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AEC-R100 RICHLAND WASH.

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GE-AEC BUSINESS RECORD

NUCLEAR SAFETY-2345 B-06

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GENERAL ELECTRIC

CHAMFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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June 17, 1955

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AUTHOR

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NR-1 18" O.D.

PR-2 1/4" 18-8-S-Cb SS

PR-1 ~ 27" High

WR-2

Then for I.D.

$$R = 22.225 \text{ cm}$$

$$H = 68.58 \text{ cm}$$

$$V = 106.42 \text{ liters}$$

For Cross sections

$$\sum_{NO_2} = 0.165 NO_2 (10)^{-4}$$

$$\sum_{Na} = 0.1256 Na (10)^{-4}$$

$$\sum_{NH_4} = 0.998 NH_4 (10)^{-4}$$

$$\sum_{SO_4} = .0307 SO_4 (10)^{-4}$$

$$\sum_{H_2O_2} = .1142 H_2O_2 (10)^{-4}$$

$$\sum_H = 1.9264 (10)^{-4} H$$

$$\sum_{H_2O} = .2156 (10)^{-4} H_2O$$

$$\sum_{La} = .390 (10)^{-4} La$$

$$\sum_K = .308 (10)^{-4} K$$

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$$H_T = .1118 H_2O + .2235 NH_4 + .05926 H_2O_2 + H^+$$

Tank NR-1

If P_u stays in SolutionThen H_r varies from 106.6 To 111.9 Σ_{poison} varies from .03281 To .0220

$$\frac{M}{V} = \frac{(10)^4}{28.97(1-w)} \left[\frac{\Sigma_{\text{poison}}}{\frac{1}{f} - \left[1 + \frac{w}{1-w} (.801) \right]} \right]$$

for $H = 111.9$ (Pure water)

$$\text{Critical } f = 14.127 B + .51272$$

$$B = \frac{T_L^2}{(R')^2} = \frac{9.8696}{(R')^2}$$

R'	B	f	$\frac{1}{f}$
16	.03855	1.0573	.9458
17	.03415	.99516	1.00486
18	.03046	.94303	1.06041
19	.02734	.89895	1.11240
20	.02467	.86123	1.16113
21	.02238	.82888	1.20644
22	.02039	.80077	1.24879
23	.01866	.77633	1.28811
24	.01713	.75472	1.32499
25	.01579	.73578	1.35910
26	.01460	.71897	1.39687
27	.01354	.7040	1.42645
28	.01259	.69058	1.44805

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$\omega\%$	$[1 + \frac{\omega}{1-\omega}(.80)]$	$\sim MWD/T$	
0	1.0000	0	28.97
1.46	1.01186	200	28.547
2.95	1.02434	400	28.1153
3.65	1.03034	500	27.9126
4.40	1.03686	600	27.6953

$\frac{V(10)^4}{M} \sum_{i=1}^n$

R'	f	0	200	400	500	600
16	.9458	0	0	0	0	0
17	1.00486	.14079	0	0	0	0
18	1.06041	1.75008	1.38596	1.01412	.83933	.652
19	1.11240	3.25623	2.87012	2.47584	2.29051	2.092
P	1.16113	4.66794	4.26122	3.84590	3.65869	3.44
21	1.20644	5.98057	5.55468	5.11981	4.91541	4.696
22	1.24879	7.20745	6.76365	6.31050	6.09751	5.86
23	1.28811	8.34655	7.88612	7.41599	7.19503	6.958
24	1.32499	9.41496	8.93893	8.45289	8.22445	7.979
25	1.35910	10.40313	9.91267	9.41190	9.17655	8.924
26	1.39087	11.32350	10.81961	10.30513	10.06333	9.804
27	1.42045	12.18044	11.66404	11.13678	10.88898	10.623
28	1.44805	12.98001	12.45193	11.91277	11.65937	11.388

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for $H = 111.9$ and $\Sigma_{\text{person}} = .0220$

R'	B	critical concentration in g/l				
		0	200	400	500	600 MWZ
16	.03555	∞	∞	∞	∞	∞
17	.03415	1563.0	∞	∞	∞	∞
18	.03046	125.7	158.7	216.9	262.1	337.3
19	.02734	67.56	76.65	88.86	96.05	105.16
20	.02467	47.13	51.63	57.20	60.26	63.92
21	.02238	36.79	39.61	42.97	44.76	46.84
22	.02039	30.52	32.53	34.86	36.08	37.48
23	.01866	26.36	27.90	29.67	30.58	31.62
24	.01713	23.37	24.61	26.03	26.75	27.57
25	.01579	21.15	22.19	23.37	23.97	24.65
26	.01460	19.43	20.33	21.35	21.86	22.44
27	.01354	18.06	18.86	19.75	20.20	20.71
28	.01259	16.95	17.67	18.47	18.87	19.32
29	.011735			17.408		
30						
31	.01027			15.78		
32						

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per 1/4" SS

 $\ell = 3.33 \text{ cm}$

Graph

if the Pu stays in solution

$$B = \left(\frac{2.4048}{R + 3.33} \right)^2 + \left(\frac{\pi}{H + 6.66} \right)^2$$

if the Pu is thrown out of solution

$$B = \left(\frac{2.4048}{R + 3.33} \right)^2 + \left(\frac{\pi}{H + \underbrace{3.33 + 6.1}_{9.43}} \right)^2$$

for NR-1, RR-2, RR-1, WR-2

 $R = 22.225$

R'	B	B _{nc}	$\sqrt{B_{nc}}$	Height in ppm
16	.03855	.02970	.17234	11.57
17	.03415	.02530	.15906	13.04
18	.03046	.02161	.14700	14.71
19	.02734	.01849	.13599	16.44
20	.02467	.01582	.12579	18.31
21	.02238	.01353	.11633	20.35
22	.02039	.01154	.10744	22.58
23	.01866	.00981	.09904	25.06
24	.01713	.00828	.09099	27.87
25	.01579	.00694	.08331	31.05
26	.01460	.00575	.07583	34.77
27	.01354	.00469	.06848	39.22
28	.01259	.00374	.06115	44.72

$$R = 22.225 \text{ cm} \quad V = \pi R^2 H = 1.5518 H$$

Volume agitator

Critical Mass

In Soln	Ppt	R'	0 MW D/t in Soln	Ppt	200 MW Ppt	400 MW Ppt	500 MW Ppt	600 MW Ppt
17.95	13.66	16	∞	∞	-	-	-	-
20.31	16.01	17	31,744	25,024	-	-	-	-
22.83	18.53	18	2,870	2,329	-	-	-	-
25.51	21.21	19	1,723	1,433	-	-	-	-
28.41	24.11	20	1,339	1,136	-	-	-	-
31.58	27.28	21	1,162	1,004	-	-	-	-
35.04	30.74	22	1,069	938	1,000	1,071	1,109	1,15
38.89	34.59	23	1,025	912	965	1,026	1,058	1,09
43.25	38.95	24	1,011	910	958	1,014	1,042	1,07
48.18	43.88	25	1,014	928	973	1,025	1,051	1,08
53.96	49.66	26	1,048	965	-	-	-	-
60.86	56.56	27	1,099	1,021	-	-	-	-
69.40	65.10	28	1,176	1,103	-	-	-	-

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P-1, P-2, CT-2

18" O. D. $\frac{1}{8}$ " SS

21" High

outside jacket $\frac{1}{4}$ " water $\frac{1}{8}$ " SS

Bottom $\frac{3}{8}$ " SS, 1" water and $\frac{3}{8}$ " SS

$$R = 22.54 \text{ cm} \quad l_R = 3.70$$

$$H_{\text{dry}} = 53.34 \text{ cm} \quad l_{H_{\text{bottom}}} = 5.45 \quad l_{H_{\text{top}}} = 6.1$$

$$B = \left(\frac{2.4048}{26.24} \right)^2 + \left(\frac{\pi}{H + 11.55} \right)^2 = .008399 + \left(\frac{\pi}{H + 11.55} \right)^2$$

R'	B	B _{Hc}	$\sqrt{B_{Hc}}$	H _c	V = 1.59611 H _c
22	.02238	.01398	.11825	15.02	23.97
23	.02039	.01199	.10950	17.14	27.36
24	.01866	.01026	.10129	19.47	31.08
25	.01713	.00873	.09343	22.08	35.24
26	.01579	.00739	.08597	24.99	39.89
27	.01460	.00620	.07874	28.35	45.25

Critical Mass

R'	V	0 MW D _k	200 MW D _k	400 MW D _k	500 MW D _k	600 MW D _k
21	23.97	881.8	949.4	1,030	1,073	1,123
22	27.36	835.0	890.0	953.8	987.1	1,025
23	31.08	819.3	867.1	922.1	950.4	982.7
24	35.24	823.5	867.2	917.3	942.7	971.6
25	39.89	843.7	885.1	932.2	956.2	983.3
26	45.25	879.2	919.9	966.1	989.2	1,015

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CT-1

I.D. = $23 \frac{5}{8}$ " $29 \frac{1}{2}$ " High $\frac{3}{16}$ " wall $\frac{3}{4}$ " water $\frac{1}{8}$ " outside wall

Thus

$R = 30.00 \text{ cm}$

$l_R = 4.75$

$H_{\text{min}} = 74.93 \text{ cm}$

$l_{\text{TOP}} = 6.1 \text{ cm}$

$l_{\text{Bottom}} = 4.75 \text{ cm}$

$$B = \left(\frac{2.4048}{34.75} \right)^2 + \left(\frac{\pi}{H + 10.85} \right)^2 = .00479 + \left(\frac{\pi}{H + 10.85} \right)^2$$

R'	B	B_{H_c}	$\sqrt{B_{H_c}}$	H_c	$V = 2.8274 H_c$	
1	.02238	.01754	.13263	12.84	36.30	
22	.02039	.01560	.12490	14.30	40.43	
23	.01866	.01387	.11777	15.83	44.76	
24	.01713	.01234	.11109	17.43	49.28	
25	.01579	.01100	.10488	19.10	54.00	
26	.01460	.00981	.09965	20.87	59.01	
27	.01354	.00875	.09354	22.74	64.29	
R'	V	0 MWD _{fr}	200 MWD _{fr}	400 MWD _{fr}	500 MWD _{fr}	600 MWD _{fr}
21	36.30	1,335	1,438			
22	40.43	1,234				
23	44.76	1,180				
24	49.28	1,152	1,213	1,283	1,318	1,359
25	54.00	1,142	1,198	1,262	1,294	1,331
26	59.01	1,146	1,200	1,260	1,290	1,324
27	64.29	1,161	1,212	1,270	1,299	1,331

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S

R-3

I.D. = 10"

16 1/2" High ~ 1/8" wall

R = 12.70 cm

l = 3.03

$$B = \left(\frac{2.4048}{15.73} \right)^2 + \left(\frac{\pi}{H + 9.13} \right)^2 = .02337 + \left(\frac{\pi}{H + 9.1} \right)^2$$

R'	B	B _{Hc}	$\sqrt{B_{Hc}}$	H _c	V = .50671/H
17	.03415	.01078	.10384	21.12	10.70
18	.03046	.00709	.08420	28.18	14.28
19	.02734	.00397	.06301	40.73	20.64
20	.02467	.00130	.03605	78.02	Tank is only 41.9 cm
21	.02238	—			

R'	V	0 mm D/r	200 mm D/r	400 mm D/r	500 mm D/r	600 mm
16	—	∞	∞	∞	∞	∞
17	10.70	16,724	∞	∞	∞	∞
18	14.28	1,795	2,266	3,097	3,743	4,817
19	20.64	1,394	1,582	1,834	1,982	2,170
20	39.53	1,863	2,041	2,261	2,382	2,527
21	∞					

V = 29

H_c = 57.23

B = .02638

f = .88589

.02561

2.95493

.87541

74.45

3.31705

66.33

HW 3784680

1C

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12" O.D. with $\frac{1}{8}$ " SS wall
 12" I.H. high
 $\frac{3}{8}$ " SS 1" water $\frac{3}{8}$ " SS bottom

$R = 14.9225$ cm $l_n = 3.03$ cm $B_R = .01794$
 $H_{max} = 30.48$ cm $l_H = 5.45 + 6.1 = 11.55$ cm

since H_{max} is small as H_c increases
 l decreases to $l_H = 5.45 + 3.03 = 8.48$ cm
 when S-1 is completely filled with P4 solution
 l begins to decrease when H_c reaches ~ 21.6 cm

R'	B	B_{H_c}	$\sqrt{B}$	l_H	H_c	$V = .6995 H_c$
17	.03415	.01621	.12732	11.55	13.12	9.178
18	.03046	.01252	.11190	11.55	16.52	11.56
19	.02734	.00940	.09695	11.55	20.85	14.59
20	.02467	.00673	.08204	10.15	28.14	19.68
21	.02235	.00444	.06663	—	—	—

Filled $B_R = .01794$ $B_H = \left(\frac{\pi}{30.48 + 8.48} \right)^2 = .006502$ $V = 21.32$
 $B = B_R + B_H = .02444$

R'	V	0 mm D _f	200 mm D _f	400 mm D _f	500 mm D _f	600 mm D _f
17	9.178	14,345	∞	∞	∞	∞
18	11.56	1,453				
19	14.59	985.7	1,118	1,296	1,401	1,534
20	19.68	927.5	1,016	1,125	1,186	1,258
21						

Filled 21.32

20.096 21.32 978.2 1,181 1,243 1,316

For S-1

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l_T	H_c	V	M_{70}^{mult}	
4	29.3	20.447	948	
5.0	27.55	19.27	919.7	4.35158
5.25	27	18.888	912.9	3.94948
5.50	26.4	18.47	907.4	3.53888
5.75	25.55	17.87	904	3.34588
6.00	23.90	16.72	911.7	3.13926

Then for $l_T = 5.75$

$$H_c = 25.55 \quad H' = 36.75 \quad B = 0.025248 \quad f = 0.86940$$

$$K_f = 1.15021 \quad V = 17.874$$

Conc, 0 200 400 500 600

50.556 55.70 62.17 65.75 70.08

Mass

903.6 995.6 1,111 1,175 1,253

for $l_T = 5.50$

$$H_c = 26.4 \quad H' = 37.35 \quad V = 18.47$$

907.4 997.3 1,109 1,172 1,246

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N-2

14" O.D. 3 1/2" S.S. wall

R = 17.30 cm

l = 3.18 cm

water surface along end flanges.

$$B = \left(\frac{2.4048}{20.48} \right) + \left(\frac{II}{H + 12.2} \right)^2 = .01379 + \left(\frac{II}{H + 12.2} \right)^2$$

$$V = .94025 H$$

R' B B_{HL} $\sqrt{B_{HL}}$ H V Not on graph

20	.62467	.1088	.10432	17.91	16.84	793.7
21	.62238	.00859	.09268	21.70	20.40	750.5
22	.02039	.00660	.08124	26.47	24.89	759.6
23	.01866	.00487	.06978	32.82	30.86	813.5

$$R + l = 20.00$$

$$R = 16.82$$

$$V = .8889 H$$

$$B = \left(\frac{2.4048}{20.00} \right)^2 + \left(\frac{II}{H + 12.2} \right)^2 = .01446 + \left(\frac{II}{H + 12.2} \right)^2$$

R' H V Not on graph

20	18.18	16.16	761.6
21	23.10	20.53	755.3
22	28.59	25.41	775.5
23	36.27	32.24	849.8

The above that if we consider the narrowing of the bottom of the flange to decrease the effective radius slightly the length of mass the critical mass.

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Thus for N-2

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R'	V	0M.WD/t	200M.WD/t	400M.WD/t	500M.WD/t	600M.WD/t
20	16.84	793.7	869.4	963.2	1,015	1,076
21	20.40	750.5	808.0	876.6	913	955.5
22	24.89	759.6	809.7	867.7	898.0	932.9
23	30.86	813.5	861.0	915.6	943.7	975.8

HW 3734680

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13

22" I.D. 1/4" SS wall 2'1" high 5/16" 3" off

$R = 27.94 \text{ cm}$ $\lambda = 3.33 \text{ cm}$ $B_0 = .00591$

assuming a water surface above sand holes.

$\lambda_{H_2O} = 12.2$

R' B B_{H_2O} $\sqrt{B_{H_2O}}$ H_c $V = 2.45247H_c$ cm^3/min

22	.02039	.01448	.12034	13.9	34.04	1040
23	.01866	.01275	.11292	15.62	38.31	1009
24	.01713	.01122	.10593	17.46	42.82	1001
25	.01579	.00988	.09939	19.41	47.60	1007
26	.01460	.00869	.09322	21.50	52.73	1024

R' V cm^3/min B_{H_2O} $400 \text{ mm}^2/\text{min}$ $500 \text{ mm}^2/\text{min}$ $600 \text{ mm}^2/\text{min}$

22	34.09	1040	1.109	1.188	1230	1278
23	38.31	1010	1.069	1.137	1172	1211
24	42.82	1001	1.054	1.115	1145	1181
25	47.60	1007	1.056	1.112	1141	1173
26	52.73	1024	1.072	1.126	1153	1183

HW 3734620

14

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UT-2

O.D. inside tank 12" with $\frac{1}{8}$ " SS wall
 $\frac{1}{4}$ " water jacket $\frac{1}{8}$ " outside wall
 15" O.D. Bottom $\frac{3}{8}$ " SS 1" water $\frac{3}{8}$ " SS

$$R = 14.9225 \text{ cm} \quad l_R = 3.70 \text{ cm}$$

$$H_{max} = 38 \text{ cm} \quad l_H = 6.1 + 5.45$$

$$B = \left(\frac{2.4048}{18.6225} \right)^2 + \left(\frac{9}{H + 11.55} \right)^2 = .01667 + B_H$$

R'	B	B_{H_c}	$\sqrt{B_{H_c}}$	l_{H_c}	H_c	$V = .69957 H_c$	0.0001 D/H
19	.02734	.01067	.10335	11.55	18.85	13.19	991.1
20	.02467	.00800	.08944	11.55	23.58	16.50	777.6
21	.02238	.00571	.07556	11.55	30.03	21.01	772.9
22	.02039	.00372	.06099	39.96	over flow	27.95	853.0

R'	V	0.0001 D/H	200.000 D/H	400.000 D/H	500.000 D/H	600.000 D/H
20	16.50	777.6	851.9	943.8	994.3	1,055
21	21.01	772.9	832.2	902.8	940.4	984.1
22	27.95	853.0	909.2	974.3	1008	1,048

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15

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F-2

20" O.D. $\frac{1}{8}$ " ss wall
2' 6" High $\frac{1}{4}$ " ss Bottom

$$R = 24.765 \text{ cm} \quad l = 3.03 \text{ cm} \quad B_p = .00749$$

$$H_{\max} = 76.20 \text{ cm} \quad l_{Hc} = 3.33 + 6.1 = 9.43 \text{ cm}$$

R'	B	B_{Hc}	$\sqrt{B_{Hc}}$	H_c	$V = 1.92675H$	$OMWD/r$
22	.02039	.01290	.11358	18.23	35.12	1,072
23	.01866	.01117	.10569	20.29	39.09	1,030
24	.01713	.00964	.09818	22.57	43.49	1,016
25	.01579	.00830	.09110	25.06	48.28	1,021
26	.01460	.00711	.08432	27.83	53.62	

R'	V	$OMWD/r$	200 MWDR	400 MWDR	500 MWDR	600 MWDR
22	35.12	1,072	1,142	1,224	1,267	1,316
23	39.09	1,030	1,091	1,160	1,195	1,236
24	43.49	1,016	1,070	1,132	1,163	1,199
25	48.28	1,021	1,071	1,128	1,157	1,190
26	53.62	1,012	1,090	1,145	1,172	1,203

HW 3734620

16

DECLASSIFIED

WR-1

24 1/2" O.D.

1/4" SS wall

25 1/2" High

 $R = 30.48 \text{ cm}$ $l = 3.33 \text{ cm}$ $B_R = .00506$ $H = 64.008 \text{ cm}$ $l = 9.43$

R'	B	B_{Hc}	$\sqrt{B_{Hc}}$	H_c	$V = 2.9186 H_c$
23	.01866	.01360	.11662	17.51	51.10
24	.01713	.01207	.10986	19.17	55.95
25	.01579	.01073	.10359	20.90	61.00
26	.01460	.00954	.09767	22.74	66.37
27	.01354	.00848	.09209	24.68	72.03

R'	V	0 mm D _h	200 mm D _h	400 mm D _h	500 mm D _h	600 mm D _h
23	51.10	1,347	1,426	1,516	1,563	1,616
24	55.95	1,307	1,377	1,456	1,496	1,542
25	61.00	1,290	1,353	1,425	1,462	1,503
26	66.37	1,289	1,349	1,417	1,450	1,489
27	72.03	1,301	1,358	1,422	1,455	1,492

1)

05-95 in
#7

HW 37346 RD

DECLASSIFIED

VP-1

8" O.D. #16 Gauge $L = 3.001$
 High: $13 \frac{15}{16} = 35.40$ cm $h = 3.03 + 6.1$

$$B = \left(\frac{2.4048}{9.906 + 8.00} \right)^2 + \left(\frac{\pi}{H + 9.13} \right)^2 = .03472 + \left(\frac{\pi}{H + 9.13} \right)^2$$

for 0 mm D_t $N_1 \rightarrow \infty$ if $\frac{L}{r} = 1$ or
 $14.127 B + .51272 = 1$

$$B \Rightarrow .03449 \quad R' - 6.1 = 10.815 \quad V = 5.3$$

Since $.03472 > .03449$ then this
 cylinder should be safe no matter what
 the concentration of Pu in the vessel.

HW 37846R0

1E
DECLASSIFIED

SR-1

6" O. D

$\frac{1}{8}$ " SS wall

16" High

$$R = 7.62 \quad L = 3.03$$

$$B = \left(\frac{2.4048}{10.65} \right)^2 + \left(\frac{\pi}{H + 9.13} \right)^2$$

$$B = .05098 + \left(\frac{\pi}{H + 9.13} \right)^2$$

Since $M \rightarrow \infty$ for $B \approx .038$

Thus this tank is infinitely safe.

HW 37346 RD

19

DECLASSIFIED

Limiting Volume
infinitely Tamped

AT and WT and SC

$$R' = 16 \text{ cm} \quad L = 6.1 \text{ cm} \quad r = 9.9$$

$$V = 4.47 \text{ liters}$$

This Volume takes an infinite mass for critical

Thus AT which is 1 to 2 liters volume is safe from a critical mass assembly no matter what the concentration of Pu in solution.

and WT which has a 3 1/2 liter capacity can not be made critical at any concentration of Pu in solution.

For SC can volume is 1.325 liters is also safe from a critical mass. However it is of interest to know if these cans were loaded with 350 gms of Pu how many cans could be stacked together if the cans were packed very closely.

$$V = 1.325 \text{ l} \quad r = 6.814 \text{ cm} \quad \frac{1}{4} \text{ SS} = .635 \text{ cm SS}$$

$$r_{\text{total}} = .635 + 6.814 = 7.449 \quad V = 1.7313 \text{ liters}$$

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HW 37346RV

20

SC Contd.

if the Pu is in 11 normal HNO_3 in the
1.325 Volume calling the 55 ~ water
the new normality becomes $\frac{11(1.325)}{1.7313} = 8.418$

and the pu concentration is $\frac{350}{1.7313} = 202.16 \text{ g/l}$

Total $NO_3 = 8.418(62) + 202.16(0.84) = 691.7$
Then $H_T = 83.2 \text{ g/l}$

if due to some error not quite all the cans
are 11 normal, then an optimistic guess at
the concentrations would be $H = 100 \text{ g/l}$ $NO_3 = 300$

So $\Sigma_{p0.50n} = .02421$ $f = 18.44 B + .46736$

$M = \frac{V(10)^4 (.02421)}{28.1154 \left(\frac{1}{f} - 1.02434 \right)}$ for 400 MWDF

$\frac{M}{V} = 202.16 \text{ g/l}$

$\frac{242.1}{202.16(28.1154)} = \frac{1}{f} - 1.02434$

$\frac{1}{f} = 1.06693$ $f = .93726$

$B = .02548$ $\sqrt{B} = .15963$

$r' = 19.68 \text{ cm}$ $r = 16.82$ $V = 19.933$

Total Number of cans $\frac{19.933}{1.7313} = 11.51 \text{ cans.}$

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HW 37846 RD

21

for PR Transfer Vessel

I.D. of 18 1/2" 1/8" SS wall + 5.1 cm spec
assuming the 5.1 cm could become filled with
water then $l = 5.75$ cm

$$B_R = \left(\frac{2.4048}{23.495 + 5.75} \right)^2 = .00676 \quad l_H = 11.85$$

R'	B	B _{Hc}	$\sqrt{B_{Hc}}$	Hc	V = 1.7342	M ^{com}
21	.02238	.01562	.12498	13.29	23.05	848.0
22	.02039	.01363	.11675	15.06	26.12	797.2
23	.01866	.01190	.10909	16.95	29.39	774.7
24	.01713	.01037	.10184	19.06	32.95	770.0
25	.01579	.00903	.09503	21.21	36.78	777.9

R'	V	0 MIN D ₁	200 MIN D ₁	400 MIN D ₁	500 MIN D ₁	600 MIN D ₁
23	29.39	774.7	820.0	872.0	898.7	929.3
24	32.95	770.0	810.4	857.7	881.4	908.4
25	36.78	777.9	816.1	859.5	881.6	906.6

8-0 37346

222

GRAMS

F

or I PLANT

4300 - 5130
1520 - 2640
140 - 300

nil
nil
nil
Pu (NO₃)₄
23,200
26-27

69 83

Vol., LITERS
H⁺

G

WT

125
35
2
3
7
40
5000
5

5160
2640
200
270
710
4000
PuO₄
28,100
27
68

21

4

H

WT

220
nil
nil
nil
35
20
PuO₄
3600
3.8

1940
25
3
3
90
1800
PuO₄
16600
19
30
4

12

35

I

WT

950 - 3100
nil
nil
nil
35
nil
Pu(NO₃)₄
400 - 8400
9

23 nil
35 - 35
nil
Pu(NO₃)₄
1100
1
12

12

35

J

WT

950
nil
nil
nil
35
nil
Pu(NO₃)₄
1100
1
12

23 nil
35 - 35
nil
Pu(NO₃)₄
1100
1
12

12

35

RECEIVED

DECLASSIFIED

PLANT	NO. GRMS	1850	-	22,320	250	-	22,320	330	nil	330	2190	950	950
Na ⁺ "	nil	60	-	6050	60	-	6050	nil	nil	210	60	nil	nil
NH ₄ ⁺ "	nil	35	-	386	35	-	386	nil	nil	nil	3	nil	35
SO ₄ ⁻ "	nil	8	-	763	8	-	763	36	36	36	91	36	36
H ₂ PO ₄ ⁻ "	nil	65	-	8100	65	-	8100	20	20	1800	1800	18	18
H ⁺	30	5	-	110	5	-	110	11	11	30	30	35	35
Pu form	Pu (NO ₃) ₄	PuO ₄	-	PuO ₄	PuO ₄	-	PuO ₄	PuO ₄	PuO ₄	Pu(NO ₃) ₄	Pu(NO ₃) ₄	Pu(NO ₃) ₄	Pu(NO ₃) ₄
H ₂ O "	18780	5000	-	51870	5000	-	51870	3500	3500	400	11600	400	400
Vol, liters	20	5	-	63	5	-	63	3.6	3.6	1	19	1	1

Precipitate only.
 < 400
 268 *

$Pu(C_4O_4)_2$	$Pu(C_4O_4)_2$
nil	< 1000
nil	1 4
1.73 or 1.85	1-3

for $H = 111.9$ using $l = 4$ cm equation and $\bar{V}_{R,\infty} = 100$

$$f = 10.989 B + .52904 \quad \text{limit } M \rightarrow \infty \quad B \rightarrow .05$$

R'	B	f	V_f
14	.05035		
15	.04386	← Limiting Volume = 5.42 l	
16	.03855	.95267	1.04968
17	.03415	.90431	1.10581
18	.03046	.86376	1.15772
19	.02734	.82948	1.20557
20	.02467	.80014	1.24978
21	.02238	.77497	1.29037
22	.02039	.75311	1.32782
23	.01866	.73409	1.36223
24	.01713	.71728	1.39415
25	.01579	.70256	1.42336

$$C = \frac{10^4 (\bar{V}_R)}{28.97(1-w) \left(\frac{1}{f} - C \right)}$$

$$C_{400} = \frac{7.682}{\frac{1}{f} - C}$$

$$.86389$$

DECLASSIFIED

HW 37346 RP

27

for 0 and 400 MWDF

$$w \% \quad \left[1 + \frac{w}{1-w} (.86594) \right] \quad \sim 17 \text{ MWDF} \quad 28.97(1-w)$$

