPERATURE NA °F MAX.	WELDER SYMBOL CLOCK NO.	Pierson 5702	Miller 5701		
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION NA		FILLER METAL GROUP NO. A-2	SHIELDING GAS NA	CUP SIZE NA	TORCH GAS FLOW RATE	NA	
AMPS, VOLTS, CURRENT, POLARITY Alternating current 48 volts, 600-650 amps							
SIZE OF ELECTRODE, IN. DIA. SIZE OF FILLER WIRE, IN. DIA.	1/8	ELECTRODE EXT. BEYOND CUP IN. NA*	TRAVEL SPEED IPM NA	WIRE FEED RPM NA	OSCILLATION 48" PM	DRILL TIME SEC.	
LIQUID PENETRANT NA	MAGNETIC PARTICLE Acceptable **		RADIOGRAPH Acceptable		ULTRASONIC TEST Acceptable		
REMARKS: Procedure qualification for welding P-3 material in the vertical position by the electroslag process using 1/8" dia. (Eaco) Ni-Mn-Mo fillerwire with Linde 124 flux. See reverse side for groove configuration.							

CHEMICAL ANALYSIS - S E NO. 66641

LOCATION	C	MN	P	S	SI	CR	NI	MO	FE	CU	CB	CO	TA	TI
Base	.22	1.37	.013	.014	.27	.11	.51	.49		.09				
Weld	.18	1.50	.015	.013	.17	.08	.30	.43		.20				

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH PSI	FRACTURE LOC.
	WIDTH	THICKNESS				
PQ-1929	.990	3.155	3.153	274,000	85,900	Weld
PQ-1929	1.015	3.119	3.165	275,000	86,890	Weld
PQ-1929	.995	2.721	2.707	232,500	85,880	Weld
PQ-1929	1.002	2.735	2.741	237,500	86,570	Weld

BEND TEST

Four side bends (Split into 16) - Acceptable (No defects)

ALL WELD METAL TENSILE

SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG % IN 2"	RED AREA

TYPE CHARPY	IMPACT TEST AT	FT. LBS.	FT. LBS. BRIDLE LOAD
BASE METAL			
WELD METAL	See reverse side		
HEAT AFFECTED ZONE			

WE CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, TESTED AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

N.R. = NOT REQUIRED N.A. = NOT APPLICABLE

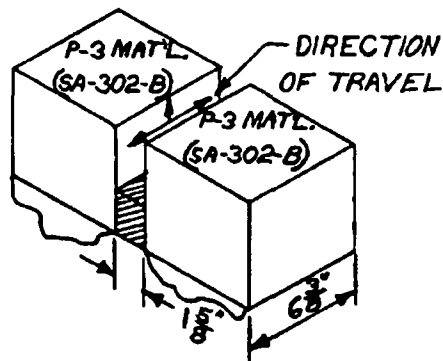
* 4" electrode spacing
** Final surface

PQ 1929

WITNESSED _____

DATE Dec. 10, 1968

BY FD Muffet
BABCOCK & WILCOX COMPANY



HEAT TREATMENT AFTER WELDING

6 1/2 HRS. @ 1675°-1725°F—BRINE QUENCH
 6 1/2 HRS. @ 1600°-1650°F—BRINE QUENCH
 6 1/2 HRS. @ 1175°-1225°F—LIQUID QUENCH
 30 HRS. @ 1100°-1150°F—FURNACE COOL

CHARPY V-NOTCH IMPACTS @ 240 FT. LBS. ENERGY LOAD

BASE METAL $\frac{1}{2}T$	
+10 °F	18
+10 °F	21
+10 °F	30
0 °F	24
0 °F	25
0 °F	20

WELD METAL $\frac{1}{2}T$	
+10 °F	80
+10 °F	40
+10 °F	55

HEAT AFFECTED ZONE $\frac{1}{2}T$	
+10 °F	33
+10 °F	41
+10 °F	31
0 °F	36
0 °F	13
0 °F	25

DROP WEIGHTS

BASE METAL $\frac{1}{2}T$	
+20 °F	F
+20 °F	F
+30 °F	F
+40 °F	F
+80 °F	NF
+70 °F	NF
+60 °F	NF
+60 °F	NF

WELD METAL $\frac{1}{2}T$	
+20 °F	F
+20 °F	F
+30 °F	F
+40 °F	F
+50 °F	F
+70 °F	NF
+70 °F	NF
+60 °F	NF

HEAT AFFECTED ZONE $\frac{1}{2}T$	
+20 °F	F
+20 °F	F
+30 °F	NF
+30 °F	NF
+25 °F	F
+25 °F	F

PQ 1929
 DATE: 12-10-68

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIO.

