PGE Portland General Electric Company

Donald J. Broehl Assistant Vice President

December 13, 1979

Mr. R. H. Engelken, Director
U. S. Nuclear Regulatory Commission
Region V
Suite 202, Walnut Creek Plaza
1990 N. California Blvd.
Walnut Creek, CA 94596

Dear Sir:

Enclosed are responses to the five questions posed at the exit meeting on December 6, 1979 in Bethesda, Maryland regarding LER 79-15 and supplements thereto.

Sincerely,

Donald J. Broehl

c: Mr. A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors
U. S. Nuclear Regulatory Commission

Mr. Lynn Frank, Director
State of Oregon
Department of Energy

95001142

8001100047

NRC Question (12/6/79)

Describe the state of stress at the interface of the masonry block and the mortar, for mortared double-wythe masonry walls, and at the interface of the masonry and core concrete for composite walls considering the following:

a. In-plane seismic loads

b. Out-of-plane seismic loads including pipe restraint reactions

c. Interstory displacements

Provide the above information for three representative walls of each type (mortared, double-wythe and composite wall types) which have the highest loading conditions per a, b, and c above. Show each interface load (stress) separately.

Answer:

The predicted interface shear stresses between masonry block and mortar for three highly stressed double wythe masonry walls and between masonry block and core concrete for three highly stressed composite walls, as well as the vertical reinforcing steel stresses for these walls, are shown in Tables 1 through 6.

Walls at el. 5 ft are selected for investigation because they resist large pipe support reactions. Walls at el. 61 ft and 72 ft are selected because they resist large seismic in-plane and out-of-plane forces. These forces include the global building shear forces, the forces produced by interstory displacement and the wall inertial loads.

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This analysis is performed for the Safe Shutdown Earthquake condition using the criteria ified in Supplement 1 to LER 79-15. The effects of wall deac oad and vertical seismic load were neglected to provide conservatism in the analyses of the vertical reinforcing steel stresses. The results indicate that for the walls analyzed, the interface shear stresses are substantially lower than the allowables (18 psi for double wythe masonry walls and 40 psi for composite walls) specified in Supplements 1 and 2 to LER 79-15. The stresses in the reinforcing steel are also within the limits specified in those supplements.

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TABLE 1

STRESSES IN 30 INCH COMPOSITE WALL AT EL. 5'-0" ON COLUMN LINE 54 BETWEEN COLUMN LINES D AND E

Loads			In-Plane Stresses			Out-of-Plane Stresses				
							Base of Wall		Mid-Section of Wall	
			V (lbs/ft)	v (psi)	f_s (psi)	V (lbs/ft)	v (psi)	f_s (psi)	v (psi)	f_s (psi)
E-W	E'	Inertial Acceleration	780	3.2	1,850	-	-	-	-	-
		Building Response	-	-	-	-	-	-	-	-
		Interstory Displacement	-	-	-	-	-	-	-	-
	H_0		560	2.3	1,300	1,550	7.2	7,660	1.0	4,600
N-S	E'	Inertial Acceleration	-	-	-	780	3.2	5,500	0.0	2,800
		Building Response	-	-	-	-	-	-	-	-
		Interstory Displacement	-	-	-	-	-	-	-	-
	H_0		560	2.3	1,300	1,550	7.2	7,660	1.0	4,600

DEFINITIONS

E' = Safe Shutdown Earthquake resulting from ground surface acceleration of 0.25g.
H_0 = Forces on structure from pipe supports on wall including seismic load, thermal, etc.
V = Shear force on wall in the in-plane or out-of-plane direction.
v = Concrete shear stress.
f_s = Vertical reinforcing steel stress.

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TABLE 2
STRESSES IN 27 INCH COMPOSITE WALL AT EL. 61'-0"
ON COLUMN LINE 51 BETWEEN COLUMN LINES E AND F

Loads			In-Plane Stresses			Out-of-Plane Stresses				
							Base of Wall		Mid-Section of Wall	
			V (lbs/ft)	v (psi)	f_s (psi)	V (lbs/ft)	v (psi)	f_s (psi)	v (psi)	f_s (psi)
E-W	E'	Inertial Acceleration	1,220	5.6	1,310	680	3.1	4,900	0	2,440
		Building Response	11,300	52.0	22,010	-	-	-	-	-
		Interstory Displacement	-	-	-	50	0.2	1,060	0.2	0
	H_0		250	1.2	400	240	1.1	1,750	0	1,240
N-S	E'	Inertial Acceleration	680	3.1	730	1,000	4.6	7,220	0	3,610
		Building Response	-	-	-	-	-	-	-	-
		Interstory Displacement	4,360	20.1	7,030	110	0.5	2,340	0.5	0
	H_0		250	1.2	400	240	1.1	1,750	0	1,240

DEFINITIONS

E' = Safe Shutdown Earthquake resulting from ground surface acceleration of 0.25g.
H_0 = Forces on structure from pipe supports on wall including seismic load, thermal, etc.
V = Shear force on wall in the in-plane or out-of-plane direction.
v = Concrete shear stress.
f_s = Vertical reinforcing steel stress.

