REGULATORY FORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8310040440 DOC.DATE: 83/09/26 NOTARIZED: NO DOCKET #
FACIL:50-397 WPPSS Nuclear Project, Unit 2, Washington Public Powe 05000397
AUTH.NAME AUTHOR AFFILIATION
SORENSEN,G.C. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION
SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards addl info re containment "Out-of Roundness" per NRC 830722 meeting.

DISTRIBUTION CODE: B001S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 29
TITLE: Licensing Submittal: PSAR/FSAR Amdts & Related Correspondence

NOTES:

	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL
	NRR/DL/ADL		1	0	NRR LB2 BC		1	0
	NRR LB2 LA		1	0	AULUCK,R.	01	1	1
INTERNAL:	ELD/HDS2		1	0	IE FILE		1	1
	IE/DEPER/EPB	36	3	3	IE/DEPER/IRB	35	1	1
	IE/DEQA/QAB	21	1	1	NRR/DE/AEAB		1	0
	NRR/DE/CEB	11	1	1	NRR/DE/EHEB		1	1
	NRR/DE/EQB	13	2	2	NRR/DE/GB	28	2	2
	NRR/DE/MEB	18	1	1	NRR/DE/MTEB	17	1	1
	NRR/DE/SAB	24	1	1	NRR/DE/SGEB	25	1	1
	NRR/DHFS/HFEB	40	1	1	NRR/DHFS/LQB	32	1	1
	NRR/DHFS/PSRB		1	1	NRR/DL/SSPB		1	0
	NRR/DSI/AEB	26	1	1	NRR/DSI/ASB		1	1
	NRR/DSI/CPB	10	1	1	NRR/DSI/CSB	09	1	1
	NRR/DSI/ICSB	16	1	1	NRR/DSI/METB	12	1	1
	NRR/DSI/PSB	19	1	1	NRR/DSI/RAB	22	1	1
	NRR/DSI/RSB	23	1	1	REG FILE	04	1	1
	RGN5		3	3	RM/DDAMI/MIB		1	0
EXTERNAL:	ACRS	41	6	6	BNL(AMDTS ONLY)		1	1
	DMB/DSS (AMDTS)		1	1	FEMA-REP DIV	39	1	1
	LPDR	03	1	1	NRC PDR	02	1	1
	NSIC	05	1	1	NTIS		1	1

TOTAL NUMBER OF COPIES REQUIRED: LTTR 53 ENCL 46

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

UTILITY AFFILIATION

LICENSING BRANCH 2

SUBJECT: Forwards addl info re containment "out-of-roundness" for [illegible] section.

DISTRIBUTION CODE: B001S COPIES RECEIVED: LTR __ ENCL __ SIZE:__________

TITLE: Licensing Submittal: PSAR/FSAR Amdts & Related Correspondence

NOTES:

RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
ACTION: [illegible]	1	0	[illegible]	1	0
[illegible]	1		[illegible] 01	1	1
INTERNAL: [illegible]	1		[illegible]	1	1
[illegible]	2	2	[illegible] 35	1	1
[illegible]	1	1	[illegible]	1	0
[illegible]	1	1	[illegible]	1	1
[illegible]	2	2	[illegible]	2	2
[illegible] 19	1	1	[illegible] 17	1	1
[illegible] 24	1	1	[illegible] 25	1	1
[illegible] 40	1	1	[illegible] 32	1	1
[illegible]	1	1	[illegible]	1	0
[illegible]	1	1	[illegible]	1	1
[illegible]	1	1	[illegible]	1	1
[illegible]	1	1	[illegible]	1	1
[illegible]	1	1	[illegible]	1	1
[illegible]	1	1	[illegible]	1	1
[illegible]	2	2	[illegible]	1	0
EXTERNAL: [illegible] 03	1	1	[illegible]	1	1
[illegible]	1	1	[illegible]	1	1
[illegible]	1	1	[illegible] 05	1	1
[illegible]	1	1	[illegible]	1	1

Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

September 26, 1983
G02-83-863

Docket No. 50-397

Director of Nuclear Reactor Regulation
Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
ADDITIONAL INFORMATION ON
CONTAINMENT OUT-OF-ROUNDNESS

References:
1) Letter, G02-82-967, G. D. Bouchey (SS) to A. Schwencer (NRC), same subject, dated December 8, 1982
2) Letter, G02-83-103, G. D. Bouchey (SS) to A. Schwencer (NRC), same subject, dated February 8, 1983
3) Letter, G02-83-480, G. D. Bouchey (SS) to A. Schwencer (NRC), same subject, dated June 1, 1983

Attached is additional information relating to containment "Out-of Roundness" requested by the NRC during a meeting on this subject with representatives of the Supply System and Burns and Roe in

B001
1/1

Bethesda, Maryland on July 22, 1983. We hope the information contained in the Attachment, in conjunction with References 1), 2) and 3), will be sufficient to enable the NRC staff to complete its evaluation of this issue.

Very truly yours,

G. C. Sorensen, Acting Manager
Nuclear Safety and Regulatory Programs

EAF/tmh
Attachment

cc: R Auluck - NRC
WS Chin - BPA
J O'Donnell - B&R
J Verderber - B&R
A Toth - NRC Site

(A) NRC Request

Provide a table showing the difference between maximum and minimum containment diameters, from the PDM as-built survey data.

Response:

See Table 1 and Appendix A to this Attachment.

(B) NRC Request

Describe how the maximum and minimum diameters recorded in the PDM as-built survey were obtained (i.e. by measuring across the containment diameter, or by adding radii measured from a plumb bob line or other demarcation of the containment axis).

Response:

Through a conversation with the PDM Project Manager at the time this work was performed (Mr. Max Schulze), we have been advised the diameter measurements provided in the PDM as-built survey were obtained both by direct measurements from one side of containment to the other, and by radial measurements. Both methods were used as checks against one another. The radial measurements have not been preserved, however, and are not contained in the quality-related documentation turned over by PDM to the Supply System. Radial measurements were obtained by Burns and Roe, as Construction Manager at the time this work was performed, as a means of determining locations and magnitude of encroachment on biological shield wall thickness, and were provided to the NRC staff at the July 22, 1983 meeting.