0 1.00000 0 28.97

2.95 1.02632 400 28.11538

R'	1/f	$\frac{V(10)^4 \Sigma_{\text{poison}}}{M}$		Critical Concentration for $\Sigma_{\text{poison}} = .0220$	
		0 MWDF	400 MWDF	0 MWDF	400 MWDF
16	1.04968	1.43923	.65678	152.86 7/10	334.97 9
17	1.10581	3.06532	2.23489	71.77	98.44
18	1.15772	4.56915	3.69436	48.15	59.55
19	1.20557	5.95536	5.03968	36.94	43.65
20	1.24978	7.23613	6.28266	30.40	35.02
21	1.29037	8.41202	7.42387	26.15	29.63
22	1.32782	9.49695	8.47679	23.165	25.95
23	1.36223	10.49380	9.44424	20.96	23.29
24	1.39415	11.41853	10.34168	19.27	21.27
25	1.42336	12.26474	11.16293	17.94	19.71

Pa 3
28

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HW 37346RD

for N-2

$$R = 17.30375$$

$$l = 1.18$$

$$B = \left(\frac{2.4048}{18.48375} \right) + \left(\frac{\pi}{H_c + 8.2} \right)^2 = .01693 + B_{H_c}$$

R'	B	B _{H_c}	$\sqrt{B_{H_c}}$	H _c	V = .94065 H _c	M _{nominal}
18	.03046	.01353	.11632	18.80	17.68	851.3
19	.02734	.01041	.10203	22.59	21.25	785.0
20	.02467	.00774	.087977	27.51	25.88	786.7
21	.02238	.00545	.07382	34.36	32.32	845.2

R'	V	M _{nominal}	M _{nominal}
18	17.68	851.3	1052.8
19	21.25	785.0	927.6
20	25.88	786.7	906.3
21	32.32	845.2	957.6

for N-1

$$R = 27.94 \quad l = 1.33 \quad B_R = .00675 \quad l_{H_c} = 8.2$$

$$R' \quad B \quad B_{H_c} \quad \sqrt{B_{H_c}} \quad H_c \quad V \quad M_0 \quad M_{H_{c0}}$$

$$22 \quad .02039 \quad .01364 \quad .11679 \quad 18.70 \quad 45.86 \quad 1062 \quad 1,190$$

for W/R-1

$$R = 30.48 \quad l = 1.33 \quad B_R = .005715 \quad l_{H_c} = 5.43$$

$$24 \quad .01713 \quad .11415 \quad .10695 \quad 23.97 \quad 69.96 \quad 1,348 \quad 1488$$

for P-1

$$R = 22.54 \quad l = 1.70 \quad B_R = .00984 \quad l_{H_c} = 7.55$$

$$21 \quad .02238 \quad .01254 \quad .11198 \quad 20.505 \quad 32.728 \quad 855.8 \quad 969$$

$$22 \quad .02039 \quad .01055 \quad .10272 \quad 23.03 \quad 36.758 \quad 851.5 \quad 954$$

for CT-1

$$R = 30.00 \text{ cm} \quad l_R = 2.75 \quad B_R = .00539 \quad l_{H_c} = 6.85$$

$$24 \quad .01713 \quad .01174 \quad .10839 \quad 22.13 \quad 62.57 \quad 1,205 \quad 1,331$$

for NR-1

$$R = 22.225 \quad l_R = 1.33 \quad B_R = .01032 \quad l_{H_c} = 5.43$$

$$22 \quad .02039 \quad .01007 \quad .110035 \quad 25.88 \quad 40.16 \quad 930 \quad 1,042$$

HW 3734680

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for S-1 $R = 14.9225$ $R' = 1.03$ $B_R = .02272$ $L_{Hc} = 7.55$
 $R' \quad B \quad B_{Hc} \quad \sqrt{B_{Hc}} \quad L_{Hc} \quad H_c \quad N \quad N$

17 .03415 .01193 .10691 21.84 15.28 1.097
18 .03046 .0074 .08798 28.15 19.69 998 1.172
19 .02734 .00462 .06797

St-2

$R = 14.9225$ $R' = 1.70$ $B_R = .02093$ $L_{Hc} = 7.55$

1 .02734 .00441 .08066 31.69 22.17 818 968

for F-2

$R = 24.765$ $R' = 1.03$ $B_R = .00869$ $L_{Hc} = 5.43$
 $R' \quad B \quad B_{Hc} \quad \sqrt{B_{Hc}} \quad H_c \quad N \quad N$

22 .02639 .01170 .1817 23.61 15.49 1053
23 .01866 .00947 .0985 26.03 50.15 1.051 1.168

for PR-3 $R = 12.70$ $R' = 1.03$ $B_R = .03067$ $L_{Hc} = 5.13$
 $R' \quad B \quad B_{Hc} \quad \sqrt{B_{Hc}} \quad H_c \quad N \quad N$

1 .03855 .00788 .08877 30.26 15.33 2.343
7 .03415 .00348 .05889 48.13 24.39 1.750 2.376
18 .03046

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PR

$$R = 23.495 \text{ cm} \quad I_R = 3.75 \quad B_R = .00779 \quad I_{10} = 7.85$$

R'	B	B_{nc}	$\sqrt{B_{nc}}$	H_c	V	M
21	.02239	.01459	.1208	18.16	31.44	823.5
22	.02039	.01260	.11225	20.14	34.93	809.2
23	.01866	.01087	.10426	22.28	38.64	809.8
24	.01713	.0939	.09664	24.66	42.77	821.2

Secret
Figure 4

31 31346R

cm

Extrapolation length

V_3

$l = 176$

Water reflector

Stainless Steel Reflector

Reflector Thickness

cm

SECRET

DECLASSIFIED

37346

find radius of the base cylinder with min mass.

R	B	B_{H_0}	$\sqrt{B}$	H	V	M
20	.02467	.01156	.10753	23.54	29.39	1,149.5
21	.02238	.0927	.09628	26.95	27.92	1,027
22	.02039	.0728	.08532	31.14	32.26	984
23	.01866	.0555	.07498	36.22	37.52	989

if $R + l_n = 21$ $l = 2.84$ $R = 18.16$
 $B_{H_0} = B - .01311$ $2l = 5.68$ $V = 1.0360 H$

if $R + l_n = 20$ $l = 2.84$ $R = 17.16$
 $B_{H_0} = B - .01446$ $V = .92509 H$

20	.02467	.01021	.10104	25.41	23.51	1,108.0
21	.02238	.00792	.08899	29.62	27.40	1,008.0
22	.02039	.00593	.07701	35.11	32.48	991.3
23	.01866	.00420	.06481	42.79	39.58	1,043.3

if $R + l_n = 22$ $l = 2.84$ $R = 19.16$
 $B_{H_0} = B - .01195$ $V = 1.1533 H$

21	.02238	.01043	.10214	25.08	28.92	1,064
22	.02039	.00844	.09187	28.52	32.89	1,004
23	.01866	.00671	.08191	32.67	37.68	993
24	.01713	.00518	.07197	37.97	43.79	1,023

DECLASSIFIED

Radius ~~was~~ Tamped SS Sphere

PROPERTY OF THE
ARMY CORP OF ENGINEERS
WASHINGTON, D.C.

DECLASSIFIED

350-14 KEUFFEL & ESSER CO.
Millimeters, 5 mm. lines accented, cm. lines heavy.
made in U.S.A.

$\gamma_0 P_0^{2.5}$

nickross

2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 3.0 3.1 3.2 3.3 3.4 3.5

$$f = (52.498 - 0.356274B + 7.147(10)^{-3}H + 0.0610) \times 10^3 \text{ HW 37849 RD}$$

$$0.97623 = 42.63922B + 0.52505 = f$$

$$f_{\text{max}} = 0.97623$$

$$B = 0.03569$$

$$\sqrt{B} = 0.18892$$

$$R + L = 12.729$$

$$\begin{cases} D = 5.85" & \text{water tamped} \\ D = 8.96" & \text{no wall or Reflector} \end{cases}$$

DECLASSIFIED

PROCESS FLOWSHEET
ISOLATION BUILDING
ELLS 3 & 4

38 HW 373460253

DECLASSIFIED

Redox Filter Boat

Redox Sample Can

T-Plant Filter Boat

T-Plant Sample Can

PROCESS FLOWSHEET
ISOLATION BUILDING
CELL 2

HW 37346 RD
7-10-53

29

DECLASSIFIED

Redox Filter Boat

T-Plant Sample Can

G.E. - RICHLAND, WASH

DON'T SAY IT --- Write It!

ROUGH DRAFT

DECLASSIFIED

DATE 4-1-54

Hw 3:346 RD

4C

To R. E. Isaacson

FROM D. D. Lanning

For the case of the bath tub being completely surrounded by reflecting materials the minimum critical mass of this vessel for low exposure plutonium is estimated to be 1020 grams.

It is assumed that the filter boat is emptied into the bath=tub and that there is no neutron interaction with vessels outside of the lucite panels surrounding the bath tub, the vessel is then estimated to be always safe from a thermal chain reaction of plutonium. However, the presence of a filter boat above the bath=tub containing plutonium and the interaction with nearby tanks such as the R-2 tank cause uncertainties that cannot easily be considered in the calculation. Hence, with present knowledge this vessel should not be considered as always safe, but safe for over 1000 grams.

DD Lanning:rm

DD Lanning

RP Raftery

+ "SAFETY CONSCIOUSNESS PAYS - WITH ACCIDENT FREE DAYS" +

MARCH 30, 1954 — ISAACSON

Hw 3734621

FILTER BOAT BATH TUB 41

DECLASSIFIED

$l_{SIDES} = 4.28$ CENTIMETERS

$$B = \left(\frac{\pi}{25.3875} \right)^2 + \left(\frac{\pi}{44.1200} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

$$= 0.01531 + 0.00507 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

$$H_c = \frac{\pi}{\sqrt{B - 0.02038}} - 12.2$$

$$\sqrt{0.00696} = 0.08343$$

$$\sqrt{0.00439} = 0.06550$$

$$\sqrt{0.00200} = 0.04473$$

$$\sqrt{0.00001} = 0.00316$$

$$\sqrt{\quad} =$$

R'	R	H_c	$\frac{0.59838}{V_c}$	M_c	M_{c400}
19	0.03734	35.456	15.232	1029	1353
20	0.02467	35.764	21.400	1008	1334
21	0.02238	58.050	34.736	1277	1492
22	0.02039				

$$B_{TUB FULL} = 0.03479 \text{ (CRIT. SAFE)}$$

37346 RD

Call Gloria ⁴²

DECLASSIFIED

Isaacson

Fitter boat with fuel

Volume

8.4 liters

about 8" from
head floor

Surrounding by

$\frac{1}{4}$ " Lucite Panels

$\frac{1}{4}$ " S.S. walls

Rectangular

S.S. box

13.97 16.8275 35.56

$5\frac{1}{2} \times 6\frac{5}{8} \times 14$

8" in front

3" on sides

12" on back to front

Note to Ray Isaacson

9.55632

$\Delta B = .000312$

$\Delta C = 5.8 \times 14$

$\Delta C = \frac{5.8 \cdot 14}{.00312} =$

$C = 104.6$

$$B = \left(\frac{\pi}{26017} \right)^2 + \left(\frac{\pi}{2900245} \right)^2 + \left(\frac{\pi}{4707600} \right)^2$$

$$= 0.01441 + 0.01171 + 0.00432$$

= 0.03045 (COMPLETELY THAWED)

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43

HW 37346R0

TANK CRIT. CONC. (a) 400 MWD (b) 0-100 M.

H-9 430 170

H-10 1860 260

J-1 20 20

J-2 20 680

J-3 20 680

J-4 20 20

J-6 20 20

J-7 20 20

J-17 440 170

J-25 20 20

G-42 360 164

G-46 20 20

G-47 470 180

G-48 470 180

G-50 220 120

RECURLEX TANKS SAFE DUE TO CRITICALLY
SAFE DIAMETER

DECLASSIFIED

✓ H-1 COL (2)

✓ H-2 COL

✓ H-3 COL (3" x 120")

H-4 COL (2)

CHECK
DIMENSIONS

J-18

J-22

J-23

✓ J-31 OK

✓ G-29 OK

45

HW 37846 RD

LIST OF TANK PRINTS
NEEDED,

DECLASSIFIED

H-1 BDS

H-1 TDS

H-2 BDS

H-2 TDS

H-3 BDS

H-3 COL (8x168)

H-3 TDS

all on 1 PRINT

H-4 BDS , H-4 COL (2) No PRINT OUT

H-4 TDS

G-16 have it

G-28 have it

~~2-24~~

J-22 No PRINT OUT

J-23 No PRINT OUT

$$C = \frac{215}{28.97(0.9705)(1.46)} - 1.02435$$

HW 37346 R0

DECLASSIFIED

$$B = \left(\frac{2.4048}{13.1359} \right)^2 + \left(\frac{\pi}{57.92} \right)^2 = 0.033515 + 0.002$$

$$= 0.036457$$

$$f =$$

TANK NO.

NO. PROS. TANKS

WITHIN 18 IN

HW 37946 R9

H-9

2

H-10

2

DECLASSIFIED

J-1

0

J-2

1

J-3

1

J-4

0

J-6

0

~~J-7~~ J-7

0

J-17

2

J-25

0

G-42

2

G-46

1

G-47

0

G-48

0

G-50

1

CHECK G-47, G-48 TO SEE IF TANK L-2 IS TAKEN INTO ACCOUNT. (O.D. L-2 IS 34 IN.)

✓ CHECK G-46 FOR EFFECT OF TANK L-2.

R = 3.5 IN

X = 11.014 IN

L10 = 24.594 IN

7.00 ID $\frac{1}{4}$ " WALLS

37846 RD

2" $\frac{1}{2}$ "
 $\frac{1}{2}$ " $\frac{1}{2}$ "
2" 1"

7.83 SAFE FOR
0.25 IN. WALLS

$$W. 3 = D^2$$

49
4
1
25
54.75

OK

DECLASSIFIED

49

HW37846 RD

I. TANKS LIKELY TO BE APPROACHED BY SEVERAL PERSONS AT ONE TIME.

G-42 H-9 J-2

DECLASSIFIED

G-46 H-10 J-3

G-47 J-7

G-48 J-17

G-50 J-25

II. TANKS NOT LIKELY TO BE APPROACHED BY MORE THAN ONE PERSON AT ONE TIME.

J-1

J-6

Check J-4

FD CONTENT HAS BEEN INCREASED

HW 37846 RD

50

A. 5' LONG, ~~3.21~~ 7.21 EQ. I.D. 6-42
3.605" R

B. 5' LONG, 7.32 EQ. I.D. 6-50
3.66" R

$$(A) B = \left(\frac{2.4048}{164.4} \right)^2 + \left(\frac{\pi}{164.4} \right)^2$$

$$L_R = 13.3504 - 9.1567 = 4.1937$$

DECLASSIFIED

EQ. REFL. TH. = 0.70

$$(B) B = \left(\frac{2.4048}{164.4} \right)^2 + \left(\frac{\pi}{164.4} \right)^2$$

$$L_R = 13.3504 - \frac{9.2964}{3.16} = 1.0540$$

EQ. REFL. TH. = 0.63

TANK H-10

$$B = \left(\frac{2.4048}{R + d_r} \right)^2 + \left(\frac{\pi \cdot 51}{H + L + l_B} \right)^2 = 0.032810 \quad \begin{matrix} 36 \\ 445 \end{matrix} \quad 3.346 \text{ RO}$$

$$R = 8.89 \text{ CM}$$

$$H = 112.375 \text{ IN.} = 107.63 \text{ CM}$$

$$L + L_B = 6 \text{ CM EA.}$$

DECLASSIFIED

0.17922

$$L_R = \frac{2.4048}{0.032810 - 0.000365} - 8.89$$

18112

$$\frac{2.4048}{0.032445} = 74.12$$

$$L_R = 4.53 \text{ CM} = 3.87$$

164.40

0.03281

4.38

365

$$\text{REFL. TH} = 0.93 \text{ IN.}$$

0.032445

$$\boxed{0.53}$$

0.000365

$$L = \frac{2.4048}{0.032445} - 9.296 = 4.05 \text{ CM} \leftarrow$$

$$\text{EQ. REFL. TH} = 0.63 \text{ IN}$$

5.15082

183.0055

0.03251

$$L = \frac{2.4048}{0.03251} = 74.12 - 9.55 = 3.79 \text{ CM}$$

$$\text{REFL. TH} = 0.52 \text{ IN}$$

119.6825

HW 3.3.46 RD

238.886

0.032810

0.000689

0.032121

DECLASSIFIED

★

$$L = \frac{2.4048}{\sqrt{0.032121}} - 9.55 = \underline{\underline{3.87}}$$

0.17985

0.17923

214.86

TH =

2.4048

0.03264

0.18068

17.31

9.55

8.76

0.47 0771

032810

0.000489

032371

183.0055

149.9855

$$L = \frac{2.4048}{\sqrt{0.032371}} - 9.55 = 3.81 \text{ m}$$

0.032371

0.17992

$$\left(\frac{3.32}{\pi} \right) \left(\frac{3.5}{10} \right)$$

NEAR SHEE REF TH.

$$\left[\frac{3.32}{\pi} \left(\frac{3.5}{12} \right) \right] = \frac{11.62}{37.699}$$

DECLASSIFIED

$\Delta L = 1.0568 \frac{R}{L_0}$

HW 3.346 R

TOT. REF. T.

(1) 6-46

$$\Delta L = \frac{1.0568(3.5)}{20} = 0.18494 \text{ cm} \quad 0.46 \text{ div} \quad l = 3.72$$

(2) J-2 & J-3

2.89

$$\Delta L = \frac{1.0568(3.5)}{12} = 0.30823 \text{ cm} \quad 0.75 \text{ div} \quad l = 4.2$$

(3) J-7

$$\Delta L = \frac{1.0568(3.625)}{12} = 0.31924 \text{ cm} \quad 0.45 \text{ div} \quad l = 3.6$$

(4) J-25

$$\Delta L = 1.0568$$

CRIT. BUCKLING FOR

0.0001/Pu = 0.034493 HW 3.3.4680

(1) 6-46

54

DECLASSIFIED

$$P_c = \left(\frac{2.4048}{12.615} \right)^2 + \left(\frac{-\pi}{89.035} \right)^2 = 0.03634 + 0.00124$$

$$P_c = 0.03758 \text{ MM}^{-2}$$

(2) J-2 & J-3

$$P_c = \left(\frac{2.4048}{13.165} \right)^2 + \left(\frac{-\pi}{164.6} \right)^2 = 0.03337 + 0.0003$$

$$P_c = 0.0337 \text{ MM}^{-2}$$

(3) J-7

$$P_c = \left(\frac{2.4048}{12.8575} \right)^2 + \left(\frac{-\pi}{151.90} \right)^2 = 0.03498 + 0.00043$$

$$P_c = 0.03541 \text{ MM}^{-2}$$

J-5

J-6

HW 3:346 RD

XIII & XIV

TANKS J-2 & J-3

DECLASSIFIED

A. OMITTING LOCITE & MAR.

$$EQ. REFL. TH. = 0.579 \text{ IN}$$

$$MAX. SAFE REFL. TH. = 0.74 \text{ IN.}$$

$$\text{THIS LEAVES } 0.161 \text{ IN. ; CORR. AL IS } 0.2875$$

$$L_0 = \frac{1.0568(3.5)}{0.2875} = 12.7 \text{ INCHES}$$

B. TAKING LONGITUDINAL BUCKLING INTO ACCOUNT

$$R = 3.56 \text{ IN.} = 9.0424 \text{ CM.}$$

$$H = 60 \text{ IN.} = 152.4 \text{ CM.}$$

$$L_T = L_B = 60 \text{ IN.}$$

$$B = \left(\frac{2.4048}{9.0424 + L_{LV}} \right)^2 + \left(\frac{\pi}{164.4} \right)^2 = 0.032810$$

$$L_{LV} = \frac{2.4048}{\sqrt{0.032810 - 0.000365}} - 9.0424 = 4.308 \text{ CM}$$

$$EQ. REFL. TH. = 0.78 \text{ CM}$$

$$\therefore 0.78 - 0.579 = 0.201 \text{ IN. ; CORR. AL IS } 0.3675 \text{ CM.}$$

$$L_0 = \frac{1.0568(3.5)}{0.3675} = 10.2 \text{ INCHES}$$

∴ TANKS J-2 & J-3 ARE SAFE "AS IS"

CALCULATIONS BASED ON HALF REFLECTOR (CONT'D)

X. (CONT'D)

TANK H-10

56

HW 37346 RD
DECLASSIFIED

B. MOVING FLANGES AWAY & OMITTING MAN & LUCITE,

EQ. REFL. TH. ~~0.362~~ = 0.362 IN.

THIS LEAVES 0.168 IN.; CORR. ALTS 0.3500 IN.

$$L_0 = \frac{1.0568(3.5)}{0.35} = 10.6 \text{ IN.}$$

TANK IS SAFE WHEN FLANGES ARE MOVED OUT.

XI.

TANK J-25

TANK IS SAFE FROM CRITICAL BUCKLING CALCULATION

XII.

TANK J-17

TANK SAFE CONSIDERING ∞ HALF REFLECTOR
AT 12 IN FROM $\frac{1}{2}$ TANK

CALCULATION ~~SECRET~~ ON HALF REFLECTOR
(CONT'D)

DECLASSIFIED

IN 37846 RD

VII. & VIII.

TANKS J-1 & J-6

BOTH TANKS SAFE.

TANKS TOO HIGH ~~BE~~ ABOVE GROUND LEVEL TO BE
READILY APPROACHED BY GROUP OF PERSONS.

IX

TANK G-46

$$B = \left(\frac{2.4048}{9.0411 + l_R} \right)^2 + \left(\frac{\pi}{88.835} \right)^2 = 0.032810$$

C. 7E
C. 17465

$$l_R = \frac{2.4048}{\sqrt{0.032810 - 0.001250}} - 9.0411 = 4.4956 \text{ LM}$$

C. 01150
C. 031560 C. 17465

MAX. SAFE. REFL. TH. = 0.72 LM

TANK IS SAFE FOR ∞ HALF REFLECTOR AT 20 IN.
(REAR HOOD FACE IS 20" FROM TANK ~~TO~~ Φ).

X

TANK H-10

A. OMITTING MAN & LUBITE,

EQ. REFL. TH. = 0.434 IN.

MAX. SAFE REFL. TH. = 0.53 IN.

THIS LEAVES 0.096 IN.; CORR. $\Delta L = 0.225$

$$L_0 = \frac{1.0568 (3.5)}{(0.225)} = 16.4 \text{ IN.}$$

SAFE WHEN Φ TANK IS 16.4 IN. FROM HOOD FACE

(CONT IN NEXT P)

██████████
CALCULATIONS BASED ON HALF REFLECTOR
(CONTINUED)

58

HW 37346R
DECLASSIFIED

VI.

TANK G-42

A. REMOVING PUMP & OMITTING MAN & LUCITE

MAX. SAFE REFL. TH. = 0.70 IN.

EFF. REFL. TH. = 0.551 IN.

THIS LEAVES 0.149 IN.; CORR. Δ IS 0.2625 IN.
7.05 D.V.

$$L_0 = \frac{1.0568(3.5)}{(0.2625)} = 14 \text{ INCHES}$$

B. REMOVING PUMP & ~~MOVING~~ MOVING ALL PRODUCT LINES FA-
THAN 12" FROM TANK EDGE & ~~REMOVING~~ OMITTING MAN
& LUCITE.

~~5~~
 $L_R = 1.46$; MAX. SAFE REFL. TH. = 0.86 IN.

E.E.G

THIS LEAVES 0.309 IN.; CORR. Δ IS 0.425 IN

$$L_0 = \frac{1.0568(2.5)}{0.425} = 8.7 \text{ IN}$$

THIS TANK IS SAFE IF PUMP IS MOVED AWAY &
THERE ARE NO PRODUCT LINES WITHIN 1 (ONE) FOOT
OF TANK SIDES.

CALC. BASED ON HALF REFLECTOR

V. (CONT'D)

HW 37.346 R

C. (CONT'D)

58

DECLASSIFIED

3. (CONT'D)

MAX SAFE REFL. TH = 0.68 IN. (NO PROD. PIPING WITHIN FV)

EQ. REFL. TH. = 0.576 CM

THIS LEAVES 0.104 IN.; EQ. ΔL IS 0.175 CM.

$$\frac{1.0568(3.625)}{L_0} = 0.175 \text{ CM.}$$

$$L_0 = 22 \text{ IN.}$$

★ D. MOVING ALL PROD. LINES TO ≥ 12 IN. FROM TANK
 & REMOVING PUMP, FLANGES, & OMITTING MAN. & LUCITE.

EQ. REFL. TH. = 0.421 IN

MAX SAFE REFL. TH. = 0.680 IN.

THIS LEAVES 0.259 IN., CORR. ΔL IS 0.5125 CM

$$L_0 = \frac{1.0568(3.625)}{0.5125} = 7.5 \text{ IN.}$$

SAFE IF PUMP & FLANGES MOVED AWAY & NO PROD.-
 BEARING LINES WITHIN 1 (ONE) FOOT OF TANK SIDES

DATE BASED ON HALF BEEL (CONT'D)

UNCLASSIFIED

HW 37346 R

60

TANK 6-50
7 1/2" I.D., 8" WALLS

MAX. SAFE BEEL THICKNESS = 0.630 IN

A. REMOVING PUMP, FLANGES, & OMITTING MAN & LOCITE

EQ. BEEL TH. = 0.421 IN

THIS LEAVES 0.209 IN. COR. AL IS 0.480 CM

$$AL = 1.0568 \left(\frac{K_o}{3.635} \right) = 0.4$$

$K_o = 9.6$ IN. ; SAFE BEEL TH. PUMP, FLANGES MOVED AWAY

B. REMOVING PUMP & OMITTING MAN & LOCITE

EQ. BEEL TH. = 0.576

THIS LEAVES 0.054 IN. COR. AL IS 0.125 CM

$\Delta L = 30$ IN

C. REMOVING ALL PROBES LINES FROM ~~FROM~~ 12 IN. FROM TANK & REMOVING PUMP & OMITTING MAN & LOCITE.

1. MAX. SAFE BEEL THICKNESS

$$H = \left(\frac{R + L_e}{\pi} \right)^2 + \left(\frac{H + L + L_e}{\pi} \right)^2 = 0.032810 ; R = 3.625 \text{ IN.}$$

$$H = 152.4 \text{ IN.} ; L_e = 6.0$$

$$L_e = 8.4048 - 9.2075 = -0.7927$$

$$L_e = 8.4048 - 0.00365 = 8.40115$$

$$0.08246$$

4.
CALC. BASED ~~ON~~ REFLECT (CONT'D)

IV.

TANK J-17
7" I.D., $\frac{1}{8}$ " WALLS

51 HW 37846 RD

MAX. SAFE WALL TH. = 0.47 IN

RECLASSIFIED

C.35E9

2 DIV

A. REMOVING FLANGES & OMITTING ^{LOCITE!} ~~MAN~~ & MAN,

EQ. REFLECT TH = 0.380

THIS LEAVES 0.09 IN; CORR TO ALL ΔL 0.1875 IN

$$\Delta L = 1.0568 \left(\frac{3.5}{L_0} \right) = 0.1875 \text{ IN}$$

$L_0 = 20$ INCHES

CALC. BASED ON ~~SECRET~~ REFL. (CONT'D)

II. & III.

TANKS G-47 & G-48

HW37846R

0.255

7 IN. I.D. & $\frac{1}{8}$ IN. WALLS

DECLASSIFIED

A. REMOVING FLANGES & OMITTING CONCRETE FLOOR

EQ. REFL. TH = $\frac{0.375}{0.44}$ IN ; ~~CORR AL = 1.0~~

MAX SAFE REFL TH = 0.48 IN.

check
this

THIS LEAVES $\frac{0.105}{0.22}$ IN FOR FLOOR ; CORR AL = 0.2 CM.