TABLE 3
STRESSES IN 34 INCH COMPOSITE WALL AT EL. 72'-0"
ON COLUMN LINE F BETWEEN COLUMN LINES 55 AND 60

Loads			In-Plane Stresses			Out-of-Plane Stresses				
							Base of Wall		Mid-Section of Wall	
			V (lbs/ft)	v (psi)	f_s (psi)	V (lbs/ft)	v (psi)	f_s (psi)	v (psi)	f_s (psi)
E-W	E'	Inertial Acceleration	980	3.6	1,050	1,640	6.0	11,170	0	5,590
E-W	E'	Building Response	-	-	-	-	-	-	-	-
E-W	E'	Interstory Displacement	6,540	24.0	21,100	160	0.6	3,270	0.6	0
E-W	H_0		250	1.0	270	250	1.0	1,700	0	850
N-S	E'	Inertial Acceleration	1,640	6.0	1,755	980	3.6	6,680	0	3,340
N-S	E'	Building Response	7,250	26.7	23,440	-	-	-	-	-
N-S	E'	Interstory Displacement	-	-	-	160	0.6	3,270	0.6	0
N-S	H_0		250	1.0	270	250	1.0	1,700	0	850

DEFINITIONS

E' = Safe Shutdown Earthquake resulting from ground surface acceleration of 0.25g.
H_0 = Forces on structure from pipe supports on wall including seismic load, thermal, etc.
V = Shear force on wall in the in-plane or out-of-plane direction.
v = Concrete shear stress.
f_s = Vertical reinforcing steel stress.

TABLE 4
STRESSES IN 14 INCH BLOCK WALL AT EL. 5'-0" ON COLUMN LINE 49 BETWEEN COLUMN LINES D AND E

Loads			In-Plane Stresses			Out-of-Plane Stresses				
							Base of Wall		Mid-Section of Wall	
			V (lbs/ft)	v (psi)	f_s (psi)	V (lbs/ft)	v (psi)	f_s (psi)	v (psi)	f_s (psi)
E-W	E'	Inertial Acceleration	400	3.6	1,140	-	-	-	-	-
		Building Response	-	-	-	-	-	-	-	-
		Interstory Displacement	-	-	-	-	-	-	-	-
	H_0		60	0.5	170	400	3.7	24,600	1.0	14,000
N-S	E'	Inertial Acceleration	-	-	-	560	5.4	25,100	0	12,600
		Building Response	-	-	-	-	-	-	-	-
		Interstory Displacement	-	-	-	-	-	-	-	-
	H_0		60	0.5	170	33	0.3	1,820	0.5	2.,140

DEFINITIONS

E' = Safe Shutdown Earthquake resulting from ground surface acceleration of 0.25g.
H_0 = Forces on structure from pipe supports on wall including seismic load, thermal, etc.
V = Shear force on wall in the in-plane or out-of-plane direction.
v = Concrete shear stress.
f_s = Vertical reinforcing steel stress.

TABLE 5
STRESSES IN 14 INCH BLOCK WALL AT EL. 61'-0" ON COLUMN LINE 55 BETWEEN COLUMN LINES C AND D

Loads			In-Plane Stresses			Out-of-Plane Stresses				
							Base of Wall		Mid-Section of Wall	
			V (lbs/ft)	v (psi)	f_s (psi)	V (lbs/ft)	v (psi)	f_s (psi)	v (psi)	f_s (psi)
E-W	E'	Inertial Acceleration	290	2.6	320	160	1.4	2,900	0	1,450
E-W	E'	Building Response	4,200	36.3	14,800	-	-	-	-	-
E-W	E'	Interstory Displacement	-	-	-	30	0.3	1,620	0.3	0
E-W	H_0		-	-	-	350	3.3	4,900	0	4,500
N-S	E'	Inertial Acceleration	160	1.4	530	290	2.6	4,300	0	2,150
N-S	E'	Building Response	-	-	-	-	-	-	-	-
N-S	E'	Interstory Displacement	870	7.9	3,200	40	0.4	2,160	0.4	0
N-S	H_0		-	-	-	350	3.3	4,900	0	4,500

DEFINITIONS

E' = Safe Shutdown Earthquake resulting from ground surface acceleration of 0.25g.
H_0 = Forces on structure from pipe supports on wall including seismic load, thermal, etc.
V = Shear force on wall in the in-plane or out-of-plane direction.
v = Concrete shear stress.
f_s = Vertical reinforcing steel stress.