(C) NRC Request

Since the difference between the maximum and minimum containment diameter at one location (elev. 564'-10") exceeds the allowable difference given in Article NE 4221.1 of the ASME Code by less than 1/16" as determined from the PDM as-built measurements (see Table 1 in Exhibit A), address the significance of this exceedance in terms of its effect on containment structural capacity.

Response:

PDM Corp. has design responsibility for the containment vessel under ASME Section III, and has concluded that this minor deviation from the ASME Code tolerance is insignificant, and therefore would not alter any of the conclusions made in the Final Stress Report for the containment. See the April 6, 1983 letter from PDM to Burns and Roe on this subject (Exhibit B to this Attachment).

This conclusion is supported by studies performed by Lockheed for the NRC on the WNP-2 Containment Vessel (Ref: "Buckling of Steel Containment Shells, Task 1b, NUREG/CR-2836).

Referring to NUREG/CR-2836, the critical stress for the WNP-2 shell in the lowest part of the drywell cone is predicted by utilizing Fig. 2.16 for the perfect and imperfect shell.

The factor of safety for the perfect shell (ratio of allowable stress for the perfect shell divided by the actual stress) is equal to 4.1.

The factor of safety for the imperfect shell (ratio of allowable stress for the imperfect shell divided by the actual stress) is reduced to 2.4. This initial imperfection shown on Figure 2.16 is that defined by NE-4220. As noted in ASME Code Case N-284, a factor of safety of 2.0 is recommended for buckling stresses that have been reduced by capacity reduction factors.

Figure 2.10 of NUREG/CR2836 presents the critical buckling mode shape of the drywell. It is noted that at elevation 564'-10", where the out-of-roundness of the containment exceeds NE-4220 requirement by 1.8%, the displacement is negligible as compared to the maximum displacement at the lower portion of the drywell. It can be concluded that the slight exceedance in imperfection at elevation 564'-10" will not lower the safety factor of 2.4.

(D) NRC Request

For the calculation relating to reduction in structural capacity of the biological shield wall due to encroachment of the containment vessel (provided by Burns and Roe at the July 22, 1983 meeting), describe the computer code used to produce the forces and moments acting at the critical section. Also, define the controlling load combination and indicate whether the 2 psi pressure load, acting on the bioshield due to compressible foam between the bioshield wall and containment, was included.

Response:

All load combinations of Table 3.8-15, Chapter 3 of the FSAR were investigated for each of 11 separate vertical segments (cones) of the wall. The maximum forces and moments were selected and used as the basis of design for each cone. In the majority of cases the Abnormal/Extreme Environmental load combination governed:

$$D + L + Ta + Ra + E'$$

D = Dead load
L = Live load
Ta = Thermal load - accident condition
Ra = Pipe reactions on structures during an accident
E' = Safe shutdown earthquake loads

The design utilized STARS-2, a commercially available program in the public domain, developed by Grumman Data Service at Bethpage, New York.

The internal pressure of 2 psi exerted on the interior face of the biological shield wall was considered in the design of the wall, and is included in all the loading categories of Table 3.8-15.

(E) NRC Question

What are the governing ACI Code requirements relating to tolerances for circularity? Are these allowable deviations considered in the calculation for reduced structural capacity of the biological shield wall?

Response:

Both ACI 349 and the WNP-2 Specifications use ACI 347 as a basis for concrete tolerances in the construction of the plant. The applicable paragraphs in ACI 347 are paragraph 3.3.1.3 and 3.3.1.4 which allow a maximum of $\pm$ 1" in plan dimensions for a structure such as the biological shield wall. A worst case situation would be a loss of 3 5/8 inches of wall thickness - discussed in Item (F) - further reduced to 4 5/8 inches. This would result in decreasing the capacity of the wall by an additional 2% leaving a design margin of 1.14.

It should be noted that the original calculations provided a contingency of 10% on all moments and shears to allow for unknowns such as those discussed in Questions 1 and 2. A review of the potential loss in capacity indicates that no more than 6% of this 10% is used.

(F) NRC Request

Quantify the effect of reductions in structural capacity of the biological shield wall in terms of its effect on design margin.

Response:

The maximum loss of concrete wall thickness possible is at elevation 496.75 feet, azimuth 90° and is recorded as 3 5/8". The effect on the capacity of the wall is as follows:

Design Capacity (60 inches wide) M_u = 465 Kip-ft.

Design Capacity (56 3/8 inches wide) M_u = 448 Kip-ft.

This represents approximately a 4% reduction in capacity. Since the actual required design moment is M=386 Kip-ft., there is still a

Design margin of $\frac{448}{386} = 1.16$

(BRI Calculation Book SV-53, Calc. #6.19-17).

Copies of these calculations were provided to the NRC staff at the July 22, 1983 meeting between the NRC, Burns and Roe, and the Supply System.

(G) NRC Request

State whether template measurements for local deviations from true circular form, required by ASME Section III, Article NE 4221.2, were made. If not, provide justification.

(H) NRC Request

Describe how as-built containment penetration locations are accommodated in construction and final stress analysis of piping.

Response:

As indicated in the material provided to the NRC staff at the July 22, 1983 meeting, cold-springing of pipe is avoided by providing make-up spool pieces fabricated longer than what would be required by design geometry, which are field-trimmed to accommodate as-built piping and anchor geometry. This prevents unaccounted-for stresses both in the piping and in the containment shell at the penetration. As indicated in the WNP-2 response to IE Bulletin 79-14, (Letter GO2-79-156, dated September 7, 1979) the as-built configuration of safety-related piping and supports is documented by field walkdowns and surveys, and is evaluated by the responsible design organization in the final stress analysis of the piping system. The procedure for final piping as-built evaluation for WNP-2 was provided to the NRC staff at the July 22, 1983 meeting. As shown in that procedure, the minimum deviation between design geometry and as-built geometry which would require reanalysis of the piping system is much larger than the as-built deviations in containment penetration locations, as indicated in Reference 3), and in the penetration as-built information provided to the NRC at the July 22, 1983 meeting.