$AL = 1.0568 \left(\frac{3.5}{L_0} \right) = 0.2$

$L_0 = 11.5$ (OK FOR 1 MAN ONLY)

0.255

B. REMOVING FLANGES & OMITTING MAN & LUCITE,

1.03 DIV

EQ. REFL. TH. = 0.380

THIS LEAVES 0.1 IN. TH., OR CORR AL of $\frac{0.250}{0.25}$

$AL = 1.0568 \left(\frac{3.5}{L_0} \right) = \frac{0.250}{0.25}$

$L_0 = 15$ INCHES. (FREE FALL 1 SE IN)

0.255

C. REMOVING FLANGES & OMITTING MAN, LUCITE, & FLOOR

1.2 DIV

EQ. REFL. TH. = 0.310 IN.

LEAVES 0.170 IN ; CORR AL = 0.4125 CM.

16

FOR ∞ HALF-PLANE (MAN & LUCITE),

$AL = \left(\frac{3.5}{12} \right) (1.0568) = 0.3082$, LEAVING 0.1043 FOR FLOOR

FOR FLOOR, $1.0568 \left(\frac{3.5}{L_0} \right) = 0.1043$

$L_0 = 35.5$ IN

CALCULATION BASED ON HALF-REFLECTOR

[REDACTED]

62

HW 37346 K

D. REMOVING PUMP & OMITTING MAN, LUCITE, & CONC. FLOOR

REFL. TH. = 0.340 IN

RECALCULATED

THIS LEAVES 0.100 IN FOR LUCITE MAN & FLOOR

CORR. $\Delta L \approx 0.225$ CM

$$\Delta L = 1.0568 \left[\left(\frac{R}{C_0} \right) + \left(\frac{R}{C_0} \right) \right] = 0.225$$

$$1.0568 \left[\frac{3.5}{C_0} + \frac{3.5}{C_0} \right] = 0.225$$

$$(C_0 + C_0) = 0.06083 C_0, C_0$$

WHEN $C_0 = 75$ IN.,

$$C_0 (1 - 1.52075) = -75$$

$$C_0 = \frac{75}{0.52075} = 48 \text{ IN.}$$

WHEN $C_0 = C_0$,

$$C_0 = \frac{1.0568(7)}{0.225} = 32.88 \text{ IN.}$$

E. REMOVING PUMP & FLANGES, & OMITTING MAN, LUCITE & CONC FLOOR

$$\text{REFL. TH.} = 0.318 \text{ IN. ; THIS LEAVES } 0.142 \text{ IN. REFL.}$$

$$\Delta L \text{ OF } \sim 0.3375$$

IF $C_0 = C_0$,

$$C_0 = \frac{1.0568(7.00)}{0.3375} = 22 \text{ INCHES}$$

2. IF $C_0 = 14$ IN.,

$$C_0 = 50 \text{ IN.}$$

$$C_0 (1 - 1.2775) = -14$$

1.

~~SECRET~~
CALCULATIONS BASED ON $\infty \frac{1}{2}$ REFLECTOR

HW 35346 RD

I. TANK H-9 - 7 IN. I.D. & 8 IN. S.S. WALLS

DECLASSIFIED

SAFE REFL TH. = 0.49 (INCL. CONG. BUCKLING)

A. REFL TH. (OMITTING LUCITE & MAN NEAR TANK) = 0.50 IN.

FOR $\infty \frac{1}{2}$ REFLECTOR AT 14 IN,

$$\Delta L = \frac{3.32}{\pi} \left(\frac{R}{L_0} \right), \text{ where } R = 3.5 \text{ IN. } \& L_0 = 14 \text{ IN}$$

$$= 1.0568 (0.25000) = 0.2642 \text{ IN}$$

$$\text{EQ. REFL. TH.} = 0.177 \text{ IN.}$$

(10.15 IN.)

$$\text{TOTAL REFL TH} = 0.500 + 0.177 = 0.627$$

B. REMOVING PUMP & OMITTING MAN & LUCITE,

$$\text{TOT. EQ. REFL. TH.} = \del{0.48} 0.48 \text{ IN.}$$

THIS LEAVES EQ. OF 0.01 FOR MAN & LUCITE,
OR A ΔL OF ABOUT 0.025 IN

FOR ∞ HALF REFL.,

$$\Delta L = 1.0568 \left(\frac{R}{L_0} \right) = \frac{(1.0568)(3.5)}{L_0} = 0.025$$

$$L_0 = \del{1.0568} (1.0568)(3.5)(40) = 148 \text{ IN.}$$

C. REMOVING PUMP & FLANGES WELDED TO TANK & OMITTING MAN & LUCIT.

$$\text{TOT. EQ. REFL. TH.} = 0.408 \text{ IN. LEAVING } 0.082 \text{ IN FOR MAN \& LUCIT.}$$

$0.082 \Delta L \text{ of } 0.175 \text{ IN.}$

$$\frac{1.0568 (3.5)}{0.175} = L_0$$

$$0.175 \del{0.082}$$

~~SECRET~~

$L_0 = 21 \text{ IN. FROM } \phi \text{ H-9 TO LUCITE PANEL TO BE COMPLETED}$

CALCULATIONS BASED ON 2 REFLECTOR

W3734680

I. TANK H-9 - 7 IN. ID. & 8 IN. S.S. WALLS

SAFE REF. TH. = 0.49 (ACC. CONG. BUCKLING)

A. REF. TH. (OMITTING CUDITE & MAN NERE TRAK) = 0.50 IN.

FOR 2 REFLECTOR AT 14 IN.

$$\Delta L = 3.32 \left(\frac{R}{L_0} \right), \text{ where } R = 3.5 \text{ IN. } \& L_0 = 14 \text{ IN.}$$

$$= 1.0568 (0.25000) = 0.2642 \text{ IN.}$$

$$\text{EQ. REF. TH.} = 0.177 \text{ IN.}$$

$$\text{TOTAL REF. TH.} = 0.500 + 0.177 = 0.677$$

B. REMOVING PUMP & OMITTING MAN & CUDITE,

$$\text{TOT. EQ. REF. TH.} = 0.48 \text{ IN.}$$

THIS LEAVES EQ. OF 0.01 FOR MAN & CUDITE,
OR A AL OF ABOUT 0.075 IN.

FOR 2 HOLE REF.

$$\Delta L = 1.0568 \left(\frac{R}{L_0} \right) = (1.0568)(3.5) = 0.075$$

$$L_0 = 1.0568 (3.5)(40) = 148 \text{ IN.}$$

C. REMOVING PUMP & FLANGES WELDED TO TANK & OMITTING MAN & CUDITE

$$\text{TOT. EQ. REF. TH.} = 0.408 \text{ IN. LEAVING } 0.082 \text{ IN. FOR MAN & CUDITE}$$

$$0.082 \text{ A AL OF } 0.175 \text{ IN.}$$

$$1.0568 (3.5) = L_0$$

$$0.175$$

$$L_0 = 71 \text{ IN. FROM H-9 TO CUDITE MAN & TO BE COMPLETED}$$

DECLASSIFIED

KW373462D

TANK J-31 - SAFE

DECLASSIFIED

ACT. I.D. = 3.75 IN.

ASSUME 5-1" PROCESS LINES

$$R' = \sqrt{\frac{3.515625}{1} + 1.25} = \sqrt{4.765625}$$

$R' = 2.18303$ IN ; DIA. = 4.36606 IN.

INTERACTION

TANK NO.	Q TO Q SEP	% EFF
J-4	26"	2.75
H-9	48"	1.48
H-10	40"	2.00
H-11	60"	1.00
J-17	54"	1.20*
J-9	60"	1.00
J-25	36"	2.36
J-2	60"	1.00
J-3		
TOT =		12.79%

TOT EFF. I.D. = 4.968 IN

SAFE FOR ANY MWD/T_{PR} SOGN

06 [REDACTED]

HW 37346 RD

RECEIVED

CRITICAL CALCULATIONS
FOR RECUPLEX TANKS
BASED ON MAXIMUM
POSSIBLE CONCENTRATIONS
AS LISTED IN HW-27491.
AND HALF PLANE
REFLECTION AT HOOD
FACE

[REDACTED]

I.

TRUCKS G-47 & G-48

HW 37346 RD

I. D. = 7.520 IN. 67.375 IN. LONG.

EQ. WALL TH. OF 0.610 IN.

DECLASSIFIED

THEN —

$$R = 9.5504 \text{ CM} \quad L_R = 4.0125$$

$$H = 171.1325 \text{ CM} \quad L_T \& L_B = 6.1 \text{ CM.}$$

$$B = \left(\frac{2.4048}{13.5629} \right)^2 + \left(\frac{\pi}{183.3325} \right)^2 = 0.0314388 + 0.0002938$$

$$B = 0.0317326 \text{ CM}^{-1}$$

$$P = 14.127B + 0.51272 = 0.44829 + 0.51272 = 0.96101$$

$$\frac{1}{P} = 1.04057$$

$$C = \frac{M}{V} = \frac{10^4}{28.97(1-W)} \left\{ \frac{\Sigma \text{POISON}}{\frac{1}{P} - \left[1 + \left(\frac{W}{1-W} \right) 0.801 \right]} \right\}$$

$$= \frac{220}{28.97(0.9705)(1.04057 - 1.02435)} \quad (\text{FOR } 400 \text{ MWD/IT Pu})$$

0.01622

$$C = 482.42 \text{ grams/liter FOR } 400 \text{ MWD/IT Pu}$$

$$= 187.18 \text{ g/l FOR } 0 \text{ MWD/IT Pu}$$

SAFE ON BASIS OF MINIMUM CRITICAL CONCENTRATION

95

(MAX. POSSIBLE CONC. ~~50-80~~ g/l (FROM HW-27491))

68

2.

II.

TANK H-9

HW 37346R

I.D. = 7.520 IN. 54.375 IN. LONG

EQ. WALL THICKNESS OF 0.630 IN

RECLASSIFIED

THEN —

$$R = 9.5504$$

$$L_R = 4.0625 \text{ CM}$$

$$H = 138.1125$$

$$L_T \& L_B = 6.1 \text{ CM}$$

$$B = \left(\frac{2.4048}{13.6129} \right)^2 + \left(\frac{\pi}{150.3125} \right)^2 = 0.0312088 + 0.0004368$$

$$B = 0.0316456$$

$$f = 14.127 \underset{0.04106}{(0.0316456)} + 0.51272 = 0.95978$$

$$\frac{1}{f} = 1.04191$$

$$C = \frac{220}{28.97(0.9705)(0.01756)} \quad \text{NEW (FOR 400 MWDT/Pu)}$$

$$C = 445.61 \text{ grams/liter FOR 400 MWDT/Pu}$$

$$181.20 \text{ g/l FOR 0 MWDT/Pu}$$

SAFE ON BASIS OF MINIMUM CRITICAL CONCENTRATION.

$$[\text{MAX. POSSIBLE CONC.} = 47.6 \text{ g/l (FROM HW-37491)}]$$

47.6

69

3

III.

TANK H-10. [REDACTED]

HW 3:346 RD

$$I.D. = 7.52 \text{ IN.}$$

$$42.375 \text{ IN. LONG.}$$

$$\text{EQ. WALL THICKNESS} = 0.560 \text{ IN.}$$

DECLASSIFIED

THEN—

$$R = 9.5504 \text{ CM} \quad L_R = 3.975 \text{ CM.}$$

$$H = 107.6375 \text{ CM} \quad L_T \& L_B = 6.1 \text{ CM}$$

$$R = \left(\frac{2.1048}{13.4754} \right)^2 + \left(\frac{\pi}{119.8325} \right) = 0.0318480 + 0.0006875$$

$$R = 0.0325355 \text{ CM}^{-2}$$

$$f = 14.127(0.0325355) + 0.51272 = 0.45963 + 0.51272$$

$$f = 0.97235$$

$$\frac{1}{f} = 1.02864$$

$$C = \frac{220}{28.97(0.9705)(0.50409)} \quad (\text{FOR } 400 \text{ MWD/TPU})$$

L-55501

$$C = 1913.219/\ell \text{ FOR } 400 \text{ MWD/TPU}$$

$$= 267.02 g/\ell \text{ FOR } 0 \text{ MWD/TPU}$$

SAFE ON BASIS OF MINIMUM CRITICAL CONCENTRATION.

$$[\text{MAX. CONC.} = 47.5 g/\ell \text{ (FROM HW-27491)}]$$

[REDACTED]

IV.

OL TANK J-1

HW 37346R0

ID = 7.520 IN. 89.375 IN. LONG

EQ. WALL THICKNESS = 0.600 IN.

DECLASSIFIED

THEN —

$$R = 9.5504 \text{ CM} \quad L_R = 4.000 \text{ CM}$$

$$H = 227.0125 \quad L_T \& L_B = 6.1 \text{ CM}$$

$$P = \left(\frac{2.4048}{9.5504} \right)^2 + \left(\frac{\pi}{227.0125} \right)^2$$

$$P = 0.0314956 + 0.0001724 = 0.0316680 \text{ cm}^{-2}$$

$$f = 14.127 \underset{0.4437}{(0.0316680)} + 0.51272 = 0.96009$$

$$\frac{1}{f} = 1.04157$$

$$C = \frac{220}{28.97(0.9705)(0.01722)} = 0.42415$$

$$C = 254.10 \text{ g/l FOR } 400 \text{ MW.D./T. Pu} \\ = 182.68 \text{ g/l FOR } 0 \text{ MW.D./T. Pu}$$

SAFE ON BASIS OF MINIMUM CRITICAL CONCENTRATION

$$[\text{MAX. CONC. } \overset{96.77}{\text{g/l}} \text{ (FROM HW-27491)}]$$

V.

TANK 3-

HW 37346 RD

I.D. = 7.21 IN. 60.0 IN. LONG

EQ. WALL THICKNESS = 0.880 IN.

DECLASSIFIED

THEN —

$$R = 9.1567 \text{ cm}$$

$$L_R = 4.4845 \text{ cm}$$

$$H = 152.4 \text{ cm}$$

$$L_T \& L_B = 6.1 \text{ cm}$$

$$P_B = \left(\frac{2.1048}{13.6442} \right)^2 + \left(\frac{\pi}{164.6} \right)^2 = 0.0310641 + 0.0003644$$

$$P_B = 0.0314285$$

$$P = 14.127(0.0314285) + 0.51272 = 0.95671$$

$$\frac{1}{P} = 1.04525$$

$$C = \frac{220}{28.97(0.9705)(0.02090)} = 1.5456 \quad (\text{FOR } 400 \text{ MMD/IT } P_u)$$

$$12.029 \quad C = 374.40 \text{ g/l FOR } 400 \text{ MMD/IT } P_u$$

$$= \frac{167.82}{174.92} \text{ g/l FOR } 0 \text{ MMD/IT } P_u$$

SAFE ON BASIS OF MAXIMUM CONCENTRATION

AS GIVEN IN HW-27491

$$[\text{MAX. CONC. } 97.37 \text{ g/l (FROM HW-27491)}]$$

VI.

TANK G-50

HW 37346 RD

72

I.D. = 7.32 IN. 60.0 IN. LONG

DECLASSIFIED

EQ. WALL THICKNESS = 0.920 IN.

THEN—

$$R = 9.2964 \text{ CM.} \quad L_D = 1.5375$$

$$H = 152.10 \text{ CM.} \quad L_T \& L_B = 6.1 \text{ CM.}$$

$$B = \left(\frac{2.1048}{13.8339} \right)^2 + \left(\frac{\pi}{164.60} \right)^2 = 0.0302169 + 0.0003644$$

$$P_B = 0.0305813$$

$$F = 14.127(0.0305813) + 0.51272 = 0.43202 + 0.51272$$

$$A = 0.94474$$

$$\frac{1}{F} = 1.05849$$

$$C = \frac{220}{(28.97)(0.9705)(0.03414)} = 0.95466$$

$$1.60446 \quad C = \frac{229.2}{129.83} \text{ g/l FOR 400 MWDIT PU}$$

$$= \frac{229.2}{129.83} \text{ g/l FOR 0 MWDIT PU}$$

SAFE FOR ^{any} ~~400~~ MWDIT PU ON BASIS OFCRITICAL CONCENTRATION. (HW-27491)

$$[\text{MAX CONC.} = \frac{67.32}{50} \text{ g/l (FROM HW-27491)}]$$

DECLASSIFIED

1.

73

HW 3:346 RD

TANK J-20 - SAFE FOR 400 MWD/TPu

ACT. I.D. = 6 IN $\leftarrow$ CHECK
4-30-54 H = 121.92 CMU
12.2
124.12

INTERACTION:

TANK NO.	DIST.	% EFF
J-2	61 IN.	7% 0.675%

0.00548

ASSUMING 5-1" PROD LINES

$$R = \sqrt{10.25} = 3.202 ; D = 6.404 \text{ IN}$$

$$D_{TOT} = 1.01 \times 6.404 = 6.468 \text{ IN.}$$

$$B = 0.032810 = \left(\frac{2.4048}{8.21436 + D_R} \right)^2 + \left(\frac{\pi}{184.12} \right)^2$$

$$L_R = \frac{2.4048}{\sqrt{0.032262}} - 8.21436$$

0.17962

$$6065483.38826 - 8.21436 = 5.1739$$

EQ. REFL. TH. = 1.5 IN. (MAX. SAFE FOR 400 MWD/TPu)

6-7795j

(MAY 17)

DECLASSIFIED

HW 3:346RD

TANK J-30 (CONT'D)

REFLECTOR

- (1) TANK WALLS & JACKET
- (2) TIE RODS (8) - $\frac{3}{8}$ " DIA - $r_o = 4.6875$ IN.
- (3) TANK K-9 (31" ϕ TO ϕ SEP.)
- (4) REAR HOOD FACE ($L_o = 18.6875$ ")
- (5) 2 - 2" PIPES @ ~ 19 " ϕ TO ϕ
- (6) 1 - 2" T @ ~ 18 " ϕ TO ϕ

0.4375 IN
(0.575 IN)

$$(2) \quad r_i^* = \sqrt{21.97266 + 1.12496} = \sqrt{23.09762} = 4.806$$

$$r_i - r_o = 0.1185 \text{ IN.} = \text{EQ. REFL. TH.}$$

$$(3) \quad \sin \theta = \frac{0.555}{0.35484}$$

$$\tan \theta = \frac{0.65854}{0.37953}$$

$$a = 20 \left(\frac{1}{V} \right) = 7.59 \text{ IN.}$$

$$A_L = 1.0568 \left(\frac{3}{20} \right) \left(\frac{1}{\left(\frac{20}{7.59} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$$= 1.0568 \left(\frac{0.15}{0.78} \right) (0.3795) = 0.06015 \text{ IN.}$$

2.4 DIV.

4. REAR HOOD FACE

$$A_L = 1.0568 \left(\frac{3}{18.6875} \right) (1) = 0.16966 \text{ IN.}$$

0.8 DIV.

(CONT'D)

REFLECTED

75

(5) 2" PIPES — @ 19"

HW: 346 RD

$$\pi (R_1^2 - R_0^2) = 2.148$$

$$R_1^2 = \frac{2.148}{\pi} + R_0^2 = 0.68373 + 361$$

$$R_1 = \sqrt{361.68373} = 19.01798$$

$$EQ. REFL. TH. = 0.01798 \text{ IN.}$$

(6) 3" I

$$R_1 = \sqrt{144.52202} = 12.02173$$

$$EQ. REFL. TH. = 0.02173 \text{ IN.}$$

SUMMATION OF REFLECTORS

	6.845	
	0.118	
	0.022	(0.578)
	1.015	
(1) TANK WALLS & JACKET		0.438 IN.
(2) TIE RODS		0.118 IN.
(3) 3 IN. I	0.578	0.022 IN.
(4) REAR HOOD FACE	AL = 0.170 UN 6.8 DIV.	0.100
(5) 2 IN. PIPES		0.018 IN.
(6) TANK K-9		0.060 IN.
	0.960	0.756 IN.

∴ J-30 IS SAFE FOR 400 MW/D/T P₀

(X)

TANK J-17, SOLV. EXT.
FE FEED TANK

HW 3.346 RD

REFLECTOR

DECLASSIFIED

REFL. THICKNESS

TANK WALLS

78

$l = 3.025 \text{ CM}$

0.1250 IN.

SUP. WELDED TO TANK

0.0760 IN.

→ FLANGES WELDED TO TANK

0.0720 IN.

$\frac{3}{16}'' \times \frac{3}{4}'' \times 7'$ LONG STRAPS

0.0050 IN.

3" L's (TANK SUP. REST ON)

0.0380 IN.

HORIZONTAL I BEAMS

0.0635 IN.

(2) 2 IN. VERTICAL PIPES

0.4309

0.0514 IN.

TO WFE →

REAR HOOD PANELS

$\Delta l = 0.0373 \text{ CM}$

~~0.0043~~ IN.

MAN NEAR TANK (1)

0.1527

6.108

$\Delta l = 0.0669 \text{ CM}$

0.0691

~~0.0043~~ IN. ~~0.0043~~ IN.

CENTRIFUGAL PUMP

$\Delta l = 0.0485 \text{ CM}$

~~0.0043~~ IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS

0.500 IN.

I.D. OF ALWAYS SAFE CYLINDER WITH 0.500 IN. SS WALLS

7.44

~~7.36~~ IN.

→ EFFECTIVE I.D. OF J-17 (INCLUDING PROD-BEARING LINES)

7.520 IN.

MAX. REFL. TH. FOR J-17 TO BE SAFE

0.440 IN.

INCLUDING LONGITUDINAL BENDING MAX. SAFE $R_1 = 0.47 \text{ IN.}$

DECLASSIFIED

J-17

54" FROM FRONT FACE OF
WOOD TO REAR FACE

TANK CENTERLINE 14 INCHES FROM
REAR FACE OF WOOD.

18 3/4" EDGE TO FIRST SEVERATION FROM END

4" TANK 10" FROM 2" I (KENT)

5'-9"

3" I

4" PIPE 68" FROM 2" TANK
(2 PIPES); (4 TOTAL)

8'-2 1/2"

7'-5 3/8"

1 1/8" IN X 7 1/2" IN

2'-4"

3" TH, 8 1/4" WIDE

1 INCHES
3/4" X 7'-0 1/2" 1 3/16" THK.

6 3/4" EDGE TO EDGE SEP OF C-5

4195330

644

2" PIPE

2" PIPE

2" PIPE

2" PIPE

2" PIPE

10 5/8"

18 3/8"

14 3/8"

14 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

2 3/8"

A. TANK WALLS — 38.175 IN.

HW 3734620

B. SUP. WELDED TO TANK 0.076 IN.

DECLASSIFIED

C. FLANGES WELDED TO TANK 0.072 IN.

D. $\frac{3}{16} \times \frac{3}{4}$ " x 7' STRAPS 0.005 IN.

E. 3 " L'S (TANK SUP. REST ON 0.038 IN)

F. HORIZONTAL T BEAMS (2 ABOVE & 2 BELOW TANK AT DIST. $R_0 = 16.4$ IN. C.S.A. 3" I = 1.64 IN²)

271.04811

16.662

355
3

$$R_2 = \sqrt{\frac{6.56}{\pi} + 268.96} = \sqrt{271.04811} = 16.46354$$

EQ. REFL. THICKNESS = 0.0635 IN.

G. (2) 2 IN. VERTICAL PIPES

 $R_1 = 6.625$; C.S.A. 2" SCH 40 = 1.074 IN²

$$R_2 = \sqrt{44.574355} = 6.6764$$

EQ. REFL. THICKNESS = 0.0514 IN.

H. REAR HOOD PANEL —

$$\Delta L = 0.18436 \left[\frac{2C_0}{\sqrt{C_0^2 - R^2}} \tan^{-1} \frac{C_0 + R}{C_0 - R} - \frac{\pi}{2} \right]$$

736

where $C_0 = 13.675$ IN, $R = 3.5$ IN.

$$\Delta L = 0.18436 \left[\frac{27.25}{\sqrt{191.890625}} \tan^{-1} \frac{16.9136}{14.66746} - 1.5708 \right]$$

26° 26' 30"

$$= 0.18436 [1.9371 (0.91528) - 1.5708] = 0.03727$$

 $\Delta L = 0.0373$ CM.

DECLASSIFIED

2.

HW 3.34620

I. MAN NEAR TANK

$$\Delta L = 1.0568 \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}} ; R = 3.5 \text{ m}; L_0 = 11 \text{ m}; a = 3.47 \text{ m}$$

$$= 1.0568 (0.2500) (0.25336) = 0.0669 \text{ m}$$

$$\Delta L = 0.0669 \text{ m}$$

J. CENTRIFUGAL PUMP

TANK J-17A

HW 37346 RD
RECEIVED

7.25 IN. O.D.

80

SAME AS H-9 SUPP. WELDED TO TANK ✓

SAME AS H-9 FLANGES WELDED TO TANK ✓

SAME AS H-9 $\frac{3}{16} \times \frac{3}{4} \times 7'$ LONG STRIPS ✓

" LI'S TANK SUPP REST ON ✓

HORIZ. T BEAMS $\begin{matrix} 2 \text{ ABOVE} \\ 2 \text{ BELOW} \end{matrix}$ — 16.4 IN. ϕ TO ϕ ✓
— 16.4 IN. ϕ TO ϕ

2 IN. VERTICAL PIPES — 6.8 IN. ϕ TANK TO ϕ PIPES (2) ✓

REAR HOOD PANEL (LUCITE) — 13.685 IN. ϕ TANK TO LUCITE

MAN NEAR TANK — 14" ϕ TANK TO MAN ✓

(CHECK ON 2 MEN ALSO, SINCE 18" SECT OF TANK IS CONSIDERED)

SAME AS H-9 CENTRIFUGAL PUMP ✓

$$\sin \phi = \frac{4.75}{16.75} = 0.28393$$

$$\tan \phi = 0.26186$$

$$a = 14 \tan \phi =$$

81

AW 37346 RD

DECLASSIFIED

$$\alpha = \alpha_0$$

~~$$\underline{\underline{A}} \quad \underline{\underline{\Delta L}} = 1.0568 \left(\frac{3.5}{14} \right) \left(\frac{1}{\left(\frac{14}{9} \right)^2 + 1} \right)^{\frac{1}{2}}$$~~

$$= 1.0568 (0.2500) \left(\frac{1}{1.8493} \right) = \del{0.1429 \text{ cm}}$$

0.1429 cm

~~$$\underline{\underline{B}} \quad \underline{\underline{\Delta L}} = 1.0568 (0.25) = \underline{\underline{0.2642 \text{ cm}}}$$~~

$$\frac{M}{V} = \frac{-3.12}{\sqrt{1.39} (1-W)} \left[\frac{1}{\frac{1}{2} - 1 - \frac{2.4648}{1-W} (0.501)} \right]$$

DECLASSIFIED

$$\frac{1}{f} = \frac{1 + \frac{W}{1-W} (0.501)}{1-W}$$

$$f = (52.498 - 0.3562 H) R + 4.147 \times 10^{-2} H + 0.061$$

$$R = \left(\frac{11}{H+0.2} \right)^2 + \left(\frac{2.4648}{K+L} \right)^2$$

$$W =$$

OK

TANK J-25, SOLV. EXTR.
CONCENTRATED CCP BECD

HW 37346 RD

$$\frac{1}{B} = \left(\frac{2.4048}{R_0 + l_R} \right)^2 + \left(\frac{\pi}{H + R_0 + l_B} \right)^2$$

