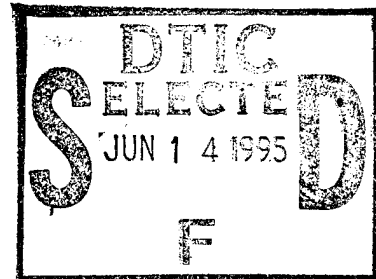


88273R02
VOLUME II
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CONCEPTUAL DESIGN ANALYSIS
NORTHWEST BOUNDARY CONTAINMENT/
TREATMENT SYSTEM
ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, COLORADO
FY 82 MCA LINE ITEM 37
DACA 45-82-C-0064

VOLUME II



Rocky Mountain Arsenal
Information Center
Commerce City, Colorado

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Prepared By
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Denver, Colorado
80217

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Project No.
C-26616

16 July 1982

REPORT DOCUMENTATION PAGE

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13. ABSTRACT (Maximum 200 words) THE PURPOSE OF THIS CONCEPT DESIGN ANALYSIS IS TO DEFINE THE FOLLOWING FOR THE NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM: 1. FUNCTIONAL AND TECHNICAL REQUIREMENTS 2. BUILDING AND EQUIPMENT REQUIREMENTS 3. SUPPORT SYSTEMS. SPECIFICATIONS ARE INCLUDED FOR THE FOLLOWING ELEMENTS: 1. CARBON TREATMENT SYSTEM 2. SITE DEVELOPMENT - GRADING AND PLACEMENT 3. BUILDING DETAILS - WALLS, FLOORS, ETC. 4. STRUCTURAL DETAILS - STEEL AND FOUNDATIONS 5. MECHANICAL - PLUMBING AND PIPES 6. ELECTRICAL. VOLUME II CONTAINS COST ESTIMATES AND DESIGN CALCULATIONS. DTIC QUALITY INSPECTED 3					
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Unannounced	☐
Justification	
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CONCEPT DESIGN ANALYSIS
NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM

VOLUME II

SECTION 1 - COST ESTIMATE BACKUP

SECTION 2 - DESIGN CALCULATIONS

Stearns-Roger

CRAFT WAGE RATES (Denver Area)

<u>TRADE</u>	<u>Rate Per Hr.</u>	<u>Health & Welfare</u>	<u>Pension</u>	<u>Vacation</u>	<u>App. Train.</u>	<u>Other</u>	<u>Average PT&I</u>	<u>Total Per Hr.</u>
Carpenters	14.87	1.20	.85	1.00	.11		3.56	21.59
Electricians	17.85	.34	1.25		.06 ⁽²⁾	.58 ⁽¹⁾	3.96	24.04
Pipe Fitters/ Plumbers	16.82	1.00	1.50	1.00	.08		4.02	24.42
Laborer	10.23	1.04	.70	.75	.10	.05 ⁽³⁾	2.54	15.41
Operating Engrs. Group 5	13.90	1.19	1.20	.60	.12	.05 ⁽⁴⁾	3.36	20.42
Millwrights	16.76	1.20	1.00		.29		3.80	23.05
Ironworkers	16.55	1.19	1.35		.17		3.80	23.06
Cement Masons	15.69	1.04	1.35		.13	.05 ⁽⁴⁾	3.60	21.86
Painter	15.61	.91	1.15		.08	1.42 ⁽⁵⁾	3.79	23.00

Notes:

- (1) NEBF = 3% of Gross.
- (2) Apprentice Training = 0.03% of Gross.
- (3) Industry Promotion.
- (4) Construction Advancement Program.
- (5) Estimated Increase for 1982 - 8%.

PTI Average For Denver Area For
The Above Crafts = 19.72018%

CONSTRUCTION COST ESTIMATE				DATE PREPARED		SHEET 1 OF 4	
PROJECT N.W. BOUNDARY GROUND WATER CONTROL SYSTEM					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____		
LOCATION ROCKY MOUNTAIN ARSENAL-COMMERCE CITY, CO							
ARCHITECT ENGINEER STEARNS, ROGER 26616							
DRAWING NO.			ESTIMATOR STEVE Y.W.		CHECKED BY		
ARCHITECTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Preengineered Metal Bldg 40x72'x8'x30'eave (see Manufacturer confirmation letter)	1			Sub-contract			\$64,300.00
TOILET ROOM							
• 6" Reinforced block wall 14'x8'H-3'7" door	120 25	SF HR	21.86 /HR	\$ 546.50	\$1.00 /SF	\$ 120.00	\$ 666.50
• Door 287°	1 3	ea HR	21.59 /HR	\$ 64.77	\$105 /ea	\$ 105.00	\$ 169.77
• Door hardware	1	set HR	21.59 /HR	\$ 21.59	\$110 /set	\$ 110.00	\$ 131.59
• Lavatory	1 3	ea HR	24.42 /HR	\$ 73.26	\$125 /ea	\$ 125.00	\$ 198.26
• Soap Dispenser	1 .5	ea HR	21.59 /HR	\$ 10.80	\$24 /ea	\$ 24.00	\$ 34.80
• Mirror	1 .5	ea HR	21.59 /HR	\$ 10.80	\$46 /ea	\$ 46.00	\$ 56.80
• Toilet Paper Dispenser	1 .5	ea HR	21.59 /HR	\$ 10.80	\$14 /ea	\$ 14.00	24.80
• Paper Towel Dispenser	1 .5	ea HR	21.59 /HR	\$ 10.80	\$25 /ea	\$ 25.00	35.80
• Trash Container	1 .5	ea HR	15.41 /HR	\$ 7.70	\$15 /ea	\$ 15.00	\$ 22.70
Drinking Fountain	1 2	ea HR	24.42 /HR	\$ 48.84	205 /ea	\$245.00	313.84
EMERG. EYE WASH & SHOWER	1 2	ea HR	24.42 /HR	\$ 48.84	335 /ea	\$335.00	383.84
Sub-total				854.70		\$1184.00	2038.70
+ Subcontract							
TOTAL							\$66,338.70

CONSTRUCTION COST ESTIMATE				DATE PREPARED		SHEET 3 OF 4	
PROJECT N.W. BOUNDARY GROUND WATER CONTROL SYSTEM					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____		
LOCATION ROCKY MOUNTAIN ARSENAL - COMMERCE CITY, CO							
ARCHITECT ENGINEER STEARNS-ROGEIR							
DRAWING NO.			ESTIMATOR STEVE V.W.		CHECKED BY		
ARCHITECTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Sewage Disposal							
• Septic Tank - 500 gal	4	EQ HR	20.42/HR	81.68	220/eq	\$220.00	\$301.68
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Dosing Tank	4	EQ HR	20.42/HR	81.68	200/eq	\$200.00	\$281.68
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Trench	25	LF	24.42/HR	97.68	1.60/LF	\$40.00	\$137.68
4" clay pipe	4	HR	20.42/HR	40.84	—	—	40.84
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Distribution box	4	EQ HR	20.42/HR	81.68	150/eq	\$150.00	\$231.68
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Leaching Field	140	LF	24.42/HR	97.68	1.00/LF	\$140.00	\$237.68
perforated PVC pipe	4	HR	20.42/HR	40.84	—	—	40.84
excavation 36"x20"x1'	2	HR	20.42/HR	40.84	—	—	40.84
backfill w/gravel	720	SF	20.42/HR	40.84	24/SF	\$172.80	213.64
backfill covering	2	HR	20.42/HR	40.84	—	—	40.84
• Backhoe rental	2	Day	—	—	495/Day	\$990.00	990.00
3/4 CY							
				\$889.64	\$1912.80		\$2802.44

CONSTRUCTION COST ESTIMATE				DATE PREPARED		SHEET 4 OF 4	
PROJECT N.W. BOUNDARY GROUND WATER CONTROL LOCATION ROCKY MOUNTAIN ARSENAL - COMMERCE CITY, CO ARCHITECT ENGINEER STEARNS - ROGER				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
DRAWING NO.		ESTIMATOR STEVE V.W.		CHECKED BY			
ARCHITECTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Summary Sht							
SHEET 1				\$854.70		\$1184.00	2038.70
+ Subcontract \$64,300							64,300.00
SHEET 2				\$496.19		\$213.33	\$ 709.52
SHEET 3				\$889.64		\$1912.80	2,802.44
TOTAL				2,240.53		3,310.18	\$69,850.71
PREENGINEERED BLDG.				—		—	\$64,300.00
TOILET ROOM				\$931.21		\$730.50	1,661.71
SEWAGE SYSTEM				889.64		\$1912.80	2,802.44
DRINKING FOUNTAIN				48.84		\$265.00	313.84
EMERG. EYE WASH & SHOWER				48.84		\$335.00	383.84
PAINTING				322.00		\$66.88	388.88
				\$2,240.53		\$3310.18	
TOTAL							\$69,850.71

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 1 OF 5	
PROJECT GROUND WATER TREATMENT FACILITY				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)			
LOCATION ROCKY MOUNTAIN ARSENAL							
ARCHITECT ENGINEER STEARNS ROGER ENGINEERING 266162							
DRAWING NO.		ESTIMATOR G. J. WHITALL		CHECKED BY			
STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<u>EXCAVATION:</u>							
TRENCHES & GRADE BMS	78.5	CY			102	\$80.07	80.07
	3.5	MH	15.41	\$53.94			53.94
Bldg FOUNDS & EQUIPMENT	54	CY			102	\$55.08	55.08
	3.0	MH	15.41	\$46.23			46.23
FLOOR & DOORWAYS	37.0	CY			0.43	\$15.91	15.91
	2.0	MH	15.41	\$30.82			30.82
	SUBTOTAL			130.99		151.06	282.05
<u>BACKFILL:</u>							
TO FOUNDATIONS ETC	72	CY			137	\$98.64	98.64
	2	MH	15.41	\$30.82			30.82
STRUCTURAL BACKFILL	58	CY			650	\$377.00	377.00
	17.5	MH	15.41	\$269.68			269.68
<u>VAPOR BARRIER</u>							
4 MILS P.V.C.	3708	SF			180	\$667.40	667.40
	8	MH	15.41	\$123.28			123.28
<u>CONCRETE: f'c 3000</u>							
COMPLETE WITH FORMS & RE-BAR							
FLOOR SLAB	26.0	CY			580	\$1508.00	1,508.00
	34.0	MH	21.80	\$743.24			743.24
EQUIPMENT FOUNDS	44	CY			650	\$2860.00	2860.00
	129	MH	21.80	\$2819.94			2819.94
DOOR PADS	7.5	CY			580	\$435.00	435.00
	10.0	MH	21.80	\$218.00			218.00

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 2 OF 5	
PROJECT GROUND WATER TREATMENT FACILITY LOCATION ROCKY MOUNTAIN ARSENAL ARCHITECT ENGINEER STEARNS ROGER				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
DRAWING NO.		ESTIMATOR G. J. WHITTALL		CHECKED BY			
STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
CONCRETE (CONT)							
BUILDING FOUND'S	8.1	CY			71 ⁰⁰	\$575.10	575.10
	32	MH	21 ⁸⁰	\$699 ⁵²			699.52
GRADE BMS & TRENCHES	53	CY			102 ⁰⁰	\$5406 ⁰⁰	5,406.00
	440	MH	21 ⁸⁰	\$9618 ⁴⁰			9,618.40
GROUT 1" THICK	12.5	SF			3 ⁵⁰	\$43.75	43.75
	3.0	MH	21 ⁸⁰	\$65 ⁵⁸			65.58
GROUT 2" THICK	708	SF			7 ⁰⁰	\$4956 ⁰⁰	4,956.00
	227	MH	21 ⁸⁰	\$4962 ²²			4,962.22
EXPANSION AND ISOLATION JOINTS	498	LF			0 ⁵⁴	\$268.92	268.92
	11	MH	21 ⁵⁹	\$237 ⁴⁹			237.49
JOINT FILL	498	LF			017	\$84.66	84.66
	9	MH	21 ⁵⁹	\$194 ³¹			194.31
STEELWORK							
CURB L FOR TRENCHES	240	LF			30 ⁵	\$732 ⁰⁰	732.00
	24	MH	23 ⁰⁰	\$553 ⁴⁴			553.44
GRATING FOR TRENCHES 1/4 THICK	276.5	SF			68 ⁵	\$1894.03	1,894.03
	11.0	MH	23 ⁰⁰	\$253 ⁶⁶			253.66
FOR WALKWAYS 1" THICK	312.5	SF			4 ⁵⁰	\$1406.25	1,406.25
	22	MH	23 ⁰⁰	\$507 ³²			507.32
ACCESS LADDERS	86	LF			25 ⁰⁰	\$2150 ⁰⁰	2,150.00
NO CAGE	33	MH	23 ⁰⁰	\$760 ⁹⁸			760.98

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 3 OF 5	
PROJECT GROUND WATER TREATMENT FACILITY				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION ROCKY MOUNTAIN ARSENAL							
ARCHITECT ENGINEER STEARNS ROGER							
DRAWING NO.		ESTIMATOR G. J. WHITTALL		CHECKED BY			

STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
STEELWORK (CONT)							
HANDRAIL & KICK ~~FE~~	230	LF			22 ⁰⁰	\$5060 ⁰⁰	5,060.00
	37	MH	23 ⁰⁰	\$853 ²²			853.22
ANCHOR BOLTS							
1" ϕ x 18" LONG	40	EA			3 ⁶⁰	\$144 ⁰⁰	144.00
	22	MH	21 ⁵⁹	\$474 ⁹⁸			474.98
1" ϕ x 24" LONG	16	EA			4 ²⁵	\$68 ⁰⁰	68.00
	10	MH	21 ⁵⁹	\$215 ⁹⁰			215.90
3/4" ϕ x 18" LONG	24	EA			2 ³⁵	\$56.40	56.40
	10	MH	21 ⁵⁹	\$215 ⁹⁰			215.90
EXPANSION BOLTS							
3/4" ϕ x 7" LONG	16	EA			3 ⁸⁰	\$60.80	60.80
DRILLING	16	EA			04 ⁷	\$7.52	7.52
	5	MH	21 ⁵⁹	\$107 ⁹⁵			107.95
STEEL FRAMING TO WALKWAYS							
	4402	LBS			0 ⁰⁰	\$2641.20	2,641.20
	75	MH	21 ⁵⁹	\$1619 ²⁵			1,619.25
				3,487.20			
					8,037.92		11,525.12

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-13-82.		SHEET 4 OF 5	
PROJECT GROUND WATER TREATMENT FACILITY LOCATION ROCKY MOUNTAIN ARSENAL ARCHITECT ENGINEER STEARNS ROBER				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
DRAWING NO.		ESTIMATOR G. J. WHITTALL			CHECKED BY		
STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SLAB FOR PROPANE STORAGE TANK:							
EXCAVATION:	4	CY			102	\$4.08	4.08
	ONE	MH	154	\$154			15.41
STRUCTURAL BACKFILL	1.33	CY			650	\$8.65	8.65
	ONE	MH	154	\$154			15.41
VAPOR BARRIER 4 MILS P.V.C	72	SF.			180	\$129.60	129.60
	ONE	MH	154	\$154			15.41
CONCRETE FC' 3000	2.67	CY			650	\$173.55	173.55
COMPLETE WITH FORMS & REBAR	7.85	MH	2180	\$171.60			171.60
TOTALS:				\$21781	\$31588	\$53377	

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 2 OF 3	
PROJECT NW BOUNDARY TREATMENT FACILITY					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION ROCKY Mtn. ARSENAL, DENVER, COLO.								
ARCHITECT ENGINEER STEARNS - ROGER								
DRAWING NO.			ESTIMATOR TKO		CHECKED BY JMC			
H/VAC SUMMARY		QUANTITY		LABOR M. H.		MATERIAL		TOTAL COST
NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	\$ PER UNIT	\$ TOTAL			
SUBTOTAL PAGE 1				76.9		2694.70		
VENT CHIMNEY, 5" DIA.		100	LF	25	25	2.50	250.00	
VENT CAP		4	EA	25	1	10	40.00	
PROPANE TANK 1000 GAL COMPLETE WITH ALL VALVES & FITTINGS (EXC LPG TANK)		1	EA	16	16	1500	1500.-	
REGULATOR VALVE 3/4" DIA (EXC LPG TANK)		1	EA	1	1	40	40.-	
EXHAUST FAN 1/2 HP		1	EA	1		2	2.-	
DUCTWORK 20 FT 5" DIA GALV STEEL		20	FT	1.10	22	.36	7.92	
WALL BRIDGE 6"X6"		1	EA	1	1	5	5.-	
THERMOSTAT (ELECT. CONTROL) TH-121		1	EA	1	1	40	40.-	
SUBTOTAL PAGE 2				123.5		4645.20		

CONSTRUCTION COST ESTIMATE				DATE PREPARED <i>7-13-82</i>		SHEET <i>1</i> OF <i>5</i>		
PROJECT <i>NORTH WEST BOUNDARY CONTAINMENT/</i> LOCATION <i>TREATMENT SYSTEM</i> <i>ROCKY MOUNTAIN ARSENAL</i> ARCHITECT ENGINEER				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____				
DRAWING NO.		ESTIMATOR <i>THORNLEY</i>		CHECKED BY				
PLUMBING	SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL <i>M.H.</i>	PER UNIT	TOTAL	
<i>PIPE - ASTM B-88</i>								
<i>TYPE K</i>								
<i>3/4"</i>								
		<i>107.0</i>	<i>LF</i>	<i>.19</i>	<i>20.33</i>	<i>1.62</i>	<i>173.34</i>	
<i>1/2"</i>								
		<i>15.0</i>	<i>LF</i>	<i>.16</i>	<i>2.40</i>	<i>1.17</i>	<i>17.55</i>	
<i>FITTINGS</i>								
<i>WRIGHT COPPER</i>								
<i>SOLDER JOINT</i>								
<i>ANSI B16.22</i>								
<i>TEE</i>								
<i>3/4"</i>								
		<i>1</i>	<i>EA</i>	<i>.67</i>	<i>.67</i>	<i>.52</i>	<i>.52</i>	
<i>90° ELL</i>								
<i>3/4"</i>								
		<i>8</i>	<i>EA</i>	<i>.42</i>	<i>3.36</i>	<i>.38</i>	<i>3.04</i>	
<i>1/2"</i>								
		<i>4</i>	<i>EA</i>	<i>.40</i>	<i>1.60</i>	<i>.14</i>	<i>.56</i>	
<i>COUPLING</i>								
<i>3/4"</i>								
		<i>4</i>	<i>EA</i>	<i>.38</i>	<i>1.52</i>	<i>.20</i>	<i>.80</i>	
<i>BUSHING</i>								
<i>3/4" x 1/2"</i>								
		<i>3</i>	<i>EA</i>	<i>.38</i>	<i>1.14</i>	<i>.20</i>	<i>.60</i>	
<i>SUB TOTAL PAGE 1</i>					<i>31.02</i>		<i>196.41</i>	

CONSTRUCTION COST ESTIMATE				DATE PREPARED <i>7-13-82</i>		SHEET <i>3</i> OF <i>5</i>	
PROJECT <i>NORTH WEST BOUNDARY CONTAINMENT/</i>				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION <i>ROCKY MOUNTAIN ARSENAL</i>							
ARCHITECT ENGINEER							
DRAWING NO.			ESTIMATOR <i>THORNTON</i>			CHECKED BY	

PLUMBING SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<i>SUBTOTAL PAGE 2</i>				<i>MH</i>			
<i>PIPE - CAST IRON</i>				<i>34.53</i>		<i>266.99</i>	
<i>ASTM A-74 HUB</i>							
<i>W/PLAIN END SPIGOT</i>							
<i>SERVICE WEIGHT</i>							
<i>4' x 6'-6"</i>	<i>3</i>	<i>EA</i>	<i>2.36</i>	<i>7.08</i>	<i>4.68</i>	<i>91.26</i>	
<i>4' x 6'-0"</i>	<i>2</i>	<i>EA</i>	<i>2.18</i>	<i>4.36</i>	<i>4.68</i>	<i>56.16</i>	
<i>4' x 5'-0"</i>	<i>3</i>	<i>EA</i>	<i>1.82</i>	<i>5.46</i>	<i>4.68</i>	<i>70.20</i>	
<i>4 x 10'-0"</i>	<i>2</i>	<i>EA</i>	<i>3.64</i>	<i>7.28</i>	<i>4.68</i>	<i>93.60</i>	
<i>FITTINGS</i>							
<i>CAST IRON ASTM</i>							
<i>A-74 SERVICE WEIGHT</i>							
<i>NIPPLES</i>							
<i>4" x 1'-0"</i>	<i>4</i>	<i>EA</i>	<i>.36</i>	<i>1.44</i>	<i>4.68</i>	<i>18.72</i>	
<i>4" x 1'-6"</i>	<i>4</i>	<i>EA</i>	<i>.55</i>	<i>2.2</i>	<i>4.68</i>	<i>28.08</i>	
<i>4" x 2'-0"</i>	<i>4</i>	<i>EA</i>	<i>.73</i>	<i>2.92</i>	<i>4.68</i>	<i>37.44</i>	
<i>4" x 2 7/8" (AS 1')</i>	<i>4</i>	<i>EA</i>	<i>.36</i>	<i>1.44</i>	<i>4.68</i>	<i>4.68</i>	
<i>SUB TOTAL PAGE 3</i>				<i>66.71</i>		<i>667.13</i>	

CONSTRUCTION COST ESTIMATE					DATE PREPARED <u>7-13-82</u>		SHEET <u>5</u> OF <u>5</u>	
PROJECT					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR <u>THORNLEY</u>		CHECKED BY			
PLUMBING SUMMARY		QUANTITY		LABOR		MATERIAL		TOTAL COST
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<u>SUBTOTAL PAGE 4</u>					<u>90.39</u>		<u>825.58</u>	
<u>PIPE C.S.</u>								
<u>GALVANIZED</u>								
<u>ASTM A-120</u>								
<u>4"</u>		<u>30</u>	<u>LF</u>	<u>.44</u>	<u>13.2</u>	<u>11.95</u>	<u>358.50</u>	
<u>FLOOR DRAIN</u>								
<u>JOSAM SERIES</u>								
<u>3510 4"</u>		<u>10</u>	<u>EA</u>	<u>1.33</u>	<u>13.3</u>	<u>41.40</u>	<u>414.00</u>	
<u>FLOOR CLEANOUTS</u>		<u>1</u>	<u>EA</u>	<u>1.33</u>	<u>1.33</u>	<u>14.40</u>	<u>14.40</u>	
<u>JOSAM SERIES 8/84</u>								
<u>SUBTOTAL PAGE 5</u>					<u>118.22</u>		<u>1612.48</u>	
<u>TOTAL COST OF</u>								
<u>LABOR</u>		<u>118.22</u>	<u>MH</u>	<u>24.42</u>	<u>2886.93</u>			
<u>TOTAL COST OF</u>								
<u>MATERIAL</u>							<u>1612.48</u>	
<u>TOTAL COST</u>								<u>4,499.41</u>

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 1 OF 15	
PROJECT NORTH WEST BOUNDARY CONTAINMENT/					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION ROCKY MOUNTAIN ARSENAL TREATMENT SYSTEM								
ARCHITECT ENGINEER STEARNS - ROGER 26616								
DRAWING NO.			ESTIMATOR FK		CHECKED BY [Signature]			
SUMMARY	QUANTITY		LABOR M.H		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
MECHANICAL WORK								
PIPE PVC								
SCH 80								
1" DIA	10	LF	.24	2.4	.26	2.6		
1 1/2" DIA	30	LF	.31	9.3	.44	13.20		
2" DIA	180	LF	.36	64.8	.60	108.00		
4" DIA	165	LF	.48	79.2	1.80	297.00		
6" DIA	226	LF	.57	128.82	3.44	777.44		
8" DIA	40	LF	.73	29.2	5.13	205.20		
10" DIA	20	LF	.83	16.60	7.75	155.00		
12" DIA	74	LF	.96	71.04	10.67	789.58		
				401.36		2352.02		

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 2 OF 15	
PROJECT					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR FH		CHECKED BY <i>[Signature]</i>			
SUMMARY	QUANTITY		LABOR M.H.		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
PVC FITTINGS	SCH 80			401.36		2352.02		
90° ELL (SLIP)								
1 1/2" DIA	2	EA	.62	4.96	2.14	17.12		
2" DIA	30	EA	.73	21.90	2.92	87.60		
4" DIA	20	EA	1.33	26.60	15.63	312.60		
6" DIA	24	EA	2.19	54.96	35.65	855.60		
12" DIA	4	EA	4.8	19.20	210.42	257.92		
45° ELL (SLIP)								
2" DIA	10	EA	.73	7.3	2.02	19.20		
4" DIA	12	EA	1.33	15.96	13.22	159.36		
TEE (SLIP)								
2" DIA	10	EA	1.14	11.40	3.39	33.90		
4" DIA	12	EA	2	24.00	25.60	307.20		
6" DIA	9	EA	3.2	28.80	51.23	461.07		
10" DIA	1	EA	4.8	4.8	99.92	99.92		
				621.24		5573.51		

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 3 OF 15	
PROJECT					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR EH		CHECKED BY <i>[Signature]</i>			
SUMMARY	QUANTITY		LABOR H.H.		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
				621.24		5573.51		
12" DIA	1	EA	6.0	6.00	150.24	150.24		
COUPLINGS (CLIP)								
2" DIA	20	EA	.73	14.60	1.38	47.60		
4" DIA	15	EA	1.33	19.95	2.86	147.90		
6" DIA	20	EA	2.30	46.00	15.37	307.40		
8" DIA	10	EA	3.0	30.0	37.73	226.38		
12" DIA	12	EA	4.0	48.0	29.44	353.28		
REDUCER BUSHING (SPIG X SLIP)								
10" x 8" DIA	3	EA	3.5	10.5	62.21	186.63		
12" x 8" DIA	1	EA	4.00	4.0	132.14	132.14		
12" x 10" DIA	1	EA	4.00	4.0	99.54	99.54		
6" x 4" DIA	6	EA	2.30	13.8	12.20	73.20		
				806.09		7297.82		

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-7-82		SHEET 7 OF 15	
PROJECT					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR FK		CHECKED BY <i>[Signature]</i>			
SUMMARY	QUANTITY		LABOR M.H.		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
				954.39		10463.66		
BUTTERFLY VALVE IN PVC WAFER TYPE WITH METAL HANDLE 4" DIA (+GF #367)	17	EA	2.82	47.94	101.70	1724.98		
DITTO 6" DIA	6	EA	3.3	19.80	161.10	966.60		
BALL VALVE IN PVC SINGLE UNION VITON SEAL 1" DIA (GF #345)	6	EA	.35	2.10	23.13	132.78		
DITTO 1 1/2" DIA	6	EA	.40	2.40	37.94	227.58		
SWING CHECK VALVE IN PVC W/ DISC SEAT AND SPRING BALANCED DISC FLANGED 4" DIA (PPS FIG 0841342)	1	EA	3.25	3.25	550.-	550.00		
				1029.88		14075.58		