In conclusion, the effect of the measured as-built deviations of penetrations from their design geometry on stresses in the piping system or containment is insignificant and does not invalidate stress analyses performed for these components.

(I) NRC Request

Provide a tabulation showing how NE 4222.1 and NE 4222.2 requirements were met for the containment vessel head.

Response:

Tabulation of results provided in the as-built records for the drywell head, which was given to the NRC staff at the July 22, 1983 meeting, is provided in Table 2, Exhibit E.

The allowable deviation of the inner surface of the head from its specified shape is given by NE 4222.1 as 1 1/4 percent of the inside diameter of the head skirt (.0125 x 9652mm = 120.6mm).

The allowable difference between maximum and minimum diameters of the skirt is given by NE 4222.2 as 1 percent of the nominal diameter (.01 x 9652mm = 96.5mm).

Response:

From discussions with Mr. Max Schulze, PDM Project Manager for Contract 213, we have been advised that circular templates were used in the construction of the containment vessel to maintain conformance with design geometry, in accordance with standard construction practice. Such templates were used for each plate in each shell course in the cylinder and cone. However, procedures governing this work and documentation of results do not exist. Whether or not segmental templates of arc length dictated by NE 4221.2 were used, and whether or not measured deviations from true theoretical form met NE 4221.2 requirements, is therefore not known.

As indicated in Reference 3), PDM's limitation on offset from true theoretical form at weld joints was substantially more restrictive than the requirements of NE 4221.2. Subsequent review of the quality documentation provided by PDM indicates that individual shell plates in the cylinder and cone were rolled and checked for geometry and curvature in a jig. If weld pads were subsequently welded to the rolled plates, curvature and geometry were rechecked after welding. If excessive deformation had occurred due to welding, the plates were reshaped to proper curvature. Refer to sample fabrication check lists (FCL 501.1, 507.1 and .2) in Exhibit C for documentation of these checks for a typical shell plate in the cylinder and one in the cone. FCL 501.1 is the fabrication check list for a typical cylinder plate, while FCL 507.1 and .2 are the fabrication check lists for a typical cone plate. Telephone discussions with PDM indicate that such checks are in accordance with current shop practice, and would have been performed at the time materials were fabricated for WNP-2.

Also in Exhibit C are copies of typical construction check lists (CCL) for horizontal and vertical weld seams in the cylinder and cone. These check lists were used to document the fit-up checks required for offset at weld joints referred to above, as well as for other quality-related inspection requirements. Copies of the PDM QA program relating to fit-up inspection for offset at weld joints, for the Pittsburgh and Provo fabrication shops, were provided to the NRC at the July 22, 1983 meeting. Exhibit D provides a copy of the same fit-up inspection requirements for the field, from the PDM Corporate Field QA manual, which forms the basis for the inspections documented on the CCL's in Exhibit C.

In summary, the geometry and curvature checks made during fabrication as indicated on the FCL's, the checks on offset at weld joints made during construction as indicated on the CCL's, and the use of templates during construction to check for conformance with design geometry provide assurance that local deviations from true circular form were tightly controlled. Due to requirements for constructability (i.e. fit-up at weld joints), the actual local deviations from true circular form are probably much less than what is permitted by NE 4221.2, although the procedural requirements of NE 4221.2 for determining conformance with true circular form may not have been followed.

EXHIBIT A

RESULTS OF AS-BUILT SURVEY ON

CONTAINMENT DIAMETERS, FOR

COMPLIANCE WITH ASME SECTION III

ARTICLE NE 4221.1

LIMITS ON OUT-OF-ROUNDNESS

RDM STEEL COMPANY
Prepared By: J. Voss
Date: June 16, 1975

WPPSS NUCLEAR PROJECT

HANFORD NO. 2 — REACTOR VESSEL

As Built Dimensions

CONTRACT 2808-213

TOP OF RING ELEVATION	DIAMETERS OF SHELL FROM . . . (inside of shell to inside of shell) 0° - 180°	45° - 225°	90° - 270°	135° - 315°	DESIGN DIAMETER	$\Delta_{max.}$
449'-8 1/2	85'-7 1/8	85'-9 5/16	85'-10	85'-9 3/8	85'-9	±1 7/8"
459'-6 9/32	85'-6 1/8	85'-8 1/4	85'-9 9/16	85'-9	85'-9	-2 7/8"
469'-4 1/16	85'-6 1/8	85'-7 7/8	85'-9 1/2	85'-8 1/2	85'-9	-2 7/8"
479'-1 27/32	85'-6	85'-7 7/8	85'-9 9/16	85'-7 5/8	85'-9	-3"
488'-11 5/8	85'-7 11/16	85'-7 15/16	85'-10 7/16	85'-8 15/16	85'-9	+1 7/16"
496'-9 3/4	83'-5 13/16	83'-6	83'-7 1/4	83'-8 1/2	83'-6 1/2	+2"
503'-8 1/4	81'-2 1/8	81'-2 5/8	81'-3 7/16	81'-4 1/8	81'-3 3/4	-1 5/8"
510'-2 9/16	75'-9 1/8	75'-9	75'-11 5/8	75'-11 7/8	75'-10	+1 7/8"
519'-8 13/16	70'-3 1/4	70'-3 7/8	70'-5 1/8	70'-4 1/8	70'-4 1/4	-1"
528'-7 7/8	65'-1 3/8	65'-1 1/2	65'-4 9/16	65'-5	65'-2 5/8	+2 3/8"
537'-6 15/16	59'-11	59'-10 7/8	60'-3 3/16	60'-1 9/16	60'-1	+2 3/16"
546'-6	54'-10 7/8	54'-8 7/8	55'-1 13/16	54'-11 13/16	54'-11 3/8	-2 1/2"
555'-5 1/16	49'-8 3/4	49'-8 3/4	49'-11 5/8	50'-1 5/8	49'-9 3/4	+3 7/8"
564'-10	44'-3 11/16	44'-1 1/2	44'-6 7/8	44'-5 3/16	44'-4 3/4	-3 1/4"
573'-3 1/4	39'-5 7/16	39'-3	39'-6 1/2	39'-5 1/2	39'-6 1/2	-3 1/2"
582'-0	31'-8 1/16	31'-7 7/8	31'-7 11/16	31'-8 3/16	31'-8	-5/16"