TABLE 6
STRESSES IN 14 INCH BLOCK WALL AT EL. 61'-0" ON COLUMN LINE 55 BETWEEN COLUMN LINES C AND D

Loads			In-Plane Stresses			Out-of-Plane Stresses				
							Base of Wall		Mid-Section of Wall	
			V (lbs/ft)	v (psi)	f_s (psi)	V (lbs/ft)	v (psi)	f_s (psi)	v (psi)	f_s (psi)
E-W	E'	Inertial Acceleration	340	3.0	250	340	3.0	7,700	0	3,850
E-W	E'	Building Response	1,900	17.0	9,410	-	-	-	-	-
E-W	E'	Interstory Displacement	-	-	-	15	0.1	1,030	0.1	0
E-W	H_0		150	1.4	750	370	3.3	13,000	3.3	13,000
N-S	E'	Inertial Acceleration	340	3.0	250	340	3.0	7,700	0	3,850
N-S	E'	Building Response	-	-	-	-	-	-	-	-
N-S	E'	Interstory Displacement	700	6.2	3,420	40	0.4	320	0.4	0
N-S	H_0		150	1.4	750	370	3.3	13,000	3.3	13,000

DEFINITIONS

E' = Safe Shutdown Earthquake resulting from ground surface acceleration of 0.25g.
H_0 = Forces on structure from pipe supports on wall including seismic load, thermal, etc.
V = Shear force on wall in the in-plane or out-of-plane direction.
v = Concrete shear stress.
f_s = Vertical reinforcing steel stress.

NRC Question (12/6/79)

Provide the basis for the stress distribution considered at the interface between the masonry block and concrete core due to pipe restraint anchor bolt loads.

Answer:

The resistance to tension developed in an expansion anchor bolt occurs in the flared section at the end of the anchor bolt. If a tensile force is placed on the bolt, shear and compression stresses develop in the zone adjacent to and above the flared portion. The load is thereby distributed horizontally to the surface of the wall. The load spreading may be considered as a 45° shear cone which projects to the surface (see Figure 2-1). To estimate the tension at the interface between the masonry block and concrete core, the vertical component of the stress on the shear cone is assumed to be uniformly distributed over the circular area formed by the intersection of the cone and the block surface. The tension on the masonry block-concrete core interface due to the surface stresses can be estimated using theories developed by Boussinesq for determination of stress distributions in an elastic media[1]. The normal stress at the block-core interface as derived from this theory is shown on Figure 2-1. The maximum stress was calculated from the Boussinesq equation for a circular area with a uniform load, and the stress distribution was obtained from stress curves[2]. Also shown is an average normal stress for a cone with 2:1 slope (Cone 1). It can be seen that this cone gives a good approximation of the stress calculated from the Boussinesq equation at the interface.

The tension on the masonry block-concrete core interface due to the surface stresses can also be calculated using theories developed by Westergaard for calculation of soil stresses under circular foundations. The stress coefficients are shown in Table 2-1 along with a comparison of the stress if cone 1 (2:1 slope) and cone 2 (1:1 slope) shown in Figure 2-1 are used. This table gives the ratio of the maximum stress at depth Z with the applied uniform stress at the surface for the four methods indicated. For expansion anchor bolts ranging in size from 1/2 in. to 7/8 in. in diameter, the ratio Z/2R ranges from 1.7 to 1.0 where R is the radius of the shear cone at the surface. For this range, cone 2 underestimates the stress and cone 1 provides an overestimate. For the upper range of Z/2R, the overestimate is by a factor of 2 to 3. Therefore, cone 1 is considered to provide a reasonable representation of the stress distribution and was used for calculating distribution for the tension stress at the concrete core-block interface.

References:

(1) Timoshenko and Goodier, Theory of Elasticity, McGraw-Hill, 1951, p 97 ff

(2) Lambe and Whitman, Soil Mechanics, Wiley & Sons, 1969, p 101

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TABLE 2-1

MAXIMUM STRESS COEFFICIENTS

Z/2R	Stress Coefficients			
	Westergaard (Maximum)	Boussinesq (Maximum)	Cone 1 (Average)	Cone 2 (Average)
0.25	0.66	0.89	0.64	0.44
0.50	0.44	0.65	0.44	0.25
0.75	0.26	0.43	0.38	0.16
1.00	0.16	0.29	0.25	[illegible]
1.25	0.12	0.20	0.20	[illegible]
1.50	0.05	0.09	0.16	0.06
1.75	0.04	0.06	0.13	0.05
2.00	0.03	0.05	0.11	0.04