CONTRACT NO. 31ME
SPECIFICATION NO. 9-24, 1957

M 401-4

RD OF PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-OC 2E4-122

NAVSHIPS 250-1500-1	ASME SECTION 2	ASME SECTION 2	OTHER	PLATE	PIPE	SINGLE PASS	MULTIPLE PASS
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
WELDING PROCESS Electroslag		QUALIFICATION POSITION Vertical		METAL THICKNESS 6-3/8 IN.		SINGLE LAYER	MULTIPLE LAYER
MATERIAL SPECIFICATION P-3 (SA-302-B)						SINGLE ARC	MULTIPLE ARC
HEAT TREATMENT See reverse side						MACRO. EXAM.	MICRO. EXAM.
						NR	NR
FLUX NAME OR COMPOSITION Linde 124	PREHEAT TEMPERATURE 70 °, MIN.	INTERPASS TEMPERATURE NA ° MAX.	WELDER SYMBOL CLOCK NO.	Eliason 5702		Miller 5701	
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION NA		FILLER METAL GROUP NO. A-2	SHIELDING GAS NA	CUP SIZE NA	TORCH GAS FLOW RATE NA		
AMPS, VOLTS, CURRENT, POLARITY Alternating current 50 volts, 590-600 amps							
SIZE OF ELECTRODE, IN. DIA. 1/8	ELECTRODE EXT. BEYOND CUP IN.	TRAVEL SPEED IPH NA	WIRE FEED IPH NA	OSCILLATION 24.5 IN	DWELL TIME SEC.		
LIQUID PENETRANT NA	MAGNETIC PARTICLE Acceptable **	RADIOGRAPH Acceptable	ULTRASONIC TEST Acceptable				
REMARKS: Procedure qualification for welding P-3 material in the vertical position by the electroslag process using 1/8" dia. (Paco) Hi-Mg-Mo filler wire with Linde 124 flux. See reverse side for groove configuration.							

CHEMICAL ANALYSIS - S & NO. 65581

LOCATION	C	MN	P	S	SI	CR	NI	NO	FE	CU	CO	TA	SI	AL
Base	.19	1.38	.012	.020	.28	.11	.50	.49		.08				
Weld	.16	1.52	.012	.014	.15	.07	.26	.51		.20				

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH, PSI	FRACTURE LOCATION
	WIDTH	THICKNESS				
PQ-1930	1.000	2.862	2.862	241,000	84,220	Weld
PQ-1930	1.000	3.080	3.080	260,500	84,580	Weld
PQ-1930	1.000	2.462	2.462	210,500	85,500	Weld
PQ-1930	1.000	3.230	3.230	271,000	83,900	Weld

BEND TEST

Four side bends (Split into 16) - Acceptable (No defects)

ALL WELD METAL TENSILE

SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG % IN 2"	RED AREA %
			NA			

TYPE CHART	IMPACT TEST AT	FT. LBS.	FT. LBS.	FT. LBS.
BASE METAL				
WELD METAL	See reverse side			
HEAT AFFECTED ZONE				

WE CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

* 2-3/4" electrode spacing
** Final surfaces

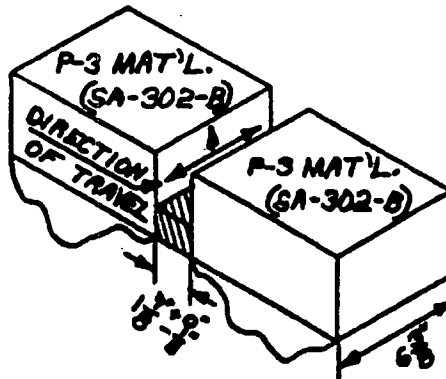
B.S. = NOT REQUIRED; N.A. = NOT APPLICABLE

WITNESSED _____

DATE Jan 1, 1963

BY F. J. Muff
BABCOCK & WILCOX COMPANY

PO 1930



HEAT TREATMENT AFTER WELDING

6½ HRS. @ 1675°-1725°F — BRINE QUENCH
 6½ HRS. @ 1600°-1650°F — BRINE QUENCH
 6½ HRS. @ 1175°-1225°F — LIQUID QUENCH
 30 HRS. @ 1100°-1150°F — FURNACE COOL

CHARPY-V NOTCH IMPACTS @ 240 FT. LBS.