TABLE 1

COMPLIANCE WITH NE 4221.1

Top of Ring Elevation	Maximum Diameter	Minimum Diameter	$D_{max} - D_{min}$	.01 X Design Diameter
449'-8 1/2"	85'-10"	85'-7 1/8"	2.88"	10.29"
459'-6 9/32"	85'-9 9/16"	85'-6 1/8"	2.44"	10.29"
469'-4 1/16"	85'-9 1/2"	85'-6 1/8"	3.38"	10.29"
479'-1 27/32"	85'-9 9/16"	85'-6"	3.56"	10.29"
488'-11 5/8"	85'-10 7/16"	85'-7 11/16"	2.75"	10.29"
496'-9 3/4"	83'-8 1/2"	83'-5 13/16"	2.69"	10.02"
500'-8 1/4"	81'-4 1/8"	81'-2 1/8"	2.0"	9.76"
510'-2 9/16"	75'-11 7/8"	75'-9"	2.88"	9.10"
519'-8 13/16"	70'-5 1/8"	70'-3 1/4"	1.88"	8.44"
528'-7 7/8"	65'-5"	65'-1 3/8"	3.63"	7.83"
537'-6 15/16"	60'-3 3/16"	59'-10 7/8"	4.31"	7.21"
546'-6"	55'-1 13/16"	54'-8 7/8"	4.94"	6.59"
555'-5 1/16"	50'-1 5/8"	49'-8 3/4"	4.88"	5.98"
564'-10"	44'-6 7/8"	44'-1 1/2"	5.38"	5.33"
573'-3 1/4"	39'-6 1/2"	39'-3"	3.50"	4.74"
582'-0"	31'-8 3/16"	31'-7 11/16"	0.50"	3.80"

EXHIBIT B

LETTER FROM PDM TO BURNS & ROE,
DATED APRIL 6, 1983, ON THE
SIGNIFICANCE OF THE DIAMETER
VARIATION AT ELEVATION 564'-10"

20257

Pittsburgh-Des Moines Corporation
3400 Grand Avenue
Neville Island
Pittsburgh, PA 15225
412-331-3000

April 6, 1983

Burns and Roe, Inc.
P.O. Box 200
Richland, WA 99352

Attention: Mr. R. Sanan

Subject: Hanford II Diameter Variation

Reference: Letter from Offineer (PDM) to Sanan (B&R) of 11/11/82

Gentlemen:

This letter is to address the as-built diameter variation discussed in the referenced letter. We were advised at that time that the 1% variation permitted by NE 422.1 had been exceeded by 0.047 inches or 0.018% at elev. 564'-10.

We believe that the requirements of NE 4221.1 are satisfied by the diameter variation measured and that the condition is acceptable.

First, given the degree of accuracy with which the diameter measurements were taken, the percentage variation cannot be calculated to more than two places. 1.018% should have been rounded off to 1.0% and should not have been considered in excess of the Code allowable.

Secondly, this minor deviation does not alter any of the conclusions made in PDM's Final Stress Report and therefore the vessel adequacy is not impaired by this condition.

Very truly yours,

PITTSBURGH-DES MOINES CORPORATION

David C. Looman

David C. Looman, P.E.
Sr. Project Engineer

DCL/ss

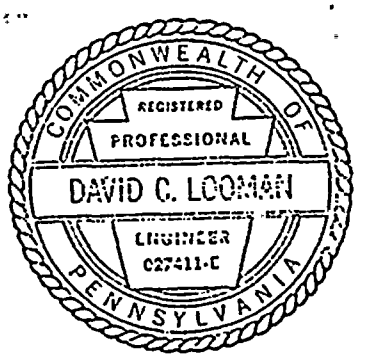

EXHIBIT C

SAMPLE FABRICATION CHECK LISTS (FCL's)
AND CONSTRUCTION CHECK LISTS (CCL's)
FOR TYPICAL CYLINDER AND SHELL PLATES

Form Q106
Rev. 1

FABRICATION CHECK LIST (FCL)

FCL PAGE 501 1 11 of

Reviewed and approved by Paul M. Howe 3-19-73
AUTHORIZED INSPECTOR DATE
(Signature required for ASME Section III related material only)

	Init.	Da
QA Approved	WP	3/19
	RCW	3/2

NONDESTRUCTIVE EXAMINATION	Procedure	Revision	Report #
RT (Radiography)			
PT (Liquid Penetrant)			
MT (Magnetic Particle)			
Other			

Contract 12764
Group BJ1
Assembly SR1
Piece Mark SR1

PDM Item # 5059 Heat # M70920 Slab # 7W1 (QA complete and signoff below)

This FCL is preceded by FCL #(s) None. KC

FOR INFORMATION ONLY

SEQ.	DEPT	OPER	DESCRIPTION	CLOCK	INSP.	DA
1	JR	622	Receive Plate Per Form Q 110.	25		9/2
2	QA	400	Inspect Identification Rev B		KJC	9/2
			See F.C.A. #1 W.M. 9-28-73			
3	JR	030	Plane Plate Per Dwg	4/20		10/
4	QA	400	Inspect Planing Rev B		KJC	10/2
5	JR	612	Roll Plate Per Dwg.	30	9/4/73	
5A			See F.C.A #1 W.M. 9-28-73. See F.C.A #2 W.M. 10-3-73			
6	PC	300	Blast Plate Per Paint Dwg P1	101		10/
7	QA	400	Inspect Blasting Rev C		WB	10/
	~~61~~		~~Code Inspect~~ See Addendum #3			
8	PC	300	Paint Plate. Per Paint Dwg. P1	47		10/
9	QA	400	Inspect Painting & Identification Marking		WB	10/
			Fill Out Form Q111 Release For Shipment	Rev. C	9/19/73	10/
9A			See Addendum #3 WP 10-5-73			
	999		Ship			