DECLASSIFIED

$$l_T = 4.67 \text{ CM. } (1 \frac{1}{8} \text{ IN. S.S.})$$

$$l_B = 3.22 \text{ CM. } (\frac{1}{4} \text{ IN. S.S.})$$

$$H = 12 \text{ IN} = 30.48 \text{ CM}$$

$$R = 3.5 \text{ IN} = 8.89 \text{ CM}$$

$$f = [54.68 - 36.24 H(10^{-2})] B + 3.812 (10^{-3}) H + 0.08616$$

$$\text{WHEN } H = 111.99 \text{ IN.}$$

$$f = 14.127 B + 0.51272$$

for 50 MWD/T PU,

$$\frac{1}{f} = 1.00402 \quad \& \quad f = 0.99600$$

$$B = \frac{0.99600 - 0.51272}{14.127} = 0.034210$$

35
116568

for 400 MWD/T PU,

$$\frac{1}{f} = 1.02435 \quad ; \quad f = 0.97623$$

LK = 0.135 1111
0.34 1111

$$B = \frac{0.97623 - 0.51272}{14.127} = 0.032810$$

$$\left(\frac{2.4048}{8.89 + l_R} \right)^2 + \left(\frac{3.1416}{58.27} \right)^2 = 0.032810$$

$$l_R = \frac{2.4048}{\sqrt{0.032810 - 0.006704}} - 8.89$$

0.02611
0.16159

$$l_R = 14.88 - 8.89 = 5.99 \text{ CM}$$

EQ. REFL. TH $\approx$ 2.68 ~~in~~

J-25

HW 3:34 GR

CENTERLINE IS 15 IN. FROM FRONT FACE OF HCU

REVISION

A. TANK WALLS — 0.125 INCHES

85

NW 37346 RQ

B. TANK SUPPORTS WELDED TO TANK

DESIGNED

$$R_1 = 3.625 \text{ IN.}$$

$$R_2 = \sqrt{\frac{1.75}{\pi} + 13.140625} = \sqrt{13.697666} = 3.701$$

$$\text{EQ. REFL. THICKNESS} = 0.076 \text{ IN.}$$

C. FLANGES ATT. TO TANK

$$R_1 = 5.625 \text{ IN.}$$

$$\text{EQ. REFL. TH.} = \frac{4.5 (0.5625) \pi}{2(5.625) \pi} = 0.07162$$

D. TWO $\frac{3}{16} \times \frac{3}{4} \times 46$ LONG STEEL PLATES

$$R_1 = 8.5 \text{ INCHES}$$

$$\text{C.S.A.} = 0.2812 \text{ IN}^2$$

$$R_2 = \sqrt{77.33951}$$

$$\text{EQ. REFL. TH.} = 0.0052 \text{ IN.}$$

E. 2-3 IN LI'S TANK SUPPORTS RESTON

$$R_1 = 10 \text{ INCHES ; C.S.A.} = 2.38 \text{ IN}^2$$

$$R_2 = \sqrt{100.75757575 \dots} = \cancel{10.0378} \text{ IN } 10.03781$$

$$\text{EQ. REFL. TH.} = 0.0378 \text{ IN.}$$

F. HORIZ. 3" I BEAM

$$R_1 = 13 \text{ IN.}$$

$$\text{C.S.A.} = 1.64$$

13.0205

$$R_2 = \sqrt{169.522027} = 13.02007$$

13.02007

$$\text{EQ. REFL. TH.} = 0.0201 \text{ IN.}$$

G. 1- 7 IN. VERTICAL PIPE

HW 3:34.6 RD

$$R_1 = 10 \text{ INCHES} ; \text{CSA} = 1.074 \text{ IN}^2$$

DECLASSIFIED

$$R_2 = \sqrt{100.341864} = 10.01708$$

10.01708

$$\text{EFF. REFL. TH} = 0.0171 \text{ IN.}$$

H. ~~WHITE~~ WHITE PANEL

$$AL = 0.8194 \alpha \left[\frac{2L_0}{L_0^2 - R^2} \tan^{-1} \sqrt{\frac{L_0 + R}{L_0 - R}} - \frac{\pi}{2} \right]$$

$$\alpha = 0.225$$

$$L_0 = 13.625 \text{ IN.}$$

$$R = 2.5 \text{ IN.}$$

$$AL = 0.18436 \left[\frac{27.25}{113.3906} \tan^{-1} \sqrt{1.691358} - 1.5708 \right]$$

$\frac{113.3906}{13.16419}$
 $\frac{1.691358}{1.80052}$
 $\frac{58.026180^\circ}{58.026180^\circ}$

$$= 0.18436 [(2.0694)(0.91528) - 1.5708]$$

$$AL = 0.0596 \text{ CM.}$$

I. MAN STANDING NEAR TANK.

$$AL = \frac{3.32}{\pi} \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$\frac{1.0637}{15.557012}$

$$R = 2.5'' ; L_0 = 14'' ; a = 3.67''$$

$$AL = 1.0568 (0.25000) (0.25358) = 0.066996 \text{ CM.}$$

0.940 = 1

$$AL = 0.0670 \text{ CM.}$$

$$0.2485 \text{ CM.}$$

J. CENTRIFUGAL PUMP

HW 3'-3 1/2" 6 RD

$$\Delta L = 10568 \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{1/2}$$

25.408455

RECLASSIFIED

$$R = 3.5 \text{ IN.}$$

$$L_0 = 16 \text{ IN.}$$

$$a = 3.43 \text{ IN.}$$

$$\Delta L = 10568 (0.21875) (0.20985)$$

$$\Delta L = 0.488 \text{ CM}$$

K. 3" I BEAMS ABOVE TANK

$$R_1 = 16 \text{ IN. ; C.S.A.} = 1.64$$

$$R_2 = \sqrt{256.52203} = 16.01631$$

$$\text{EQ. REFL. TH.} = 0.0163 \text{ IN.}$$

L. 3" L'S SUPPORTING H-10

$$R_1 = 18 \text{ IN. ; C.S.A.} = 2.38 \text{ IN}^2$$

$$R_2 = \sqrt{324.7575757} = 18.02103 \text{ IN}$$

$$\text{EQ. REFL. TH.} = 0.02103 \text{ IN}$$

M. REFLECTION FROM CONCRETE FLOOR

$$\Delta L = 0.6728 \left[\frac{2L_0}{\sqrt{L_0^2 - R^2}} \tan^{-1} \frac{L_0 + R}{L_0 - R} - \frac{\pi}{2} \right] ; L_0 = 21 \text{ IN.}$$

$R = 3.5 \text{ IN.}$

$$= 0.6728 \left[\frac{42}{\sqrt{428.75}} \tan^{-1} 1.4000 - 1.5708 \right]$$

20.70628 $54^\circ 27' 45''$

$$= 0.6728 [(2.0284) (0.95055) - 1.5708]$$

$$\Delta L = 0.24038 \text{ CM}$$

N. PROCESS PIPING NEAR TANK

Kw 0.046 R

DECLASSIFIED

ASSUME 5 - $\frac{3}{4}$ IN PRODUCT-WEARING LINES NEAR TANK

$$C.S.A. PIPES = 5\pi(0.375) = 5.8905 \text{ IN}^2$$

$$C.S.A. TANK = \pi(3.5)^2 = 38.4846 \text{ IN}^2$$

$$R = \sqrt{\frac{44.3751}{\pi}} = \sqrt{14.125} = 3.75832$$

$$EQ. RAD = 3.75 \text{ IN.}$$

$$DIA = 7.52 \text{ INCHES}$$

NO PROCESS PIPING — 5 - $\frac{3}{4}$ IN PRODUCT LINES

$$C.S.A. PIPES = 38.48460 \text{ IN}^2$$

$$C.S.A. TANK = 2.20900$$

$$40.69360$$

$$R' = \sqrt{\frac{40.69360}{\pi}} = \sqrt{12.95323}$$

$$R' = 3.59906 \text{ IN.} = 9.14161 \text{ CM}$$

$$D' = 18.38322 \text{ CM} = 7.19812 \text{ IN.}$$

TANK WALLS

0.125

1403.346 R0

SUP. ATT TO TANK

0.076 IN

FLANGES ATT. TO TANK

0.072 IN

 $\frac{3}{16} \times \frac{3}{4} \times 36$ STRAPS

0.005 IN

2 IN. L.I'S (2)

0.078 IN

(1) 3 IN. I ; $R_1 = 15$ IN.

$$R_2 = \sqrt{225.529674} = 15.01765$$

$$\text{EQ. REFL. TH.} = 0.0176 \text{ IN.}$$

(2) 2 IN. I'S $R_1 = 12$ IN

$$R_2 = \sqrt{145.044054} = 12.04343$$

$$\text{EQ. REFL. TH.} = 0.0434 \text{ IN.}$$

(1) 2 IN. VERT. PIPE $R_1 = 10$ IN

$$R_2 = \sqrt{100.34186} = 10.01708$$

$$\text{EQ. REFL. TH.} = 0.0171 \text{ IN}$$

(1) 3 IN. I ABOVE TANK $R_1 = 18.5$ IN

$$R_2 = \sqrt{342.77967} = 18.51431$$

$$\text{EQ. REFL. TH.} = 0.0143 \text{ IN}$$

LUCITE HOOD PANEL

DECLASSIFIED

2.

$$AL = 0.18436 \left[\frac{2L_0}{L_0^2 - R^2} \tan^{-1} \frac{L_0 + R}{L_0 - R} - 1.5708 \right]$$

$$L_0 = 12.625; R = 2.5$$

$$130052 \quad AL = 0.18436 \left[\frac{27.25}{\sqrt{173390625}} \tan^{-1} \frac{1691358}{125252} - 1.5708 \right]$$

$13.16779 \quad 52^\circ 26' 30''$

$$= 0.18436 [2.0694 (0.91528) - 1.5708] = 0.0595997$$

$$AL = 0.0596 \text{ CM.}$$

CENTRIFUGAL PUMP

$$AL = 0.0485 \text{ CM}$$

$$L_0 = 16$$

(1) MAN.

$$AL = 1.0568 \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{R} \right)^2 + 1} \right)^{\frac{1}{2}}; R = 2.5; L_0 = 14; a = 3.67$$

$$= 1.0568 (0.2500) (0.25358) = 0.066996$$

$$AL = 0.0670 \text{ CM}$$

REF ID: A6, 4-14-54

91 TANK H-11

DECLASSIFIED
DATE 10-16-80

$$EQ. RAD. = 3.74052 IN. = 9.50092 CM$$

$$H = 224.79 CM \quad \text{EQ. DIA.} = 7.48104$$

I. ASSUME COMPLETE WATER TAMPING

$$P_2 = \left(\frac{2.4048}{15.60092} \right)^2 + \left(\frac{\pi}{236.99} \right)^2 = 0.02376 + 0.00018$$

$$P_2 = 0.02394$$

$$20.65465$$

$$f = 0.85092$$

$$\frac{1}{f} = 1.17520$$

$$\frac{1}{f} - 1.02435 = 0.15085$$

$$MIN. CRIT. CONC. = 51.87 GRAMS/LITER$$

II. ASSUME $P_6 = H_2O$ AS REFLECTOR; THEN $L_R = 5.06256$

$$P_2 = \left(\frac{2.4048}{74.56342} \right)^2 + 0.00018 = 0.02745$$

$$f = 0.90051 \quad ; \quad \frac{1}{f} = 1.11048 \quad ; \quad \frac{1}{f} - 1.02435 = 0.08613$$

$$MIN. CRIT. CONC. = 90.85 GRAMS/LITER$$

DECLASSIFIED

SECRET 4 102

TANK J-31

HW 373468

ACTUAL TANK DIMENSIONS —

I.D. = ^{3.45} 3.45 IN.

HEIGHT = 9.25 IN.

WALL THICKNESS (CAN) = 0.125 IN.

VOL. OF J-31 IS 1.674 LITERS & IS SAFE

93

KW 37346R2

TANK H-11

DECLASSIFIED

6.4 IN
 ACTUAL I.D. = ~~6.4~~ IN ; H = 88.5 IN = 224.79 CM
 WALL THICKNESS ~~1/2~~ (2 WALLS) ; 1/16
 EFF. I.D. = 60.77938
 (INCLUDING 5-1" PROD LINES & INTERACTION
~~WITH~~ WITH SURROUNDING TANKS)

CRIT. B FOR 400 MWD/T $P_{th} = 0.032810 \text{ W/M}^2$

A-29-54

6" JCH 100

0.800 IN. WALLS

$\frac{111}{111} \rightarrow +0.505 = 1.305 \text{ IN EQ. REFL. TH.}$
 $L_R = 5.0625 \text{ W/M}$ (65.75 DIV.)

0.6" THICK TOTAL
 CRACKED WALL

4-11

0.637

112.5

113.4

229

126

126

54

127

112.5

113.4

229

0.229

REFLECTORS OTHER THAN TANK WALLS (DOUBLE) &
 LEAD SHIELD ARE ~~TO~~ TO TANK H-9
 TANKS INTERACTING WITH H-11

TANK L TO R SEP % INC. (EFF) IN DIA.

H-9	26"	3.75	1.45	2.05
H-10	38"	3.75	0.85	1.05
J-17	28"	3.75	1.30	2.05
J-25	40"	1.18	0.425	0.05
J-4	56"		0.475	0.05
TOTAL		10.35	4.500	11.49%

4-28-54

51

HW 37846 RD
DECLASSIFIED

$$B = \left(\frac{2.4048}{14.228} \right)^2 + \left(\frac{\pi}{236.99} \right)^2 = 0.02857 + 0.00018$$

$$= 0.02875$$

$$f = 0.91887$$

$$\frac{1}{f} = 1.08829$$

$$\frac{1}{f} - 1.02488 = 0.06394$$

$$\text{CRIT. CONC.} = 172.9/l$$

95

HW 37346 RD

RESEARCH

$$\text{AREA PIPES} = 5(0.35)(\pi) = \text{---} \text{ IN}^2$$

$$EQ. RAD. = \sqrt{\frac{2.2^2 \pi + (\pi)}{\pi}} = 2.38969$$

$$EQ. DIA = 6.77938 \text{ in.}$$

$$EQ. DIF_{FINAL} = 1.1035 () = 748105 \text{ IN.}$$

$$Rad = 3.74052$$

$$R = 0.032810 = \left(\frac{2.1048}{9.50092 + iR} \right)^2 + \left(\frac{\pi}{836.99} \right)^2$$

$$l_c = \sqrt{\frac{2.4048}{0.032684}} - 9.50092 = 3.811 \text{ (m)}$$

EQ. REFL. THICKNESS = ~~2.5~~ 0.5 IN.

$$6.4 \times 1.15 = 7.36$$

93

HW 3734620

TANK H-11

DECLASSIFIED

$$\text{ACTUAL I.D.} = 6.4 \text{ IN.} ; H = 88.5 \text{ IN.} = 224.79 \text{ CM}$$

$$\text{ACT. WALL THICKNESS} = 0.8 \text{ IN.}$$

OK

TANK J-1, SOLV. EXTR. HW 3734680

CCP RECEIVER

BASED ON CALCULATIONS FOR H-9

DECLASSIFIED

TOTAL EFF REFLECTOR THICKNESS

0.450 in.

I.D. OF ALWAYS SAFE CYLINDER WITH 0.450 IN. S.S. WALLS

7.500 in.

EFF. I.D. OF J-1 (INCLUDING PRODUCT-BEARING LINES)

7.350 in.

MAX. REFL. THICKNESS FOR J-1 TO BE SAFE

0.560
~~0.470 in.~~

45
07
52

TANKS J-2 & J-3, SOLV. EXTR.

DECLASSIFIED

CCP SAMPLE TANKS

REFLECTORS NEAR TANK

HW 3734680

REFLECTOR

EFF. REFL. TH.

TANK WALLS

$L = 3.025 \text{ CM}$

✓ 0.125 IN.

SUPPORTS WELDED TO TANK

✓ 0.180 IN.

4" L & STRAP ATT TO TANK

✓ 0.048 IN.

12" ISO* FLANGES ATT. TO TANK

✓ 0.165 IN.

3" I BEAM (TANK SUPP ATT TO)

0.033 IN.

REAR HOOD PANEL

$\Delta L = 0.0712 \text{ CM}$

— 0.040 IN.

3" T AT END OF TANK SUPP.

0.012 IN.

2" VERTICAL PIPE

0.016 IN.

MAN NEXT TO REAR FACE OF HOOD

$\Delta L = 0.1171 \text{ CM}$

— 0.061 IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS

0.680 IN.

INSIDE DIAMETER OF THE ALWAYS SAFE CYLINDER
WITH 0.680 IN. S.S. WALLS

7.19 IN.

→ EFFECTIVE I.D. OF TANKS J-2 & J-3, ASSUMING
3 - 3/4" PRODUCT-BEARING LINES NEAR EACH TANK

7.12 IN.

MAX. REFLECTOR THICKNESS FOR J-2 & J-3 TO BE SAFE

0.74 IN.

J-2

DECLASSIFIED

100 J-3

HW 3734580

J-2 1/4" FROM & OF (1) 3" PIPE
& HORIZ. T. BEHINDS AT
SONAR ET EDGE

12.75
36.25
5.625

DECLASSIFIED

SUPPORTS WELDED TO TANK - ~~SAME AS G-42~~TANK WALLS - 0.125 IN. WALLS; $l = 3.025$ CM

L & STRAP ATT. TO TANK (SAME AS G-42)

1 1/2" ISO # FLANGES ATT. TO TANK (SAME AS G-42)

3" I BEAM (TANK SUP. ATT. TO (SAME AS G-42)

" " " AT END OF TANK SUPP. (SAME AS G-42)

REAR ~~HOOD~~ LUCITE HOOD PANEL ($l_0 = 11.875$, $R = 3.5$)2" VERTICAL PIPES (SEE SKETCH) (12" ϕ TO ϕ)MAN NEXT TO BACK FACE OF HOOD. ($l_0 = 12.75$ IN.; $R = 3.5$ IN.)

A. SUPPORTS WELDED TO TANK

$$\text{AREA OF EQ. RING} = \pi(R_2^2 - 13.1406) = 4.2 \text{ IN.}^2$$

3.80493

$$R_2 = \sqrt{1.3369 + 13.1406} = \sqrt{14.4775} = 3.80493$$

EQ. REFLECTOR THICKNESS = 0.1800 INCHES

B. TANK WALLS - 0.125 INCHES

C. 4" L & STRAP ATT. TO TANK.

$$R_1 = 7.625$$

$$R_2 = \sqrt{\frac{2.2925}{\pi} + 58.140625} = \sqrt{58.870345} = 7.6727$$

EQ. REFLECTOR THICKNESS = 0.0477 INCHES

D. 1 1/2" ISO # FLANGES ATTACHED TO TANK.

EQ. REFLECTOR THICKNESS = 0.165 INCHES

E. 3" I BEAM (TANK SUP. ATT. TO)

$$R_1 = 8 \text{ IN}$$

8.03256

$$R_2 = \sqrt{\frac{1.64}{\pi} + 64} = \sqrt{64.522027} = 8.03256$$

EQ. REFL. THICKNESS = 0.0326 IN.

F. 8" I BEAM AT END OF TANK SUPPORT

102

DECLASSIFIED

$$R_1 = 11 \text{ IN.}$$

$$R_2 = \sqrt{\frac{1.64}{\pi} + 121} = \sqrt{121.5207} = 11.0237$$

EQ. REFLECTOR THICKNESS = 0.0118 INCHES
11.0235

G. REAR WHITE HOOD PANEL

$$Ad = \frac{0.6728}{2L_0} \sqrt{L_0^2 - R^2}$$

$$Ad = 0.8194 \alpha \left[\frac{2L_0}{L_0^2 - R^2} \tan^{-1} \sqrt{\frac{L_0 + R}{L_0 - R}} - \frac{\pi}{2} \right]$$

11.35

11.3465

11.3475

$$\alpha = 0.225; L_0 = 11.875 \text{ IN}; R = 3.500 \text{ IN.}$$

$$Ad = 0.18436 \left[\frac{23.75}{128.76562} \tan^{-1} \frac{13.5492}{8.375} - 1.5708 \right]$$

$$= 0.18436 \left[\frac{8.0930}{11.3475} (0.97498) - 1.5708 \right]$$

$$Ad = 0.0712 \text{ CM.}$$

H. 2" PIPE

$$R_1 = 11 \text{ IN.}$$

$$R_2 = \sqrt{\frac{1.074}{\pi} + 121} = \sqrt{121.34186} = 11.01553$$

EQUIVALENT REFLECTOR THICKNESS = 0.0155 IN.

I. MAN NEXT TO REAR FACE OF HOOD.

$$Ad = \frac{3.72 \alpha}{\pi \alpha_0} \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}} = (1.0568)(0.28571)(0.38776)$$

$$R = 3.5; L_0 = 12.25; a = 5.1532; \alpha = \alpha_0$$

$$Ad = 0.1171 \text{ CM.}$$

J. PROCESS PIPING NEAR TANK

HW 37846 RD

DECLASSIFIED

ASSUME 3 - $\frac{3}{4}$ " PRODUCT-PEPPING LINE

$$\text{AREA (CROSS SECTION)} = 3\pi(0.375)^2 = 1.32531 \text{ IN}^2$$

$$\text{C.S.A. TANK} = \pi(3.5)^2 = 38.48460$$

$$\text{EQ RAD TANK + PROC LINES} = R = \sqrt{\frac{39.80991}{\pi}} = 712.67185$$
$$= 3.55975$$

$$\text{EQ RAD.} = 3.56 \text{ IN.} ; \text{DIA}_{\text{EQ}} = 7.12 \text{ IN.}$$

J-A

CH. 9-28-54

1.

I.D. = 7.00 IN

18.0 IN CONG

HW 35.05585
(45.72 IN)

ASSUME COMPLETELY TAPPED

DECLASSIFIED

$$B = \left(\frac{2.4048}{14.99} \right)^2 + \left(\frac{\pi}{30.2} \right)^2$$

$$= 0.02574 + 0.00472$$

$$= 0.03046$$

$$f = 14.127 B + 0.51272 = 0.94303$$

$$\frac{1}{f} = 1.06041$$

$$C = \frac{220}{28.97(0.9705)(0.03606)} \quad (\text{FOR 400 MWDT/Pu}) \quad \leftarrow 1.01364$$

$$C = 217 \text{ g/l FOR 400 MWDT/Pu}$$

10.57% FOR CANDID F

$$\text{CORRESPONDING MASS (MAY NOT BE MIN.)} = 2463.3 \text{ GRAMS}$$

THIS QUITE CONSERVATIVE APPROACH DOESN'T INDICATE THAT THE TANK IS SAFE. $\therefore$ FIND MAX REFLECTOR SAFE, BY USE OF EXTRAPOLATION LENGTHS AND CRITICAL BUCKLING

INCLUDE (2) - $\frac{1}{2}$ " & (1) - $\frac{3}{8}$ " PRODUCT LINES TO OBTAIN EQ. I.D. OF J-4

$$\text{EQ. I.D.} = 7.046 \text{ IN.}$$

$$B = \left(\frac{2.4048}{8.94842 + l_r} \right)^2 + \left(\frac{\pi}{45.72 + l_r + l_b} \right)^2 = 0.032810$$

(FOR 400 MWDT/Pu)

(OR IT'D)

J-4 (CONT'D)

DECLASSIFIED

2.

when $l_R = 5.0 \text{ CM}$ 105

HW 3.346 RD

$$l_T + l_B = \frac{\pi}{\sqrt{0.003085}} - 15.72$$

C 55543

$$= 56.56 - 45.72$$

$$l_T + l_B = 10.84 \text{ CM}$$

∴ TANK IS SAFE FOR ANY CONCENTRATION OF 400 MG/LIT PH IF THE EQUIVALENT REFLECTOR THICKNESS AROUND THE TANK DOES NOT EXCEED 1.24 INCHES.

1 END OF TANK 6 INCHES FROM FRONT FACE OF HOOD

~~2~~ OTHER END ^{MAIN} FLUSH WITH FRONT FACE OF ~~HOOD~~ HOOD

19 ³/₄ IN. FROM SIDE OF HOOD EXTENSION

$$\text{MAX CONC.} = 400 \text{ g/l}$$

106

HW 3:346 RD
DECLASSIFIED

$$C = \frac{220}{(28.97)(0.9705)(\frac{1}{f} - 1.02435)} \quad \text{FOR } 400 \text{ MWD/TPu}$$

$$= 400$$

$$\frac{1}{f} = \frac{220}{(400)(28.97)(0.9705)} + 1.02435 \quad 11,241.154$$

$$\frac{1}{f} = 1.04391 \quad \text{FOR } 400 \text{ MWD/TPu} ; \frac{1}{f} = 1.01898 \quad \text{FOR } 0 \text{ MWD/TPu}$$

$$f = 0.95794 \quad \text{FOR } 400 \text{ MWD/TPu} ; f = 0.98137 \quad \text{FOR } 0 \text{ MWD/TPu}$$

$$B = \frac{f - 0.51272}{14.127}$$

$$B = 0.031516 \text{ cm}^{-2} \quad \text{FOR } 400 \quad B = 0.033174 \text{ cm}^{-2} \quad \text{FOR } 0 \text{ MWD/TPu}$$

$$\left(\frac{2.1048}{8.94842 + L_R} \right)^2 + \left(\frac{\pi}{45.72 + L_T + L_B} \right)^2 = 0.031516$$

$$\text{ASSUME } L_T = L_B = 6.1 \text{ cm}$$

$$L_R = \frac{2.1048}{\sqrt{0.030232}} - 8.94842$$

$$= 13.83022 \text{ cm} \quad \downarrow$$

$$\text{THEN } L_R = \frac{2.1048}{\sqrt{0.031516 - 0.002942}} - 8.94842$$

$$= 14.22621 - 8.94842$$

CORR. REFL. TH = 1.15 IN. ON
SIDES OF TANK IF COMPLETELY
TAMPED ON ENDS (FOR
0 MWD/TPu SOLN)

$$L_R = 5.27779 \text{ cm} \quad (\text{BASED ON } 400 \text{ MWD/TPu})$$

CORR. REFL. TH. = 1.48 INCHES
ON SIDES — COMPLETELY
TAMPED ON ENDS.

BASED ON MAX. CONC. OF 400 g/l $\epsilon_{\text{eff}} = 0.0220$

107

HALF-REFLECTORS

HW 37843 R

(a) SIDE — $L_0 = 19.5$ IN.

(b) TOP — $L_0 = 10.0$ IN.

(c) BOTTOM — $L_0 = 12.0$ IN.

(a) $Ad = 1.0568 \left(\frac{3.5}{19.5} \right) = 0.18968$ CM

(b) $Ad = 1.0568 \left(\frac{3.5}{10} \right) = 0.36988$ CM

0.86779 CM.

(c) $Ad = 1.0568 \left(\frac{3.5}{12} \right) = 0.30823$ CM

(d) WALL THICKNESS OF TANK = 0.125 IN
 $l = 3.025$ CM.

(e) FLANGES ON TANK, (2) $\frac{1}{2}$ " 150 # WELDING NECK FLANGES

EQ. REFL. TH. = 0.144 (BASED ON H-10)

(f) $\frac{3}{8}$ " DIA. ROD FOR SUSPENDING TANK

$R_1 = 3.625$; C.S.A. = 0.110427 IN²

$R_2 = \sqrt{\frac{0.110427 + 13140625}{\pi \cdot 13.17577}} =$

= 0.00484 61.5 3.62984

DECLASSIFIED

HW is 3.56 RD

$$\Sigma \text{ REFLECTORS} = 0.26948 \text{ IN} + \text{AL OF } 0.86779 \text{ cm}$$

13.5" (24.1")

$$\text{TOT. EQ. REFL. TH.} = 0.70 \text{ IN.}$$

TANK IS SAFE FOR ANY EXPOSURE PU, IF THE
PU CONCENTRATION DOES NOT EXCEED 100 g/l

15 5575

PLEASE (KE [REDACTED] - 54

DECLASSIFIED¹

HW 37346 AD

TANKS G-54 & J-5

(SAFE FOR 400 MWD/7 Pu SOUWS)

$$\text{ACTUAL I.D.} = 2.45 \text{ IN.} ; H = 20.25 \text{ IN.} = 51.435$$

$$\frac{17.2}{68.635}$$

CONSIDERING 5-1" PROD. LINES,

$$\text{EQ. RAD.} = 3.08474 \text{ IN.} ; \text{DIA.} = 6.16948 \text{ IN.}$$

$$0.01948$$

INTERACTING TANKS —

★

0.032810

(a) G-54

(b) J-5

TANK NO. DIST. % EFF

NONE

TANK NO. DIST. % EFF

J-7 28 IN. 2.17 16375

4-29-53

NEW EQ. (TOT) DIA =

13.7984E

(a) 6.16948 IN

(b) 6.20336 IN

RAD. = 3.08474 IN

RAD. = 3.15168 IN

$$(a) L_e = \frac{2.4048}{\sqrt{0.030377}} - 7.87524 = 5.96 \text{ CM}$$

(0.17428)

$$\text{EQ. REFL. TH.} = 2.5 \text{ IN.}$$

$$(b) L_e = \frac{2.4048}{\sqrt{0.030377}} - 8.00527 = 5.79 \text{ CM}$$

(0.1742E)

$$\text{EQ. REFL. TH.} = 2.2 \text{ IN.}$$

[REDACTED]

DECLASSIFIED

2.

110 [REDACTED]

Hw 3:346 R

1. REFLECTORS ON TANKS THEMSELVES

- ✓ (a) TANK WALLS — 0.125 IN. THICK
- ✓ (b) 1-1" ^{2H} 40 PIPE 7 1/2" ϕ TO ϕ
- ✓ (c) 1-1" ^{5H} 40 PIPE 10 1/2" ϕ TO ϕ
- (d) 1-1" 150# WELDING NECK FLANGE ATT. TO TANK

A. ADDITIONAL REFL. NEAR J-5

FRONT HOOD FACE (9" ϕ TO FACE)

TANK K-2 (21" ϕ TO ϕ)

SUPPORTING FRAMEWORK (2" PIPES, I'S, ETC.)