BASE METAL (½T)	
+10°F	44
+10°F	52
+10°F	15
+10°F	32
+10°F	50
+10°F	44

WELD METAL (½T)			
+10°F	10	+20°F	78
+10°F	72	+40°F	62
+10°F	70	+40°F	94
+10°F	75	+30°F	89
+10°F	16	+20°F	72
+10°F	14	+10°F	39
+40°F	90	0°F	45
-20°F	31	-10°F	67

HEAT AFFECTED ZONE (½T)	
+10°F	65
+10°F	52
+10°F	54
-10°F	10
-10°F	65
-10°F	30

DROP WEIGHTS

BASE METAL (½T)	
+20°F	F
+20°F	F
+10°F	F
+30°F	NF
+30°F	F
+40°F	NF
+40°F	NF
+35°F	F

WELD METAL (½T)	
+20°F	F
+20°F	F
+10°F	F
+30°F	F
+40°F	NF
+40°F	NF
+30°F	NF
+30°F	F

HEAT AFFECTED ZONE (½T)	
+20°F	F
+20°F	F
+10°F	F
+30°F	NF
+30°F	F
+40°F	NF
+40°F	NF
+40°F	NF

PQ 1930
 DATE: 10-10-68

90-0356

RECORD OF TEST RESULTS

THE BABCOCK & WILCOX COMPANY
BARBERTON, OHIOBase Metal: 6-3/8" thk
SA-302-B
Parallel weld groove
side walls 1-3/8" + 1/8"
apart

CT		CUSTOMER General Electric
ASME Code Weld Test Plate (Electroslag WS-40)		CUSTOMER ORDER NO.
TEST NO. PQ-1931	ASSOCIATED PROCESS QUALIFICATION NO.	B&W CONTRACT NO. 610-0111

DESCRIPTION OF TEST Heat treatment 6-1/2 hrs @ 1675-1725°F - Brine quench
after welding: 6-1/2 hrs @ 1600-1650°F - Brine quench
6-1/2 hrs @ 1175-1225°F - Liquid quench
30 hrs. @ 1100-1150°F - Furnace cool

WELD CHEMICAL ANALYSIS E-66319

C	Mn	Si	P	S	Cr	Ni	Mo	Cu
.20	1.52	.12	.015	.021	.05	.38	.59	.19

BASE METAL CHEMICAL ANALYSIS E-66319

C	Mn	Si	P	S	Cr	Ni	Mo	Cu
.21	1.32	.18	.015	.034	.04	.60	.55	.10

BEND TEST: TYPE NUMBER RESULTS
Four side bends (split into 16) - Acceptable (No defects)

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)

SIMAN NO.	WIDTH	THICKNESS	AREA SQ. IN.	ULTIMATE LOAD LBS.	ULT. TENSILE STRENGTH PSI	LOCATION OF FRACTURE
PQ-1931	1.009	2.769	2.794	236,000	84,470	Weld
PQ-1931	.883	2.854	2.520	211,000	83,740	Weld
PQ-1931	1.000	3.056	3.056	256,500	83,940	Weld
PQ-1931	1.001	2.945	2.947	243,500	82,620	Weld

WELD METAL TENSILE

SPECIMAN NO.	DIAMETER	AREA SQ. IN.	YIELD POINT PSI	TENSILE STRENGTH PSI	E LONG % IN. 2"	RED AREA %
			NR			

HARPY IMPACT TESTS

TYPE	AT	OF	FT. LBS. ENERGY LOAD.
LOCATION	FT. LBS.	LOCATION	FT. LBS.
	See reverse side		