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-9-82		SHEET 12 OF 15	
PROJECT				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION							
ARCHITECT ENGINEER							
DRAWING NO.		ESTIMATOR FK		CHECKED BY H. H. H.			
SUMMARY	QUANTITY		LABOR H.H.		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
				1283.43		37205.53	
PIPE CARBON STEEL							
SCH 80 SOCKET							
WELDED							
(COMPRESSED AIR							
SYSTEM)							
2" DIA	60	LF	.26	15.60	4.40	264.00	
VALVES GLOBE							
BRONZE SCREWED							
ENDS 150#							
SERVICE							
2" DIA	3	EA	.73	2.19	80.00	240.00	
VALVES GATE							
BRONZE SCREWED							
ENDS 150#							
2" DIA	2	EA	.73	1.46	42.00	84.00	
				1302.68		37793.53	

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-9-82		SHEET 2 of 3	
PROJECT <u>NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM</u>				BASIS FOR ESTIMATE			
LOCATION <u>RMA - COMMERCE CITY, COLO</u>				☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
ARCHITECT ENGINEER <u>STEARNS-ROGER</u>							
DRAWING NO.		ESTIMATOR <u>W.E.W.</u>		CHECKED BY <u>W.E.W.</u>			
ELECTRICAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<u>LIGHTING FIXTURES</u>							
150 W HPS	6	EA	180	1080	150	900	
COE TYPE WB-1 ENTRY FIXT.	1	EA	60	60	40	40	
EXIT SIGN W/POWER PACK & 1 REMOTE HEAD	1	EA	53	53	250	250	
COE TYPE R-2D LAV. FIXT.	1	EA	53	53	15	15	
COE TYPE VG-4	1	EA	53	53	45	45	
RECESSED HEAT LAMP FOR LAVATORY	1	EA	60	60	75	75	
<u>DISTRIBUTION</u>				\$1359		\$1325	
20 CKT LTG PNL.	1	EA	600	600	950	950	
10KVA DRY-TYPE TRANS	1	EA	312	312	500	500	
MCC, 3-VERT. SECT.	1	EA	1800	1800	9000	9000	
				\$2712		\$10450	
<u>DEVICES</u>							
SWITCH-BOX-COVER	4	EA	12	48	40	160	
DUPLEX RECP-BOX-COVER	13	EA	14	182	42	546	
				\$230		\$706	
<u>LIGHTNING PROT.</u>							
CADWELDS & MISC.	50	EA			3	150	
CLASS I CONDUCTOR	400	FT		—	1	400	
CU AIR TERMINALS	12	EA		—	5	60	
POINT BASES	12	EA		—	17	204	
CABLE HOLDERS	130	EA		—	2	260	
GROUND RODS	6	EA		—	30	180	
ADHESIVE FOR AIR TERM. & HOLDERS	15	GAL		—	34	510	
CABLE SPLICERS	4	EA		—	6	24	
						\$1788	
LABOR	JOB	120 HRS	24.04	2,885			

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 3 of 3	
PROJECT <u>NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM</u>				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☒ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify) _____			
LOCATION <u>RMA - COMMERCE CITY, COLO</u>							
ARCHITECT ENGINEER <u>STEARNS-ROGER</u>							
DRAWING NO.		ESTIMATOR <u>WEN</u>		CHECKED BY <u>AG!</u>			
ELECTRICAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<u>GROUND GRID</u>							
#4 SDBC CROSS-RUN	200	LF	1.56	312	1.35	270	
#4 SDBC PERIM. RUN	300	LF	1.92	576	2.20	660	
BOLTED CONNS. ABOVE GRADE	JOB	⁶⁰ HRS	24.04	1442	LS	100	
CADWELD CONNS. & MISC	JOB	²¹ HRS	24.04	505	LS	200	
				2835		\$ 1230	
<u>WIRE & CONDUIT</u>							
3" RGS CONDUIT & FITTINGS	100	LF	12	1200	4.50	450	
1 1/2" RGS " "	200	LF	5.75	1150	1.55	310	
1" RGS (TEL. CONDUIT)	60	LF	3.60	216	1.00	60	
3/4" RGS CONDUIT & FITTINGS	1000	LF	3.35	3350	0.80	800	
1" RGS CONDUIT & FITT.	50	LF	3.60	180	1.00	50	
1 1/2" LIQUID TIGHT FLEX	24	LF	7.90	190	5.00	120	
3/4" " "	12	LF	3.60	43	1.90	23	
<u>WIRE, THHN-THWN:</u>							
#6 AWG	800	LF	0.30	240	0.28	224	
#10 AWG	1000	LF	0.22	220	0.12	120	
#12 AWG	1500	LF	0.19	285	0.08	120	
				\$ 7074		\$ 2277	✓
<u>MOTOR & CONTROL</u>							
MOTOR HOOKUP	JOB	¹² HRS	24.04	288		MATERIAL	
CONTROL CKT HOOKUP	JOB	¹² HRS	24.04	288		ABOVE	
				\$ 576			✓



ARMCO BUILDING SYSTEMS

J. SHELBY WELCH, JR.
District Manager

July 7, 1982

Stearns Roger Engineering Corporation
P. O. Box 5888
Denver, Colorado 80217

Attention: Mr. Steve Van Winkle

Reference: Northwest Boundary Ground Water Control System
Rocky Mountain Arsenal
Project No. C26616

Gentlemen:

In accordance with your request, we are pleased to submit for your consideration the following estimate for the above referred to project:

One complete Armco building, type RF-80, size 40'-0" wide x 72'-8" long x 30' high, designed for 30# LL and 25# WL per UBC. The roof panels to be 24 gage ALUMINIZED steel with standing seams and concealed fasteners. The wall panels to be 24 gage galvanized steel with interlocking ribs, concealed fasteners and factory finish color coating with a 20 year warranty. Both endwalls to be designed for future expansion. The following accessories are included:

- 3 - 3070 single swing steel doors with top half glazed and necessary hardware
- 1 - 10' x 14' overhead sectional steel door insulated
- 1 - 12' x 24' overhead sectional steel door insulated
- 1 - 30' length of 12" throat ridge vent with damper and birdscreen
- Gutters and downspouts for both side walls
- Roof insulated with 3" fiberglass blanket to meet U factor of 0.10
- Walls insulated with 3" fiberglass batts to meet U factor of 0.15
- Steelliner to protect insulation up to 8' high around perimeter of building

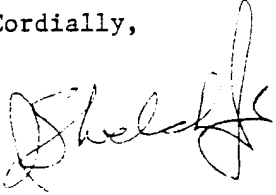
All of the above delivered and erected on foundation by others for the sum of\$63,000.00

At the present time and subject to prior orders received, shipment can be made in approximately six weeks.

Stearns Roger Engineering Corporation
July 7, 1982
Page 2

We thank you for the opportunity to present this information. Please contact me if you have further questions.

Cordially,

A handwritten signature in dark ink, appearing to read "J. Shelton", written over a horizontal line.

JSW:mp

Enclosures



ARMCO BUILDING SYSTEMS

J. SHELBY WELCH, JR.
District Manager

July 8, 1982

Steve Van Winkle

REFER TO

NOTE

JUL 09 1982

Gen. Files

ANS'D

Stearns Roger Engineering Corporation
P. O. Box 5888
Denver, Colorado 80217

Attention: Mr. Steve Van Winkle

Reference: Northwest Boundary Ground Water Control System
Rocky Mountain Arsenal
Project No. C26616

Gentlemen:

Supplementing our letter of July 7, please be advised that to increase the length of building to 77'-8" (3 bays @ 25') the cost would be increased by \$1300.00.

Cordially,

JSW:mp

QUOTATION
GOULDS PUMPS, INC.
VERTICAL SUMP PUMP

REPLY TO:

PIONEER EQUIPMENT, INC.
P.O. Box 27024
Tucson, AZ 85726

Attn: Dick Cahill

All quotations subject to terms and conditions on the reverse side and expire unless accepted within 30 days from date of quotation. All quotations subject to change with or without notice.

FORM 4844 EE-500 (11-74)

To: Rubel and Hager, Inc.
4400 E. Broadway
Tucson, AZ 85711

Date: 7/8/82
Proposal No.:
Revision No.:

Page:

Attention: Mr. Frederick Rubel, Jr., P.E.
Inquiry Date: 7/8/82
Inquiry No.: Rocky Mr. Arsenal

Copies: Goulds Denver
Pioneer Equip, Phoenix

Item No.: P-101,102,
103,104.

In answer to your inquiry, we propose to furnish GOULDS PUMPS as described below:

CONDITIONS OF SERVICE -

LIQUID Water

G.P.M. 500 Sp. Gr. @ 60°F 1.0 PH Value _____ Solids % _____

T.D.H. 162 Sp. Gr. @ P.T. _____ Abrasives _____ Solids Size _____

Pumping Temp _____ Visc. @ P.T. _____

PUMP DESCRIPTION -

QUANTITY 4
MODEL 3171
Size 3X4-13
Group M
Pit Type ☒ Wet ☐ Dry
Pit Depth 12 fto.
Assembly No 22

Steady Bearing Lubrication _____
Support Plate Std.
Pit Cover None
Case Cast iron
Impeller Cast iron
Shaft Steel
Steady Brngs. Carbon

MATERIALS

CONTROL EQUIPMENT:

Float Switch = 2
Alternator = None
Hi Water Alarm = None
Single Cont. Voits None
Mag. Start Size None
NEMA Encl. 4
Curve No. 1182-3

Efficiency 71.5
B.H.P. Rating 28.8
Max. B.H.P. 32.3

IMPELLER DIAMETER:

Approx. Rating 12.5
Min. Max. 10 / 13

For detailed specifications see Bulletin 726.1

DRIVER -

H.P. 40
Enclosure 1.15/SF

R.P.M. 1750
Insulation B

Phase/Hz 3/60
Frame 324

Volts 230/460
Furnished by Goulds

UNIT PRICES -

PUMP SUPPORT PLATE and COUPLING \$ _____

COMPLETE PRICE EACH
AS DETAILED ABOVE 5,332.00

DRIVER \$ _____

FREIGHT (estimated) \$ _____

TOTAL ~~XXXXXX~~ QUANTITY FOUR 21,328.00

Weight, pounds: _____

1926

TOTAL WEIGHT 7704

PRICES ARE F.O.B. LUBBOCK, TEXAS

Pre-paid job site

SHIPMENT 6-8 weeks after complete engineering and manufacturing information and full approval to proceed with work

TERMS. 30 DAYS NET
PER APPROVED CREDIT

PIONEER EQUIPMENT, INC.

Dick Cahill
Richard J. Cahill
Sales Representative

FILTEMP SALES, INC.

filtration • flow • heat • control

243-4245

S-101 A,B

S-102 A,B

S-103 A,B

MAILING ADDRESS:
P.O. BOX 15173
PHOENIX, ARIZONA 85060

OFFICE:
3601 S. 42ND STREET
PHOENIX, ARIZONA 85040

July 8, 1982

RECEIVED

JUL 12 1982

RUBEL & HAGER, INC.

Rubel & Hager
4400 E. Broadway, Suite 602
Tucson, Arizona 85711

Attention: Mr. Fred Rubel

Reference: Rocky Mountain Arsenal
Northwest Boundary Treatment System

Dear Mr. Rubel:

We are pleased to quote the following Filterite Equipment per your request.

A Qty

6 Filterite Model 66MS03-316-4FD-C150
Code Vessel - 316SS - 150 # Operating Pressure
1" NPT Vent - 1 1/2 " NPT Drain - 316SS
Top Seat Plate & Springs - Ethylene Propylene
Gasket - "UM" stamp standard - includes eye nuts -
Houses 22-30" cartridges - See Bulletin 1762.

Price each: \$4,550.00
Qty--6 at: \$27,300.00
Est Frt - Total: \$580.00
6 Sets of Cart (U100AW30U) : \$800.00

Total Cost: \$28,680.00

B

Option B same as item A except Vessel is 304SS instead of 316SS.

Price each: \$3,761.00
Qty--6 at: \$22,566.00
Est Frt - Total: \$580.00
6 Sets of Cart (U100AU30U) : \$800.00

Total Cost: \$23,946.00

C

Replacement Cartridges

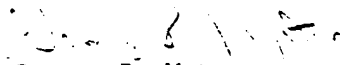
Filterite U100AW30U
100 Micron - 30" length - Polypropylene
Core and Polypropylene Wind

July 8, 1982
Rubel & Hager
Page 2

Lot Price, 150 Cart : \$975.00
F.O.B. Phoenix

Both Item A and Item B include non code stamp at no additional charge.
If you require "U" stamp then please add \$250.00 to total cost. In my
opinion the "UM" stamp is more than sufficient. Please contact our
office if we can provide further information.

Sincerely,


George R. Metro
Filtemp Sales, Inc.

nam

ADSORPTION SYSTEM EQUIPMENT

Westvaco

July 9, 1982

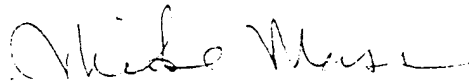
Mr. Fred Rubel
Rubel & Hager, Inc.
4400 E. Broadway, Suite 602
Tucson, AZ 85711

Dear Fred:

In accordance with your request, I have enclosed a proposal for a Westvaco Pulsed Bed Adsorption System for the Northwest Boundary Containment Treatment Facility, Rocky Mountain Arsenal. Included is a budget estimate of the uninstalled cost of this equipment.

If you require further information or details, please contact me.