CONCRETE FLOOR (13 1/2" CENTER OF TANK TO FLOOR)

(b) ADDITIONAL REFL. NEAR ~~J-5~~ G-54

REAR HOOD FACE (18" ϕ TO FACE)

SUPPORTING FRAMEWORK (PIPES, I'S, ETC.)

CONCRETE FLOOR (13 1/2" CENTER OF TANK TO FLOOR)

$$\Delta L = \frac{332\alpha}{\pi\alpha_0} \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}}$$

CLASSIFIED

HW 3: 34680

for $\alpha = \alpha_0$ & $a = \infty$, $\Delta L = \frac{332\alpha R}{\pi L_0}$

CALCULATIONS FOR J-5

1) FRONT HOOD FACE

$$\Delta L = 1.0568 \left(\frac{2.875}{8.625} \right) = 0.35226 \quad (14 \text{ DIV})$$

2) TANK K-2

$$\sin \theta = \frac{12}{31} = 0.41935$$

$$\tan \theta = 0.46192$$

$$a = L_0 \tan \theta = 8.314 \text{ IN.}$$

$$\Delta L = 1.0568 \left(\frac{2.875}{17.875} \right) \left(\frac{1}{\left(\frac{15.875}{8.314} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$$0.17766 \Delta L = 1.0568 (0.16084) (0.42173) = 0.07168 \text{ IN.} \quad (3 \text{ DIV})$$

3) CONCRETE FLOOR

$$\Delta L = 1.0568 \left(\frac{2.875}{13.5} \right) = 0.22505 \text{ IN.} \quad (9 \text{ DIV})$$

ACTUAL ATTACHMENTS TO TANKS

CSH = 0.4939 1) TANK WALLS REFL. THICKNESS = 0.175 IN.

2) 1 - 1" SCH 40 PIPE (7 1/2" O.D.) (10 1/2" I.D.)

$$\pi (R_2^2 - R_1^2) = 0.4939$$

(a) $R_2 = \sqrt{\frac{56.40721}{7.12721}} = 2.81047 \text{ IN.}; \text{EQ. RE. TH.} = 0.010 \text{ IN.}$

(b) $R_2 = \sqrt{\frac{110.40721}{7.12721}} = 3.92748 \text{ IN.}; \text{EQ. RE. TH.} = 0.007 \text{ IN.}$

W 2:34:40

NOT RECORDED

16 = 3 1/4

142

2 1-1" 150# WELDING NECK FLANGE ATT TO TANK

$$BQ. REF. TH. = 4.5 (0.5625) = 0.08057 \text{ IN.}$$

$$a(s)(T)$$

SELECTIONS FOR J-5

TANK WALLS

1 IN. PIPES

0.125 IN.

0.017 IN.

0.081 IN.

WELDING NECK FLANGE

1.223

1.156

FRONT HOOD FLANGE

AL=0.35226 IN

14 DIV

26 DIV

AL=0.07168 IN

2 DIV

CONCRETE FLOOR

AL=0.22505 IN

9 DIV

TOT

0.520 IN.

FRAMWORK
SUPPORTING

MUCH LESS THAN
"2" STILL ALLOWABLE
TO STILL BE SAFE

6-54 1/2 IS SAFER THAN J-5

6-54 1/2 ARE SAFE FOR ANY CONC
OF 400 MILD/T IN 5000.

TANK J-6, SOLV. EXTR.
VACUUM TRAP

NW 3:346R9

SAFE (BASED ON COMPARISON WITH OTHER TANKS
PREVIOUSLY CALCULATED)

113

DECLASSIFIED

∞ ←

[REDACTED]

$\mathcal{F} = 1$

TANK J-7, SOLV. EXTR.
C.C.P. EVAPORATOR
REFLECTORS NEAR TANK
115

W37346AS
DECLASSIFIED
EFF REFL. TH.

REFLECTOR

TANK WALLS

0.125 IN.

WALLS OF INSULATING SHELL

0.125 IN.

2 INCH VERTICAL PIPE

0.265

0.019 IN.

REAR FACE OF HOOD (LUCITE)

$\Delta L = 0.0767$ CM.

0.031 IN.

MAN STANDING NEAR TANK

$\Delta L = 0.0905$ CM.

0.050 IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS

0.350 IN.

INSIDE DIAMETER OF THE ALWAYS SAFE
CYLINDER WITH 0.350 IN. S.S. WALLS

7.660 IN.

INSIDE DIAMETER OF TANK J-7

7.750 IN.

THICKNESS
MAX. REFLECTOR FOR J-7 TO BE SAFE

0.640 IN.

5.551 (5.5)

TANK J-7

A. TANK WALLS 116

HW 3.346 AS

0.125 IN.; $\alpha = 3.025$

DECLASSIFIED

B. WALLS OF INSULATING SHELL

0.125 IN.

C. 2 IN. VERT. PIPE

 $R_1 = 9$ IN.

$$R_2 = \sqrt{\frac{4074}{\pi} + 81} = \sqrt{8134186} = 901897$$

EQ. REFL. TH. = 0.0190 IN

D. REAR FACE OF HOOD (LUCITE)

$$\Delta L = 0.8194 \alpha \left[\frac{2L_0}{L_0^2 - R^2} \tan^{-1} \frac{L_0 + R}{L_0 - R} - \frac{\pi}{2} \right]$$

 $L_0 = 11.625$ IN. $R = 3.625$ IN. $\alpha = 0.225$ IN.

$$\Delta L = 0.18436 \left[\frac{23.250}{\sqrt{122.00000}} \tan^{-1} \frac{1.90625}{1.35667} - 1.5708 \right]$$

11.04536 54° 5' 8"

$$= 0.18436 [(2.1050)(0.94397) - 1.5708]$$

$$\Delta L = 0.0767 \text{ CM}$$

E. MAN STANDING NEAR TANK

$$\Delta L = \frac{3.32}{\pi} \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}} = (1.0568)(0.30208) \left(\frac{1}{3.5264} \right)$$

 $L_0 = 12$ IN.; $R = 3.625$; $a = 3.5486$

$$\Delta L = 0.0905 \text{ CM}$$

J-7

EVAPORATOR

SECRET

NW 3:346R

DECLASSIFIED

INTERLINE 15
1/2" FROM BACK OF
HOOD

Q NEAREST 2" PIPE 9" FROM Q TANK

SECRET

TANK J-7

I.D. = $7\frac{1}{4}$ IN.

118

HW 35846R0

DISCLOSED

① TANK WALLS - 0.125 INCHES

② WALLS OF INSULATING SHELL (0.0625 IN. (2 WALLS

④ TANK 12 IN. FROM REAR FACE OF HOOD

~~11.625~~ 11.625 IN FROM ϕ TO LUCITE

③ ϕ 1-2" PIPE 9" FROM ϕ TANK

⑤ MAN NEAR TANK

ASSUME NO ~~PIPE~~ PRODUCT-BEARING PIPES
NEAR TANK

$$\sin \theta = 0.28358$$

$$\tan \theta = 0.29572$$

$$a = 3.5486$$

$$\frac{3}{7} \times \frac{32}{18} = \frac{46}{18}$$

TANK H-9, SOLV. EXTR.
FEED TANK
REFLECTORS NEAR

HW 3" 560
DESIGNED

REFLECTORS

119

EFF. REFL. TH.

TANK WALLS

$$L = 3.025 \text{ CM.}$$

0.125 IN.

TANK SUPP. WELDED TO TANK

$$\Delta L = \frac{332(R)}{\pi(CS)}$$

0.076 IN.

→ FLANGES ATT. TO TANK

Calc
with
Lucite
Welded
out

0.072 IN.

2- $\frac{3}{16} \times \frac{3}{4} \times 46$ " LONG STRIPS

0.005 IN.

2- 3" L's, (TANK SUPP. REST ON)

0.038 IN.

HORIZONTAL 3" I BEAM

0.020 IN.

1- 2" VERTICAL PIPE

USE TO REFLECT

0.017 IN.

0.125

to 0.4429

0.076 LUCITE PANEL

$$\Delta L = 0.0596 \text{ CM.}$$

IN.

0.125

0.055 MAN. STANDING NEAR TANK

$$\Delta L = 0.0670 \text{ CM.}$$

0.080 IN.

0.000

0.443 CENTRIFUGAL PUMP & MOTOR

$$\Delta L = 0.0485 \text{ CM.}$$

IN.

0.560

3" I's ABOVE TANK

0.016 IN.

0.111

3" L's SUPPORTING H-10

0.021 IN.

REFLECTION FROM CONCRETE FLOOR

$$\Delta L = \frac{0.1761}{\text{CM.}}$$

0.090 IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS

0.560 IN.

0.560 IN.

I.D. OF ALWAYS SAFE CYLINDER WITH ^{0.560} S.S. WALLS

7.560 IN.

→ EFFECTIVE I.D. OF H-9, AFTER TAKING INTO ACCOUNT PRODUCT-BEARING LINES

7.520 IN.

MAXIMUM REFLECTOR THICKNESS FOR H-9 TO BE SAFE

0.435 IN.

including longitudinal Buckling Max Safe P_L

0.49 IN.

1. 1/2" THK
 2. 1/2" THK
 3. 1/2" THK
 4. 1/2" THK
 5. 1/2" THK
 6. 1/2" THK
 7. 1/2" THK
 8. 1/2" THK
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 96. 1/2" THK
 97. 1/2" THK
 98. 1/2" THK
 99. 1/2" THK
 100. 1/2" THK

H-9

2 TANK 14" FROM FRONT FACE OF HOOD
 10" 2\"/>

① — TANK WALLS

0.125 IN. $\times$ 3' 3 1/2" 6" RD
HW 3' 3 1/2" 6" RD

121

② — FLANGES ON TANK — C.S.A. OF ~~10~~ AT DIST OF $R_1 = 8.625$; $\frac{9}{16}$ " THICK $\frac{1}{2}$ " DIA PIN FROM TANK EDGE③ — TANK SUPPORTS WELDED TO TANK; ~~1.75~~ OF 1.75 IN² A.T.T.④ — 2 — $\frac{3}{16} \times \frac{3}{4} \times 46$ " LONG PLATES ($\frac{8.6}{16}$ IN. FROM ϕ TANK⑤ — CHANNELS TANK SUPPORTS REST ON ($\frac{10}{16}$ IN. ϕ TO ϕ)⑥ — HORIZONTAL 3" I BEAMS — $\frac{13}{16}$ " ϕ TO ϕ ⑦ — 2 IN VERTICAL PIPES — 1, 10" ϕ TO ϕ ⑧ — LUCITE PANELS — $13 \frac{5}{8}$ " ϕ TANK TO PANEL⑨ — PROCESS PIPING PARALLEL TO TANK — ASSUME ABOUT 4 — $\frac{3}{4}$ " LINES⑩ — MAN STANDING NEAR TANK; $L_0 = 14$ INCHES⑪ — REFLECTION FROM CONCRETE FLOOR; ~ 21 IN FROM TANK EDGE ϕ TO FLOOR

⑫ — VALVES NEAR TANK ? (NODE CONSIDERED)

⑬ — CENTRIFUGAL PUMP ~ 16 IN. FROM ϕ TANK (at end) TO EDGE PUMP.

ASSUME PUMP OF SAME MASS & DIMENSIONS AS ON 6-42 & 6-80.

⑭ — 3" CHANNELS SUPPORTING TANK H-10 ~ 18 " FROM TANK ϕ ⑮ — 3" I BEAMS ABOVE TANK ~ 16 IN. FROM ϕ TANK.

159.75

1005681.765

1130638

100371461.6

14.5 IN.

TANK H-9

REFLECTORS NEAR TANK

HW 37340 R9

REFLECTOR

EFF. REFL. TH.

TANK WALLS

DECLASSIFIED

TANK SUPP. WELDED TO TANK

FLANGES ATT. TO TANK

2- $\frac{3}{16} \times \frac{3}{4} \times 46$ " LONG STRAPS

2- 3" L1'S (TANK SUP. REST ON)

HORIZ. 3" I BEAM

1- 2 IN. VERT. PIPE

LOCITE PANEL

MAN STANDING NEAR TANK

CENTRIFUGAL PUMP & MOTOR

3" T'S ABOVE TANK

3" L1'S SUPPORTING H-20

REFLECTION FROM *Handwritten Signature*

REFLECTOR

TANK H-10, SOLV. EXTR.

DEGRADIC PUMP TANK

HW 35' REFL. TANK

TANK WALLS

123

$l = 3.025 \text{ CM}$

0.125 IN.

SUP. ATT. TO TANK

DECLASSIFIED

0.076 IN.

FLANGES ATT. TO TANK

0.072 IN.

$\frac{3}{16} \times \frac{3}{4} \times 36''$ STRAPS

0.005 IN.

3" H'S

0.038 IN.

3" T'S

0.061 IN.

2" VERTICAL PIPE

0.304
TO FREE $\rightarrow$

0.017 IN.

LUCITE PANEL

$\Delta l = 0.0596 \text{ CM}$

CENTRIFUGAL PUMP

REFL

$\Delta l = 0.0485 \text{ CM}$

7.5

0.086 IN.

MAN NEAR TANK (1)

$\Delta l = 0.0670 \text{ CM}$

3" E ABOVE TANK

0.014 IN.

TOTAL EQUIV. REFL. THICKNESS

0.494 IN.

I.D. OF ALWAYS SAFE CYL. WITH 0.494-IN. SS. WALLS 7.450 IN

$\rightarrow$ EFF I.D. OF H-10 (PRODUCT LINES INCLUDED)

7.520 IN

MAX. REFL. TH. FOR H-10 TO BE SAFE

~~0.495 IN.~~

0.435 IN

using longitudinal Buckling Max safe $t_R = 0.530 \text{ in}$

H-10

2 OF THICK 14" FROM FRONT OF HOOD
" " 10" " 2 FRONT I BEAMS

1221

3" I

4' 8 3/4"

37 1/2" V

1 1/8" THK
1 1/2" DIA

3' 6 3/8"

7" ID

7 1/4" OD

3/4" WIDE
30" LONG
3/16" THK

1/2" THK X 8" WIDE

(2) 3" L-15, A-1#

FLAT FACE 1 1/2" X 6 1/8" FROM 1 1/2"

3" I

58 3/8"

1221

22932628

5' 9"

1221

TANK H-10

DECLASSIFIED

TANK WALLS

0.125 IN.

SUP. ATT TO TANK

4-9

HW 37945 R0

FLANGES WELDED TO TANK H-9

LONG $\frac{3}{8} \times \frac{3}{4}$ STRAPS 4-9

(2) 3 IN. CHANNELS SHOWN AS H-9

(1) 3 IN I (11 TO 3 IN L'S) ~ 15 IN ϕ TO ϕ

(1) 3 IN I (1 TO 3 IN L'S) ~ 12" ϕ TO ϕ

(1) 3 IN I (1 TO 3 IN L'S) ~ 12"

(1) 2 IN VERT. PIPE 10 IN ϕ TO ϕ

3 IN I'S ABOVE TANK; (1) 15.5 IN ϕ TO ϕ

LUCITE PANEL 15.75 IN ϕ TO LUCITE

CENTRIFUGAL PUMP SHOWN AS H-9

(1) MAN 14 IN ϕ TO 14 IN

$$\text{MAN } \phi = \frac{4.75}{18.75}$$

DECLASSIFIED

123

HW 37846 R9

H-1, H-2, & H-3 TDS

DECLASSIFIED

8" O.D. $\pm \frac{1}{8}$ " $\times \frac{3}{8}$ " TO $\frac{33}{64}$ " WALL THK. $\times 18$ " LONG $\pm \frac{1}{8}$ "

CORNING PYREX GLASS OR EQUAL

FRONT OF HOOD

1) FRONT & REAR HOOD FACES

$$AL = 2(1.0568) \left(\frac{3.875}{15} \right) = 0.54601$$

1.0312 2) RT. END PANEL

3.85

$$AL = 1.0568 \left(\frac{3.875}{12} \right) = 0.34125$$

3) LEFT END PANEL

$$AL = 1.0568 \left(\frac{3.875}{22} \right) = 0.18614$$

4. 8 1/2" $\times$ 1/2" $\times$ 1/2" L'5" $\sim$ 12" FROM TANK EDGE

$$R' = \sqrt{\frac{0.8}{\pi} + \frac{1}{16}} = \sqrt{66.2546478}$$

$$R' = 8.01590 \text{ IN}$$

$$EQ. REFL. TH. = 0.016 \text{ IN}$$

(1:12)

[REDACTED] (CONTD.)

HW 323461
 11/18/83

INTERACTION BETWEEN TANKS

TANK NO. % 100 IN SEE DIR.
 H-1-TDS 4.5 %
 H-2-TDS 6.6 %
 H-3-TDS 4.5 %

ASSUMING 3, 1" PROCESS CUBES

~~$R = 1.16 \times 10^{-5}$
 $D_{IR} = 8.85 \times 10^{-11}$~~

TOTAL EFF. DIAMETERS

~~H-1-TDS $D = 8.53370 \times 10^{-11}$ $R = 1.16 \times 10^{-5}$
 H-2-TDS $D = 8.44196 \times 10^{-11}$ $R = 1.16 \times 10^{-5}$
 H-3-TDS $D = 8.53370 \times 10^{-11}$ $R = 1.16 \times 10^{-5}$~~

RELEVATORS

TANK WALLS 0.51562 IN.
 LEADS NEAR TANK - 0.016 IN.
 NOOD FACES

TOTAL =

6-11

H-1, H-2, & H-3 BDS

Col Kurtz check the glass

RECEIVED

main section had one
section at bottom
retaining flange removed

all left $\frac{3}{4}$ " flange top and bottom
ends same as before

before

O.D. $6 \frac{9}{16} \pm \frac{1}{64}$

with $2 \frac{1}{64} \pm \frac{3}{64}$ wall

max I.D. $6 \frac{1}{4}$ " before

now using

6" sched 10

O.D. $6.625 \pm \frac{.005}{.002}$

wall .134 - .017

Max I.D. 6.454

see

Bob:

Kurtz would like this checked
and apparently this piece has been
sent to the vendor so he would like
an answer right away.

7:17.5

4:55

100 G/L

5-1-64

1.

HW 3:346K

130

H-1, H-2, & H-3 BDS

DECLASSIFIED

EQ. DIAMETER = 8.48528 IN.

EQ. RADIUS = 4.24264 IN. = 10.77631 CM

HEIGHT = 15 IN. = 38.1000 CM

$l_T = l_B = 6.1$ CM

$l_R =$ CM

INTERACTION BETWEEN TANKS —
EFFECT ON CENTER TANK = 6.9 %

NEW EQ. DIA. = 9.06228 IN.
NEW EQ. RAD. = 4.53114 IN = 11.50910 CM.

131

2.

REFLECTORS NEAR TANKS

HW 37846 RD

1) TANK WALLS ✓ $\frac{5}{16}$ PYREX
 0.7125 IN
 15.6 DIV.

$$L = 3.4125 \text{ CM}$$

2) FACES OF HOOD

DECLASSIFIED

$$\Delta L_1 = 1.0568 \left(\frac{3}{15} \right) = 0.21136 \text{ CM}$$

$$\Delta L_2 = 1.0568 \left(\frac{3}{39} \right) = 0.08129 \text{ CM}$$

3) 4, $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{4}$ IS @ 8 IN.

$$\text{AREA OF 4 IS} = 2.76 \text{ IN.}^2$$

$$R' = \sqrt{\frac{2.76}{\pi} + 64} = \sqrt{64.878533} = 8.05472$$

$$\text{EQ. REFL. TH.} = \frac{3.7 \text{ DIV.}}{0.05472 \text{ IN.}}$$

132

HW 37340k

TOTAL REFLECTOR THICKNESS = 0.490 in.

$$\text{TOTAL } L_R = 3.8 \text{ CM} \approx 4 \text{ CM}$$

$$P_R = \left(\frac{2.4048}{15.5091} \right)^2 + \left(\frac{\pi}{50.3} \right)^2 = 0.02404 + 0.00390$$

$$P_R = 0.02794$$

$$f = 0.90743 ; \frac{1}{f} = 1.10201 ; \frac{1}{f} - 1.02435 = 0.07766$$

$$\text{MIN. CRIT. CONC.} = \frac{7.82490}{0.07766} = 100.75 \text{ GRAMS/LITER}$$

0...63.18931

88T-1

HW 37346 R9

DECLASSIFIED

CONSIDERING EFFECT OF K-1 ON H-3BDS,

$$\text{DIA K-1} = 26''; \text{ETO SEP} = 43 \text{ IN}$$

$$\text{DIA H-3BDS (ACT)} = 6''$$

$$\Delta L = 1.0568 \left(\frac{2}{20} \right) \left(\frac{18}{43} \right) = 0.02194 \text{ IN}$$

FEBRUARY 15, 1954

W 32364

1.

UNCLASSIFIED

REUPLEX INSTALLATION 150. KURTZ.

INSIDE
EQ. DIH. OF "T" SECTION = 9.13473 IN.
HGT. HT = 38.10 IN.
ADJ. MAX. LD. ENH. LG = 6.454 IN.
MAX. WALL THICKNESS = 0.134 IN.
 $\Delta \pi = \Delta L_3 = 6.11612$

REFLECTORS

- 1) TANK WALLS (0.134 IN. X) $L = 3.04$ IN.
- 2) HOOD FIELDS
a) 0.21156 IN.
b) 0.08139 IN.
3.33265 IN.
- 3) NEAR T - EQ. REF. TH. = 0.05442 IN.

REFLECTOR THICKNESS 0.310
TOTAL $L_T = 3.46$ IN.

INTERACTION EFFECTS ON LENTER THK = 4.30 %

FINHL EQ. DIH. = 9.51980
RHD. = 4.75490 IN. = 13.09015 CM

$$B_1 = \left(\frac{2.4048}{13.055013} \right)^2 + \left(\frac{50.20}{-0.02392} \right)^2 = 0.02392 + 0.00390$$

$$B_2 = 0.02782 \text{ CM}^{-2} \text{ g} \cdot f = 0.90543 \text{ g} \cdot f - 1.02435 = 0.07943$$

$$\text{MIN. CRIT. CON.} = \frac{7.82490}{0.07943} = 98.14 \text{ GRAMS/LITER}$$

125

DECLASSIFIED

6" scheduled 10 pipe 6.625" O.D. Thin (.134")
6.357" I.D.

JUDSON

RECUPERATOR - PULSE (89)

ADDITION ORDER OF REFLECTORS

3.345 RD

DECLASSIFIED

TANK WALLS (D) 136

SUPPORTS WELDED TO TANK (K, L)

1/2" STRAP ATTACHED TO TANK (K, b)

1 1/2" 150# BLIND FLANGES ATTACHED TO TANK (J)

3" I BEAMS (TANK SUP. ATT. TO) (F)

CENTRIFUGAL PUMP (A)

REAR HOOD PANEL (LOCITE) (B)

3" I BEAM AT END OF SUP. FRAMEWORK (E)

2, 2IN VERTICAL PIPES (G)

MAN NEXT TO REAR ENCE OF HOOD (C)

$T = 0.125 IN$
 $L = 3.025 CM$

0.174 IN

0.046 IN

0.229 IN

0.031 IN

$\Delta L = 0.1879 CM$

$\Delta L = 0.07356$
 $\Delta L = 0.06376 CM$

0.072 IN

0.024 IN

$\Delta L = 0.05959 CM$

0.604"

$\Delta L = 0.2615$

TANK G-50

137

RECEIVED

1.

3.345 RD

✓ A CENTRIFUGAL PUMP AND MOTOR ASSEMBLY

$$\Delta l = 0.6728 \left[\frac{2L_0}{R \sqrt{\left(\frac{L_0}{R}\right)^2 - 1}} \tan^{-1} \left(\frac{x \left(\frac{L_0}{R} + 1 \right)}{\sqrt{\left(\frac{L_0}{R}\right)^2 - 1} \sqrt{L_0^2 + x^2 + L_0}} \right) - \tan^{-1} \left(\frac{x}{L_0} \right) \right]_0^a$$

WHERE

$$R = 3.625$$

$$L_0 = 8.780$$

$$a = 3.886$$

$$\Delta l = 0.6728 \left[\frac{17.560}{3.625 \sqrt{\left(\frac{8.780}{3.625}\right)^2 - 1}} \tan^{-1} \left(\frac{3.886 \left(\frac{8.780}{3.625} + 1 \right)}{\sqrt{\left(\frac{8.780}{3.625}\right)^2 - 1} \sqrt{8.780^2 + 3.886^2 + 8.780}} \right) - \tan^{-1} \left(\frac{3.886}{8.780} \right) \right]$$

3.20603

$$= 0.6728 \left[\frac{0.9954}{2.1959} \left(\tan^{-1} \frac{0.32195}{18^\circ 9' 28''} \right) - \tan^{-1} 0.44260 \right]$$

23° 52' 27"

$$= 0.6728 \left[\frac{0.31692}{0.69592} \left(\frac{0.33607}{0.27923} \right) - 0.41669 \right]$$

$\Delta l = 0.1879 \text{ CM}$

(CONT'D)

#0373 44 RD

✓ B REAR HOOD PANEL ($\frac{3}{8}$ " LUCITE) WITHIN 18" OF TANK EDGE.

$$\alpha = 0.225$$

$$R = 3.625 \text{ IN.}$$

$$L_0 = 12 \text{ IN.}$$

$$Q = 18.140$$

UNCLASSIFIED

$$\Delta L = 0.8194 \alpha \left[\frac{2L_0}{R \sqrt{\left(\frac{L_0}{R}\right)^2 - 1}} \tan^{-1} \left(\frac{x \left(\frac{L_0}{R} + 1 \right)}{\sqrt{\left(\frac{L_0}{R}\right)^2 - 1} \left(\sqrt{L_0^2 + x^2} + L_0 \right)} \right) - \tan^{-1} \left(\frac{x}{L_0} \right) \right]_0^Q$$

$$\Delta L = 0.8194(0.225) \left[\frac{24.00}{3.625 \sqrt{\left(\frac{12}{3.625}\right)^2 - 1}} \tan^{-1} \left(\frac{18.14 \left(\frac{12}{3.625} + 1 \right)}{\sqrt{\left(\frac{12}{3.625}\right)^2 - 1} \left(\sqrt{12^2 + 18.14^2} + 12 \right)} \right) - \tan^{-1} \left(\frac{18.14}{12} \right) \right]$$

$\frac{78.1894}{3.1556} \quad \frac{106.2527}{21.7491}$

$$= 0.1844 \left[2.0980 \tan^{-1} 0.73418 - \tan^{-1} 1.51166 \right]$$

$36^\circ 17' 7'' \quad 56^\circ 30' 6''$

$$= 0.1844 \left[2.0980 (0.63330) - 0.98614 \right]$$

0.56252

$$\Delta L = 0.06316$$

✓ C MAN NEXT TO REAR FACE OF HOOD.

$$R = 3.625 \text{ IN.}; L_0 = 15.268; Q = 4.552$$

$$\Delta L = 0.6728 \left[\frac{30.536}{3.625 \sqrt{\left(\frac{15.268}{3.625}\right)^2 - 1}} \tan^{-1} \left(\frac{4.552 \left(\frac{15.268}{3.625} + 1 \right)}{\sqrt{\left(\frac{15.268}{3.625}\right)^2 - 1} \left(\sqrt{15.268^2 + 4.552^2} + 15.268 \right)} \right) - \tan^{-1} \left(\frac{4.552}{15.268} \right) \right]$$

$\frac{4.2119}{4.09143} \quad \frac{23.7246}{15.9321}$
 12.74526

$$= 0.6728 \left[2.0589 \tan^{-1} 0.18585 - \tan^{-1} 0.29814 \right]$$

$10^\circ 31' 42'' \quad 16^\circ 36' 6''$

$$= 0.6728 \left[2.0589 (0.18375) - 0.28975 \right]$$

$$\Delta L = 0.05959 \text{ CM}$$

✓ B. REAR HOOD PANEL (LUGS - 00 PLANE)

HW 3-3 4580
L₀ = 12 IN.

R = 3.625 IN.