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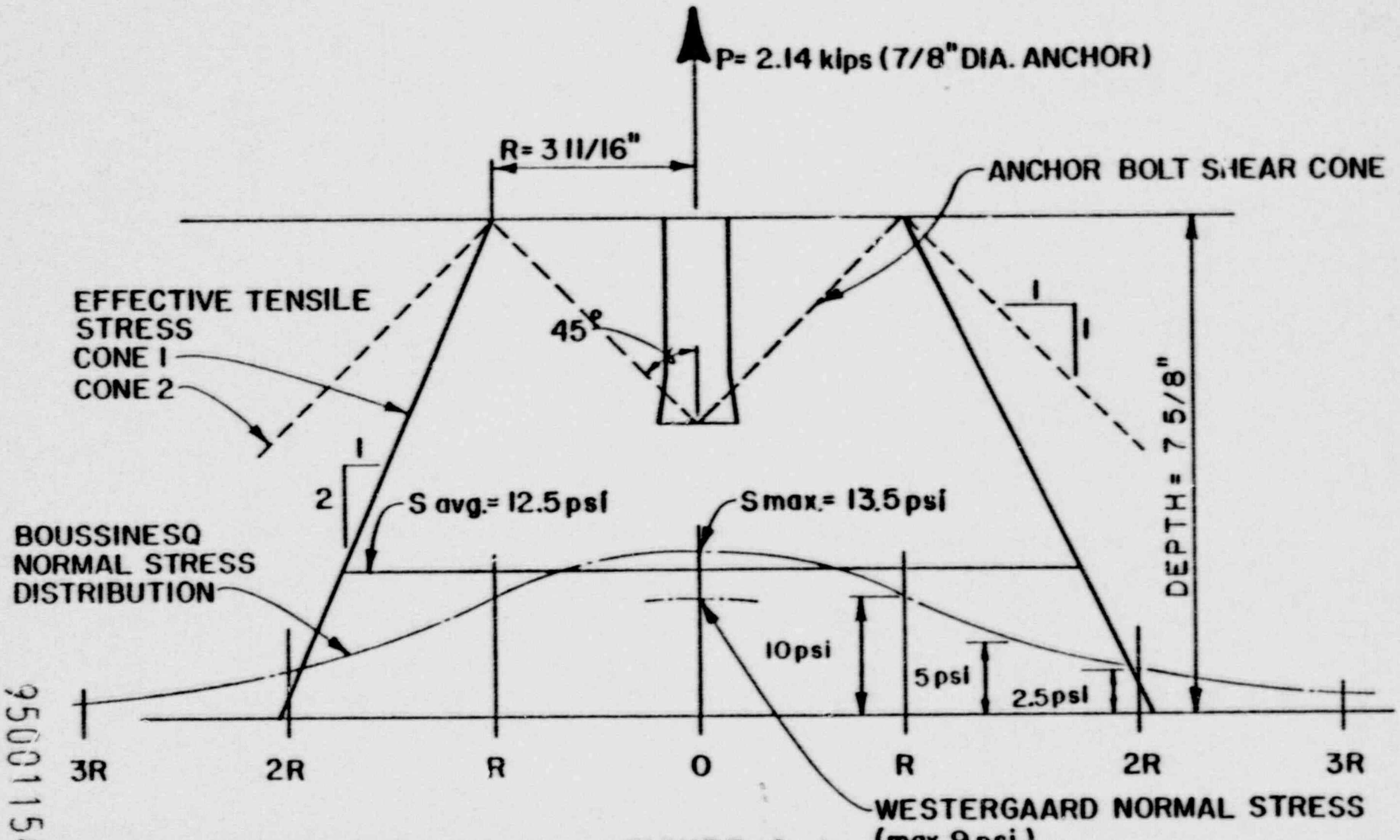

S= NORMAL STRESS AT INTERFACE

FIGURE 2-1

BLOCK-CORE INTERFACE NORMAL STRESS DISTRIBUTION

N.T.S.

NRC Question (12/6/79)

Question 3 Page 1 of 2

Provide documentation which will substantiate the extent of inspection performed on masonry construction to support your claim that the masonry construction at Trojan qualifies under the category of "special inspection" per the UBC. Also provide additional verification of the completeness of mortar between masonry wythes based on field testing and inspection (1" ± diameter core drills).

Answer:

Installation of the concrete unit masonry was performed by L. C. Pardue, a subcontractor to Hoffman Construction Company. This subcontractor implemented a QA Program in conformance with applicable sections of Appendix B to 10 CFR 50, which contained inspection responsibilities that were performed on a daily basis. Hoffman Construction Company's QA procedures assured the quality of L. C. Pardue's effort. In addition, both the Construction Manager (CM) and the Licensee implemented QA programs which contained inspection and monitoring requirements. The CM performed daily inspection of the masonry work to assure conformance with drawing and specification requirements. The implementation of such programs and procedures is evidenced by QA audit reports, nonconformance reports, and inspection reports. Attachment 3-1 provides a sampling of such reports.

To assure that the specified requirements were met during the construction period, the Licensee contracted with Northwest Testing Laboratory (an independent testing laboratory) to provide on-site inspection and testing services for masonry and concrete. One of the services they provided was furnishing qualified inspectors to perform daily inspection of masonry wall construction and testing of materials used therein. This laboratory implemented a QA program approved by the CM. Attachment 3-2 is a letter from Northwest Testing Laboratory which documents the fact that their inspection of the masonry construction at Trojan qualifies the work under the UBC classification of "Special Inspection".