Sincerely yours,



Michael L. Massey, Ph.D., P.E.
Manager, Carbon Systems

MLM/sa
Enclosure

Chemical Division
Carbon Department
Covington, Virginia 24426
Telephone: 703-962-1121

PROPOSAL FOR A
WESTVACO PULSED BED ADSORPTION SYSTEM

PROVIDED BY
WESTVACO CORPORATION
CARBON DEPARTMENT
CARBON SYSTEMS GROUP
COVINGTON, VIRGINIA 24426

FOR
ROCKY MOUNTAIN ARSENAL
NW BOUNDARY TREATMENT SYSTEM
COMMERCE CITY, COLORADO
JULY 9, 1982

Introduction

Westvaco has been requested to prepare a proposal, including budget estimate, for a Westvaco Pulsed Bed Adsorption System. This system will provide carbon adsorption treatment of groundwater at the proposed NW Boundary project at Rocky Mountain Arsenal, Commerce City, CO.

The treatment process will consist of the following:

- A. Three standard pulsed bed adsorption columns.
- B. Two carbon storage tanks, one for fresh carbon and one for spent carbon.
- C. A dual blowcase assembly for carbon transport.
- D. 150,000 pounds of virgin carbon, Nuchar WV-G.

The price covers the cost of delivery of assembled treatment modules as described in the process description. It does not cover the cost of on-site installation. Details of the proposed system are as follows:

Process Description

The Westvaco Pulsed Bed Adsorption System shall include the following standard Westvaco components as required by the specifications:

- A. Adsorption Unit
 - 1. The carbon adsorption system shall be three upflow Pulsed Bed Systems as manufactured by Westvaco.
 - 2. Each 42,000 lb contactor unit shall be a ten-foot diameter 1400 cu ft capacity ASME 50 psig Design Pressure Vessel with potable water lining.
 - 3. Influent and effluent connections shall be designed to insure even flow distribution.

4. Each adsorber shall be mounted on a support structure designed to support the contactor and all piping and attached equipment under all operating conditions. The support structure shall be designed to provide ready access to piping and valves.
5. Connections to each adsorber shall be as follows:
 - a. Raw water inlet and treated water outlets shall be four 6-inch connections.
 - b. Fresh carbon inlet and spent carbon outlet connections shall be 2-inch and properly designed to facilitate carbon handling.
 - c. Three 1/2-inch 316SS sample nozzles are to be spaced at the quarter points of the adsorber, with the nozzle penetrating 6 inches into the carbon bed.
6. Each adsorber shall be furnished with two 20-inch diameter manholes--one manhole to be located on the top of the vessel and the other on the side near the bottom of the vessel. An access ladder in conformance with applicable safety standards shall be provided for the top manhole.

B. Fresh Carbon Storage Tank

1. One ten-foot diameter 740 cu ft capacity fresh carbon storage tank shall be provided. The tank will be an open top cone-bottom vessel suitable for storing a minimum of 20,000 lb (dry weight) of spent carbon. A full water level will be maintained in the tank by a float valve.
2. The tank shall be of all-welded carbon steel construction with potable water lining.
3. The structure and baseplate shall be designed to support the tank, tank contents, and attached equipment under all operating conditions. Lugs, adequate for all lifting and moving the tank, shall be provided.

4. Connections to the fresh carbon storage tank shall be as follows:
 - a. The bottom carbon outlet shall be 4-inch diameter (minimum)
 - b. A 2-inch diameter raw water connection
 - c. The tank overflow shall be 4-inch diameter and shall be located above the normal liquid level. The outlet shall be screened to prevent loss of activated carbon.

C. Spent Carbon Storage Tank

1. One ten-foot diameter 740 cu ft capacity spent carbon storage tank shall be provided. The tank will be an open top cone bottom vessel suitable for storing a minimum of 20,000 lb (dry weight) of spent carbon. A full water level will be maintained in the tank by a float valve. Removal of spent carbon will be by the use of an eductor.
2. The tank shall be all-welded carbon steel construction with potable water lining.
3. The structure and baseplate shall be designed to support the tank, tank contents, and attached equipment under all operating conditions. Lugs, adequate for all lifting and moving of the tank, shall be provided.
4. Connections to the spent carbon storage tank shall be as follows:
 - a. The bottom carbon outlet shall be 4-inch diameter (minimum)
 - b. A 4-inch diameter raw water connection
 - c. The tank overflow shall be 4-inch diameter and shall be located above the normal liquid level. The outlet shall be screened to prevent loss of activated carbon.

D. Carbon Transport System

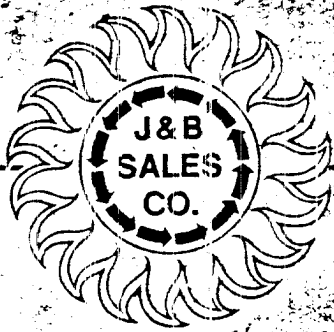
1. The carbon transport system shall consist of separate fresh and spent carbon blowcases to transfer carbon slurry from the fresh carbon storage tank to each adsorber unit and from each adsorber unit to the spent carbon storage tank. Carbon transport will be by air pressurization and eductors. Normal pulsing operation will consist of transporting 2,000 lb of dry carbon per cycle.
2. The blowcases shall be 70 cu ft capacity ASME 50 psig Design Pressure Vessels. All wetted parts of the vessels shall be 316 L stainless steel. The pressure vessels shall be stamped in compliance with ASME Code.
3. A common support structure and baseplate shall be provided for the two blowcases. The support structure and baseplate shall be designed to support the blowcases, contents, and all attached piping and appurtenances under all operating conditions. The support structure shall be carbon steel. Lifting lugs, adequate for all lifting and moving of the blowcases, shall be provided.
4. Each blowcase shall be provided with a 16-inch diameter quick-opening, hinged manhole for top access and observation. An access ladder and platform, designed in conformance with applicable safety standards, shall be provided.

E. Granular Activated Carbon

Westvaco shall supply and install an initial inventory of 150,000 lb of virgin granular activated carbon. The initial carbon supply shall be Westvaco Nuchar WV-G.

Price

The estimated cost for the equipment as described in this proposal is \$638,000, FOB job site.



QUOTATION

J & B SALES CO.

3441 N. 29th Ave. PHOENIX, ARIZONA 85018

TELEPHONE 602 • 253-1545

JOB Rocky Mountain Arsenal

Page 1 of 1

N.N. Boundry Treatment System

Arch. Rubel & Hager

P-105

Eng. Rubel & Hager

Quote No. 2106

Date 7-8-82

Due 7-9-82

Quan.

Description

Net Price

To: Rubel & Hager, Inc.
440 E. Broadway Suite 602
Tucson, AZ 85711

Attn: Mr. Fred Rubel

1 Bell & Gossett Model 1531 - 2AC Close Coupled Pump.
Duty: 175 gpm @ 175 TDH 5,200' Elev.
15 HP 460/3/60 3500 rpm ODP Motor

Total Price FOB Factory, PFA Commerce City, Colorado. \$1,600.00

RECEIVED

JUL 9 1982

RUBEL & HAGER, INC.

Above Prices Are Full Freight Allowed Unless Otherwise Stated

Starters, Vibration Bases & Accessories Are Not Included Unless Listed

Quotation Automatically Expires Thirty (30) Calendar Days From The Date Issued

QUOTATION

ALBANY
INTERNATIONAL

Engineered Systems
Division

P.O. BOX 310, QUAKER RD., GLENS FALLS, N.Y. 12801 / TEL. 518-793-8801 / TELEX 145339

Mr. Fred Rubel
RUBEL & HAGER
4400 East Broadway
Suite 602
Tucson, AZ 85711

July 8, 1982

Quotation Number: Q82-041T

S-104

QTY.	UNIT PRICE	TOTAL
1	AES Model 5250S20A2 Multiple Filter with external backwash	70,133.00
	Application: Granular Activated Carbon Pressure Rating: 25 psi (operating pressure) Flow: 1500 gpm Fabrication: 316 stainless steel Construction: 20 barrels; assembled and mounted on a mild steel frame. Inlet/Outlet Header Size: 12" flanged External Backwash Header: 2" threaded Drain Size: 2-1/2" threaded Media: .003" wedge wire Valve Size & Seats: 2" Teflon Seals: EPDM Gauges: 0-400 psi Filter Media Area: 8160 sq. inches Backwash Automation (Time Clock and Differential Pressure Switch)	
	<u>Option:</u>	
	Service Step	500.00
	Reference Drawing: D-10640	

WARRANTY: ALBANY ENGINEERED SYSTEMS WARRANTS ALL AES PRODUCTS AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP IN NORMAL USE FOR ONE YEAR FROM DATE OF SHIPMENT, SUCH WARRANTY BEING LIMITED TO REPLACEMENT OR REPAIR OF DEFECTIVE PARTS AT OUR DISCRETION. WE HAVE NO LIABILITY FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED. THERE ARE NO OTHER WARRANTIES EXCEPT AS SET FORTH ABOVE.

CUSTOMER'S COPY

QUOTATION

ALBANY
INTERNATIONAL

Engineered Systems
Division

P.O. BOX 310, QUAKER RD., GLENS FALLS, N.Y. 12801/TEL. 518-793-8801/TELEX 145339

Page Two

Quotation Number: Q82-041T

MANUALS : Two operating manuals supplied with purchase of this equipment. Additional manuals \$15 each. Reproducibles of drawings (sepia or microfilm aperture cards) available at \$5 each.

START-UP SERVICE : For the AES Products as outlined in this quotation, no charge service will be provided as follows:

Field Service Technician: Two Days
Applications Engineer : Two Days

The customer has the option of assigning this no charge service time for Training Sessions, Installation Inspection or Start-Up Assistance. Should additional service be required, the following rates apply:

Field Service Technician @ \$220 per day
Applications Engineer @ \$350 per day

When service is scheduled by the customer with less than one week's notice, travel expenses will be charged at cost. A Purchase Order must be issued to cover the additional service requirements beyond the allocation as stated above.

VALIDITY: The prices quoted are firm for order placement 60 days from the date of this quotation for delivery not to exceed six (6) months from date of order issuance.

WARRANTY: ALBANY ENGINEERED SYSTEMS WARRANTS ALL AES PRODUCTS AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP IN NORMAL USE FOR ONE YEAR FROM DATE OF SHIPMENT, SUCH WARRANTY BEING LIMITED TO REPLACEMENT OR REPAIR OF DEFECTIVE PARTS AT OUR DISCRETION. WE HAVE NO LIABILITY FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED. THERE ARE NO OTHER WARRANTIES EXCEPT AS SET FORTH ABOVE.

CUSTOMER'S COPY

QUOTATION

ALBANY
INTERNATIONAL

Engineered Systems
Division

P.O. BOX 310, QUAKER RD., GLENS FALLS, N.Y. 12801/TEL. 518-793-8801/TELEX 145339

Page Three

Quotation Number: Q82-041T

SHIPMENT: After receipt of order and full customer approved technical data enabling us to proceed with engineering and manufacturing, our delivery schedule for the equipment specified in this quotation is detailed below. Any delay in our receipt of customer approved technical data may adversely affect the delivery date.

FOB: Denver, Co - 12-14 weeks

TERMS : 25% with prints for customer approval - Net 30 days.
75% at shipment - Net 30 days.

ACCEPTANCE: Orders are subject to acceptance at Glens Falls, NY.

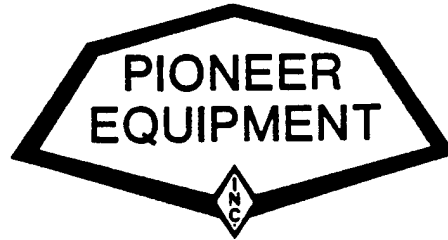
By: Peg Campbell
Customer Service

WARRANTY: ALBANY ENGINEERED SYSTEMS WARRANTS ALL AES PRODUCTS AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP IN NORMAL USE FOR ONE YEAR FROM DATE OF SHIPMENT, SUCH WARRANTY BEING LIMITED TO REPLACEMENT OR REPAIR OF DEFECTIVE PARTS AT OUR DISCRETION. WE HAVE NO LIABILITY FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED. THERE ARE NO OTHER WARRANTIES EXCEPT AS SET FORTH ABOVE.

CUSTOMER'S COPY

PROPOSAL

☐ P.O. Box 6753
Phoenix, Arizona 85005-6573
(602) 269-1323



☒ P.O. Box 27024
Tucson, Arizona 85726-7024
(602) 792-3255

FORMERLY AIR COMPRESSOR SERVICE

TO: Rubel and Hager, Inc.

DATE July 8, 1982

This proposal effective for 30 Days.

Attn: Mr. Frederick Rubel, Jr., P.E.

Gentlemen: We are pleased to quote on the following equipment:

C-101

QUAN.	DESCRIPTION	UNIT PRICE	AMOUNT
ONE	INGERSOLL-RAND COMPRESSOR PACKAGE, MODEL 7E3, COMPLETE WITH THE FOLLOWING MAJOR COMPONENTS: a) BARE COMPRESSOR #253 b) 7½ H.P. NEMA 3 PHASE 230/460 V MOTOR c) 120 GAL. ASME RECEIVER TANK d) PRE-WIRED AND MOUNTED MAGNETIC STARTER e) AIR COOLED INTERCOOLER f) ENCLOSED BELT GUARD g) AUTO/START/STOP CONTROL h) SAFETY SERVICE AND DRAIN VALVE. <u>PERFORMANCE DATA</u> a) 26.2 CFM PISTON DISPLACEMENT b) 20.3 CFM @ 100 PSI c) COMPRESSOR RPM - 660. TOTAL NET PRICE.....		2,800.00
	All Applicable Taxes to Apply		

F.O.B. Delivered Job Site

Delivery One week

Terms Net 30 days

PIONEER EQUIPMENT, INC.