β = 0.225

$$\Delta L = 0.8194 \beta \left[\frac{2L_0}{L_0^2 - R^2} \tan^{-1} \sqrt{\frac{L_0 + R}{L_0 - R}} - \frac{\pi}{2} \right]$$

DECLASSIFIED

$$= 0.8194 (0.225) \left[\frac{24}{144 - 3.625^2} \tan^{-1} \sqrt{\frac{15.625}{8.375}} - \frac{\pi}{2} \right]$$

$$= 0.1844 \left[2.0980 \tan^{-1} 1.3659 - 1.57080 \right]$$

0.93884 53°47'30"

$$\Delta L = 0.07356 \text{ CM}$$

✓ D. TANK WALLS

REFL. THICKNESS 0.185 IN.

$$L = 8.075 \text{ CM}$$

✓ E. 3" I BEAM AT END OF TANK SUPPORT FRAMEWORK

$$R_1 = \frac{2.5}{12} \text{ IN}$$

$$\text{AREA EQ. RING} = \pi(R_2^2 - R_1^2) = 1.64 \text{ IN}^2$$

$$R_2 = \sqrt{\frac{1.64}{\pi} + \frac{1.414}{144}} = \frac{1.414}{144} = 18.000$$

$$\text{EQ. REFL. THICKNESS} = R_2 - R_1 = \frac{1.414}{144} - \frac{2.5}{12} = 0.022 \text{ IN}$$

✓ F. 3" I BEAM (TANK SUPPORTS ATTACHED TO)

$$R_1 = 8.5 \text{ IN}$$

$$R_2 = 8.53 \text{ IN}$$

$$\text{EQ. REFL. THICKNESS} = 0.022 \text{ IN}$$

✓ G. 2 2" VERT. PIPES (SUPPORTS)

$$R_1 = 14.562; \text{ AREA EQ RING} = \pi(R_2^2 - 212.0625) = 2.148 \text{ IN}^2$$

$$R_2 = \sqrt{\frac{2.148}{\pi} + 212.0625} = 14.586; \text{ EQ REFL. TH} = 0.024 \text{ IN.}$$

✓ B. REAR HOOD PANEL (LUBING - ∞ PLANE) HW 3.3 4.5 8.0
 $L_0 = 12 \text{ IN.}$
 $R = 3.625 \text{ IN.}$

$$\Delta L = 0.8194 \beta \left[\frac{2L_0}{L_0^2 - R^2} \tan^{-1} \frac{L_0 + R}{L_0 - R} - \frac{\pi}{2} \right] \quad \beta = 0.225$$

DECLASSIFIED

$$= 0.8194 (0.225) \left[\frac{24}{144 - 3.625^2} \tan^{-1} \frac{15.625}{8.375} - \frac{\pi}{2} \right]$$

$$= 0.1844 \left[2.0980 \tan^{-1} 1.3659 - 1.57080 \right]$$

$0.93884 \quad 53^\circ 47' 20''$

$$\Delta L = 0.07356 \text{ CM}$$

✓ D. TANK WALLS

REFL. THICKNESS 0.125 IN.

$$L = 3.025 \text{ CM}$$

✓ E. 3" I BEAM AT END OF TANK SUPPORT FRAMEWORK

$$R_1 = \frac{3.75}{12} \text{ IN}$$

$$\text{AREA EQ. RING} = \pi(R_2^2 - R_1^2) = 1.64 \text{ IN}^2$$

$$R_2 = \sqrt{\frac{1.64}{\pi} + R_1^2} = \sqrt{\frac{1.64}{\pi} + \left(\frac{3.75}{12}\right)^2} = 12.000$$

$$\text{EQ. REFL. THICKNESS} = R_2 - R_1 = 12.000 - 3.75 = 8.25 \text{ IN}$$

✓ F. 3" I BEAM (TANK SUPPORTS ATTACHED TO)

$$R_1 = 3.5 \text{ IN}$$

$$R_2 = 3.53 \text{ IN}$$

$$\text{EQ. REFL. THICKNESS} = 0.032 \text{ IN}$$

✓ G. 2 2" VERT. PIPES (SUPPORTS)

$$R_1 = 14.562; \text{ AREA EQ RING} = \pi(R_2^2 - 212.0625) = 2.148 \text{ IN}^2$$

$$R_2 = \sqrt{\frac{2.148}{\pi} + 212.0625} = 14.586 \text{ IN} \quad \text{EQ REFL TH} = 0.024 \text{ IN}$$

✓ H. PROCESS PIPING.

140

HW 3" 0.46 RD

1 - 1" PRODUCT BEARING LINE.

$$AREA = 0.7853 IN^2$$

DECLASSIFIED

$$AREA TANK + LINE = \cancel{7} \text{ } 42.067609$$

$$\therefore R_{AD} = \sqrt{13.39059} = 3.65932 IN \text{ FOR EQ. TANK}$$

$$DIA = 7.3186$$

✓ I. VALVES WITHIN 18 IN

NONE FOR SECTION CONSIDERED

✓ J. 2 1 1/2" 150# BLIND FLANGES ATTACHED TO TANK.

$$R_1 = 3.75 IN$$

$$AREA OF FLANGES = \pi R^2 = 3.14 (6.25) = 19.6349$$

$$\frac{19.6349}{5} = 3.9270$$

$$EQ. REFL. THICKNESS = \frac{3.9270 (1.375)}{7.5 \pi} = \frac{5.5996}{23.5618}$$

$$= 0.229 IN$$

✓ K. SUPPORTS WELDED TO TANK

$$R_1 = 3.75 INCHES$$

✓ (a) PIECES ACTUALLY IN CONTACT WITH TANK

$$AREA. EQ. RING = \pi (R_2^2 - 14.0625) = 2 + 2.2 = 4.2 IN^2$$

$$R_2 = \sqrt{\frac{4.2}{\pi} + 14.0625} = \sqrt{15.3994} = 3.9242$$

$$EQ. REFL. THICKNESS = 0.174 INCHES$$

K. (CONT'D.)

✓ (b) 4" L & STRAP ATTACHED TO TANK

DECLASSIFIED
HW 3:345 RD

$$R_1 = 7.75$$

$$R_2 = \sqrt{\frac{2.2925}{\pi} + 60.0625} = \sqrt{60.7922}$$

$$R_2 = 7.797$$

EQ. REFL. THICKNESS = 0.046 IN

DECLASSIFIED

$$(15.2) \quad \Delta h_1 = \frac{3.9270}{2.5\pi} (2.275) = \frac{8.933925}{23.5620} = 0.37917$$

$$(15.7) \quad \Delta h_2 = \frac{3.9270}{2.25\pi} (2.275) = \frac{8.933925}{22.7766} = 0.39224$$

Δh_1 corresponds to a reflector thickness of 0.155 in.
 Δh_2 corresponds to a reflector thickness of 0.165 in.

TANK G-50

PUMP 2.5 IN FROM 123

RECEIVED

AW 3-3-50 R0

$$\Delta L = 0.6728 \left[\frac{2L_0}{R \left(\left(\frac{L_0}{R} \right)^2 - 1 \right)^{\frac{1}{2}}} \tan^{-1} \frac{X \left(\frac{L_0}{R} + 1 \right)}{\sqrt{\left(\frac{L_0}{R} \right)^2 - 1} \sqrt{L_0^2 + X^2 + L_0}} \right] - \tan^{-1} \left(\frac{X}{L_0} \right) \Big|_0^L$$

WHERE R = 3.625 IN.

L₀ = 6.25 IN.

X = 2.530 IN.

$$\begin{aligned} \Delta L &= 0.6728 \left[\frac{12.50}{\frac{1.97262(3.625)}{5.0913}} \tan^{-1} \frac{6.892}{(1.4045) \sqrt{39.062 + 6.401 + 6.25}} \right] - \tan^{-1} 0.40480 \\ &= 1.6518 \tan^{-1}(0.37768) - 0.6728 \tan^{-1} 0.40480 \\ &\quad 21^\circ 41' 25'' \quad 22^\circ 21' 18'' \end{aligned}$$

$$= 1.6518 (0.36112) - 0.6728 (0.38464)$$

$$\underline{\Delta L} = 0.5965 - 0.2588 = \underline{\underline{0.3377 \text{ CM}}}$$

114

RECEIVED

H-2-15432 RD
(SHOWN ON

(1) PUMPS ON 6-42

(3" FROM TANKS

H-2-15432

SHEET 2)

DIA

2" FLUID
COLUMN

POSSIBLY 4" DIA.

6-58

ALSO

H-2-16628

ENGR FLOW

DIAGRAM

$8\frac{1}{4} \times 8\frac{1}{4}$

(2) SIZE OF VALVES COMPARED TO
PIPES. $\frac{1}{4}$ " TO $\frac{3}{4}$ " LINES

AUTO - VALVES

ASSOCIATED (AUTOMATIC)
VALVES

RECEIVED 4-29-54
 140
 OFFICE 346 RD

TANK G-51

3.575
 ACTUAL I.D. = 7.75 IN. ; H = 60.96 CM

PROD. BEARING LINES - 5-1" LINES.

$$R' = \sqrt{16.265638} = 4.0331 ; D' = 8.0662$$

INTERACTION (WITH G-16, $t_{TOP} \text{ BEP} = 26"$) = ~~375%~~
 2035%

TOT. EQ. DIA. = 8.36868 IN

$$B = \left(\frac{2.4048}{14.2632 \cdot \frac{10.62822 + 3.575}{4.0331}} \right)^2 + \left(\frac{\pi}{73.16} \right)^2 = 0.0286659 + 0.0018438$$

$$= 0.0305097$$

$$f = 14.127 \left(\sqrt{\quad} \right) + 0.51272 = 0.94373$$

$$\frac{1}{f} = 1.05962$$

$$C = \frac{7.82489}{0.03527} = 221.86 \text{ g/l}$$

DECLASSIFIED

TANK C-51 (CONT'D)

HW 3.846 KD

REFLECTORS

(0) TANK WALLS

(1) REAR OF HOOD ($L_0 = 16"$)(2) END OF HOOD ($L_0 = 16"$)(3) 2-3" I BEAMS ($R_0 = 20.4 IN$, $R_2 = 19.3 IN$)

(0) TANK WALLS

0.175 IN.

$$(1) \Delta L = 1.0568 (2) \left(\frac{3.875}{16} \right) = 0.51189 CM$$

0.240 IN

20.5 DIV.

$$(3-a) R' = \sqrt{\frac{3.28}{\pi} + 416.16} = \sqrt{417.20405} = 20.42557$$

EQ. REFL. TH. = 0.026 IN

$$(3-b) R' = \sqrt{\frac{1.64}{\pi} + 372.49} = \sqrt{373.01203} = 19.31352$$

EQ. REFL. TH. = 0.014 IN.

TOT. = 0.380 IN.

$$L_R = 3.575 CM$$

RECHECKED 4-29-51

DECLASSIFIED

117

TANKS G-16 & G-28 - SAFE

HWB: 34680

ACT. I.D. OF TANKS 7.00 IN. ; H = 46.385
WITH 5-1" PROC. LINES WITHIN FOOT,

$$R' = \sqrt{13.5} = 3.67424 \text{ IN}$$

$$D' = 7.34848 \text{ IN}$$

INTERACTION

G-16			G-28		
TANK NO.	DIST.	PERCENT	TANK NO.	DIST.	PERCENT
G-51	36"	3.75	G-16	60"	1.00
G-28	60"	1.00			0.0675
		0.0675			0.0675
TOTAL		4.75%	TOTAL		1.00%
$D_{G-16}'' = 7.69753$			$D_{G-28}'' = 7.42196$		

REFLECTORS

TANK WALLS	0.125	$l = 0.02$
REAR HOOD FACE ($L_0 = 12"$)	0.170	$\Delta d = 0.30824$
TANK G-17 (34" $\perp$ TO $\perp$ G-16; 26" $\perp$ TO $\perp$ G-28)	0.015	$\Delta d = 0.02713$
2-3" I-BEAMS ($\sim 17.0"$ $\perp$ TO $\perp$)	0.016	Δ 0.016

TOT. REFL. TH. = 0.336 IN.

118

MEASURED

HW 3534620

(1) REAR HOOD FACE

$$\Delta L = 1.0568 \left(\frac{3.5}{12} \right) = 0.30824 \text{ IN}$$

(2) TANK G-17

~~$$\sin \theta = \frac{3.5}{26}$$~~

$$\sin \theta = \frac{3.5}{26} =$$

$$\tan \theta = 0.13586$$

$$a = 22.5 \tan \theta = 3.057 \text{ IN}$$

$$1.018125147$$

$$\Delta L = 1.0568 \left(\frac{3.5}{22.5} \right) \left(\left(\frac{1}{\left(\frac{22.5}{3.057} \right)^2 + 1} \right)^{\frac{1}{2}} \right)$$

$$= 1.0568 (0.15556) (0.13463) = 0.07213 \text{ IN}$$

(3) TANK WALLS 0.125 IN

$$\frac{3.0 \text{ IN}}{3.33037}$$

$$= 0.9008$$

(4) 2-2" I BEAMS

$$< 0.0402 \text{ IN}$$

(2 DIV)

129

UNCLASSIFIED

A. TANK G-16

HW 37.346 RD

$$\text{EFF. I.D.} = 7.69758$$

$$\text{RAD} = 9.77585 \text{ CM} ; H = 16.955$$

$$R = 0.032810 = \left(\frac{2.4048}{9.77585 + l_r} \right)^2 + \left(\frac{\pi}{58.555} \right)^2$$

$$l_r = \frac{2.4048}{\sqrt{0.032810}} - 9.77585 = 4.124 \text{ CM}$$

$$\text{EQ. REFL. TH} = 0.66 \text{ IN. } 16.16$$

B. TANK G-28

$$\text{EFF. I.D.} = 7.42196$$

$$\text{RAD} = 9.42588 \text{ CM}$$

$$l_r = \frac{4.47389}{\sqrt{0.032810}} - 9.42588 = 1.1 \text{ IN}$$

$$\text{EQ. REFL. TH.} = 0.88 \text{ IN.}$$

TANK G-46, RECEIVED
PUREX RECEIVER

DECLASSIFIED

REFLECTORS NEAR TANK

HW 3:346 RD

REFLECTOR

EFF. REFL. TH.

TANK WALLS

$L = 3.075 \text{ CM}$ 0.125 IN.

$1\frac{1}{2}$ " 150# FLANGES ATT. TO TANK

0.165 IN.

3- 2" VERTICAL PIPES

$L = 3.37$ 0.037 IN.

REAR HOOD PANEL

$AL = 0.038$ 0.020 IN.

MAN STANDING NEXT TO REAR FACE OF HOOD

$AL = 0.035$ 0.023 IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS

0.370 IN.

INSIDE DIAMETER OF THE ALWAYS SAFE
CYLINDER WITH 0.370 IN. S.S. WALLS

7.63 IN.

EFFECTIVE INSIDE DIAMETER OF TANK G-46 (TAKING
INTO ACCOUNT PRODUCT BEARING LINES AS SHOWN
ON PRINTS.)

7.119 IN.

MAX. REFLECTOR THICKNESS FOR G-46 TO BE SAFE

0.675 IN.

DECLASSIFIED

A. WALLS OF TANK

$$\text{THICKNESS} = 0.175 \text{ IN.}$$

$$L = 3.075 \text{ CM.}$$

HW 3.346 RD

B. 1 1/2 150# FLANGES ATTACHED TO TANK

$$\text{EQ. REFL THICKNESS} = 0.165 \text{ INCHES}$$

C. REAR HOOD PANEL (3/8" LUCITE)

$$AL = 0.8194 \alpha \left[\frac{2L_0}{\sqrt{L_0^2 - R^2}} \tan^{-1} \sqrt{\frac{L_0 + R}{L_0 - R}} - \frac{\pi}{2} \right]$$

$$\alpha = 0.225$$

$$R = 3.5 \text{ INCHES}$$

$$L_0 = \frac{19.625}{23.125} \text{ INCHES}$$

$$AL = 0.1844 \left[\frac{39.25}{\sqrt{372.8906}} \tan^{-1} \sqrt{1.4341} - \frac{\pi}{2} \right]$$

1.19754
50° 8' 9"

$$= 0.1844 [2.0326 (0.87503) - 1.5708]$$

$$AL = 0.038 \text{ CM.}$$

D. MAN STANDING NEAR TANK

$$AL = \frac{2.32 \alpha}{\pi \alpha_m} \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{\alpha} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$$R = 3.5 \text{ IN.}$$

$$\alpha = \alpha_m$$

$$L_0 = 20 \text{ IN.}$$

$$\alpha = 3.91 \text{ IN.}$$

$$27.164/146$$

$$5.2-12$$

$$5.2119$$

$$AL = 1.0568 (0.1750) \left(\frac{1}{5.2119} \right)$$

$$AL = 0.035 \text{ CM.}$$

E. 2" VERTICAL PIPES (FRAMEWORK SUPPORTS) ^{W/2} 346 RD

$$1. R_1 = 11 \text{ IN.}; \text{ AREA EQ. RING} = \pi (R_o^2 - 121) = 1.074 \text{ IN}^2$$

$$R_2 = \sqrt{\frac{1.074}{\pi} + 121} = 11.0155 \text{ IN.}; \text{ EQ. REFL. TH.} = 0.0155$$

0.34186

$$2. R_1 = 13 \text{ IN.}; \text{ AREA EQ. RING} = \pi (R_o^2 - 169)$$

$$R_2 = \sqrt{\frac{1.074}{\pi} + 169} = 13.0131 \text{ IN.}; \text{ EQ. REFL. TH.} = 0.0131$$

19.8

$$3. R_2 = \sqrt{\frac{1.074}{\pi} + 392.04} = 19.80863 \text{ IN.}; \text{ EQ. REFL. TH.} = 0.0086 \text{ IN.}$$

392.34186

$$\text{TOTAL EQ. REFL. TH.} = 0.0372 \text{ IN.}$$

F. PROCESS PIPING

3 - 3/4" PROCESS PIPES

$$\text{TOTAL CROSS-SECTION AREA} = 1.32531 \text{ IN}^2$$

$$\text{C. S. A. OF TANK} = 38.4846$$

$$\text{EQ. RAD} = \sqrt{\frac{39.80991}{\pi}} = \sqrt{12.67185} = 3.5597$$

$$\text{DIA. OF EQ. TANK} = 7.119 \text{ IN.}$$

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HW 37346 RD

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840.

6-6
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DECLASSIFIED

✓ 31' FROM REARLINE REEDED ($\frac{3}{8}$ " LUCITE)

✓ DIST 4 E-46 TO 2" FIBER

HW 3-3-6 RD

✓ (1) 11 IN.

✓ (2) 13 IN.

✓ (3) 19.83 IN.

✓ NO T'S NEAR SIDES OF TANK

✓ PANEL TO PROTECT PIPES 2" FROM TANK EDGE (4 E CD)

✓ 3 - $\frac{3}{4}$ " PROCESS PIPES WITHIN 1 FOOT OF E-46

✓ TANK WALLS.

✓ 1 $\frac{1}{2}$ " 150# FLANGES. ATT. TO TANK.

✓ MAN STANDING NEAR TANK

3/4 4.75
0.125

1.5
BO = 7
STE
1.2
4.75
0.125

$$4.75 = \frac{4.75}{24.75} = 0.19192$$

$$4.75 = \frac{4.75}{24.75} = 0.19556$$

$$0 = 10 \text{ dany}$$

RECEIVED
FEB 24 1964

TANKS G-47 & G-48, RECEPT BLEND
DATA RECEPTION & FEED TANKS
REFLECTORS NEAR TANKS

REFLECTORS 155 EFF. REFL. TH.

TANK WALLS 0.125 IN

SUPP WELDED TO TANK 0.076 IN

FLANGES AT TO TANK 0.072 IN

2 3/4" X 3/4" X 5' 1006 STRIPS
2 3" X 1/2" (TANKS UP BEST QM)

HORIZ. 3" I BEAM 0.038 IN

1- 2" VERTICAL PIPE 0.020 IN

0.357 TO HETE 0.021 IN

LUGS & PANEL

(1) MAIN REAR TANK

AL = 0.0874 QM

AL = 0.0485 QM

EFFECT OF TANK C-2 (-L-2) 0.3689
AL = 0.1198 QM

AL = 0.1608 QM

CONCRETE FLOOR

TOTAL EFF. REFL. TH.

I.D. OF ALWAYS SHRE CYL. WITH 0.540 IN. S.S. WALLS 7.380 IN.

EFF. I.D. 6-47 & 8 (PROGRESS KINES INDIC.) 7.520 IN.

MAX. REFL. TH. FOR G-47 & 8 TO BE SHRE

0.438
0.477 IN

including: Longitudinal Recept. Max Safe R = 0.48 IN.

#2246 R

G-47 & G-48

Q 6-47 12" FROM FRONT OF HOOD
Q 6-48 12" FROM BACK OF HOOD

5/8" DIA

PIPE

2" FROM TANK

6'9"

6'9 3/4"

5'7 3/8"

2 7/8" C.D.
7 I.D.

1" HOLE

8" WIDE

8'10"

3" 3/16" x 3/4" x 60"

EDGE TO EDGE 5/8" OF 6 3/4"

3/4" RING

5/8" DIA

3/8" DIA

3/8" DIA

1/2"

PIPE

12" FROM TANK

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

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3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

3/8" DIA

✓ 23 IN. FROM G-47 TO CONCRETE FLOOR

HW 3:34:50 RD

✓ 8 IN. FROM G-47 TO 2" VERT. PIPE (CONSIDER 1 PIPE)

? DIST FROM TANK L-2 (a) ~ 4" (PLAN)
(b) ~ 16" (ELEVATION)
SEP OF TANKS = ~ 16.5 IN.

(Rad L-2 = 17 IN) HEIGHT ~ 45

X G-42 & G-80 DIRECTLY ABOVE G-48 (~ 20" EDGE TO EDGE SEP.)

0 3" L x 1" W - SAME AS H-9 $\frac{7.5}{4} = \frac{x}{7.2}$

0 2 3 IN HORIZ T BEAMS (SAME AS H-9)

0 3/8 x 3/4 STRAPS

0 SUP. WELDED TO TANK

0 PROCESS PIPING - 5 3/4" PIPES (SAME AS H-9)

0 FLANGES ON TANK (SAME AS H-9)

0 G EXT. PUMP - SAME AS H-9

✓ LUCITE - 11.75 IN FROM TANK S

X NO BEAMS ABOVE TANK WITHIN 18 INCHES

✓ MAN NEAR TANK (1)

RECEIVED

1.

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REFLECTION FROM L-2

20 IN FROM ϕ

$$R = 3.5 \text{ IN.}$$

$$\Delta L = \frac{3.82}{\pi} \left(\frac{R}{L_0} \right) \left[\frac{1}{\left(\frac{L_0}{\alpha} \right)^2 + 1} \right]^{\frac{1}{2}}$$

$$\Delta L = 1.0568 (0.17500) (0.64765)$$

$$\Delta L = 0.11978 \text{ CM}$$

2.32408166

1.50402

REFLECTION FROM CONCRETE FLOOR

$$\Delta L = 1.0568 \left(\frac{3.5}{23} \right) = 0.1608 \text{ CM}$$

3 IN. VERT PIPE

RELEASED

2.

$$= 134 \quad k_2 = \sqrt{64.341864} = 8.02134 \text{ IN}$$

HW 3' 3.46 RD

$$\text{EQ. REFL. TH.} = 0.021 \text{ IN.}$$

LUCITE PANEL

$$\Delta L = 0.18436 \left[\frac{260}{\sqrt{L^2 - R^2}} \tan^{-1} \sqrt{\frac{L+R}{L-R}} - \frac{\pi}{2} \right]$$

$$L = 11.75 \text{ IN.}; R = 3.5 \text{ IN.}$$

1.0568

$$\Delta L = 0.18436 \left[\frac{23.50}{\sqrt{125.8125}} \tan^{-1} \sqrt{\frac{16.4848}{1.25959}} - 1.5708 \right]$$

1.121662

$$= 0.18436 [2.0951 (0.93662) - 1.5708]$$

$$1.5959 \quad \Delta L = 0.07218 \text{ CM}$$

MAN NEAR TANK (1)

$$\Delta L = 1.0568 \left(\frac{R}{L_0} \right) \left(\frac{1}{\left(\frac{L_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}}$$

13.4767979

2.52509

$$R = 3.5 \text{ IN.}; L_0 = 12 \text{ IN.}; a = 3.55 \text{ IN.}$$

$$\Delta L = 1.0568 (0.29167) (0.28368) = 0.087439$$

$$\Delta L = 0.0874 \text{ CM}$$

TANK G-50, RECEPT. & BLEND.
60 RECEIVER
REFLECTORS NEAR TANK

DELETED

INSIDE

REFL. TH.
NW 3.3 ± 0.20

REFLECTOR

TANK WALLS

$L = 3.025$ CM 0.125 IN.

SUPPORTS WELDED TO TANK

0.174 IN.

$1 \frac{1}{2}$ STRAP ATTACHED TO TANK

0.046 IN.

$1 \frac{1}{2}$ " 150 # FLANGES ATTACHED TO TANK

0.155 IN.

3" I BEAM (TANK SUP ATT. TO)

0.030 IN.

CENTRIFUGAL PUMP & MOTOR

$AL = 0.7481$ CM 0.140 IN.

REAR HOOD PANEL (LUCITE)

$AL = 0.0736$ CM 0.050 IN.

3" I. AT END OF SUP FRAMEWORK

0.022 IN.

2-2" VERTICAL PIPES

0.024 IN.

MAN NEXT TO REAR FACE OF HOOD.

$AL = 0.0874$ CM 0.054 IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS

0.820 IN.

INSIDE DIAMETER OF THE ALWAYS SAFE CYLINDER

WITH 0.820 IN. SS WALLS

7.00 IN.

EFFECTIVE INSIDE DIAMETER OF TANK G-50 (TAKING INTO ACCOUNT PRODUCT BEARING LINES AS SHOWN ON PRINTS)

7.32 IN.

MAX. REFLECTOR THICKNESS FOR G-50 TO BE SAFE.

0.580 IN.

Using Longitudinal Buckling Max Safe $R_t = 0.630$ in

161 TANK G-42, RECEIPT & BLEND
RECEIVER
REFLECTORS NEAR TANK

3'-0 1/2" 580

REFLECTORS

REFLECTOR

EFF. REFL. TH.

TANK WALLS	$l = 3.025 \text{ CM}$	0.125 IN.
0.17
SUPPORTS WELDED TO TANK		0.174 IN.
1" STRAP ATT. TO TANK		0.046 IN.
1 1/2" 150# FLANGES ATT. TO TANK		0.165 IN.
3" I (TANK SUPP ATT. TO)		0.030 IN.
CENTRIFUGAL PUMP & MOTOR	$\Delta l = 0.2481 \text{ CM}$	0.140 IN.
REAR HOOD PANEL (LUCITE)	$\Delta l = 0.0736 \text{ CM}$	0.040 IN.
2" VERTICAL PIPE		0.011 IN.
MAN NEXT TO REAR FACE OF HOOD	$\Delta l = 0.0874 \text{ CM}$	0.050 IN.

TOTAL EFFECTIVE REFLECTOR THICKNESS 0.781 IN.

INSIDE DIAMETER OF THE ALWAYS SAFE
CYLINDER WITH 0.781 IN. J.S. WALLS 7.07 IN.

→ EFFECTIVE INSIDE DIAMETER OF TANK G-50
(TAKING INTO ACCOUNT PRODUCT BEARING LINES
AS SHOWN ON PRINTS) 7.21 IN.

MAX REFLECTOR FOR G-42 TO BE SAFE 0.67 IN.

USING LONGITUDINAL BUCKLING, MAX SAFE R_i = 0.70 IN.