The inspection of walls identified in Attachment 5, Supplement 2 to LER 79-15 disclosed some void areas in the inter-wythe mortar. As voids were found, they were filled with Five Star Grout in accordance with manufacturer's instructions. In addition to those walls, the N-line wall at elevation 65, the 46-line wall at elevations 61 and 77, and the east wall of the Control Building Mechanical Room at elevations 61 and 77 have been field checked for the presence of inter-wythe mortar by random sampling with a 1-1/2" core drill of 10 locations at different elevations in each wall. Based on this sampling, greater than 90% mortar was determined to be present in each wall, which is substantially greater than that required to develop the 18 psi shear capacity allowed by 1.5 UBC.

Attachment 3-8

NORTHWEST TESTING LABORATORIES

4119 N. MISSISSIPPI AVENUE
PORTLAND 17, OREGON

CHEMICALS INSPECTION
CONSTRUCTION INSPECTION
PHYSICAL TESTING
CHEMICAL ANALYSIS

WELDING CERTIFICATION
[illegible]

GENERAL CONSTRUCTION INSPECTION
DAILY REPORT

Project: Trojan Nuclear Plant

Job No.: C-48

Location: Rainier Oregon

Date: 28 April 72

Time: 4pm - Midnight

Engineer: Bechtel

Architect: -do-

Contractors:

Masonry: Pardue

Concrete: Hoffman

Steel: Tri-M

Mix Proportions:

Masonry

Compression Tests Prepared

Set No.	Ref. No.	Slump
1	M-2	[illegible]

Grout

Mortar 1 sack cement & 1 sack lime 2 4 cu ft sand

Concrete

Source ______ Ticket No. ______ Load No. ______

Temp. 41° Weather Clear & Cloudy Quantity ______

Pour Location and Notes: [illegible] outer area of East side shielding wall, Containment Bldg. Constructed small [illegible] dam along block line [illegible] to start day on low side. This area later removed.

Joints in this wall, which show, are being [illegible] out thereby making a very neat appearing job.

Reinforcing Steel Inspection and Notes: Steel in as per specs and drawings [illegible] 1 additional row of #3 bars were installed 2" [illegible] to prevent the bottom from kicking out when being filled in core area later.

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POOR ORIGINAL

Inspector's Signature [signature]

Concrete Permit No. 47

Masonry Permit No.

POOR ORIGINAL

Attachment 3.1

NONCONFORMANCE REPORT

PARDUE

Class I ☒ Other ☐

PAGE 1 OF 1

SKETCH ATTACHED yes ☐ no ☒

No. 13

DATE 11 2 73

Item held	Area/Bldg	Dwg/Part No	Rev	Item Name
Masonry	Area 3 Aux Bldg	6478 A-70	9	Void in Cell fill

DOCUMENT NUMBER & TITLE

INSPECTION CRITERIA DWG ☐ SPEC ☐ WRI ☐ OTHER ☐ (EXPLAIN)

ADDRESS

SOURCE SUPPLIER ☒ ENGRG ☐ CONSTR ☐

PO No N/A

No.	NONCONFORMANCE (DISCREPANCY) DESCRIPTION (LIST IDENTIFICATION NUMBERS WHERE APPLICABLE)
1	3-61-19 East & West side of wall on E line [illegible]
2	3-61-19,18 East & West side of partition between Rm # 197-198-199-200
3	3-61-20 North & south side of wall on [illegible] line F [illegible]
4	3-61-24 North & south side of wall [illegible] Between [illegible] 206 & waste gas decay Tanks
5	3-61-23 East & west side of wall between Rm 201 & 204
6	3-61-24 North & south side of wall between Rm 203 & 205
7	3-61-20 [illegible] wall around [illegible] Tank Rm 204
8	3-61-24 East & west side of wall between Rm 204 & 205
9	3-61-23 East & west side of wall between Rm 203 & 205-202
	All 8" walls

12. FIELD PRELIMINARY DISPOSITION Use as is ☐ Rework ☒ Repair ☐ Reject ☐

Provide clean out holes at bottom of void. Remove debris & inspect with a mirror to detect any obstructions in the walls. A [illegible] hole will be provided at the top of void and [illegible] Grout used to fill void area. No pour [illegible] will be done until approved by the engineer. A properly signed pour card will be provided.

Hoffman Construction [illegible] 11-5-73

13. NCR PREPARED BY [signature]

14. APPROVAL OF FIELD PRELIMINARY DISPOSITION Project Manager

NEW DCN REQD YES ☐ NO ☐ DCN No

15. FINAL DISPOSITION REPAIR ☐ REJECT ☐ USE AS IS ☐ SEE BELOW ☒

Return to Project Engineering ☐

PROCEED AS INDICATED IN ITEM #12.