BY Dick Cahill

This quotation not valid unless signed

Prices quoted are subject to adjustment to price in effect at time of shipment.

Warranty is limited to that on new machines as furnished by Manufacturers or as otherwise stated herein.

All items quoted herein are subject to prior sale or other disposition.

All orders taken which require financing are subject to the approval of our credit department or that of the financing institution.

Delivery date given on this order is contingent upon promised shipment from our suppliers and upon government restrictions or other factors beyond our control.

The above proposal is hereby accepted as outlined:

Customer _____

BY _____

Northwest Boundary Containment Treatment Facility
Rocky Mountain Arsenal, Commerce City, Colorado
Stearns-Roger Subcontract No. 7000 C26616

Process Design Calculations

Prepared by: D. G. Hager *DGH*
Checked by: F. Rubel, Jr. *FRJ*

I. Sizing of Liquid Phase Adsorption Vessels

A. Design Criteria

- 1) Superficial residence (empty bed) time required in upflow packed granular activated carbon bed for removal of 0.8 µg/l excess DBCP from potable water - 15 minutes minimum.
- 2) Raw water flow rate - 1500 gpm maximum.
- 3) Standard Westvaco Pulse Bed Adsorber volume - 1400 ft.³.

B. Calculations

- 1)a. Try two (2) standard Pulse Bed Adsorbers -
Volume = 2 x 1400 ft³ = 2800 ft³ = 21,000 gallons
Superficial Residence Time = $\frac{21,000 \text{ gallons}}{1500 \text{ gpm}} =$
14 minutes < 15 minutes. ∴ NG
- b. Try three (3) standard Pulse Bed Adsorbers -
Volume = 3 x 1400 ft³ = 4200 ft³ = 31,500 gallons
Superficial Residence Time = $\frac{31,500 \text{ gallons}}{1500 \text{ gpm}} =$
21 minutes > 15 minutes. ∴ OK

Use Three (3) standard Pulse Bed Adsorbers

2) Flow rate per adsorber

$$\frac{1500 \text{ gpm}}{3 \text{ adsorbers}} = 500 \text{ gpm/adsorber}$$

II. Process Pipe Sizing

A. Design Criteria

- 1) Pipe material - schedule 80 Type I PVC
- 2) Flow rate per treatment branch (train) ≤ 500 gpm
- 3) Raw water velocity ≤ 8.0 ft/sec
- 4) Treated water velocity ≤ 5.0 ft/sec
- 5) Slurry Flush/Eductor/Backwash water velocity ≤ 8.0 ft/sec

B. Calculations

- 1) Raw water pipe size (identical piping for each train)

- a) Try 4", $v = 8.99$ ft/sec > 8.0 ft/sec $\therefore$ NG
- b) Try 6", $v = 6.27$ ft/sec < 8.0 ft/sec $\therefore$ OK

Use 6" Schedule 80 Type I PVC Pipe and Fittings for Raw Water.

- 2) Treated water pipe size - Effluent from one adsorber

- a) Try 6", $v = 6.27$ ft/sec > 5.0 ft/sec $\therefore$ NG
- b) Try 8", $v = 3.57$ ft/sec < 5.0 ft/sec $\therefore$ OK

Use 8" Schedule 80 Type I PVC Pipe and Fittings for Effluent from one Adsorber.

- 3) Treated water pipe size - Effluent from two adsorbers

- a) Try 8", $v = 7.14$ ft/sec > 5.0 ft/sec $\therefore$ NG
- b) Try 10", $v = 4.54$ ft/sec < 5.0 ft/sec $\therefore$ OK

Use 10" Schedule 80 Type I PVC Pipe and Fittings for Effluent from two Adsorbers.

- 4) Treated water pipe size - Effluent from three adsorbers

- a) Try 10", $v = 6.80$ ft/sec > 5.0 ft/sec $\therefore$ NG
- b) Try 12", $v = 4.81$ ft/sec < 5.0 ft/sec $\therefore$ OK

Use 12" Schedule 80 Type I PVC Pipe and Fittings for Effluent from three Adsorbers.

5) Slurry Flush/Eductor/Backwash water pipe size

- a) Try 3", $v = 8.72 \text{ ft/sec} > 8.0 \text{ ft/sec} \therefore \text{NG}$
- b) Try 4", $v = 5.02 \text{ ft/sec} < 5.0 \text{ ft/sec} \therefore \text{OK}$

Use 4" Schedule 80 Type I PVC Pipe and Fittings
for Slurry Flush/Eductor/Backwash Water System.

III. Carbon Slurry Transfer Pipe Sizing

A. Criteria

- 1. Carbon Slurry Transfer to and from Carbon Transport Trailer - 4" Polypropylene lined Carbon Steel (flanged) Pipe
- 2. Carbon Slurry Transfer to and from Carbon Blowcases - 2" Polypropylene lined Carbon Steel (flanged) Pipe
- 3. Carbon Slurry Velocity = 5 ft/sec
- 4. Dry carbon density = 30 lb/ft³

B. Calculations

- 1. Time to transfer 20,000 lbs. granular activated carbon truckload to or from Carbon Transport Trailer

Pipe inside diameter = 3.612 in., Area = 10.25 in.² = .0712 ft²
@ velocity = 5 ft/sec Volume = 0.3558 ft³/sec = 21.35 ft³/min = 640 lb/min
Transfer Time = $\frac{20,000 \text{ lbs.}}{640 \text{ lbs/min}} = \underline{\underline{31.3 \text{ minutes}}}$

- 2. Time to transfer 2,000 lb. granular activated Carbon Pulse to and from Carbon Blowcases

Pipe inside diameter = 1.723 in., Area = 2.35 in.² = .0164 ft²
@ velocity = 5 ft/sec Volume = 0.0818 ft³/sec = 4.91 ft³/min = 147 lbs/min
Transfer Time = $\frac{2,000 \text{ lbs.}}{147 \text{ lbs/min}} = \underline{\underline{13.6 \text{ minutes}}}$

IV. Process Water Pressure Drop through each Treatment Train

A. Criteria

1. Since the piping design has not been accomplished at this time, a pressure drop calculation based upon conservative assumptions is provided.
2. Flow rate 500 gpm through 6" and 8" Pipe; head loss per 100' is 0.87 and 0.22 psig respectively.
3. Flow rate 1500 gpm through 12" Pipe; head loss per 100' = 0.24 psig.

B. Calculations

1. Pressure Drop through Pipe and Fittings

	Equivalent Pipe Length	ΔP
a) 80'-6" Sch. 80 PVC Pipe	80	2.3
b) 3 -6" Sch.80 PVC Tee @ 32.2'	96.6	
c) 6 -6" Sch.80 PVC 90° Ell @15.2'	91.2	
d) 40'-8" Sch.80 PVC Pipe	40	0.4
e) 1 -8" Sch.80 PVC Tee @39.9	39.9	
f) 4 -8" Sch.80 PVC 90° Ell @20'	80	
g) 40'-12" Sch.80 PVC Pipe	40	0.3
h) 3 -12" Sch.80 PVC 80° Ell @ 30	90	
		3.0 psig

2. Pressure Drop Through Valves and Flow Controller

a) 1-6" Check Valve @ 0.1 psig@	0.1
b) 3-6: Butterfly Valves @ 0.3 psig@	0.9
c) 1- Rate of Flow Controller @ 7.0 psig (max.)	9.0
10.0 psig	

3. Pressure Drop Through Adsorber and Filter Modules (pressure drop will build up in each of these modules until a maximum is reached at which time backwash or cartridge change will significantly decrease the pressure drop).

	<u>ΔP</u>
a) Prefilter Module - 15 psi (max.)	15.0
b) Pulse Bed Adsorber Module - 25 psi (max.)	25.0
c) Post filter Module - 10 psi (max.)	<u>10.0</u>
	50.0 psig
4. Gravity head - 12 ft.	5.2 psig
5. Velocity head	0.3 psig
6. Total ΔP (1 through 5 above)	<u>68.5 psig</u>

Stearns-Roger

PAGE

1

JOB NO. 26616 DATE 7-2-82 BY GLW CH'K. _____
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT.
SUBJECT DESIGN LOADS STRUCTURAL.

BUILDING LOADS PRELIMINARY DESIGN.

Roof DEAD LOAD = 20 psf
LIVE LOAD OR } = 30 psf = (0.8 x 35 psf)
SNOW LOAD } ANSI 7.2.1

CONTINGENCY LOAD AT MID SPAN = SAY 5.0 K.

WALL LOAD = 5 psf

WIND LOAD = 24 psf. ANSI Exposure "C"
80 MPH.

SEISMIC ZONE 1

SOIL BEARING PRESSURE 3000 psf.

EQUIPMENT LOADS

ABSORBERS = 140,000 LBS. EACH

DUAL BLOW CASE = 20,000 LBS

STORAGE MODULE = 75,000 LBS EACH.

PRE FILTERS =

POST FILTER =

PUMPS =

ACCESS WALKWAY DEAD LOAD = 25 psf
LIVE LOAD = 100 psf

ALLOW FOR EQUIPMENT PADS TO BE
4" ABOVE FINISHED FLOOR LEVEL WITH
ALLOWANCE OF GROUT FOR LEVELLING.

FOUNDATION DEPTHS TO BELOW FROST LINE
OF 3'-6"

A E I M 9. 1/81.

Stearns-Roger

PAGE

2

JOB NO. 26616 DATE 7-2-82 BY GLW CH'K.
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT
SUBJECT FOUNDATION LOADS FROM BUILDING

CENTER COL.

TRIBUTARY WIDTH 25'-0" SPAN 40'-0"
HEIGHT 30'-0"

Roof $DL = 20 \times 25'-0" = 0.5^k/ft$
 $LL = 30 \times 25'-0" = 0.75^k/ft$
 $1.25^k/ft$

REACTION AT COL = $1.25 \times \frac{40}{2} = 25.0^k$
 5.0^k CONTINGENCY + 2.5^k
Roof TOTAL / COL = 27.5^k

LOAD FROM SIDING = $5 \times 25 \times 30'-0" = 3.75^k$

TOTAL VERTICAL AT BASE = 31.25^k

END COLS WILL BE $\frac{1}{2}$ THIS LOAD
PLUS VERTICAL END WALL LOAD

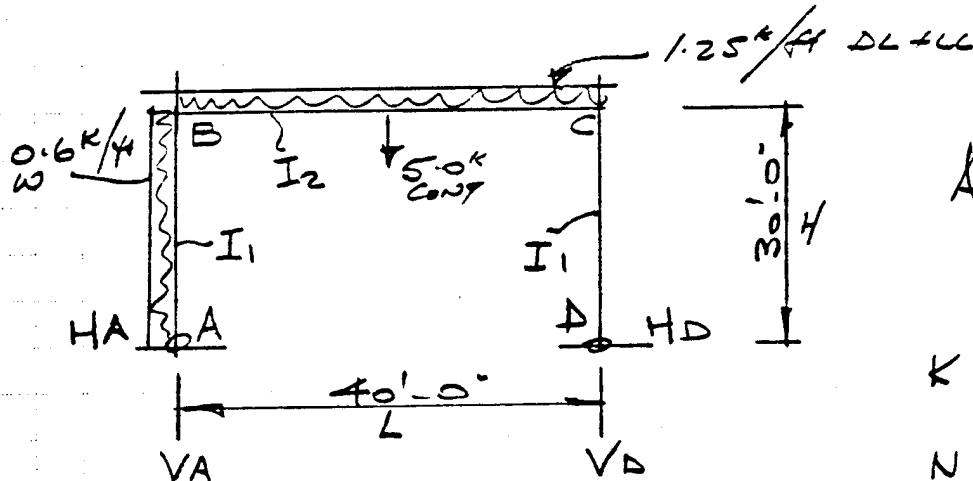
$= 31.25/2 + 5 \times 14 \times 30 = 17.73^k$

WIND LOAD ON SIDE WALL
 $= 24 \times 25'-0" = 0.6^k/ft$ CENTER COL
 $0.3^k/ft$ END COL

By INSPECTION WIND WILL CONTROL
BUILDING DESIGN AND SEISMIC WILL
CONTROL FOUNDATIONS FOR INTERIOR
VESSELS.

JOB NO. 26616 DATE 7-2-82 BY gfw CH'K.
CUSTOMER RMA PROJECT GROUND WATER TREATMENT
SUBJECT FOUNDATION LOADS FROM BUILDING

FROM STEEL DESIGNERS MANUAL BY UNGER
USE FRAME TYPE II (pg 291).



Assume I_1 & I_2
 $= 1.0$

$$K = \frac{I_2}{I_1} \times \frac{30}{40} = 0.75$$

$$N = 2K + 3 = 4.75$$

Roof LL+LL

$$M_B = M_C = \frac{1.25 \times 40^2}{4 \times 4.75} = -105.26 \text{ K-ft}$$

$$V_A = V_D = \frac{wL}{2} = +25.0 \text{ K}$$

$$H_A = H_D = -\frac{105.26}{30} = -3.5 \text{ K}$$

WIND

$$M_B = \frac{0.6 \times 30^2}{4} \left[-\frac{0.75}{2 \times 4.75} + 1 \right] = +124.2 \text{ K-ft}$$

$$M_C = \frac{0.6 \times 30^2}{4} \left[-\frac{0.75}{2 \times 4.75} - 1 \right] = -145.8 \text{ K-ft}$$

$$H_D = -\frac{M_C}{H} = -\frac{-145.8}{30} = +4.86 \text{ K}$$

$$H_A = -(0.6 \times 30 - 4.86) = +13.14 \text{ K}$$

$$V_A = V_D = -\frac{0.6 \times 30^2}{2L} = V_A = -6.75 \text{ K}, V_D = +6.75 \text{ K}$$

Stearns-Roger

PAGE

4

JOE NO. 26616 DATE 7-2-82 BY gfw CHK.
CUSTOMER RMA PROJECT GROUND WATER TREATMENT
SUBJECT FOUNDATION LOADS FROM BUILDING.