This FCL is followed by FCL #(s) None

Form Q107
Rev. 5

FABRICATION CHECKLIST ADDENDUM

Reviewed and approved by Authorized Code Inspector Paul M. Howe Date 10-8-73
(Signature required for fabrication of ASME Section III related material only)

Contract No.	Group No.	ID No.	Piece Mark	Assembly	Addendum #	Page
12764	BJ1	5059		SR1	1	1 of 1

Originated by	Date	QA Approved by	Date
W. A. McCausland	9-28-73	[illegible]	9/28/73

Reference	FCL Page 501.1/1 of 1	Sequence No. 2 & 5

SEQ.	DEPT.	OPER.	DESCRIPTION	AUTH. INSP.	CLOCK	DATE	Inspector Init.	Inspector DwgRev.
2A	JR	A20	Layout Plate For Burning Excess Fat	7	25	9/29/73		
2B	QA	400	Inspect Layout			9/29/73	KJC	B
2C	JR	C20	Preheat & Torch Burn Per Layout		154	9/29/73		
5A	QA		Inspect Rolling			10/10/73	KJC	C

Continue Fabrication	Sequence No. 3 & FCA #2	FCL Page 501.1/1 of 1

FOR INFORMATION ONLY

DRN. Q105.
REV. 4

FABRICATION CHECK LIST (FCL)

FCL PAGE 507.1/11 OF 1

	TYPE	DATE
QA APPROVED		11/7/73

Reviewed and Approved by Paul M. Howe 11-13-73
AUTHORIZED INSPECTOR DATE
(Signature required for ASME Section III related material only)

NONDESTRUCTIVE EXAMINATION	PROCEDURE	REVISION	REPORT #
RT (Radiography)			
PT (Liquid Penetrant)			
MT (Magnetic Particle)			
Other			

Contract 12764
Group DA1
Assembly 507C2C
Piece Mark A

CM ID # 5121 Heat # E66773 Slab # 1W1 (QA Complete and Signoff Below)

This FCL is preceded by FCL # (s)

FOR INFORMATION ONLY

SEQ.	DEPT	OPER	DESCRIPTION	AUTH. INSP.	CLOCK	DATE	Inspector Init	Insp Rec
1	JR	622	Receive Plate Per Form Q 110		25	11-13-73		
2	JR	A20	Layout Plate Per Dwg. (1" Flat at Top)		25	11-13-73		
3	QA	H00	Inspect Identification			11/13/73	WB	A
			Inspect Layout			"	"	"
4	JR	C30	Preheat & Torch Cut Plate Per Dwg & Layout, Beveling Both Ends & Bottom		18	11/16/73		
5	QA	H00	Inspect Cutting & Beveling			11/17/73	KJC	A
6	JR	G12	Roll Plate Per Dwg.		30	2/4/74		
7	RL	G33	Press Plate If Reqd. (NOT REQ'D)			2/12/74	KJC	C
8	QA	H00	Inspect Rolling In Jig.			2/12/74	KJC	C
9	RL	C30	Bevel Top Edge Per Dwg & Layout		188	2/15/74		
10	HK	U70	Repair Plate Edges If Read Per Repair Proc. RP5		111	2/26/74		

2/11/74

This FCL is followed by FCL # (s) 507.2

RM Q106
v. 4

DM

FABRICATION CHECK LIST (FCL)

FCL PAGE 507.2 11 OF 2

	INIT.	DATE
QA APPROVED	~~HBG~~	2/1/74

viewed and Approved by Paul M. Howe 2-18-74
AUTHORIZED INSPECTOR DATE
(gnature required for ASME Section III related material only)

Contract 12764
Group DA-1
Assembly 507C2C
Piece Mark A, B, C, D

NDESTRUCTIVE EXAMIN-TION	PROCEDURE	REVISION	REPORT #
(Radiography)			
(Liquid Penetrant)			
(Magnetic Particle)			
ner			

l ID # _____ Heat # _____ Slab # _____ (QA Complete and Signoff Below)

ls FCL is preceded by FCL # (s) 507.1, CS5180.1, CS5181.1

Q.	DEPT	OPER	DESCRIPTION	AUTH. INSP.	CLOCK	DATE	Inspector Init	Inspector DwgRev
	RL	A20	Layout R A For Weld Pads		25	2/27/74		
	QA	400	Inspect Layout			2/27/74	KJC	C
	RL	L70	Preheat & Fit & Tack Weld Pads					
			To R A Per Dwg & Proc 68-4, 68-5 or					
			~~N. M. 2-6-74~~ C. Note Proc. & Position Used					
			Seam # 1 68-4 2G		111	2/27/74		
			Seam # 2 68-4 2G		111	2/27/74		
			Seam # 3 68-4 2G		111	2/27/74		
			Seam # 4 68-4 2G		111	2/27/74		
			Seam # 5 68-4 2G		111	2/27/74		
			Seam # 6 68-4 2G		111	2/27/74		
			Seam # 7 68-4 2G		111	2/27/74		
			~~Seam #~~					
	QA	400	Inspect Fit Up			2/27/74	KJC	C

FOR INFORMATION ONLY

)M Q106
:v. 4

PDM

FABRICATION CHECK LIST (FCL)

FCL PAGE 507.2 /2 OF 2

:viewed and Approved by Paul M. Howe 2-12-74
AUTHORIZED INSPECTOR DATE
:ignature required for ASME Section III related material only)

	INIT.	DATE
QA APPROVED		

NDESTRUCTIVE EXAMI: ATION	PROCEDURE	REVISION	REPORT #
: (Radiography)			
: (Liquid Penetrant)			
: (Magnetic Particle)			
:her			

Contract 12764
Group D.A1
Assembly 507C2C
Piece Mark A, B, C, D

M ID # _____ Heat # _____ Slab # _____ (QA Complete and Signoff Below)