6-42

101

(OTHER DIRECTIONS)
PAGE 83 G-42)

8 1/2" DIA X 2 1/2" LONG UNCOATED AND 50 # (WATER) TANK (CHECK FOR IDENTICAL) - 50 # (WATER) TANK

6-50

DECLASSIFIED

54

HW 3.045 RD

MAN STANDING NEAR TANK

$$L_0 = 12.25$$

$$R = 3.625$$

$$a = 3.565$$

$$AL = \frac{3.32}{\pi} \left(\frac{3.625}{12.25} \right) \left(\frac{1}{\frac{12.80747}{3.5788}} \right)^{\frac{1}{2}} = \frac{12.035}{137.7278}$$

$$\underline{AL = 0.0874 \text{ CM.}}$$

0.29

6-42

~~6-42~~

VERY NEARLY SAME AS 6-50

165

6-50

DECLASSIFIED

HW 3:346RD

I. CENTRIFUGAL PUMP & MOTOR ASSEMBLY

$$\Delta l = \frac{3.32}{\alpha_{\infty}} \left(\frac{N'}{N} \right)$$

$$\Delta l = \frac{3.32}{\alpha_{\infty}} \frac{R}{\pi} \left(\frac{1}{C_0} \right) \left(\frac{1}{\left(\frac{C_0}{a} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$$\alpha = \alpha_{\infty}$$

$$R = 3.625 \text{ IN.}$$

$$C_0 = 6.750 \text{ IN.}$$

$$a = 2.7665 \text{ IN.}$$

$$\Delta l = \frac{3.32}{\pi} \left(\frac{3.625}{6.750} \right) \left(\frac{1}{\left(\frac{6.750}{2.7665} \right)^2 + 1} \right)^{\frac{1}{2}}$$

11/11/11
12.035

52.7298
48.5103

$$\Delta l = \frac{0.2481 \text{ CM}}{10. \text{ ~~3.32~~}}$$

6.0 Max

2.66512
2.47062

1/2" Lucite
1

10

3 1/4" I.F.

10

4" O.D.

6.0" I.D.

3/8" wall

$$5.29 \text{ " } + \frac{7}{64} - \frac{13}{64}$$

Complex - B. G. Jackson
ed Shielding

166

Sept. 8, 1954

DECLASSIFIED

G-47

$$\frac{1}{F} = 1 + \left(\frac{W}{1-W} \right) 0.801$$

$$\frac{(1-W)(\frac{1}{F}-1)}{0.801} = W$$

$$W = \frac{0.01860}{0.801} (1-W) = 0.02322 (1-W)$$

$$W = \frac{0.023332}{1.02322} = 0.02369$$

G-48

$$W = \frac{0.02776}{1.02776} = 0.02654$$

H-9

$$W = \frac{0.02775}{1.02775} = 0.02682$$

H-10

$$W = \frac{0.02708}{1.02708} = 0.02637$$

J-2

$$W = \frac{0.02085}{1.02085} = 0.02042$$

J-3

$$W = \frac{0.02507}{1.02507} = 0.02446$$

Recuplex - B. H. Jackson
cd Shielding

MS 345 10
September 8, 1954

J-2 $R = \left(\frac{20.4048}{17.24464} \right)^2 + 0.00036 = 0.03333 \text{ cm}^{-2}$

$f = 0.98757$; $\frac{1}{f} = 1.01670$; $w = 0.02042$

SAFE FOR ANY MWD/T $P_L > 2.75 \text{ MWD/T}$

CRIT. COND. = $\frac{7.59406}{0.01670} = 454 \text{ g/l}$

J-3 $R = \left(\frac{20.4048}{13.79058} \right)^2 + 0.00036 = 0.03310 \text{ cm}^{-2}$

$f = 0.98032$; $\frac{1}{f} = 1.02008$; $w = 0.02446$

SAFE FOR ANY MWD/T $P_L > 2.75$

CRIT. COND. = $\frac{7.59406}{0.02008} = 378 \text{ g/l}$

APRIL 30, 1954

HW 37345 RD 40

8. TANK J-30

168

RECLASSIFIED

$$\text{ACTUAL } I_0 D_0 = \cancel{60.4445} 6 \text{ IN}_0$$

$$\text{EFF}_0 I_0 D_0 = 60.4445$$

$$\text{EQ}_0 \text{ REFL. TH}_0 = 00.756 \text{ IN}_0$$

$$R = 80.18452$$

$$Q_R = 40.3 \text{ CM}$$

$$H = 1210.92$$

$$L_T = L_B = 601 \text{ CM}$$

$$P = \left(\frac{20.4048}{120.48452} \right)^2 + \left(\frac{\pi}{1340.12} \right)^2 = 0.03710 + 0.00055$$

$$\underline{P_0 = 0.03765}$$

SAFE FOR ANY MWD/T Pu

APRIL 30, 1954 - RECUPLEX

50

9. H-1, 2, 3-TDS

HND 345 RD

$$ACT_0 \text{ } 10 D_0 = 70.375 \text{ (MAX.)}$$

$$EFF_0 \text{ } 10 D_0 = 80.07716$$

$$EQ_0 \text{ REFL } 0 TH_0 =$$

DECLASSIFIED

$$R = 10.25799 \quad ; \quad l_R = 4.446$$

$$H = 46.0375 \quad ; \quad l_T = l_B = 60.1 \text{ cm}$$

$$B = \left(\frac{20.4048}{14.70399} \right)^2 + \left(\frac{\pi}{58.2375} \right)^2 = 0.02675 + 0.002910$$

$$B = 0.02966 \quad ; \quad f = 0.93173$$

$$\frac{1}{f} = 1.07327 \quad ; \quad \frac{1}{f} - 1.02435 = 0.04892$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.07327} = 963.6 \text{ g/l}$$

$$\text{CRIT. CONC}_{400} = \frac{70.82490}{0.04892} = 1447.7 \text{ g/l}$$

10. H-1, 2, 3-TDS

$$ACT_0 \text{ } 10 D_0 = 60.454 \text{ (MAX.) (EACH LEG OF T)}$$

$$EFF_0 \text{ } 10 D_0 = 90.51980$$

$$EQ_0 \text{ REFL } 0 TH_0 = 0.310$$

90.1781165

$$R = 9.51980 \quad ; \quad l_R = 3.46$$

$$H = 38.10 \quad ; \quad l_T = l_B = 60.1 \text{ cm}$$

$$B = \left(\frac{20.4048}{15.55015} \right)^2 + \left(\frac{\pi}{50.30} \right)^2 = 0.02392 + 0.00390$$

$$B = 0.02782 \quad ; \quad f = 0.90573$$

$$\frac{1}{f} = 1.10408 \quad ; \quad \frac{1}{f} - 1.02435 = 0.07973$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.10408} = 678.0 \text{ g/l}$$

$$\text{CRIT. CONC}_{400} = \frac{70.82490}{0.07973} = 888.4 \text{ g/l}$$

July 15, 1954 - Keayplex
EFFECT OF
CD SAILED TANKS

130 74 Quorum

3:046

TANK NO.

OLD LIMIT (g/l)

NEW LIMIT (g/l)

	0 MWD/T	200 MWD/T	400 MWD/T	0 MWD/T	200 MWD/T	400 MWD/T
G-47	110		175	317	640	SAFE
G-48	101		155	271	480	SAFE
J-1	340		SAFE	SAFE	SAFE	SAFE
J-2	143		274	841	SAFE	SAFE
J-3	131		234	615	SAFE	SAFE
H-1-BDS	73		98	84	99	SAFE

170 103 346 202
105
DECLASSIFIED

June 21, 1954

170 HW 3-34620

For B.F. Jackson

RECEIVED

Check limits on following lenses
with 20 mils Cd wrappings.

G-47

G-48

J-1

J-2

J-3

H-1-70DS

MIN. EXPOSURE SAFE IN J-7 IS 15?
IS ?

INTERACTION & REFLECTION EFFECT ONLY $\frac{2}{3}$ AS
LARGE WITH CADMIUM (CONSERVATIVE)

JUNE 28, 1954 — RECUPLEX — R.F. JUDSON

HW 37846 RD

172

1. TANK J-7 — NO cadmium shielding

$$EQ. REFL. TH. = 0.45 \text{ IN} ; d_R = 3.74 \text{ CM}$$

$$R_{EFF} = 9.44330 \text{ CM} ; H = 129.70 \text{ CM}$$

DECLASSIFIED

$$B = 0.03371$$

$$f = 0.98894 ; \frac{1}{f} = 1.01118$$

$$\frac{1}{f} = 1 + 0.801 \left(\frac{w}{1-w} \right) = 1.01118 \text{ FOR } \infty \text{ CRIT. CONC.}$$

$$w = 1.3766 \%$$

SAFE FOR ~150 MWD/T PY

2. TANK G-47 WITH 20 MILS Cd SHIELDING

INTERACTION CHANGED FROM 4.25% TO 2.833%

$$\text{NEW EQ. } d_R = 2.7183 ; \text{RAD.} = 9.80225 \text{ CM}$$

$$\text{EXT. LENGTH " " } 4.040 \text{ CM TO } 3.740 \text{ CM}$$

$$B = \left(\frac{2.4048}{13.54225} \right)^2 + 0.00029 = 0.03182$$

$$f = 0.96224 ; \frac{1}{f} = 1.03924$$

$$\frac{1}{f} - 1.02435 = 0.01489$$

$$\text{CRIT. CONC. } 0 \text{ MWD/T} = 192 \text{ g/l}$$

$$\text{CRIT. CONC. } 400 \text{ MWD/T} = 525 \text{ g/l}$$

$$\frac{1}{S} = \frac{1}{R_{AC}} + \frac{1}{R_{MS}} \quad 3d = 0.145 \text{ m} ; L_R = 30.6$$

2(b)

$$\ln p_1(\hat{y}) = -\frac{1}{2} \ln |C| - \frac{1}{2} \hat{y}^T C^{-1} \hat{y}$$

July 14, 1954 - Receptor - B. H. Hudson

129

HW 3.346R

2. TANK G-47 WITH 20 MILS Pb SHIELDING

$$OLD_{EFF. DIR.} = 70.818 \text{ IN.}$$

NEW " " = 70545 No.

DECLASSIFIED

OLD. $l_R = 4040 \text{ cm}$

NEW dr = ~~2.77~~ in
2.742

OLD EQ. REFL. TH. = 0.610 W.

NEW " " " = 00460 No.

$$RAD_0 = 9.58315 \text{ cm}$$

$$P_2 = \left(\frac{30.4018}{130.33915} \right)^2 + 0.00039 = 0.03384 \text{ cm}^{-2}$$

$$f = 0.97665 \text{ g} \quad \frac{1}{f} = 1.03391$$

a) SAFE FOR 400 MWD/T Pu

b) CRIT. CONC. = $\frac{7.59406}{0.003391} = 317 \text{ g/l}$

c) CRIT. CONC.₂₀₀ = $\frac{7070750}{0.01304} = \underline{\underline{640 \text{ g/l}}}$

No.

July 14, 1954 - 1200 Hrs. - 1200 Hrs. - 1200 Hrs.

3. Tank 6-48 with no milk & shielding

DECLASSIFIED

OLD EFF. DIR. = 7.884 m.
" " = 7.589 m.

OLD LR = 4.040 cm
NEW LR = 3.747 cm

OLD EQ. REFL. TH. = 0.610 m.
" " = 0.460 m.

TRD. = 9.68803 cm

B. = $\left(\frac{7.4048}{13.78303} \right)^2 + 0.00029 = 0.03357 \text{ cm}^2$

f = 0.97784 g f = 1.03792

f - 1.02435 = 0.00357 g f - 1.01187 = 0.01605

a) $\overline{\text{REL. COND.}}_{.400} = \frac{7.82490}{2191} = \frac{0.00357}{2191} \text{ g/l}$

b) $\overline{\text{REL. COND.}}_{.200} = \frac{7.70750}{480} = \frac{0.01605}{480} \text{ g/l}$

c) $\overline{\text{REL. COND.}}_{.0} = \frac{7.59406}{271} = \frac{0.03792}{271} \text{ g/l}$

July 14, 1954 - ¹⁻¹⁰Recuplex - Bo H. Judson

40 Tank J-1 with 20 mils Cd Shielding

Ref 37846 R0

OLD EFF DIA = 70.439 IN.
NEW " " = 70.798 IN.

DECLASSIFIED

OLD LR = 30.86 CM
NEW LR = 30.62 CM

OLD EQ REFL TH = 0.520 IN.
NEW " " " = 0.395 IN.

RAD = 90.76711 CM

$$B = \left(\frac{204048}{120882.11} \right)^2 + 0.00029 = 0.03514 \text{ CM}^{-2}$$

3090

SAFE FOR ANY MWD IT Pu

40

So Tank J-2 with 20 mils cd shielding

SECRET

$$\begin{aligned} \text{OLD EQ. REFL. TH.} &= 0.459 \text{ IN.} \\ \text{NEW EQ. " " } &= 0.520 \text{ IN.} \end{aligned}$$

$$R = 9.27100 \text{ cm}$$

$$B = \left(\frac{2.4048}{13.0138} \right)^2 + 0.00026 = 0.03386 \text{ nm}^{-2}$$

SAFE FOR MWD/T ≥ 200

$$\text{CRIT. CONC.}_0 = \frac{7.59406}{0.00902} = 841 \text{ g/l}$$

$$f = 0.99106 \quad g \frac{1}{f} = 1.00902$$

30 917

July 15, 1954 - ^{Y-78}Complex - Bo to ^{Hubert}Judson RD

6. Tank T-3 with 20 mils of shielding

OLD EFF. DIA. = 7.5050 IN.
NEW " " = 7.3367 IN.

DISCONTINUED

old $h_e = 4.390$ cm
new $h_e = 3.867$ cm

OLD EQ. REFL. TH. = 0.759 IN.
NEW " " " = 0.520 IN.

$$R = 9.3176 \times 10^3 \text{ cm}$$

$$B_2 = \left(\frac{204048}{13018461} \right)^2 + 0.00036 = 0.03362 \text{ cm}^{-2}$$

$$f = 0.98781 \quad g \quad \overset{1}{f} = 1.01234$$

$$\text{CRIT. CONC.}_{200} = \frac{7.70750}{0.00047} = 16,400 \text{ g/L}$$

SAFE FOR MWD/T ≥ 200

$$\underline{\text{CRIT. CONC.}_0} = \frac{7.59406}{0.01234} = \underline{615 \text{ g/d}}$$

6.

11-11-63

NEW " " = 9.38898 IN.

$$R = 110.93400 \text{ u}$$

NEW $L_R = 30.353 \text{ cm}$

OLD EQ. REFL. TH. = 0.310 IN.

NEW " " " = 00370 IN.

$$B = \left(\frac{20.4048}{15.37700} \right)^2 + 0.00390 = 0.02868 \text{ cm}^{-2}$$

$$f = 0.91288 \text{ g} \quad \frac{1}{f} = 1.08947$$

a) CRIT. CONC.₄₀₀ = $\frac{70.87490}{0.06512} = 170 \text{ g/d}$

$$b) \text{ CRIT. CONC.}_{200} = \frac{7.70750}{0.07760} = 99 \text{ g/d}$$

c) CRIT. CONC. = $\frac{7.59406}{0.08947} = 84$ g/l

53.30815
53.30823

TITLE OF PROJ.

Recycle - 30 Hz Inductor

AW/NC

WORKS

SUBJECT

TANK H-1-FDS

COMPUTER

DATE

July 29, 1954

176

RECEIVED

CALCULATION CONSIDERING VOLUME OF
SOLUTION DISPLACED BY PULSE
GENERATOR IN PULSE LEG AND CADMIUM
SHIELDED.

$$VOL. OF PULSE LEG = 2799.67 \text{ cm}^3$$

$$ACTUAL D_0 OF EACH LEG = 8.11308 \text{ CM}$$

$$1. \text{ CET } h = 4 \text{ IN} = 10.16 \text{ CM}$$

$$VOL_0 = 4900.61 \text{ CM}^3$$

$$RAD_0 = 12.37094 \text{ CM}$$

$$DIA = 24.78188 \text{ CM}$$

INTERACTION =
2.86668%

$$\pi (8.11308)^2 = 206.78530$$

$$L_T = L_B = \frac{4342.49 + 6(275.55844)}{482.34371} = 12.43064$$

$$EFF_0 D_0 C_d = 25.49238 \text{ CM}$$

$$EFF_0 RAD_0 C_d = 12.74619 \text{ CM}$$

$$F_2 = \left(\frac{2.4048}{16.09919} \right)^2 + \left(\frac{\pi}{35.02178} \right)^2 = 0.02231 + 0.00805$$

$$F = 0.074161 \quad ; \quad F = 1.06201$$

$$CRIT. CONC_{400} = \frac{7.82490}{0.03766} = 207 \text{ g/l}$$

$$CRIT. CONC_{400} = \frac{7.70750}{0.05014} = 153 \text{ g/l}$$

$$CRIT. CONC_{400} = \frac{7.59406}{0.05201} = 146 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - 130 H. Jackson

PROJ. No.

103-345 RD

SUBJECT

TANK H-1-BDS

COMPUTER

180

WORKS

DATE

July 29

19

DISCOUNTED

$$2. \text{ CET } h = 3 \text{ in.} = 7.62 \text{ cm}$$

$$VOL_0 = 4375.37 \text{ cm}^3$$

$$RAD_0 = 13.51935 \text{ cm}$$

$$l_T = l_B = \frac{4342.49 + 6(367.41017)}{574.18544} = 11.40196 \text{ cm}$$

$$EFF_0 RAD_{ed} = 13.90695 \text{ cm}$$

$$B = \left(\frac{2.4048}{17.25995} \right)^2 + \left(\frac{\pi}{30.42392} \right)^2 = 0.01941 + 0.01066 = 0.03007 \text{ cm}^{-2}$$

$$f = 0.93752 ; \frac{1}{f} = 1.06664$$

$$CRIT_0 \text{ CONC}_{400} = \frac{7.82490}{0.04329} = 185 \text{ g/d}$$

$$CRIT_0 \text{ CONC}_{200} = \frac{7.70750}{0.05477} = 140 \text{ g/d}$$

$$CRIT_0 \text{ CONC}_0 = \frac{7.59406}{0.06664} = 113 \text{ g/d}$$

TITLE OF PROJ.

Complex - B. H. Lyndson

PROJ.

W-3508

SUBJECT

TANK H-1-BDS

COMPUTER

WORKS

DATE

July 30, 1954

DECLASSIFIED

$$3. \text{ LET } h = 2.1W_0 = 5.08 \text{ CM}$$

$$VOL_0 = 3850.14 \text{ CM}^3$$

$$RAD_0 = 15.53218 \text{ CM}$$

$$L_T = L_B = \frac{4342.49 + 6(551.11657)}{757.90184} = 10.09258 \text{ CM}$$

$$EFF. RAD_{ED} = 15.97749 \text{ CM}$$

$$B = \left(\frac{2.4048}{19.33049} \right)^2 + \left(\frac{\pi}{25.26516} \right)^2 = 0.01548 + 0.01546 = 0.03094 \text{ CM}^{-2}$$

$$f = 0.94981 \quad ; \quad \frac{1}{f} = 1.05284$$

$$CRIT. CONC_{400} = \frac{7.82490}{0.02849} = 274 \text{ g/l}$$

$$CRIT. CONC_{200} = \frac{7.70750}{0.04097} = 188 \text{ g/l}$$

$$CRIT. CONC_0 = \frac{7.59406}{0.05284} = 143 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - 30 70 Jackson

PROJ. NO.

HW 3:30 500

SUBJECT

TANK H-1-BDS

COMPUTER

187

WORKS

DATE

July 30, 54

$A_0 \text{ LET } h = 3.5 \text{ IN.} = 8.89 \text{ CM}$

DECLASSIFIED

$VOL_0 = 4637.99 \text{ CM}^3$

$RAD_0 = 170.88665 \text{ CM}$

$L_T = L_B = \frac{4342.49 + 6(314.92354)}{5210.70884} = 11.94542 \text{ CM}$

$EFF. RAD_{0.9} = 130.35611 \text{ CM}$

$P_2 = \left(\frac{30.4048}{16.60911} \right)^2 + \left(\frac{\pi}{32.98084} \right)^2 = \frac{0.002096}{0.003015} + 0.00919 = 0.003112 \text{ CM}^{-2}$

$f = \frac{0.003112}{0.0093865} ; \frac{1}{f} = \frac{1}{0.0093865} = 10.6536$

$CRT_0 \text{ CONC}_{0.400} = \frac{7.82490}{0.004101} = \frac{190}{0.004101} \text{ g/l}$

$CRT_0 \text{ CONC}_{0.200} = \frac{7.70750}{0.005349} = \frac{144}{0.005349} \text{ g/l}$

$CRT_0 \text{ CONC}_{0.0} = \frac{7.59406}{0.006536} = \frac{116}{0.006536} \text{ g/l}$

TITLE OF PROJ.

Recuplex - Bo Ho Jackson

PROJ. NO.

Ans: 335 RD

SUBJECT

TANK H-1-B.D.S

COMPUTER

183

WORKS

DATE

July 30 1954

DECLASSIFIED

$$So \text{ CET } h = 30.5 \text{ in } W_0 = 60.35 \text{ cm}$$

$$VOL_0 = 41120.76 \text{ cm}^3$$

$$RAD_0 = 140.35839 \text{ cm}$$

$$L_T = L_B = \frac{4242.49 + 6(440.89355)}{6470.67885} = 10.78906 \text{ cm}$$

$$EFF_0 RAD_{0eff} = 140.77004 \text{ cm}$$

$$P_2 = \left(\frac{20.4048}{18.12304} \right)^2 + \left(\frac{\pi}{27.92812} \right)^2 = 0.01761 + 0.01265 = 0.03026 \text{ cm}^{-2}$$

$$f = 0.94020 \quad ; \quad \frac{1}{f} = 1.06360$$

$$CRIT_0 CONC_{0.400} = \frac{70.82490}{0.03925} = 199 \text{ g/l}$$

$$CRIT_0 CONC_{0.200} = \frac{70.70750}{0.05173} = 148 \text{ g/l}$$

$$CRIT_0 CONC_{0.0} = \frac{70.59406}{0.06360} = 119 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - 30 7/8 Jackson

PROJ. No.

HW 3.345 R1

SUBJECT

TANK H-1-BDS

COMPUTER

WORKS

DATE

July 20, 1954

$$R = \left(\frac{V}{\pi h} \right)^{\frac{1}{2}}$$

184

UNCLASSIFIED

1. FOR $h = 4$ IN.

$$R = \left(\frac{4900.61}{31.91845} \right)^{\frac{1}{2}} = (153.53534)^{\frac{1}{2}}$$

2. FOR $h = 3$ IN.

$$R = \left(\frac{4375.37}{23.93884} \right)^{\frac{1}{2}} = (182.77285)^{\frac{1}{2}}$$

3. FOR $h = 2$ IN.

$$R = \left(\frac{3850.14}{15.95923} \right)^{\frac{1}{2}} = (241.24848)^{\frac{1}{2}}$$

4. FOR $h = 3.5$ IN.

$$R = \left(\frac{4637.99}{27.97865} \right)^{\frac{1}{2}} = (166.06567)^{\frac{1}{2}}$$

5. FOR $h = 2.5$ IN.

$$R = \left(\frac{4112.76}{19.94903} \right)^{\frac{1}{2}} = (206.16341)^{\frac{1}{2}}$$

TITLE OF PROJ.

Recuplex - 130 H. J. Jackson

HW

35.35 RD

PROJ. NO.

SUBJECT

TANK H-1-BDS

COMPUTER

WORKS

DATE

July 30, 1954

139

RECEIVED

h (IN)	400 MWD/T	200 MWD/T	0 MWD/T
4.0	207	153	122
3.5	190	144	116
3.0	185	140	113
2.5	199	148	119
2.0	274	188	143

[REDACTED]

TITLE OF PROJ.

Complex - B. F. Hudson

PROJ. NO.

3-330R0

SUBJECT

TANK H-1-BDS

COMPUTER

ESU

WORKS

DATE

July 20, 1954

RECEIVED

ACTUAL I.D. OF EACH LEG = 6.38875 IN.
= 160.22616 CM

ACTUAL WALL THICKNESS = 0.134 IN.
204.56915

VOL. OF PULSE LEG (A₁) = 204.56915 IN.³
= 3.35229 LITERS
3.35229

ACT. RAD. OF EACH LEG = 8.11308 CM

CROSS-SECTIONAL AREA = 206.78530

TITLE OF PROJ.

Recuplex - Bo H. Judson

PROJ. NO.

AW 3-34561

SUBJECT

TANK H-1-BDS.

COMPUTER

187

WORKS

DATE

July 31, 1984

Choosing various values for the equivalent cylinder height (h), we can find the minimum critical mass concentrations.

UNCLASSIFIED

1. LET $h = 10 \text{ in.} = 25.4 \text{ cm}$

$VOL. = 8604.64 \text{ cm}^3$

$RAD. = 10.38426 \text{ cm}$

$DIA. = 20.76852 \text{ cm}$

$L_T = L_B = \frac{A_1 A_2}{A_1 + A_2} = \frac{A_1 (206.78530) + A_2 (1316.98026)}{338.76556}$

$= 150.15612 \text{ cm}$

$B = \left(\frac{20.4048}{14.03498} \right)^2 + \left(\frac{\pi}{55.71224} \right)^2 = 0.0293168 + 0.000318 = 0.03254 \text{ cm}^{-2}$

$f = 0.97341$ $\frac{1}{f} = 1.02837$

$CRIT. CONC. = \frac{7.82490}{0.00402} = 1946 \text{ g/l}$

$CRIT. CONC. = \frac{7.70750}{0.01650} = 467 \text{ g/l}$

$CRIT. CONC. = \frac{7.59406}{0.02837} = 267 \text{ g/l}$

TITLE OF PROJ.

SUBJECT

PROJ. NO.

WORKS

DATE

1954

TANK H-1-BDS

COMPUTER

184

July 27
RECEIVED

60357

$$\text{MAX. } I.D. (\text{SINGLE LEG}) = 6.38825 \text{ IN.} \\ = 16.22616 \text{ CM}$$

$$\text{EQUIV. DIA. 2 LEGS} = 9.03435 \text{ IN.} \\ = 22.94725 \text{ CM}$$

El 619476145

BEFORE cd —

$$\text{EQ. REFL. TH.} = 0.310 \text{ IN. } \} L_R = 3.46 \text{ CM.}$$

WITH cd & INTERACTION INCLUDED ($\frac{2}{3} \times 4.30\%$)

$$\text{EQ. } I.D. = 9.29336 \text{ IN.} \\ = 23.60513 \text{ CM.} \} \text{ 2 legs added together.}$$

$$\text{EQ. REFL. TH.} = \text{IN.}$$

$$L_R = 3.253 \text{ CM}$$

TITLE OF PROJ.

Recuplex - 30% Junction

PROJ. NO.

3-3-5-RD

SUBJECT

TANK H-1-BDS

COMPUTER

189

WORKS

DATE July 27 1954

CONT'D FROM P. 2

DECLASSIFIED

1. (CONT'D) — $h = 25.0 \text{ cm}$

INTERACTION = 20.86668% (WITHCD)

$EFF_0 \text{ } l_0 D_0 = 210.36395 \text{ cm}_0$

$RAD_0 = 100.68198 \text{ cm}$

(REST — CRIT. COND., ETC., ON P. 2)

$l_{Rcd} = 30.353 \text{ cm}_0$; $REFL. TH. (EQ.)_{cd} = 0.265 \text{ cm}_0$

2. LET $h = 5 \text{ cm}_0 = 120.70 \text{ cm}$

5978.46

$VOL_0 = 5978.46 \text{ cm}^3$

$RAD_0 = 120.34105 \text{ cm}$

$l_{Rcd} = 30.353 \text{ cm}$

$DIA_0 = 24.48310 \text{ cm}$

$l_T = l_R = \frac{\pi (2060.78530) + 6 (263.95945)}{470.74475}$
 $= 120.58908 \text{ cm}_0$

$EFF_0 \text{ } l_0 D_0_{cd} = 125.18400 \text{ cm}$

$EFF_0 \text{ } RAD_{cd} = 120.59200 \text{ cm}$

$P_0 = \left(\frac{20.4048}{120.94500} \right)^2 + \left(\frac{\pi}{37.87816} \right)^2 = 0.003275 + 0.00688$
 $= 0.00963 \text{ cm}^{-2}$

$f = 0.93130$; $f = 1.07377$

(CONT'D)

TITLE OF PROJ.