5.0K CONTINGENCY LOAD.

$$M_B = M_C = - \frac{3 \times 5 \times 40}{8 \times 4.75} = -15.8 \text{ Kgf}$$

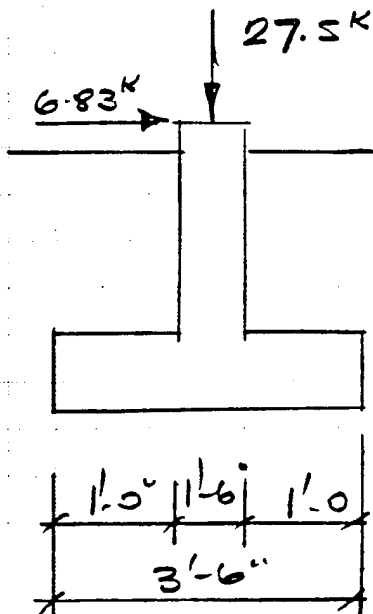
$$V_A = V_D = 5/2 = +2.5 \text{ K}$$

$$H_A = H_D = - \frac{15.8}{30} = -0.53 \text{ K}$$

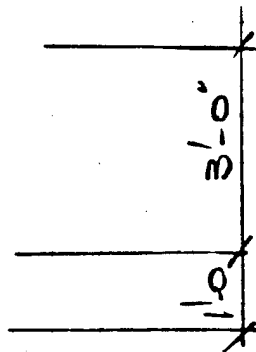
TOTAL LOADS

LOAD	M _B	M _C	V _A	V _D	H _A	H _D
DL+LL	-105.26	-105.26	+25.0	+25.0	-3.5	-3.5
WIND	+124.2	-148.8	-6.75	+6.75	-4.86	+13.14
5.0K.	-15.8	-15.8	+2.5	+2.5	-0.53	-0.53
DL+LL+5.0	-121.06	-121.06	+27.5	+27.5	-4.03	-4.03
WITH WIND AT 0.75	2.36 ^{ff}	200 ^{ff}	+15.56 ^K	+25.69 ^K	-6.67 ^K	+6.83 ^K

JOE NO. 26616 DATE 7-2-82 BY gfw CH'K
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT
SUBJECT BUILDING FOUNDATIONS



Worst Case



Try Base $3'-6 \times 3'-6$
= 12.25 sq ft

$$\begin{aligned} \text{PIER} &= 1.5 \times 1.5 \times 3 \times 0.15 = 1.0125 \times 1.75 = 1.77 \\ \text{SLAB} &= 3.5 \times 3.5 \times 1.0 \times 0.15 = 1.8375 \times 1.75 = 3.22 \\ \text{SOIL} &= (3.5^2 - 1.5^2) \times 2.5 \times 0.1 = 2.5 \times 1.75 = 4.375 \\ P &= \frac{27.5}{32.85} \times 1.75 = 48.125 \\ \Sigma W &= 57.49 \text{ k} \end{aligned}$$

$M_{OT} = 6.83 \times 4.0 = 27.32 \text{ k ft}$

$\bar{X} = \frac{57.49 - 27.32}{32.85} = 0.918 \text{ ft} < 1.17$

$e = \frac{3.5}{2} - 0.918 = 0.832 \text{ ft}$

$I = \frac{3.5 \times 3.5^3}{12} = 12.5 \text{ ins}^4$

$P = \frac{32.85}{12.25} + \frac{32.85 \times 0.832 \times 1.75}{12.5}$
= 2.68 + 3.826 > 3 ksf

Try 5'-0" Squ.

Stearns-Roger

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JOB NO. 26616 DATE 7-2-82 BY GFW CH'K. _____
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT
SUBJECT BUILDING FOUNDATIONS

$$\begin{aligned} \text{PIER} &= 1.5 \times 1.5 \times 3 \times 0.15 = 1.0125 \times 2.5 = 2.53 \\ \text{SLAB} &= 5.0 \times 5.0 \times 1.0 \times 0.15 = 3.75 \times 2.5 = 9.375 \\ \text{SOIL} &= (5.0^2 - 1.5^2) \times 3 \times 0.1 = 6.825 \times 2.5 = 17.063 \\ P &= 27.5 \times 2.5 = 68.75 \\ \Sigma W &= 39.1 \text{ K} \quad \Sigma MR = 97.72 \text{ Kft} \end{aligned}$$

$$M_{OT} = 6.83 \times 4 = 27.32 \text{ Kft}$$

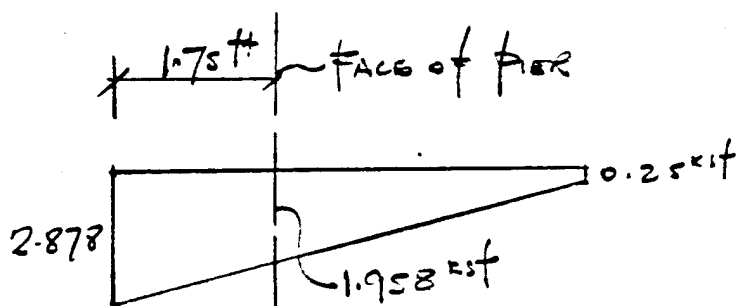
$$\bar{X} = \frac{97.72 - 27.32}{39.1} = 1.8 \text{ ft}$$

$$e = \frac{5.0}{2} - 1.8 = 0.7 \text{ ft}$$

$$I = \frac{5.0 \times 5.0^3}{12} = 52.08 \text{ in}^4$$

$$P = \frac{39.1}{25.0} \pm \frac{39.1 \times 0.7 \times 2.5}{52.08}$$

$$= 1.564 \pm 1.314 = +2.878 \text{ Ksf} < 3.0 \\ + 0.25 \text{ Ksf}$$



$$\text{Bnl @ Face of Pier} = \frac{1.958 \times 1.75^2}{2} + \frac{0.92 \times 1.75^2 \times 0.66}{2} \\ = 3.0 + 1.0 = 4.0 \text{ Kft}$$

$$A_s = \frac{M}{a d} = \frac{4.0}{1.76 \times 9} = 0.25 \text{ in}^2$$

$$\text{Min } A_s = 12 \times 12 \times 0.002 = 0.288 \text{ in}^2$$

USE #5 @ 12" c/c Both Ways IN SLAB.

Stearns-Roger

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JOB NO. 26616 DATE 7-6-82 BY g/w CH'K _____
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT
SUBJECT BUILDING FOUNDATIONS

PIER REINFORCING

$$BM = 6.83 \times 3.0 = 20.49 \text{ Kft}$$

$$As = \frac{20.49}{1.76 \times 13.5} = 0.862 \text{ in}^2$$

USE 2-#6 $As = 0.88 \text{ in}^2$

SO USE 4-#6 IN PIERS WITH
#3 TIES AT 12" CENTERS.

CORNER COLS WILL HAVE $\frac{1}{2}$ ROOF LOAD & $\frac{1}{2}$ WIND LOAD. BUT WILL HAVE ADDITIONAL SIDING LOAD.

$$\text{SO HORIZONTAL FROM WIND} = 6.83/2 = \underline{3.42 \text{ K}}$$

$$\text{VERTICAL: SIDING} = 10 \times 5 \times 30 = 1.5 \text{ K}$$

$$+ 3.75/2 = 1.875 \text{ K}$$

$$\text{FROM ROOF} = 25.0/2 = 12.5 \text{ K}$$

$$+ 5.0 \text{ K CONTINGENCY} = 5.0$$

$$\underline{20.875 \text{ K TOTAL VERT}}$$

$$\text{SAY } \underline{21.0 \text{ K}}$$

TRY 3'-6" Sq BASE (295)

$$\text{PIER} = 1.5 \times 1.5 \times 3 \times 0.15 = 1.0125 \times 1.75 = 1.77$$

$$\text{SLAB} = 3.5 \times 3.5 \times 1.0 \times 0.15 = 1.8375 \times 1.75 = 3.22$$

$$\text{SOIL} = (3.5^2 - 1.5^2) \times 2.5 \times 0.1 = 2.5 \times 1.75 = 4.375$$

$$P = \underline{21.0} \times 1.75 = \underline{36.75}$$

$$\Sigma W = \underline{26.38 \text{ K}}$$

$$\Sigma M = \underline{46.115 \text{ Kft}}$$

$$MOT = 3.42 \times 4.0 = 13.68 \text{ Kft}$$

JOB NO. 26616 DATE 7-6-82 BY g/w CH'K. 8
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT
SUBJECT BUILDING FOUNDATIONS

CORNER COLS (CONT).

$$\bar{X} = \frac{46.11 - 13.68}{26.38} = 1.23 \text{ ft.}$$

$$e = \frac{3.5}{2} - 1.23 = 0.52 \text{ ft.}$$

$$I = 12.5 \text{ in}^4$$

$$P = \frac{26.38}{12.25} + \frac{26.38 \times 0.52 \times 1.75}{12.5}$$

$$2.15 \pm 1.92 = 4.07 > 3.0$$

FOR PRELIMINARY DESIGN
USE 4'-0" Sq WITH #5 @ 12" CRS BOTH WAYS
USE SAME FOR PIER 1'-6" SQUARE
A-#6 @ #3 TIES.

EQUIPMENT FOUNDATIONS:

WITH EQUIPMENT BEING INSIDE BUILDING
SEISMIC WILL CONTROL DESIGN OF FOUNDATION
ABSORBERS W = 140K EACH, 9'-0" Ø, 23'-0" HIGH

$$V = ZKCW$$

$$= 0.25 \times 2.0 \times 0.1 \times 140 = 7.0 \text{ K}$$

$$OTM = 7.0 \times 11.5 = 80.5 \text{ Kft}$$

$$\begin{aligned} \text{RESISTING MOMENT} &= 140 \times 4.5 = 630 \text{ Kft} \\ + \text{BASE WEIGHT} &= 9.0 \times 9.0 \times 0.83 \times 0.15 \\ &= 10.12 \text{ K} \times 4.5 = 45.5 \text{ Kft} \end{aligned}$$

Stearns-Roger

JOB NO. 26616 DATE 7-6-82 BY glo CH'K. 9
CUSTOMER RMA PROJECT GROUND WATER TREATMENT
SUBJECT FOUNDATIONS.

ADSORBERS (cont).

$$\bar{X} = \frac{675.5 - 80.5}{150.12} = 3.96 \text{ ft}$$

$$e = \frac{9.0}{2} - 3.96 = 0.54 \text{ ft}$$

$$I = \frac{9.0 \times 9.0^3}{12} = 546.75 \text{ ins}^4$$

$$P = \frac{150.12}{81} \pm \frac{150.12 \times 0.54 \times 4.5}{546.75}$$

$$= 1.853 \pm 0.667 = + 2.52 \text{ ksf} \\ + 1.186 \text{ ksf}$$

$$\text{Min } A_s = 12 \times 10 \times 0.002 \\ = 0.24 \text{ Sq ins}$$

Use #4 @ 9" CRS ($A_s = 0.27$)
BOTH WAYS IN BOTTOM.

By inspection of ALL EQUIPMENT LOADS
AND SIZE OF FOUNDATIONS, USE T/E ABOVE
FOR ALL LARGE FOUNDATIONS

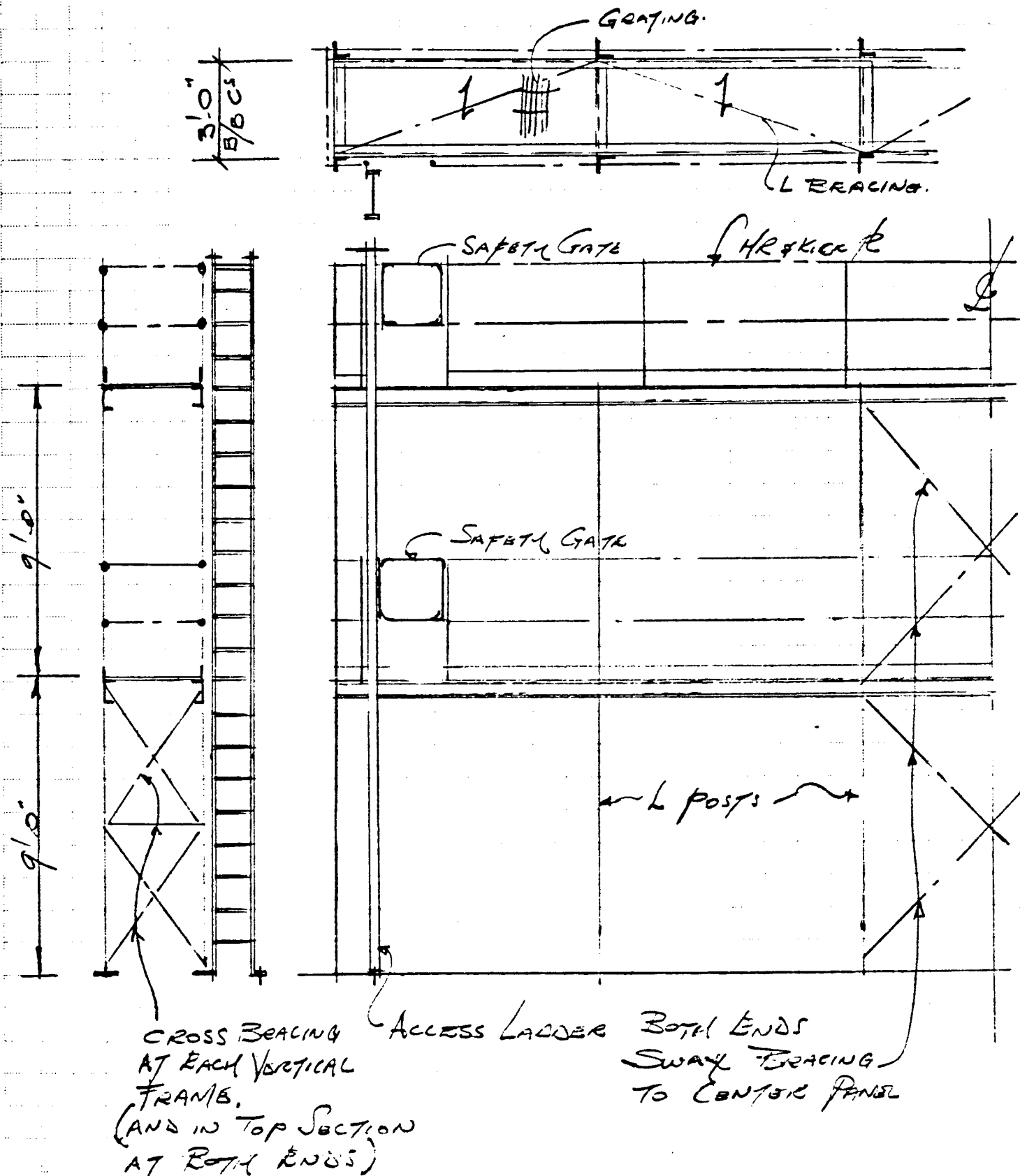
USE 1'-3 THICK SLAB + 2" GROUT ALLOWANCE
UNDER ALL LARGE EQUIPMENT FOUND'S
TO ALLOW FOR 1" Ø ANCHOR BOLT PULL OUT CAPACITY
& EMBEDMENT LENGTH OF 12"
FOR FLOOR SLAB 6" THICK REINFORCED WITH
ONE LAYER WWT 4x4 - W4.0 x W4.0