:is FCL is preceded by FCL # (s)

FOR INFORMATION ONLY

:Q.	DEPT	OPER	DESCRIPTION	AUTH. INSP.	CLOCK	DATE	Inspector Init	Dwg Rev.
	HK	270	Preheat & Weld Pads Per Dwg & Proc					
			68-4; 68-5 or ~~68-6~~ 2F, 2H 2-6-74 (Note Proc. & Position Used.					
			Seam # 1 68-4 2G		111	3/27/74		
			Seam # 2 68-4 2G		111	3/29/74		
			Seam # 3 68-4 2G		111	3/1/74		
			Seam # 4 68-4 2G		111	3/1/74		
			Seam # 5 68-4 2G		1183	3-1-74		
			Seam # 6 68-4 2G		111	3/1/74		
			Seam # 7 68-4 2G		111	3/1/74		
			~~Seam #~~					
	RL	312	Clean Assembly For Inspection		179	3/1/74		
	QA	400	Inspect Assembly Indig For Curvature & Dimensions			3/7/74	KJC	C
	RL	633	Press Assembly To Proper Curvature If Reqd.		85	3/7/74		
	QA	400	Visual Inspect All Welds Per Proc VTI			3/7/74	KJC	C
0	QA	H21	MT All Welds Per Dwg & Proc MTI & WPS Par. 16.2.1			3/7/74	KJC	C

PDM STEEL COMPANY

CONSTRUCTION CHECK LIST (CCL)

CCL FILE NO. CA 003

CONTRACT 12764

ASSEMBLY Cylinder Section Second Ring (~~Vertical Seam~~) SEAM NO. SEE ATTACHED SCHEDULE

Reviewed and approved by Burt L. Forbush 12-10-73
AUTHORIZED INSPECTOR DATE
(Signature required for ASME Section III related material only)

QA Approved L.R.S 12.10.73
Initial Date

NONDESTRUCTIVE EXAMINATION	PROCEDURE	REVISION	PIM DRAWING(s)	
RT (Radiography)	RT-2	1.25.74	E6 REV.	E8 4/23/74 REV.
PT (Liquid Penetrant)	N/A	N/A	REV.	REV.
MT (Magnetic Particle)	N/A	N/A	REV.	REV.
VT (Visual)	VT-1	12-18-73	PIM WELDING PROCEDURE(s)	
VB (Vacuum Box)	N/A	N/A	68-5 SMAW 3G Vertical	
LT (Halide Leak Test)	N/A	N/A	72-69 FCAW 3G Vertical	
Other	N/A	N/A		

SEQ.	0.1 SEE CCA #1a. DESCRIPTION	SIGNATURE	DATE
1.0	Q.A. inspector fit-up to the applicable procedure specification and WPS-83.		
1.1	Authorized inspector hold point.		
2.0	Q.A. monitor in process welding to the applicable procedure specification and WPS-83, using calibrated instruments.		
2.1	Authorized inspector hold point.		
3.0	Q.A. inspect finished weld and surface area 2" to each side of weld.		
3.1	Authorized inspector hold point.		
4.0	Q.A. perform radiography.		
4.1	Authorized inspector hold point.		
	SEE CCA #6 FOR SEAM #E9		

NOTE: SEE ATTACHED SCHEDULE FOR SEQUENTIAL SIGN-OFFS.

FOR INFORMATION ONLY

Form Q203 Rev. 4

AUTHORIZED INSPECTOR ONLY: V-Verify W-Witness

PITTSBURGH-DES MOINES STEEL COMPANY

CONTRACT 12764 SEQUENTIAL SIGN-OFFS FOR CCL FILE NO. CA-003

ASSEMBLY Cylinder Section Second Ring (VERTICAL SEAM) CCL PAGE 2 of 2

SEAM NO.	SEQ.NO. 1.0	DATE	SEQ.NO. 1.1	DATE	SEQ.NO. 2.0	DATE	SEQ.NO. 2.1	DATE
E1	Dewey	12/11/73	BZ Eshelman	12-12-73	Dewey	12/12/73	BZ Eshelman	12-13-73
SEE CCA#1 Seq. 1.0 E2	Dewey	12/11/73	BZ Eshelman	12-12-73	Dewey	12/11/73	B.Z Eshelman	12-13-73
E3	Lynch	12/11/73	BZ Eshelman	12-11-73	Lynch	12/13/73	B.Z. Eshelman	12-13-73
E4	Lynch	12/11/73	BZ Eshelman	12-11-73	Lynch	12/13/73	BZ Eshelman	12-13-73
E5	Lynch	12/12/73	BZ Eshelman	12-12-73	Dewey	12/13/73	BZ Eshelman	12-13-73
E6	Lynch	12/12/73	BZ Eshelman	12-12-73	Dewey	12/13/73	BZ Eshelman	12-13-73
E7	Lynch	12/12/73	BZ Eshelman	12-12-73	Dewey	12/12/73	BZ Eshelman	12-13-73
E8	Dewey	12/11/73	BZ Eshelman	12-12-73	Dewey	12/12/73	B.Z Eshelman	12-13-73

SEAM NO.	SEQ.NO. 3.0	DATE	SEQ.NO. 3.1	DATE	SEQ.NO. 4.0	DATE	SEQ.NO. 4.1	DATE
E1	Dewey	12/21/73	[illegible]		D J Connolly	2-6-74	BZ Eshelman	2-20-74
E2	Dewey	12/20	[illegible]		D J Connolly	1-2-74	R. Stevenson By BZE	1-22-74
SEE CCA#3 Seq 4.0 E3	Dewey	12/20	[illegible]		D J Connolly	1-2-14	R Stevenson by BZE	1-22-74
SEE CCA#2 SEQ.4.0 E4	Dewey	12/20	[illegible]		D J Connolly	2-11-74	B.Z Eshelman	2-20-74
SEE CCA#4 Seq. 4.0 E5	Lynch	12/21/73	[illegible]		D J Connolly	2-11-74	B.Z. Eshelman	2-20-74
SEE CCA#5 Seq. 4.0 E6	Lynch	12/21/73	[illegible]		D J Connolly	2-6-74	B.Z Eshelman	2-20-74
E7	Lynch	12/21/73	[illegible]		D J Connolly	1-3-74	R Stevenson by BZE	1-22-74
E8	Lynch	12/21/73	[illegible]		D J Connolly	1-4-74	R. Stevenson By BZE	1-22-74