RECEIVED NOV 12 1973 HOFFMAN CONST. CO./PCA TROJAN NUCLEAR PLANT

16 APPROVAL OF FINAL DISPOSITION	[signature] PE [illegible]	RE-INSPECTION ACCEPT ☐ REJECT ☐	QA Rep [signature] 11-12-73 SIGNATURE QA [signature]

WHITE ORIGINATOR YELLOW-PARDUE QA

PINK DC ENGR GOLDENROD QA ENGR

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POOR ORIGINAL

Attachment 3-1

BECHTEL CORPORATION
FIELD INSPECTION/SURVEILLANCE REPORT QC-SC

1. SHEET 1 OF 1

TROJAN PROJECT – JOB 6478

2. DATE 7 May 74
3. SHIFT DAY
4. LOCATION SEE BELOW
5. ELEVATION SEE BELOW
6. "Q" LIST NO. SEE BELOW
7. CRITERIA SEE BELOW
8. CONTRACTOR SEE BELOW
9. CONTRACTOR (OTHER)
10. WEATHER CLDY

11.

AREA 3, Ele 93, Q 1.1113, A-1, PARDUE
WRITER OBSERVED CONTRACTOR QA MANAGER AND A CIVIL FIELD ENGINEER MONITORING THE GROUTING OF WALL ON THIS LEVEL. NO DISCREPANCIES WERE NOTED.

AREA 3, Ele 77, Q 1.1113, A-1, PARDUE
WRITER OBSERVED CONTRACTOR QA MANAGER AND A CIVIL FIELD ENGINEER MONITORING BLOCK MASONRY IN THIS AREA.

AREA 3, Ele 77, Q 4.52, E 83, F12
WRITER OBSERVED ELECTRICAL CABLES RESTING ON SHARP EDGE OF TRAY [illegible]. WRITER WILL INFORM CONTRACTOR QA MANAGER ON 10 MAY 74.

AREA 3, Ele 45, Q 3.2410, M-1, [illegible]
WRITER OBSERVED SMOKE DEPOSITS ON THE SIDE OF [illegible] SIS ACCUMULATOR. INFORMED ENGINEER.

95001159

12. PREPARED BY Patrick M. O'Brien DATE 7 May 74

13. REVIEWED BY DATE

Attachment 3-1

NORTHWEST TESTING LABORATORIES

4115 N. Mississippi Avenue
Portland, Oregon 97217
-7086

POOR ORIGINAL

4427 Nugget Way
Eugene, Oregon 97
746-9049

CONCRETE COMPRESSION TESTS

Tested For: P.G.E Cert. No. M-19

Cast By: W. Carter Slump:

Project: Trojan Date Made: 10-17-73

Proportions: ____ Plus ____ % psi concrete ____ Date Rec'd.

____ sack mix ____ max. sized aggregate

Additives: 1sk. Cement, 1sk Lime, 2.4 cu.ft. Sand

Source: Contractors Supply Co.

Condition of Storage:

Ticket No.: ____ Air Temp: 50° Time: 11:00 am cy. yds.

Load No.: ____ Conc. Temp: ____ Weather Overcast % Air

Location of Pour: Room 217 Elev 93 Area 2 North wall

Test Date	Mark	Weight Pounds	Max. Load	Load lbs. per sq. in.	Average	Age Tested	Remarks
10-24			7.6	2420		7	
"			7.4	2360		7	
11-14			14.8	4715		28	
"			14.5	4615		28	

Cert. No. ____ Processed by: (Initial) ____

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Attachment 3-1

POOR ORIGINAL

NORTHWEST TESTING LABORATORIES

4115 N. MISSISSIPPI AVENUE
PORTLAND 17, OREGON

MATERIALS INSPECTION
CONSTRUCTION INSPECTION
PHYSICAL TESTING
CHEMICAL ANALYSIS

WELDING CERTIFICATION
ASSAYING
SOIL TESTING
BACTERIOLOGY

GENERAL CONSTRUCTION INSPECTION DAILY REPORT

Project: Trojan Nuclear Plant
Permit No.: 54-78
Location: Rainer, Oregon
Date: 2-15-74
Time:

Engineer: Bechtel Corp
Architect:
Contractors:
Masonry: Perdue
Concrete: Hoffman
Steel: Tri M

Mix Proportions:
Masonry
Grout
Mortar
Concrete

Compression Tests Prepared

Set No.	Ref. No.	Slump

Source
Ticket No.
Load No.
Temp. 48°
Weather Rain
Quantity —

Pour Location and Notes: No grout poured today. Continued laying block area 12 elev 45' tonnel exh hall 10 x 4. Continued on line 8 area 9 elev 45

Reinforcing Steel Inspection and Notes: Reinforcing steel placed as per approved dwgs & specifications

Inspector's Signature B. [illegible]
Concrete Permit No.
Masonry Permit No. 377

95001161

Attachment 3-1

NORTHWEST TESTING LABORATORIES

A-1

POOR ORIGINAL

[illegible] N. Mississippi Avenue
[illegible]tland, Oregon 97217
288-7086

4427 Nugget Way
Eugene, Oregon 97403
746-9648

MORTAR CYL'S
~~CONCRETE~~ COMPRESSION TESTS

Tested For: PGE Cert. No. M-3

Cast By: John Bing - Dan Reed Slump: Mortar

Project: Trojan Date Made: 8 May 72

Proportions: 2000 Plus ___ % psi concrete ___ Date Rec'd. 8 May 72

___ sack mix ___ max. sized aggregate ___

~~Admixture~~ 1 Sack Cement 1/2 Sack Lime 8.4 cu ft Sand

Source: Jobsite

Condition of Storage: ASTM

Ticket No.: N/A Air Temp: 62 Time: 1 Pm cy. yds. N/A

[illegible]d No.: 3 Conc. Temp: 60 Weather Overcast % Air —

Location of Pour: Representative of mortar used in 41 line inner wall - Control Bldg 55 Level