OP WEIGHT IMPACT TESTS

LOCATION	HEIGHT	WEIGHT
See reverse side		

TEMPERATURE OF

F = FAILURE

NF = NO FAILURE

Nov. 1, 1968 WITNESSED

A-23

BY

Paul F. Campbell

CHARPY V-NOTCH IMPACTS

LOCATION	TEMP. °F.	FT. LBS.
1/2 T WELD	+10	47
"	+10	24
"	+10	33
"	+10	57
"	+10	50

LOCATION	TEMP. °F.	FT. LBS.
1/2 T HAZ	+10	36
" "	+10	30
" "	+10	75
" "	-20	29
" "	-20	24
" "	-20	16

LOCATION	TEMP. °F.	FT. LBS.
1/2 T BASE	+10	82
" "	+10	56
" "	+10	74
" "	-20	39
" "	-20	30
" "	-20	50

DROP WEIGHTS

LOCATION	TEMP. °F.	RESULTS
1/2 T WELD	+20	F
" "	+20	F
" "	+30	NF
" "	+30	NF
" "	+20	F

LOCATION	TEMP. °F.	RESULTS
1/2 T HAZ	+20	F
" "	+20	F
" "	+30	NF
" "	+30	NF
" "	+20	F

LOCATION	TEMP. °F.	RESULTS
1/2 T BASE	+20	NF
" "	+20	NF
" "	0	NF
" "	-20	F
" "	-10	NF
" "	-10	NF
" "	-20	F
" "	-20	F

PQ 1931

DATE: 11-1-68

WELDERS

PIERSON — 5702

MILLER — 5701

THE BABCOCK & WILCOX COMPANY

MT. VERNON, INDIANA

CONTRACT NO. 610-0122
SPECIFICATION NO. WS-40

1-6 OF PROCEDURE AND/OR OPERATOR QUALIFICATION TEST-QC 2E4-122 Code No. 235*

NAVSHIPS 290-1500-1 <input type="checkbox"/>	ASME SECTION 2 <input checked="" type="checkbox"/>	ASME SECTION 1 & 2 <input checked="" type="checkbox"/>	OTHER A.S.M.E. Sect. IV* <input checked="" type="checkbox"/>	PLATE <input checked="" type="checkbox"/>	PIPE <input type="checkbox"/>	SINGLE PASS <input checked="" type="checkbox"/>	MULTIPLE PASS <input type="checkbox"/>
WELDING PROCESS Electroslag		QUALIFICATION POSITION Vertical		METAL THICKNESS 6 1/2" IN.		SINGLE LAYER <input checked="" type="checkbox"/>	MULTIPLE LAYER <input type="checkbox"/>
MATERIAL SPECIFICATION P-3 (SA-302 Gr. B. Mod.)						SINGLE ARC <input type="checkbox"/>	MULTIPLE ARC <input checked="" type="checkbox"/>
HEAT TREATMENT See Reverse Side						MACRO. EXAM. N.R.	MICRO. EXAM. N.R.
FLUX NAME OR COMPOSITION Linde #124		PREHEAT TEMPERATURE 70° MIN.	INTERPASS TEMPERATURE N.A. ° MAX.	WELDER SYMBOL Irvin NO. 1068			
TYPE OF BACKUP (STRIP OR GAS) AND COMPOSITION N.A.		FILLER METAL GROUP NO. Raco Hi-Mn-Mo(A-2)		SHIELDING GAS N.A.	CUP SIZE N.A.	TORCH GAS FLOW RATE N.A.	

AMPS, VOLTS, CURRENT, POLARITY Alternating Current 48-52 Volts 575-625 Amps	
SIZE OF ELECTRODE, IN. DIA. 1/8"	ELECTRODE EXT. BEYOND CUP IN. N.A.
TRAVEL SPEED IPM N.A.	WIRE FEED IPM N.A.
OSCILLATION SIDE See Reverse Side	
LIQUID PENETRANT N.A.	VISUAL INSPECTION Acceptable
MAGNETIC PARTICLE Acceptable/No Defects	RADIOGRAPH Acceptable/No Defects
ULTRASONIC TEST Acceptable/No Defects	
REMARKS: Procedure Qualification for welding P-3 material in the vertical position by the Electroslag Process using 1/8" Dia. (RACO) Hi-Mn-Mo Filler Wire with Linde #124 Flux. See Reverse Side for Groove Configuration.	

CHEMICAL ANALYSIS - % E NO.													
POSITION	C	MN	P	S	SI	CR	NI	MO	FE	CU	CS	CO	VA

REDUCED SECTION TENSILE (TRANSVERSE TO WELD)						
SPECIMEN NO.	DIMENSIONS, INCHES		AREA SQ. IN.	ULTIMATE LOAD LBS.	ULTIMATE TENSILE STRENGTH PSI	FRACTURE LOC.
	WIDTH	THICKNESS				
T1A	.962	2.895	2.785	248,500	89,250	Weld
T1B	.978	3.193	3.123	278,250	89,100	Weld
T10A	.890	3.095	2.755	244,000	88,600	Weld
T10B	.965	2.969	2.865	255,250	89,100	Weld

BEND TEST
(4) Side Bends Split into 16 - Acceptable/No Defects

ALL WELD METAL TENSILE						
SPECIMEN NO.	DIAMETER, IN.	AREA SQ. IN.	YIELD POINT PSI	TENSILE STR. PSI	ELONG. IN. 2	REDUCED SECTION