FOR INFORMATION ONLY

[illegible]

CONSTRUCTION CHECK LIST (CCL)

CCL FILE NO. CA-004

CONTRACT 12764

CCL PAGE 1 of 1

ASSEMBLY Cylinder Section Second Ring (Horizontal Seam)

SEAM NO. DE

Reviewed and approved by: Burkett L. Eshelman 12-10-73
AUTHORIZED INSPECTOR DATE
(Signature required for ASME Section III related material only)

QA Approved L.R.S. 12-10-73
Initial Date

NONDESTRUCTIVE EXAMINATION	PROCEDURE	REVISION	PIM DRAWING(s)	
RT (Radiography)	RT-2	EE 1-75	E6 REV. EK 4/13/74	REV.
PT (Liquid Penetrant)	N/A	N/A	REV.	REV.
MT (Magnetic Particle)	N/A	N/A	REV.	REV.
VT (Visual)	VT-1	BC 12-20-73	PIM WELDING PROCEDURE(s)	
VB (Vacuum Box)	N/A	N/A	68-4 SMAW 2G Horiz.	
LT (Halide Leak Test)	N/A	N/A	72-71 SMAW/SAW 2G Horiz.	
Other	N/A	N/A		

SEQ.	DESCRIPTION	SIGNATURE	DATE
1.0	Q.A. inspect fit-up to the applicable procedure specification and WPS-83.	Lynch	12/14/73
1.1	Authorized inspector hold point.	B.L.Eshelman V	12-14-73
2.0	Q.A. monitor in process welding to the applicable procedure specification and WPS-83, using calibrated instruments.	H.E.Graf Jr.	12-21-73
2.1	Authorized inspector hold point.	B.L.Eshelman W	12-21-73
3.0	Q.A. inspect finished weld and surface area 2" to each side of weld.	H.E.Graf Jr.	12-21-73
3.1	Authorized inspector hold point.	B.L.Eshelman W	12-21-73
SEE CCA#1 4.0	Q.A. perform radiography.	W.J.Connelley	1-30-74
4.1	Authorized inspector hold point.	R.Ingram W	2-22-74

FOR INFORMATION ONLY

Form Q203 Rev. 4

AUTHORIZED INSPECTOR ONLY: V-Verify W-Witness

CONSTRUCTION CHECK LIST (CCL)

CCL FILE NO. CC-008

CONTRACT 12764

CCL PAGE 1 of 2

(Vertical Seams)

ASSEMBLY Cone Section - Fourth Ring SEAM NO. See Attached Schedule

Reviewed and approved by Bertel L. Eschbach 5-7-14 AUTHORIZED INSPECTOR DATE (Signature required for ASME Section III related material only)	QA Approved LPS 5/7/14 Initial Date

NONDESTRUCTIVE EXAMINATION	PROCEDURE	REVISION	PIM DRAWING(s)	
RT (Radiography)	RT-2	F 5/7/14 E 6/7/14	E19 REV. F 5/7/14	REV.
PT (Liquid Penetrant)	N/A	N/A	REV.	REV.
MT (Magnetic Particle)	N/A	N/A	REV.	REV.
VT (Visual)	VT-1	C	PIM WELDING PROCEDURE(s)	
VB (Vacuum Box)	N/A	N/A	68-5 SMAW	
LT (Halide Leak Test)	N/A	N/A	~~72-97 FCAW~~ LPS	
Other	N/A	N/A	72-70 FCAW	

SEQ.	DESCRIPTION	SIGNATURE	DATE
1.0	Engineering verify location.		
2.0	Q. A. inspect material identification.	NOTE: See Attached Schedule for Sequential Sign-Offs.	5/7/14
3.0	Q. A. inspect fit-up to the applicable procedure specification and WPS-83.		
3.1	Authorized inspector hold point for seam No. L8		
4.0	Q. A. monitor in-process welding to the applicable procedure specification and WPS-83 using calibrated instruments.		
6.0	Q. A. inspect finished weld and surface area 2" to each side.		
6.0	Q. A. perform 100% RT.		
6.1	Authorized inspector hold point. Inspection of finished weld and review of radiography. L8		

FOR INFORMATION AND NOTATION ONLY

Form Q203 Rev. 4 NOTE: Provisions are made on the sign-off sheets for construction steps other than those stipulated by him, so that he may verify or witness them if he elects to do so.

PITTSBURGH-DES MOINES STEEL COMPANY

CONTRACT 12764 SEQUENTIAL SIGN-OFFS FOR CCL FILE NO. CC-008

ASSEMBLY 4TH CONE RING CCL PAGE 2 of 2

SEAM NO.	SEQ.NO. X.0	DATE	SEQ.NO. 2.0	DATE	SEQ.NO. 3.0	DATE	SEQ.NO. 3.1	DATE
L 1	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 9 74		
2	D. Eby	5/7/74	Lee	5 7 74	Lynch	5 8 74		
3	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 9 74		
4	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 9 74		
5	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 9 74		
6	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 9 74		
7	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 15 74		
8	D. Eby	5/7/74	Lee	5 7 74	Dewey	5 8 74	BZ Eckhart W	5-8-74
9	D. Eby	5/7/74	Lee	5 7 74	Lynch	5 8 74		