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15 May			22.0	2290		7 day	
do			21.5	2180		do	
June			9.0	2765		28 day	
do			9.2	2930		do	

[illegible] No. ___ Processed by (Initial) ___

[illegible]

95001162

Attachment 3-1

POOR ORIGINAL

NORTHWEST TESTING LABORATORIES

4119 N. MISSISSIPPI AVENUE
PORTLAND 17 OREGON

GENERAL CONSTRUCTION INSPECTION
DAILY REPORT

Project: Trojan Nuclear Plant.
Permit No.: 6478
Location: Rainier, Oregon
Date: 10-15-73
Time: 8:00 to 4:30

Engineer: Bechtel Corp.
Architect:
Contractors:
Masonry: Perdue
Concrete: Hoffman
Steel: Tri-M

Mix Proportions:
Masonry
Grout
Mortar
Concrete

Compression Tests Prepared

Set No.	Ref. No.	Slump

Source ____ Ticket No. ____ Load No. ____

Temp. 63° Weather Cloudy Quantity ____

Pour Location and Notes: No grout placed this date. Continued laying block at the following locations. Room 260, Wall #5 Elev. 66' Area 3. Room 192 Wall #8 Elev. 61' Area 3. Room 201 Wall #16 Elev. 61' Area 3. Heavy Wt. block used at all locations.

Reinforcing Steel Inspection and Notes: Reinforcing steel placed as per approved dwgs & specifications.

Inspector's Signature: [signature]
Concrete Permit No. 37
Masonry Permit No. 3

9500I163

Attachment 3-1

POOR ORIGINAL

NORTHWEST TESTING LABORATORIES

4119 N MISSISSIPPI AVENUE
PORTLAND 17, OREGON

MATERIALS INSPECTION
CONSTRUCTION INSPECTION
PHYSICAL TESTING
CHEMICAL ANALYSIS

WELDING CERTIFICATION
ASSAYING
SOIL TESTING
BACTERIOLOGY

GENERAL CONSTRUCTION INSPECTION
DAILY REPORT

Project: Trojan Nuclear Plant

Job No.: 6479

Location: Rainier Oregon

Date: 4 May 72

Time: 4th Midnight

Engineer: Bechtel

Architect: -do-

Contractors:

Masonry: Purdue

Concrete: Hoffman

Steel: Tri M.

Mix Proportions:

Masonry

Grout

Mortar 1 Sack Cement ½ Sack Lime 2.8 Cu ft Sand

Concrete

Compression Tests Prepared

Set No.	Ref. No.	Slump

Source ______ Ticket No. ______ Load No. ______

Temp. 50 Weather Clear Quantity ______

Pour Location and Notes: Topping out East shielding wall Containment bldg. Rest of shift cleaning up & removing scaffolding. Stocking Control bldg

Reinforcing Steel Inspection and Notes: Steel in as per Specs & drawings.

cc:

Inspector's Signature [signature]

Concrete Permit No. Pending

Masonry Permit No. ______

95001164

Attachment 3-1

POOR ORIGINAL

L. C. PARDUE, INC.

3605 S. W. CORBETT AVE. PORTLAND, OREGON 97201

October 17, 1972

Hoffman Construction Co.
900 S.W. Fifth
Portland, Oregon

Re: Portland General Electric Audit of L. C. Pardue Inc.

Gentlemen:

In regards to the recent audit preformed by PGE of our QA records I would like to make the following statements regarding corrective action.

1) QA Manual: An Bechtel approved copy of the L. C. Pardue QA manual is now available in the L. C. Pardue site office as of October 6, 1972.

2) MRR #10263: MRR#10263 stated that all records and material were received on 7/19/72. On close examination of the test results accompanying the certification a discrepancy was found by L.C. Pardue QA personnel. The material in question was put on hold at that time untill a typographical error could be corrected by Northwest Testing on 7/21/72 at which time the material was released for use. A note has been added to MRR#10263 stating the reason for the date discrepancy.

3) Drawings: A complete audit of all drawings was initiated upon completion of the PGE audit. Upon completion of our audit all noncurrent drawings were brought to a current status with Hoffmans drawing log.

4) Audits: Three audits of Empire Building Material were present in the L.C. Pardue files at the time of the PGE audit. Unfortunately one of the audit reports was filed with the field inspection reports. This brings the amount of audits of Empire to three which is in accordance with the L.C. Pardue QA manual. An audit check list has been initiated for L.C. Pardue inhouse audits.

5) Storage Report: A material storage and protection report has been incorporated in the Pardue field inspection report file and will be maintained.