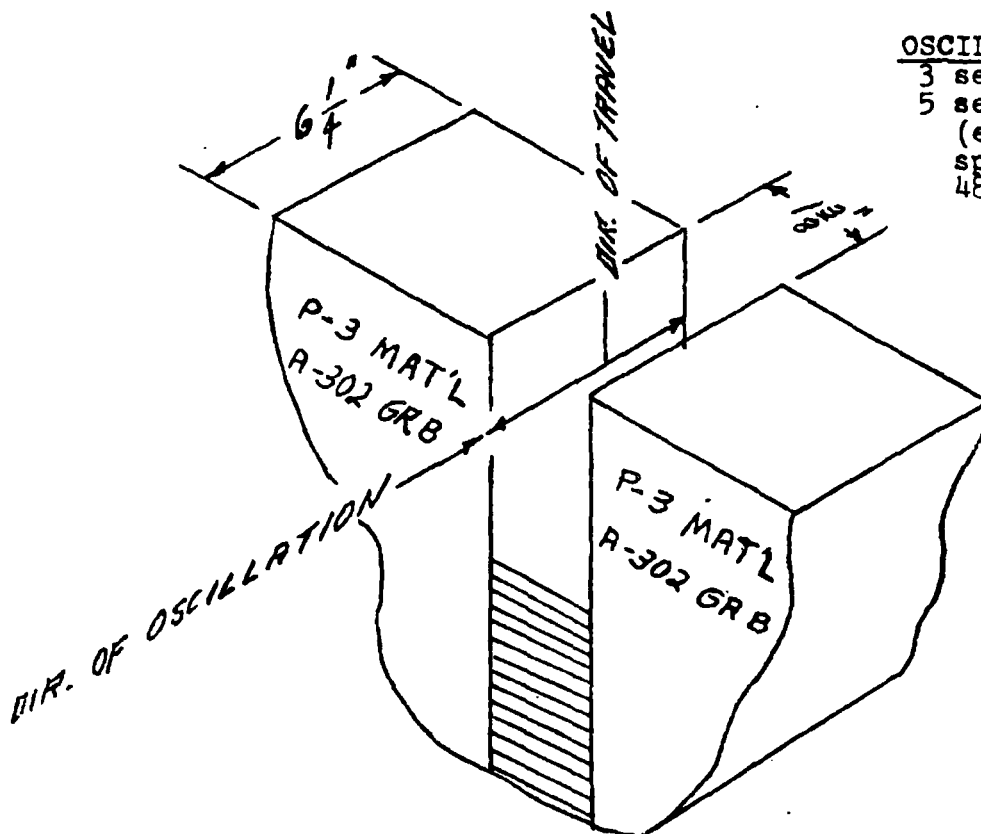
TYPE CHARPY V-Notch		IMPACT TEST AT		FT. LBS. ENERGY LOAD	
BASE METAL	AT	79, 84, 69	FT. LBS.		
ELB METAL	Surface	59, 47, 49	FT. LBS.	Weld Metal @T	27, 34, 32
EAT AFFECTED ZONE	AT	84, 80, 76	FT. LBS.		

CERTIFY THAT TO THE BEST OF OUR KNOWLEDGE THE STATEMENTS MADE IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE APPLICABLE SPECIFICATIONS.

*Revised 1/26/71.W.L.W.

WITNESSED Hartford (ASME) DATE 5/22/70 BY D. V. Collins
BABCOCK & WILCOX

235 PO 2563
MTV-170



OSCILLATION *

3 second traverse
5 second dwell
(equivalent to a trav.
speed of approximately
48 I.P.M.)

HEAT TREATMENT

6 1/2 HRS @ 1675° - 1725°F - BRINE QUENCH
6 1/2 HRS @ 1600° - 1650°F - BRINE QUENCH
6 1/2 HRS @ 1175° - 1225°F - BRINE QUENCH
42 HRS @ 1100° - 1150°F - FURNACE COOL

DROP WEIGHT TESTS PER ASTM-E208

BASE METAL 1/2 T	
-10°F	NF
-20°F	NF, NF
-30°F	NF, F
-40°F	F

WELD METAL 1/2 T	
+20°F	NF, NF
+10°F	F

HAZ 1/2 T	
-10°F	NF, NF
-20°F	NF, F
-30°F	F
-40°F	F

N. D. T. T. = WELD + 10°F
HAZ - 20°F
B. M. - 30°F

Revised 1/26/71 W.L.W.

P.Q. 2563

MTV-148

DATE-5/22/70