SEAM NO.	SEQ.NO. 4.0	DATE	SEQ.NO. 5.0	DATE	SEQ.NO. 6.0	DATE	SEQ.NO. 6.1	DATE
L 1	Lynch	5 13 74	Dewey	5 18 74	W Connolley	5-22-74	BZ Eckhart W	5-23-74
2	Lynch	5 13 74	Dewey	5 18 74	W Connolley	5-21-74	BZ Eckhart W	5-23-74
SEE CCA #3 Seq. 6.0 3	Lynch	5 13 74	Dewey	5 18 74	W Connolley	5-21-74	BZ Eckhart W	5-23-74
4	Dewey	5 14 74	Dewey	5 22 74	W Connolley	5-23-74	BZ Eckhart W	5-23-74
5	Dewey	5 14 74	Dewey	5 18 74	W Connolley	5-22-74	BZ Eckhart W	5-23-74
SEE CCA #2 Seq. 6.0 6	Dewey	5 15 74	Dewey	5 22 74	W Connolley	6-20-74	BZ Eckhart W	6-25-74
7	Dewey	5 15 74	Dewey	5 18 74	W Connolley	5-22-74	BZ Eckhart W	5-23-74
SEE CCA #1 Seq. 6.0 8	Lynch	5 10 74	Dewey	5 18 74	W Connolley	6-21-74	BZ Eckhart W	6-25-74
9	Lynch	5 10 74	Dewey	5 18 74	W Connolley	5-22-74	BZ Eckhart W	5-23-74

FOR INFORMATION ONLY

PDM STEEL COMPANY

CONSTRUCTION CHECK LIST (CCL)

CCL FILE NO. CC-009

CONTRACT 12764

CCL PAGE 1 of 1

(Horizontal Seam)

ASSEMBLY Cone Section - Fourth Ring SEAM NO. KL

Reviewed and approved by [signature] 5-7-74
AUTHORIZED INSPECTOR DATE
(Signature required for ASME Section III related material only)

QA Approved LRS 5/1/74
Initial Date

NONDESTRUCTIVE EXAMINATION	PROCEDURE	REVISION	PIM DRAWING(s)	
RT (Radiography)	RT-2	E 5/1/74 & 6/1/74	E19 REV. 5 5/15/74	REV.
PT (Liquid Penetrant)	N/A	N/A	REV.	REV.
MT (Magnetic Particle)	N/A	N/A	REV.	REV.
VT (Visual)	VT-1	C	PIM WELDING PROCEDURE(s)	
VB (Vacuum Box)	N/A	N/A	70-71A (SMAW)	
LT (Halide Leak Test)	N/A	N/A	72-98 (SAW/SMAW)	
Other	N/A	N/A		

SEQ.	DESCRIPTION	SIGNATURE	DATE
1.0	Q. A. inspect fit.	[signature]	5 16 74
2.0	Q. A. monitor in-process welding to the applicable procedure specification and WPS-83 using calibrated instruments.	[signature]	5 17 74
3.0	Q. A. inspect finished weld and surface area 2" to each side of weld.	[signature]	6-5-74
	SEE CCA#1		
4.0	Q. A. perform 100% RT.	[signature]	6-26-74
4.1	Authorized inspector hold point. Inspection of finished weld and review of radiography.	[signature]	7-16-74

Form Q203 Rev. 4

FOR INFORMATION ONLY

EXHIBIT D

FIT-UP INSPECTION REQUIREMENTS

FOR OFFSET AT WELD JOINTS,

FROM THE PDM ASME SECTION III

CORPORATE FIELD QA MANUAL

PROCESS CONTROL PROCEDURE

Owner Mandatory Hold Points:

If mandatory inspection hold points, which require witnessing or inspecting by Engineer or Owner or both and beyond which work shall not proceed without consent of Engineer or Owner or both, are required, the specific hold points shall be indicated on the CCL or CCA. Such consent shall be documented on the CCL or CCA prior to the continuation of work beyond the designated hold point.

Fit-up Inspection:

QA inspects alignment of sections such that the maximum offset will not be greater than the applicable amount listed below, where t is the nominal thickness of the thinner section at the joint. (Joints in spherical vessels and within heads and joints between cylindrical shells and hemispherical heads shall meet the requirements for longitudinal joints.)

Section Thickness, in.	Longitudinal	Circumferential
Up to 1/2, incl.	1/4 t	1/4 t
Over 1/2 to 3/4, incl.	1/8 in.	1/4 t
Over 3/4 to 1½ incl.	1/8 in.	3/16 in.
Over 1½ to 2, incl.	1/8 in.	1/8 t
Over 2	Lesser of 1/16t or 3/8 in.	Lesser of 1/8t or 3/4 in.

QA inspects the joint to be welded for conformance to the geometry requirements as indicated in the procedure specification (PS) for the particular joint configuration. Permissible tolerances are as indicated in WPS-83.

QA indicates acceptance of the above checks by signoff on the CCL or CCA.

FOR INFORMATION ONLY

PROCESS CONTROL PROCEDURE Cont.

Visual Examination:

QA performs in-process welding inspection for conformance to the requirements of WPS-83 and visual examination of welded joints in accordance with procedure VT-1 and indicates acceptance by signoff on the CCL or CCA.

Nondestructive Examination (NDE):

QA performs NDE in accordance with the applicable written procedure, as required on the drawings, and indicates acceptance by signoff on the CCL or CCA.

FOR INFORMATION ONLY

EXHIBIT E

TABULATION OF RESULTS OF MEASUREMENTS

AS-BUILT GEOMETRY

OF THE DRYWELL HEAD

TABLE 2

A. DEVIATION FROM SPECIFIED SHAPE OF DRYWELL HEAD

Region	Allowable Deviation (mm)	Actual Maximum Deviation (mm)
Skirt (cylinder)	120.6	10
Saucer plate	120.6	15
Knuckle	120.6	7

B. OUT OF ROUNDNESS OF DRYWELL HEAD

	DIAMETER				
Location	0^o-180^o	45^o-225^o	90^o-270^o	135^o-315^o	D_{max}-D_{min}*
Upper Skirt	9650	9659	9642	9648	17
Mid Skirt	9654	9662	9650	9651	12
Lower Skirt	9656	9671	9654	9654	17

* Allowable $D_{max} - D_{min} = 96.5mm$