6) NCR Log: L.C. Pardue NCR#3 has been closed out in the NCR log.

9500116S

7) Pour Cards: The use of one pour card for more than one lift or pour will not be permitted in the future. The invoice number of all grout invoices will be listed on each pour card and the pour card wall numbers listed on each invoice for cross reference and material control. All pour cards and grout invoices in the L.C. Pardue file now contain this information.

Yours truly,

L. C. Pardue Jr.

NORTHWEST TESTING LABORATORIES

4115 N. MISSISSIPPI AVENUE
P.O. BOX 17126
PORTLAND, OREGON 97217

CONSTRUCTION INSPECTION
MATERIALS INSPECTION
CHEMICAL ANALYSIS
PHYSICAL TESTING

NON-DESTRUCTIVE TESTING
WELDING CERTIFICATION
SOIL TESTING
ASSAYING

December 11, 1979

Portland General Electric Co.
121 SW Salmon
Portland, Oregon

Re: Masonry Inspection
Trojan Nuclear Plant
Rainier, Oregon

Gentlemen:

We would like to confirm our telephone conversation of the last few days regarding the masonry inspection at the Trojan Nuclear Plant at Rainier, Oregon.

We did as a course of our work (inspection and testing) provide special inspection of the masonry work during its construction at the Trojan Nuclear Plant.

The full time inspection of the masonry work at Trojan was performed by qualified personnel and thus would qualify for the classification in the U.B.C. as masonry work performed under special inspection.

If we can be of further service please call on us.

Very truly yours,

NORTHWEST TESTING LABORATORIES, INC.

Charles R. Lane

Charles R. Lane, P.E.
General Manager

CRL:sb

NRC Question (12/6/79)

Provide documentation which supports the use of an allowable value of 18 psi (ie 12 psi x 1.5) for shear transfer at the interface between masonry block and mortar for the mortared double wythe walls.

Answer:

The following information substantiates the design criteria given in Supplements 1 and 2 to LER 79-15 relative to shear values at block-mortar interfaces.

The most relevant tests to establish shear values for vertical mortar joints in masonry construction are shear tests to demonstrate adhesion between masonry veneer and masonry backing. Albyn MackIntosh* has reviewed these test reports and has characterized them as consistently showing a value for shear stress exceeding 50 psi and ranging as high as 200 psi. The test laboratory where these tests were performed (Smith-Emery Test Laboratory, Los Angeles, California) will not release these test results since they are considered to be proprietary reports by the organizations requesting the tests. However, Bechtel was informed by the test laboratory that such consistently high shear values formed the basis for the 50 psi allowable shear stress at the veneer mortar interface in UBC Chapter 29, 1967 edition.

The most relevant available test data concerns transverse bending of multiple wythe unreinforced masonry. Failure consistently occurred in tension between mortar and masonry units at the wall surface. At this failure load, the shear stress present in the inter-wythe space can be computed even though failure has not occurred at this location. Transverse bending tests have been performed on 8 in. double wythe

* Chairman of ACI Committee 531 which is specifically charged with providing requirements for design and construction of concrete masonry and composite elements.

95001168

brick walls (Attachment 1) and 10 in. brick-hollow block "composite" walls (Reference 1). The tests performed on the 8 in. brick with metal truss wall ties (Attachment 1) provide useful information in evaluating the performance of the inter-wythe joint of the double wythe masonry wall construction at Trojan. As expected, these walls failed in tension at the horizontal brick-mortar interface when subjected to lateral bending. It is important to note that the 8 in. brick walls demonstrated an average transverse strength of over four times the average strength of similarly tested 4 in. brick walls, thus demonstrating composite action of the two wythes. At the load level at which the tensile bond failed, the inter-wythe shear can be computed to be from 9.0 psi to 14.5 psi for these brick walls (Tests TS-1 thru TS-5, Table 5-1). Because of the tension failure mode, inter-wythe shear was never fully developed. Considering the fact that the Trojan masonry walls are reinforced concrete masonry with equivalent ties and type M rather than the type S mortar used in these tests, we believe that these tests demonstrate that composite action will occur and the 12 psi allowable stress in UBC (multipled by 1.5) is reasonable for masonry block walls. Similar results were derived from the 10 in. composite walls, tests 4C2, 4C9 through 4C11 in Reference 1.

The lateral load tests of unreinforced masonry cavity walls referred to by Mr. Mackintosh at the December 5, 1979 meeting in Bethesda, Maryland as demonstrating composite action using masonry ties only are identified in Reference 2.

References:

1. Fattal and Cattaneo, "Structural Performance of Masonry Walls under Compression and Flexure". National Bureau of Standards Building Science, Series 73. 57 pages, 1976.

2. Whittmore, Stang and Parsons, "Structural Properties of a Concrete Block Cavity Wall Construction", sponsored by the National Concrete Masonry Association. National Bureau of Standards, Building Materials and structures Report BMS 21. 10 pages, 1939.