Stearns-Roger

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JOB NO. 26616 DATE 7-6-82 BY gfw CH'K.
CUSTOMER D.M.A. PROJECT GROUND WATER TREATMENT
SUBJECT WALKWAY ACCESS TO ADSORBERS.



Stearns-Roger

PAGE 1

JOB NO. 26616 DATE 7-8-82 BY TKO CH'K. JMC
CUSTOMER Rocky Mtn Arch. Inc. PROJECT RAW WATER TREATMENT FACILITY
SUBJECT TOILET ROOM

VENTILATION

SIZE OF ROOM 6' W x 8' L x 9' H → FROM ARCH.

MIN. VENTILATION = 10 AC / HR. PER TMS-810-1 PG. 22

VOLUME OF ROOM = (6')(8')(9') = 432 FT³

$$\therefore \text{MIN CFM} = (432 \text{ FT}^3) \left(\frac{10}{\text{HR}} \right) \left(\frac{\text{HR}}{60 \text{ MIN}} \right) = 72 \text{ CFM}$$

COST OF FAN FROM MEAD 1982 PG 226 ⇒ \$63.00
INSTALLATION = 1 M. H.

20 FT DUCTWORK @ .66 / FT ⇒ COST = \$13.20
INSTALLATION ⇒ .03 M. H. / FT
TOTAL = 1 M. H.

WALL GRILLE → 6" x 6" COST = \$5.00
LABOR = 1 M. H.

Stearns-Roger

PAGE 2

JOE NO. 26616 DATE 7-8-82 BY _____ CH'K JMC
CUSTOMER _____ PROJECT _____
SUBJECT TOILET ROOM

HEATING

TWO OUTSIDE WALLS $\Rightarrow U = .15 \frac{\text{BTUH}}{\text{CF} \cdot \text{FT}^2}$

AREA WALL 1 $8' \text{ W} \times 8' \text{ H} = 64 \text{ FT}^2$

WALL 2 $6' \text{ W} \times 8' \text{ H} = 48 \text{ FT}^2$

TOTAL AREA $= 112 \text{ FT}^2$

DESIGN TEMP FROM TMS-810-1, PG 1, TEMP = 60°F
FROM TMS-785 WINTER DESIGN DRY-BULB $\Rightarrow 97.5\% = 10^\circ\text{F}$
 $\therefore \Delta T = 10^\circ\text{F}$

$\therefore \Delta T = 60 - 1 = 59^\circ\text{F}$

$\therefore Q = (U)(A)(\Delta T) = (.15)(112)(59)$
 $Q_{\text{OUTSIDE}} = 990 \text{ BTUH}$

ESTIMATE U VALUE OF INTERNAL WALLS & CEILING = $.30 \frac{\text{BTUH}}{\text{CF} \cdot \text{FT}^2}$
FROM ASHRAE 1981 FUNDAMENTALS TABLE 4C PG 23.21

$\therefore$ AREA OF WALLS = 112 FT^2 SAME AS EXTERIOR WALLS
AREA OF CEILING = $8' \times 6' = 48 \text{ FT}^2$

$\therefore$ TOTAL AREA = 160 FT^2
 $\Delta T = 60 - 40 = 20^\circ\text{F}$

$\therefore Q = U A \Delta T = (.3)(160)(20^\circ\text{F})$
 $= 960 \text{ BTUH}$

$\therefore$ TOTAL HEAT NEED = $960 + 990 = 1950 \text{ BTUH} \sim 2000 \text{ BTUH}$
 $\sim 600 \text{ W}$

Stearns-Roger

PAGE 3

JOB NO. _____ DATE _____ BY TKO CH'K. JMC
CUSTOMER _____ PROJECT _____
SUBJECT _____

DESIGN USING INFRARED HEATING.

FOR A DAYTON 550 W, GRANGER STOCK # 31374

PRICE = \$47.00

120V

THERMOSTAT = \$40

USING A GENERAL ELECTRIC GH500 T3 500W INCANDESCENT
LIGHT WITH A RECESSED FIXTURE. PRICE \$15.00.

USE A THERMOSTAT = \$40.00

TO BE ESTIMATED BY ELECTRICAL.

Siearns-Roger

PAGE 1

JOB NO. 26616 DATE 7-1-82 BY TKO CHK JML
CUSTOMER Rocky Mtn. Arsenal PROJECT RAW WATER TREATMENT FACILITY
SUBJECT HEAT LOAD CALC.

ASSUME U VALUES:

$$\left. \begin{array}{l} \text{WALL} = .15 \frac{\text{BTU}}{\text{F}^2\text{FT}} \\ \text{ROOF} = .10 \frac{\text{BTU}}{\text{F}^2\text{FT}} \end{array} \right\} \text{REF. DOD. 4270; 1-M TABLE 9.2}$$

DESIGN INTERIOR TEMP = 40°F , REF: DOD 4270.1-M, CH. 9-2.1

CALC. OF HEAT LOAD.:

REF.: ASHRAE FUNDAMENTALS '1981 $\rightarrow$ 25.2

$$Q = UA \Delta T$$

WINTER DESIGN DRY-BULB $\rightarrow 97.5\% = 10^{\circ}\text{F}$ TMS-785

$$\therefore \Delta T = 40 - 1 = 39^{\circ}\text{F}$$

FROM ARCH. DWG. ROOF AREA = $(40\text{ FT})(73\text{ FT}) = 2920\text{ FT}^2$

$$\text{WALL AREA} = 30\text{ FT}(2(40\text{ FT}) + 2(73\text{ FT})) = 6780\text{ FT}^2$$

$$Q = UA \Delta T \Rightarrow$$

$$Q_{\text{WALL}} = (.15)(6780)(39) = 3970 \text{ BTUH}$$

$$Q_{\text{ROOF}} = (.10)(2920)(39) = \underline{11400 \text{ BTUH}}$$

TOTAL HEAT LOAD FOR WINTER = 51100 BTUH DUE TO TRANSMISSION
HEAT LOSS

Stearns-Roger

PAGE 2

JOB NO _____ DATE _____ BY TRO CH'K. JML
CUSTOMER _____ PROJECT _____
SUBJECT _____

PER ASHRAE CH 22.8 ESTIMATE 1 A.C./HR. DUE TO INFILTRATION
 $\therefore \text{VOLUME OF AIR} \Rightarrow (30)(40)(73) = 87600 \text{ FT}^3$
 $\therefore Q = (1.08)(.825)(\text{CFM})(\Delta T)$
 $= (1.08)(.825)(87600)(60)(40-1)$
 $= 50800 \text{ BTUH}$

$\therefore \text{HEAT LOAD DUE TO INFILTRATION} = 50800 \text{ BTUH}$

HEAT LOAD THRU SLAB $\Rightarrow$ ASHRAE 1981 FUNDAMENTALS $\Rightarrow 25.8 \Rightarrow 25.9$

$$Q = F_2 P (T_i - T_o)$$

EST. FOR A METAL STUD WALL WITH INSULATION $F_2 = .53$
 $P = \text{PERIMETER OF SLAB} = (2)(40') + 2(73') = 226 \text{ FT}$

$$\therefore Q = (.53)(226)(40-1) = 4670 \text{ BTUH}$$

$\therefore \text{HEAT LOAD DUE TO FLOOR SLAB} = 4670$

$$\begin{array}{r} \therefore \text{TOTAL DESIGN HEAT LOAD} = 51100 \\ 50800 \\ \underline{4670} \\ 106570 \text{ BTUH} \end{array}$$

ADD 15% SAFETY FACTOR $\Rightarrow (1.15)(106570) \text{ BTUH} = 122560 \text{ BTUH}$

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PAGE 3

JCB NO. _____ DATE _____ BY TKO CH'K. JMC
CUSTOMER _____ PROJECT _____
SUBJECT _____

HEATING LOAD = 122,560 BTUH

USE 4 MODINE PA-50 HEATERS

RATED: INPUT 50,000 BTUH

OUTPUT: 40,000 BTUH

DERATED: INPUT: $(.84)(50,000) = 42,000 \text{ BTUH}$
OUTPUT: $(.84)(40,000) = 33,600 \text{ BTUH}$

TOTAL CAPACITY: INPUT: $(4)(42,000) = 168,000 \text{ BTUH}$
OUTPUT: $(4)(33,600) = 134,400 \text{ BTUH}$

HEAT THROW (FE): 23

PROPANE: 20 CFH EA. OR 80 CFH TOTAL

COST FOR UNIT HEATER: \$420.00 EA WITH INTERMITTENT PLOT
LABOR: 16 M.H. TOTAL

COST FOR 5" DIA. VENT CHIMNEY: 5" DIA $\rightarrow$ 100 FT

MATERIAL: \$2.50 L.F. $\rightarrow$ \$250.00

LABOR: 25 M.H. .25 M.H. / L.F.

THERMOSTATS B-C TA-121 MATERIAL \$55 EA.

PIPING: 3/4" $\rightarrow$ 200' TOTAL PIPING

50' UNDERGROUND $\rightarrow$ 16 M.H. + TRENCHER

150' HUNG $\rightarrow$ 24 M.H.

MATERIAL \$1.00 LF $\rightarrow$ \$200

FITTINGS $\rightarrow$ \$200

Stearns-Roger

PAGE 4

JOB NO. 26616 DATE 7-7-87 BY TKO CHK. JMC
CUSTOMER ROCKY MOUNTAIN ARGENT PROJECT RAW WATER TREATMENT FACILITY
SUBJECT CALC. OF PROPANE USAGE

REF. HEAT LOAD CALCULATIONS.

$$\begin{aligned} \therefore Q_{WALL} &= (.15)(6780)(\Delta T) = (1017)(\Delta T) \\ Q_{ROOF} &= (.10)(2920)(\Delta T) = (292)(\Delta T) \\ Q_{TRANSMISSION} &= (1017 + 292)(\Delta T) = (1309)(\Delta T) \\ Q_{INFILTRATION} &= (1.08)(.825)(87600)(\frac{1}{60})(\Delta T) \\ &= (1301)(\Delta T) \\ Q_{SLAB} &= (.53)(226)(\Delta T) = (120)(\Delta T) \\ \therefore Q_{TOTAL} &= (.15)(1309 + 1301 + 120)(\Delta T) \\ &= (3140)(\Delta T) \end{aligned}$$

REF. ASHRAE SYSTEMS 43.12 FOR DENVER AREA

OUTDOOR TEMP	HRS	BTUH @ 1°F	ΔT 40°F	BTUH HEAT LOSS	TOTAL BTU
37	717	3140	3	9420	6754140
32	721		8	25120	18111520
27	553		13	40820	22573460
22	359		18	56520	20290680
17	216		23	72220	15599520
12	119		28	87920	10462480
7	78		33	103620	8082360
2	36		38	119320	4295520
-3	22		43	135020	2970440
-8	6		48	150720	904320
-13	1		53	166420	166420
-18	1		58	182120	182120

TOTAL

110392980 BTU

ASSUME 80% EFFICIENCY ON HEATERS $\Rightarrow \frac{110392980}{.80} = 137,911,230$ BTU

$\frac{92000 \text{ BTU}}{\text{GAL. PROPANE}} \Rightarrow \text{GAL PROPANE} = \frac{137911230}{92000} = 1500 \text{ GAL}$

$\therefore$ DESIGN YEARLY USE OF PROPANE = 1500 GAL

Stearns-Roger

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JOB NO. 26616 DATE 7-7-82 BY TKO CH'K. JNC
CUSTOMER _____ PROJECT _____
SUBJECT _____

∴ SIZE FOR 1000 GAL PROPANE TANK TO BE FILLED
MONTHLY IN THE WINTER

COST OF TANK : \$1500.00
REGULATING VALVE : \$50.00

MUST INSTALL TANK 25FT MIN FROM BLDG.

INSTALLATION: 16 M.H.

HANGERS FOR THE HEATERS → \$20.00 FOR EA. HEATER
TOTAL COST = \$80.00

ISOLATION VALVES FOR HEATERS AND REGULATOR, ∴ 10 VALVES
\$10.00 EA.

VENT CAP @ \$20 EA. ∴ \$80.00

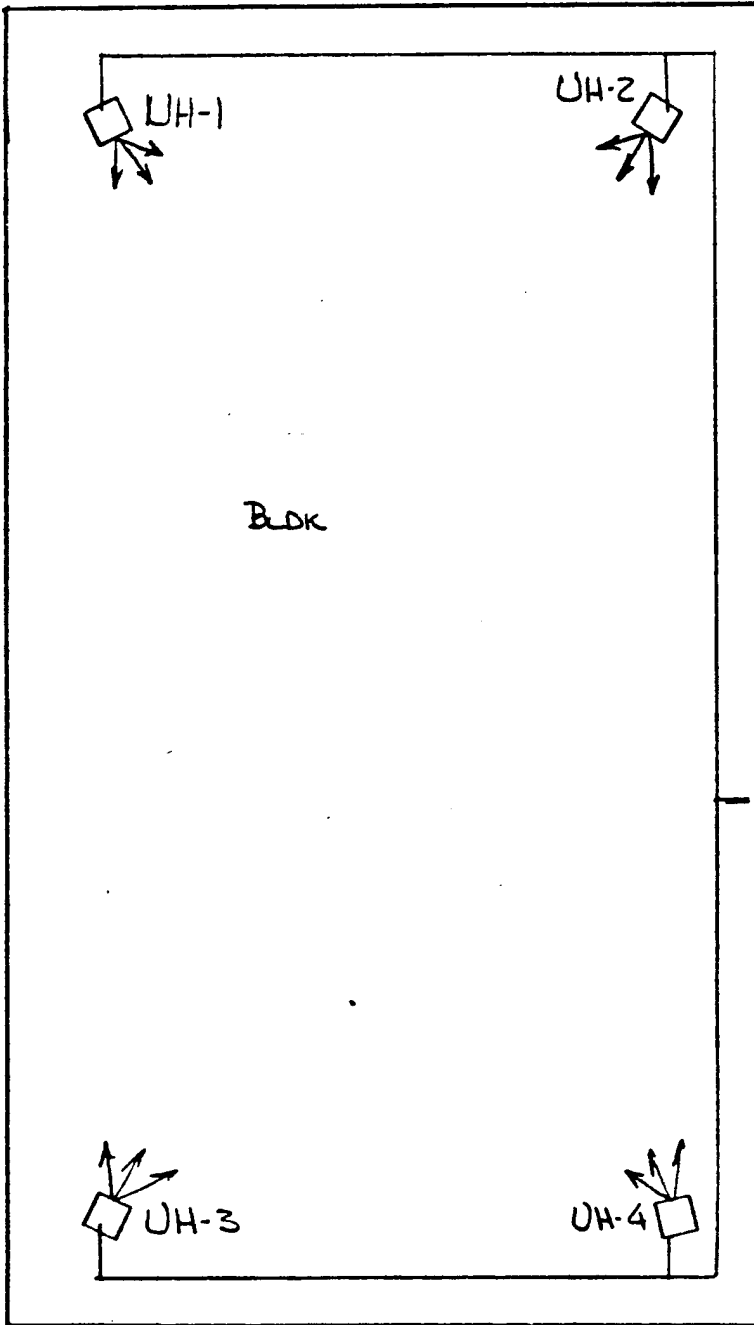
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JOB NO. _____ DATE _____ BY TKC CH'K. JMC

CUSTOMER _____ PROJECT _____

SUBJECT _____



TACK
1000
GAK

Stearns-Roger

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JOB NO. 21616 DATE 7-7-82 BY TKO CH'K. JMC
CUSTOMER ROCKY MTN. ARSENAL PROJECT RAW WATER TREATMENT FAC.
SUBJECT COOLING LOAD

ASHRAE FUND. 1981 PG. 26.3 $Q = U * A * CLTD$

COOLING LOAD DUE TO ROOF

$$U = .10 \frac{\text{BTU}}{\text{H} \cdot \text{F}^2} \text{ DOD 4270.1-M TABLE 9.2}$$

$$A = (40') (75') = 3000 \text{ FT}^2$$

CLTD $\Rightarrow$ ASHRAE FUND. PG. 26.8

TABLE 5A CLTD = 79°F @ 14:00

$$\text{PG. 26.8 } CLTD_{\text{corr}} = [(CLTD + LM)K + (T_B - T_R) + (T_o - 85)] * f$$

WHERE $T_{\text{room}} = 102^\circ\text{F}$ EQUIPMENT MAX. TEMP.

$T_{\text{outside}} = 91^\circ\text{F}$ 97.5% SUMMER DRY BULB TMS-785

$f = 1.0$ NO ATTIC

$LM = 2$ FROM TABLE 9A

$K = 1.0$ INDUSTRIAL AREA

$$\therefore CLTD_{\text{corr}} = (79 + 2) + (78 - 102) + (91 - 85) = 63^\circ\text{F}$$

$$\therefore Q_{\text{ROOF}} = (.10) (3000) (63) = 18900 \text{ BTU/H}$$

COOLING LOAD DUE TO WALLS

$$U = .15 \frac{\text{BTU}}{\text{H} \cdot \text{F}^2} \text{ DOD 4270.1-M TABLE 9.2}$$

AREAS OF WALL $\rightarrow$ NORTH AREA = $A_N = (40') (30') = 1200 \text{ FT}^2$

SOUTH AREA = $A_S = (40') (30') = 1200 \text{ FT}^2$

EAST AREA = $A_E = (75') (30') = 2250 \text{ FT}^2$

WEST AREA = $A_W = (75') (30') = 2250 \text{ FT}^2$

FROM TABLE 6 GROUP B WALL

$\therefore$ FROM TABLE 7A : NORTH WALL @ 2:00 CLTD_N = 9°F

SOUTH WALL @ 2:00 CLTD_S = 12°F

EAST WALL @ 2:00 CLTD_E = 22°F

WEST WALL @ 2:00 CLTD_W = 14°F

$$\text{PG. 26.12 } \Rightarrow CLTD_{\text{corr}} = (CLTD + LM) * K + (T_B - T_R) + (T_o - 85)$$

SAME DESIGN CONDITIONS AS ABOVE

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JOB NO. 26616 DATE 7-7-82 BY TKO CH'K. JML

CUSTOMER _____ PROJECT _____

SUBJECT _____

$$CLTD_{CORR_N} = (9+1)(1.0) + (78-102) + (91-85) \\ = -8^{\circ}F$$

$$CLTD_{CORR_S} = (12-1) + (78-102) + (91-85) \\ = -7^{\circ}F$$

$$CLTD_{CORR_E} = (22+1) + (78-102) + (91-85) \\ = 5^{\circ}F$$

$$CLTD_{CORR_W} = (14+1) + (78-102) + (91-85) \\ = -3^{\circ}F$$

$$\therefore Q_{NORTH\ WALL} = (.15)(1200)(-8) = -1440\text{ BTUH} = Q_{NW}$$

$$Q_{SOUTH\ WALL} = (.15)(1200)(-7) = -1200\text{ BTUH} = Q_{SW}$$

$$Q_{EAST\ WALL} = (.15)(2250)(5) = 1690\text{ BTUH} = Q_{EW}$$

$$Q_{WEST\ WALL} = (.15)(2250)(-3) = -1010\text{ BTUH} = Q_{WW}$$

$$\therefore \text{TOTAL } Q \text{ FROM WALLS} \Rightarrow Q_W = Q_{NW} + Q_{SW} + Q_{EW} + Q_{WW} \\ = -1440 - 1200 + 1690 - 1010 \\ Q_W = -2020\text{ BTUH}$$

$$\therefore \text{TOTAL TRANSMISSION GAIN} = Q_{ROOF} + Q_{WALL} = 18900 + (-2020) \\ \therefore Q_T = 15180\text{ BTUH}$$

$$\text{ESTIMATE LIGHT LOAD} = 1\text{ W/FT}^2$$

USE INCANDESCENT LIGHTS

$$\text{AREA} = (40' \times 75') = 3000\text{ FT}^2$$

$$Q_L = (1\text{ W/FT}^2)(3000\text{ FT}^2)(3.4\text{ BTUH/W})$$

$$Q_L = 10200\text{ BTUH}$$

JCB NO. 26616 DATE 7-7-82 BY TKO CH'K. JML
CUSTOMER _____ PROJECT _____
SUBJECT _____

ESTIMATE EQUIPMENT, PUMP & AIR COMPRESSOR MOTOR LOADS
TO BE 20 H.P. TOTAL. FROM ASHRAE 1961 FUNDAMENTALS
TABLE 24 PG. 26.29 MOTOR IN, DRIVEN EQUIPMENT OUT OF THE
AIR STREAM:

$$Q_m = 7610 \text{ BTUH}$$

PERSONNEL LOAD

FROM ASHRAE 1981 FUND., TABLE 18, PG. 26.25 LIGHT BENCH
WORK, MALE

$$Q_p = 880 \text{ BTUH}$$

∴ TOTAL DESIGN HEAT LOAD IN THE BLDG.

15180 BTUH → TRANSMISSION

10200 BTUH → LIGHTING

7610 BTUH → MOTORS

880 BTUH → PERSONNEL

$$Q_{\text{TOTAL}} = 33870 \text{ BTUH}$$

ADD 20% SAFETY FACTOR

$$\therefore Q_{\text{TOTAL}} = (1.2)(33870) = 40650 \text{ BTUH}$$

DESIGN FEA ROOM TEMP. = 102°F

OUTSIDE AIR TEMP. = 91°F

$$\therefore \Delta T = 11^\circ\text{F}$$

∴ AMOUNT OF VENTILATION AIR ⇒

$$\text{CFM} = \frac{Q}{(1.08)(.825)(\Delta T)} = \frac{40650}{(1.08)(.825)(11)}$$

$$\text{CFM} = 4150$$

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JOB NO. 26616 DATE 7-7-82 BY TKO CHK. JMC
CUSTOMER _____ PROJECT _____
SUBJECT _____

ACCORDING TO TMS-810-1 PG. 20 DESIGN USING GRAVITY AIR
MOVERS WITH MANUAL SHUT OFF DAMPERS BASED ON A WIND
VELOCITY OF 41 MPH.

DESIGN FOR A STACK HEIGHT OF 30 FT AND A TEMP. DIFF. OF 10°F.

∴ DESIGN USING A PENN RX-AIR RIDGE GRAVITY ROOF
VENTILATOR AT DESIGN CONDITIONS $\Rightarrow 359 \frac{\text{CFM}}{\text{FT}^2}$ OPENING

$$\therefore \text{OPEN AREA NEEDED} = \frac{4150 \text{ CFM}}{359 \text{ CFM/FT}^2} = 11.6 \text{ FT}^2$$

FROM PERFORMANCE TABLE A 12 IN X 10 FT LONG UNIT HAS
A CAPACITY OF 2620 CFM. THEREFORE 2 UNITS ARE
NEEDED.

COST OF EACH UNIT IS \$400⁰⁰.

DESIGNED AROUND ARNCO. INFORMATION ON UNITS ARE NOT GIVEN.
SINCE LOUVERS ARE NOT INSTALLED FOR MAKE-UP AIR AND THE
EFFICIENCY OF ARNCO GRAVITY AIR MOVERS IS UNKNOWN SEE
FOR THREE UNITS AT 12 IN. WIDE X 10 FT LONG.

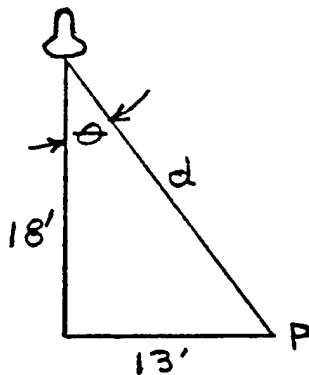
JOB NO. C-26616 DATE 7-8-82 PAGE WEW
CUSTOMER COE - RMA N.W. BOUNDARY CONTAIN/TREAT. SYS
SUBJECT CONCEPT LIGHTING CALC. - BLDG. INTERIOR

BLDG. INTERIOR DIMENSIONS (APPROX)

75 FT X 39 FT X 29 FT HIGH

FIXTURE TYPE: PRISMATIC GLASS REFLECTOR
MFR.: HOLOPHANE
CAT. NO.: 1938
LAMP: 150 W HPS
MTG. HT.: 18 FT

FOOTCANDLE CALCULATION AT 13 FT FROM
0° (NADIR) —



$$\tan \theta = \frac{13}{18}, \theta = 35.84^\circ$$

$$d = \sqrt{13^2 + 18^2} = 22.2'$$

$$I \approx 5300 \text{ (FROM PHOTOMETRIC TEST DATA)}$$

$$E = \frac{I}{d^2} \cos \theta$$

$$= \frac{5300}{(22.2)^2} \cos 35.84^\circ = 8.7 \text{ FC}$$

AT "P"

USE 6 FIXTURES (2 ROWS OF 3 EACH)

THE CONTRIBUTION OF ILLUMINATION FROM
6 LTG. UNITS WILL INCREASE THE AVERAGE
ILLUMINATION TO AN ESTIMATED 20 FC AT
THE WORK PLANE.