Recuplex - Bo 7/2 Jackson

PROJ. NO. HW 37-046R1

SUBJECT

TANK H-1-BDS

COMPUTER

WORKS

DATE July 27 1954

2. (CONT'D); $h = 13.70 \text{ cm}$

RECALCULATED

$$\text{CRIT. CONC}_{400} = \frac{7.82490}{0.04942} = 158 \text{ g/l}$$

$$\text{CRIT. CONC}_{200} = \frac{7.70750}{0.06190} = 124 \text{ g/l}$$

$$\text{CRIT. CONC}_0 = \frac{7.59406}{0.07377} = 103 \text{ g/l}$$

3. LET $h = 3 \text{ IN.} = 7.62 \text{ CM}$

$$\text{VOL.} = 4927.99 \text{ CM}^3$$

$$\text{RAD}_0 = 14.34774 \text{ CM}$$

$$\text{DIA}_0 = 28.69548 \text{ CM} \quad \text{g RAD} = 3.353 \text{ CM}$$

2.86668% INTERACTION

$$L_T = L_B = \frac{4342.49 + 6(439.93298)}{646.71824}$$

$$\text{EFF. } 10 \text{ D. } C_3 = 39.51818 \text{ CM}$$

$$\text{EFF. RAD}_0 = 14.75909 \text{ CM} = 10.79618 \text{ CM}$$

$$R = \left(\frac{2.4048}{18.11209} \right)^2 + \left(\frac{\pi}{39.31336} \right)^2 = 0.01763 + 0.01156 = 0.02919 \text{ CM}^{-2}$$

$$f = \frac{1}{0.97509} \quad ; \quad \frac{1}{f} = 1.08098$$

$$\text{CRIT. CONC}_{400} = \frac{7.82490}{0.05663} = 138 \text{ g/l}$$

$$\text{CRIT. CONC}_{200} = \frac{7.70750}{0.06911} = 111 \text{ g/l}$$

$$\text{CRIT. CONC}_0 = \frac{7.59406}{0.08098} = 93 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - B. 7/2 Jackson

PROJ. NO.

WORKS

3.05080

SUBJECT

TANK H-1-BDS

COMPUTER

DATE

July 27, 1954

$$A_o \text{ CET } h = \frac{3.14 \times 5.08}{190} = 5.08 \text{ cm}$$

$$VOL_o = 4403.75 \text{ cm}^3$$

$$RAD_o = 16.60950 \text{ cm}$$

$$DIA_o = 33.81900 \text{ cm} ; l_{rad} = 3.353 \text{ cm}$$

$$l_T = l_B = \frac{4242.49 + 6(659.89962)}{866.68492} = 9.57880 \text{ cm}$$

$$EFF_o \text{ } l_{D_{ocd}} = 34.17138 \text{ cm}$$

$$EFF_o \text{ } RAD_{ocd} = 17.08569 \text{ cm}$$

$$P_o = \left(\frac{20.4048}{20.43869} \right)^2 + \left(\frac{\pi}{24.73780} \right)^2 = 0.01384 + 0.01680 = 0.03064 \text{ cm}^{-2}$$

$$f = 0.94557 ; \frac{1}{f} = 1.05756$$

$$CRIT_o \text{ } CONCo_{400} = \frac{7.82490}{0.03331} = 235 \text{ g/l}$$

$$CRIT_o \text{ } CONCo_{200} = \frac{7.70750}{0.04569} = 168 \text{ g/l}$$

$$CRIT_o \text{ } CONCo_o = \frac{7.59406}{0.05756} = 131 \text{ g/l}$$

RECEIVED

INTERACTION_{cd}
2.86668%

TITLE OF PROJ.

Recuplex - 130 H. Jackson

PROJ. NO.

WORKS

SUBJECT

TANK H-1-BDS

COMPUTER

DATE

DECLASSIFIED
UNCLASSIFIED

5. $CET \ h = A \ W_0 = 10.16 \text{ cm}$

$VOL_0 = 5453.33 \text{ cm}^3$

$RAD_0 = 13.07093 \text{ cm}$

$DIA_0 = 26.14184 \text{ cm}$

$\% R_{cd} = 3.353$

$L_T = L_A = \frac{4342.49 + 6(329.95035)}{536.73564} = 11.77897$

$EFF_0 \ 10D_{cd} = 26.89132 \text{ cm}$

$EFF_0 \ RAD_{cd} = 13.44566 \text{ cm}$

$F_2 = \left(\frac{2.4048}{16.79866} \right)^2 + \left(\frac{\pi}{33.71794} \right)^2 = 0.02049 + 0.00868$

$f = 0.92180 \ ; \ \bar{f} = 1.08131$

$CERT_0 \ CORR_{0.400} = \frac{7.82490}{0.05696} \text{ g/l} = 137 \text{ g/l}$

$CERT_0 \ CORR_{0.200} = \frac{7.70750}{0.06944} \text{ g/l} = 110 \text{ g/l}$

$CERT_0 \ CORR_{0.0} = \frac{7.59406}{0.08131} \text{ g/l} = 93 \text{ g/l}$

INTERACTION
70.86668%

ENGINEERING DEPARTMENT

COM. SECTION SHEET

SHEET NO. 8

W 37530X
37530X

Leupoldex - 130 ft. In. down

TRACK H-1-BDS

COMPUTER

DATE July 28, 1954

$$6. \text{ SET } h = 3.5 \text{ in.} = 8.89 \text{ cm}$$

$$\text{VOL.} = 5190.61 \text{ cm}^3$$

$$\text{RAD.} = 13.63277 \text{ cm}$$

$$\text{DIA.} = 27.26554 \text{ cm}$$

$$k = k_g = 4343.49 + 6(377.08495) = 110.31244$$

$$\text{EFF. L.D.} = 28.04734$$

$$\text{EFF. RAD.} = 14.02362$$

$$I_2 = \left(\frac{20.4048}{170.37662} \right) + \left(\frac{316.51488}{11} \right) = 0.01915 + 0.00994 = 0.02909 \text{ cm}^2$$

$$f = 0.92367 ; f = 1.08264$$

$$\text{A.P.I.T. CORR.}_{+0.00} = \frac{7082490}{0.05829} = 134$$

$$\text{A.P.I.T. CORR.}_{+0.00} = \frac{7070750}{0.07077} = 108$$

$$\text{A.P.I.T. CORR.}_{+0.00} = \frac{7059406}{0.08264} = 91$$

TITLE OF PROJ.

Recuplex - Bo Ho Qualson

PROJ. No.

WORKS 3.3.5080

SUBJECT

TANK H-1-BDS

COMPUTER

194

DATE

July 28, 1954

RECEIVED

h (in.)	400 MWD/T	200 MWD/T	0 MWD/T
10	1946	467	267
5	158	134	102
4	137	110	93
3	138	111	93
2	235	168	131
3.5	134	108	91

REPORTED VALUES

MWD/T	PULSE GENERATOR a) IN	b) OUT
400	150	130
200	140	105
0	110	90

ENGINEERING DEPARTMENT

Complex - 13.07.1944

W 3.030.80

SUBJECT

TRASH H-1-BDS

COMPUTER

1953

WORKS

DATE

July 19 1954

$$I.D. = 6.38875 \text{ I.D.} = 16.37616 \text{ CM.}$$

6" SCHEDULE 10S — 304L S.S. PIPE.

FROM PRINT H-2-15427

$$VOLUME = 18.3185(\pi)(3.19412)^2 + 5.78135(\pi)(3.19412)^2 = 5.29562$$

$$= 586.94602 + 185.39866 + 15.47622 = 787.72090 \text{ I.D.}^3$$

$$= 12,908.43965 \text{ CM}^3 = 12.90843 \text{ LITERS}$$

RAD. OF EQUIVALENT SPHERE

$$R = \sqrt[3]{\frac{12.90843965}{3}} = (3081.67299)^{\frac{1}{3}}$$

$$R = 14.55221 \text{ CM}$$

TITLE OF PROJ.

Reamley - B. F. Jackson

PROJ. NO. 0-045087
WORKS

SUBJECT

TANK H-1-BDS

COMPUTER

195

DATE

July 19, 1954

I. CONSIDERING 20 MILS OF CADMIUM SHIELDING

$$r_c = 3.353 \text{ CM} ; R = 14.55271 \text{ CM}$$

$$B = \left(\frac{\pi}{17.90571} \right)^2 = 0.03079 \text{ CM}^{-2}$$

$$f = 0.94769 ; \frac{1}{F} = 1.05520$$

$$a) \text{ CRIT. CONC.}_{400} = \frac{7.82490}{0.03085} = 253.6 \text{ g/l}$$

$$b) \text{ CRIT. CONC.}_{200} = \frac{7.70750}{0.04333} = 177.9 \text{ g/l}$$

$$c) \text{ CRIT. CONC.}_{\text{unshielded}} = \frac{7.59406}{0.05520} = 137.6 \text{ g/l}$$

II. CONSIDERING NO CADMIUM SHIELDING

r_c

TITLE OF PROJ.

Complex - B. F. Hudson

SUBJECT

TANK G-42

COMPUTER

DATE

July 30, 1954

196

EFFECT OF VALVE AT DISTANCE OF 9"
(EDGE TO EDGE) FROM G-42.

$$L_0 = 120.625 \text{ IN.}$$

$$R = 30.5 \text{ IN.}$$

$$R' = 20.5 \text{ IN.}$$

$$a = L_0 \tan \theta = 120.625 (0.16589) = 20.08679 \text{ IN.}$$

$$\Delta d = 10.05679 \left(\frac{30.5}{120.625} \right) \left(\frac{1}{\left(\frac{120.625}{20.08679} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$$= 10.05679 (0.27723) (0.16308)$$

$$= 0.04778 \text{ CM} \quad (2.389 \text{ DIV.})$$

$$L_{\text{TOT}} = 40.55 \text{ CM. (from 40.50)}$$

$$B = \left(\frac{20.4048}{140.23740} \right)^2 + \left(\frac{\pi}{140.23740} \right)^2 = 0.02857 + 0.000036 = 0.02893 \text{ CM}^{-2}$$

$$f = 0.92141 \quad ; \quad F = 10.08529$$

$$\text{CRIT. CONCO}_f = \frac{70.89406}{0.08529} = 89 \text{ g/l}$$

$$\text{CRIT. CONCO}_{400} = \frac{70.82490}{0.06094} = 118 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - B. H. G. Johnson

PROJ. NO. 3-34500

SUBJECT

TANK G-48

COMPUTER

19A

DATE

August 2, 1954

EFFECT OF VALVE AT DISTANCE OF 9"
(EDGE TO EDGE) FROM G-48

$$A_L = 0.04778 \text{ cm}$$

$$h_{TOT} = 4.35 \text{ cm}$$

$$B = \left(\frac{2.4048}{14.10046} \right)^2 + \frac{0.000039}{0.000074} = 0.02938 \text{ cm}^{-2}$$

$$f = 0.92777 \quad \frac{1}{f} = 1.07785$$

$$\text{CRIT. CONC.} = \frac{7.59406}{0.07785} = 97 \text{ g/l}$$

$$\text{CRIT. CONC.} = \frac{7.83490}{0.05350} = 146 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - B. H. Jackson

SUBJECT

TANK G-48

COMPUTER

196

WORKS

DATE

August 2, 1954

DETERMINE EFFECT OF PLACING 0.125 IN.
THICK SLEEVE IN TANK, LEAVING 0.75 IN.
ANNULUS BETWEEN TANK WALL AND SLEEVE.

CLASSIFIED

5.125
6.250
7.175

160.15134

a) CONSIDER MERELY EFFECT OF PHYSICAL REDUCT.
IN REACTOR FLUID CROSS-SECTIONAL AREA.

AREA (NO SLEEVE) = 248.28566 CM²
RADIUS (") = 8.89 CM
AREA (WITH SLEEVE) = 237.13447 CM²
EFF. RAD (") = ~~7.175~~ CM
8.59599

TAKING INTO ACCOUNT ONLY REDUCTION IN
C.O.A. OF TANK DUE TO SLEEVE

ENGINEERING

COMPUTATION SHEET

SHEET NO.

TITLE OF PROJ.

Recuplex - Bo. Ho. Jackson

SUBJECT

HORIZONTAL VESSEL RECHECK

DATE

August 6, 1954

Recalculation for several tanks due to error in addition of effect due to process lines near tank.

TANK NO.	OLD VALUE	NEW VALUE
	a) 400 MWD/T; b) 0 MWD/T	a) 400 MWD/T; b) 0 MWD/T
→ G-47	>150 (175) 110	>150 (485) >150 (185)
→ G-48	>150 (155) 100	>150 (375) >150 (165)
→ H-9	>150 (170) 105	>150 (460) >150 (180)
→ H-10	150 100	>150 (335) >150 (160)
J-17	110 80	>150 (180) 110

TITLE OF PROJ.

Complex - B. H. Jackson

SUBJECT

G-48 RECHECK

COMPUTER

DATE

WORKS

August 3, 1954

G-48

201

RECEIVED

$$EQ. DIA. = 7.19814 \text{ IN.}$$

$$EQ. RAD. = 3.59907 \text{ IN.}$$

ADDING 5.200% INTERACTION

$$EQ. DIA. = 7.54814 \text{ IN.}$$

$$EQ. RAD. = 3.77407 \text{ IN.} = 9.58614 \text{ CM}$$

$$T_2 = \left(\frac{20.4048}{13.63615} \right)^2 + 0.00029 = 0.08144 \text{ CM}^{-2}$$

$$f = 0.95687 \quad ; \quad \frac{1}{f} = 1.04507 \quad ; \quad \frac{1}{f} - 1.02435 = 0.02072$$

$$\text{CRIT. CONC.}_{400} = \frac{7.82490}{0.02072} = \frac{377 \text{ g/l}}{150}$$

$$\text{CRIT. CONC.}_0 = \frac{7.59406}{0.04507} = \frac{168 \text{ g/l}}{4}$$

0	400	
10	175	G-47 ✓
20	155	G-48 ✓
35	170	H-9 ✓
45	150	H-10 ✓
55	145	H-11 ✓
70	145	J-1 ✓
110		J-17 ✓

70532

HW 3-330 RD

TITLE OF PROJ.

Recuplex - 30% of Hudson

PROJ. NO.

SUBJECT

TANK H-10 RECHECK COMPUTER

WORKS

DATE

August 4, 1954

202

$$ACTO \text{ } 10 D_0 = 700 \text{ IN}_0$$

$$EFFO \text{ } 10 D_0 (\text{INT. \& LINES INCL.}) = 7073012 \text{ IN}_0$$

$$EFFO \text{ } RAD_0 = 3086506 \text{ IN}_0 = 9081725 \text{ CM}$$

$$LR = 3093 \text{ CM}$$

$$B_0 = \left(\frac{204048}{13074735} \right)^2 + 0.00069 = 0.003129 \text{ CM}^{-2}$$

$$f = 0.95475 \quad ; \quad \frac{1}{f} = 1.04739$$

$$\text{CRITO CONCO}_{100} = \frac{7083490}{0.00304} = 339 \text{ g/L}$$

$$\text{CRITO CONCO}_0 = \frac{7059406}{0.04739} = 160 \text{ g/L}$$

TITLE OF PROJ.

Recuplex - B. H. Quabon

PROJ. NO.

3.346 R

SUBJECT

TANK G-47 RECHECK COMPUTER

DATE

August 4, 1954

$$ACT_0 \text{ I.D.} = 7.0 \text{ IN.}$$

203

DECLASSIFIED

$$EFF_0 \text{ I.D. (INT. \& LINES INCL.)} = 7.49562 \text{ IN.}$$

$$EFF_0 \text{ R.H.D.} = 3.74781 \text{ IN.} = 9.51944 \text{ CM}$$

$$L_R = 4.040 \text{ CM}$$

$$T = \left(\frac{2.04048}{13.55944} \right)^2 + 0.00079 = 0.03174 \text{ CM}^2$$

$$f = 0.96111 \quad ; \quad \frac{1}{f} = 1.04046$$

$$\text{CRIT. CONC.}_{100} = \frac{7.82490}{0.01611} = 485 \text{ g/l}$$

$$\text{CRIT. CONC.}_L = \frac{7.59406}{0.04046} = 187 \text{ g/l}$$

TITLE OF PROJ.

Recuplex - B. H. Guobson

SUBJECT

TANK H-9 RECHECK

COMPUTER

WORK

DATE

August 4, 1954

$$ACT_{10} D_0 = 7.0 \text{ IN.}$$

204

$$EFF_{10} D_0 (\text{INT. \& LINES INCL.}) = 7.51312 \text{ IN.}$$

$$EFF_{10} RAD_0 = 3.75656 \text{ IN.} = 9.54166 \text{ CM}$$

$$L_R = 4.0675 \text{ CM}$$

$$R = \left(\frac{2.4048}{13.60416} \right)^2 + 0.00044 = 0.03169 \text{ CM}^{-2}$$

$$f = 0.96040 \quad ; \quad \frac{1}{f} = 1.04123$$

$$\underline{CRIT_{10} CONC_{400}} = \frac{7.82490}{0.01688} = \underline{463 \text{ g/d}}$$

$$\underline{CRIT_{10} CONC_0} = \frac{7.59406}{0.04123} = \underline{184 \text{ g/d}}$$

TITLE OF PROJ.

Recuplex - 130 G. Jackson

PROJ. No.

HW 3:04:00

SUBJECT

TANK J-17 RECHECK COMPUTER

WORK

DATE

August 4, 1954

205

$$ACT_0 / D_0 = 7.0 \text{ IN}_0$$

$$EFF_0 / D_0 (\text{INT. \& LINES INCL.}) = 7.78962 \text{ IN}_0$$

$$EFF_0 \text{ RAD}_0 = 3.89481 \text{ IN}_0 = 9.89382 \text{ CM}$$

$$L_R = 4.02 \text{ CM}$$

$$T_R = \left(\frac{3.4048}{13.91282} \right)^2 + 0.00017 = 0.03005 \text{ cm}^2$$

$$f = 0.93723 \quad ; \quad \frac{1}{f} = 1.06697$$

$$\frac{CRIT_0 \text{ CON } C_{0.400}}{0.04362} = \frac{7.83490}{0.04362} = \underline{183 \text{ g/d}}$$

$$\frac{CRIT_0 \text{ CON } C_{0.0}}{0.06697} = \frac{7.59406}{0.06697} = \underline{113 \text{ g/d}}$$

10275% INTO

EMPADE 3742 2-45 ROB

ENGINEERING DEPARTMENT

COMPUTATION

COMPUTATION

SHEET 60

TITLE OF PROJ.

Recuplex - B. H. Jackson

PROJ. NO.

203.34580

SUBJECT

TANK J-1 RECHECK

COMPUTER

205

WORKS

DATE

August 5, 1954

$$\text{ACTUAL } I_o D_o = 7.0 \text{ IN}$$

$$\text{EFF } I_o D_o = 7.47925 \text{ IN}$$

$$\text{CRIT. CONC}_{400} = \infty$$

$$\text{CRIT. CONC}_0 = 340 \text{ g/d}$$

TANK H-11, RECHECK

$$\text{ACTUAL } I_o D_o = 6.4 \text{ IN}$$

$$\text{EFF } I_o D_o (\text{INT. \& LINES WCL}) = 7.06738 \text{ IN}$$

$$\text{EFF. RAD}_0 = 3.53369 \text{ IN} = 8.97557 \text{ CM}$$

$$\text{CRIT. CONC}_{400} = 149 \text{ g/d}$$

$$\text{CRIT. CONC}_0 = 99 \text{ g/d}$$

TITLE OF PROJ.

Recuplex - B. H. Gudman

Drawn NO. 3-3-5 RD

SUBJECT

TANKS G-42 & G-50 COMPUTER

DATE August 16, 1950

209

EFFECT OF MOVING FLANGES FROM SURFACE
OF TANK TO 6 INCHES FROM SURFACE.

REFL. TH.

OLD (~~ΔL~~ VALUES) FOR FLANGES —

a) G-42 $\Delta L = 0.165 \text{ CM}$

b) G-50 $\Delta L = 0.155 \text{ CM}$

NEW ΔL VALUES (FLANGE AT 6 IN.)

$$a) \Delta L = 3.9270(2.145) = 8.42342 = 0.13928$$

$$\begin{array}{r} 19.25 \pi \\ 19.25 \end{array} \quad \begin{array}{r} 41.62680 \\ 60.47580 \end{array}$$

$$b) \Delta L = 3.9270(2.145) = 8.42342 = 0.13750$$

$$\begin{array}{r} 19.25 \pi \\ 19.25 \end{array} \quad \begin{array}{r} 41.62680 \\ 61.026120 \end{array}$$

$$a) \text{EQ. REFL. TH.} = 0.085 \text{ IN.}$$

$$0.060$$

$$b) \text{EQ. REFL. TH.} = 0.080 \text{ IN.}$$

$$0.060$$

$$\text{TOT. EQ. REFL. TH. G-42} = 0.085 \text{ IN.} ; l_p = 4.360$$

$$\begin{array}{r} 0.775 \\ 0.800 \end{array} \quad \begin{array}{r} 4.360 \\ 4.330 \end{array}$$

$$\text{TOT. EQ. REFL. TH. G-50} = 0.085 \text{ IN.} ; l_p = 4.355$$

$$\begin{array}{r} 0.875 \\ 0.845 \end{array} \quad \begin{array}{r} 4.330 \\ 4.355 \end{array}$$

TITLE OF PROJ.

Complex - B. H. Jackson

712W 3535080

SUBJECT

TANKS G-42 & G-50 COMPUTER

DATE

WORKS

August 16, 1954

$$a) P_2 = \left(\frac{204048}{13.97740} \right)^2 + 0.00036 = 0.02996 \text{ cm}^{-2}$$

$$f = \frac{0.93596}{0.93837} ; \frac{1}{f} = 1.06568$$

$$\text{CRIT. CONC.}_{100} = \frac{7.82490}{0.04407} = \frac{189}{177} \text{ g/d}$$

$$\text{CRIT. CONC.}_0 = \frac{7.59406}{0.06842} = \frac{115}{110} \text{ g/d}$$

$$b) P_2 = \left(\frac{204048}{14.03645} \right)^2 + 0.00036 = 0.02976 \text{ cm}^{-2}$$

$$f = \frac{0.93159}{0.93314} ; \frac{1}{f} = 1.07165$$

$$\text{CRIT. CONC.}_{100} = \frac{7.82490}{0.04908} = \frac{165}{159} \text{ g/d}$$

$$\text{CRIT. CONC.}_0 = \frac{7.59406}{0.07343} = \frac{105}{102} \text{ g/d}$$

TANK
NO.FLANGE
"45 1/2"FLANGE
6" OUT

400 MWD/T

G-42

135 g/d

150 g/d

G-50

170 g/d

150 g/d

0 MWD/T

G-42

90 g/d

110 g/d

G-50

85 g/d

105 g/d

TITLE OF PROJ.

Recuplex - B. H. Jackson

PROJ. No.

SUBJECT

Cd - S.S. SANDWICH

COMPUTER

WORKS

DATE

August 17, 1954

PROPOSED SANDWICH TYPE SHIELD FOR
RECUPLEX TANKS

DECLASSIFIED

Receptor - 130 7/8 Hudson
cd Shielding

210 September 8, 1954

	20 MIL cd SHEATH		20 MIL cd + 0.0175 IN. 5050 SHEATH	
	MIN. SAFE MWD	CRIT. CONC. 0	MIN. SAFE MWD	CRIT. CONC. 0
G-47	50	1889 g/l	300	408 g/l
G-48	100	1041 g/l	350	347 g/l
H-9	50	1889 g/l	300	406 g/l
H-10	100	1020 g/l	350	350 g/l
* J-2	25	3515 g/l	375	454 g/l
* J-3	75	1395 g/l	335	378 g/l
* FLANGES MOVED 6 IN. FROM TANK SURFACE ALSO				

[REDACTED]

TITLE OF PROJ.

Recuperator - B. H. Jackson

PROJ. No.

SUBJECT

Cd Wrapping

COMPUTER

219

WORK

DATE

Aug 30, 1954

T. Determine what effect cadmium wrapping will have on tanks G-47, G-48, H-9, & H-10 after correction for interacting pipes was made.

A. TANK G-47

$$\text{EFFECTIVE } I_o D_o (\text{NO Cd}) = 7.49562 \text{ W}_o$$

$$\text{ACTUAL } I_o D_o = 7.0 \text{ W}_o$$

$$\text{OLD } L_p = 4.040 \text{ CM}$$

$$\text{NEW } L_p = 3.747 \text{ CM}$$

$$\text{EFF. } I_o D_o \text{ WITH Cd} = 7.33041 \text{ W}_o$$

$$\text{RADIUS} = 9.30961 \text{ CM}$$

$$B = \left(\frac{3.4048}{13.05661} \right)^2 + 0.00039 = 0.03421 \text{ CM}^{-2}$$

$$f = 0.99600 \quad ; \quad \bar{f} = 1.00402 \quad ; \quad w = 0.00499$$

SAFE FOR ANY MUD/T $P_o > 50 \text{ W}_o$

$$\text{CRIT. CONC.}_o = \frac{7.59406}{0.00402} = 1889 \text{ g/l}$$

0046

TITLE OF PROJ.

Complex - B. H. Jackson

Job No. 3461

SUBJECT

Cd Wrapping

COMPUTER

214

WORKS

DATE

Sept 1, 1954

RECORDED

Re TANK 6-4B

EFFECTIVE $10D_0$ WITH $Cd = 7.36543$ IN.OLD $L_R = 4.040$ CMNEW $L_R = 3.747$ CM

EFF. RADIUS = 9.35410 CM

$$F = \left(\frac{2.4048}{13.10110} \right)^2 + 0.00029 = 0.03398 \text{ CM}^{-2}$$

$$f = 0.99376 ; \frac{1}{f} = 1.00729 ; W = 0.0090190$$

SAFE FOR ANY MUD/T $P_a > 100$ MUD/T

$$\text{CRIT. COND.} = \frac{7.59406}{0.00739} = 1041.9/L$$

TITLE OF PROJ.

Recuplex - B. H. Jackson

PROJ. NO.

W. 37 346 R1

SUBJECT

Cd Wrapping

COMPUTER

WORKS

DATE

Sept 19, 54

213

C. TANK H-9

EFFECTIVE DIAMETER WITH Cd = 7.34208

OLD L_p = 40.0675 CMNEW L_p = 30.767 CM

EFF. RADIUS = 9.33444 CM

$$R = \left(\frac{20.4048}{13.08644} \right)^2 + 0.00044 = 0.03421$$

$$f = 0.99600 \quad ; \quad \frac{1}{f} = 1.00402 \quad ; \quad w = 0.00499$$

SAFE FOR ANY MWD/T $P_d > 50$ CRIT. CONCO = 1889 g/d

TITLE OF PROJ.

Recuplex - 170 To Hudson

DRAW. NO.

10 RD

SUBJECT

Cd Wrapping

COMPUTER

WORKS

DATE

Sept 1, 1954

214

Do TANK H-10

EFFECTIVE $10 D_o$ WITH $Cd = 7.48675$ IN.OLD $L_R = 7.93$ CMNEW $L_R = 7.673$ CM

EFF. RAD. = 9.50818 CM

$$R = \left(\frac{7.4048}{17.18118} \right)^2 + 0.000069 = 0.03397$$

$$f = 0.99261 \quad ; \quad \frac{1}{f} = 1.00744 \quad ; \quad W = 0.00920$$

SAFE FOR ANY MUD/T. $P_u > 100$

$$\text{CRIT. COND.} = \frac{7.59406}{0.00744} = 1020 \text{ g/l}$$

TITLE OF PROJ.

Complex - B. H. Johnson

PROJ. NO.

346 R

SUBJECT

Cd Wrapping

COMPUTER

215

WORKS

DATE

Sept. 19, 1954

1954

E. TANK J-2 — Cd wrapped & FLANGES
MOVED 6" FROM EDGE OF TANK.

REFLECTORS INSIDE CADMIUM SHEATH (20 MILS.)

TANK WALLS

— 0.175 IN.

7.25 a) EFFECT OF MOVING FLANGES FROM SURFACE
7.62 OF TANK TO 6 IN. FROM SURFACE
REFL. TH

OLD ~~REFL. TH~~ FOR FLANGES = 0.165 ~~REFL. TH~~ IN.

NEW ~~REFL. TH~~ = 0.13928

NEW ^{EQ.} REFL. TH. = 0.060

TOT. EQ. REFL. TH. (J-2) = 0.654 IN.

TOT. EQ. REFL. TH. (J-3) = 0.654 IN.

$L_R = 4.080$ CM

EFF. λ_D J-2 = 7.45075 IN.

EFF. λ_D J-3 = 7.8050 IN.

b) EFFECT OF Cd SHIELDING

NEW EFF. λ_D = (J-2) 7.8050 IN.

(J-3) 7.83667 IN.

NEW $L_R = 3.773$ CM

EFF. RAD. (J-2) = 9.87164 CM

EFF. RAD. (J-3) = 9.8758 CM

TITLE OF PROJ.

Kempsey - Bo. To Jackson

DECLASSIFIED

PROJ. NO.

SUBJECT

cd Wrapping

COMPUTER

216

WORK

DATE

Sept. 8, 1954

1) J-2 —

$$B = \left(\frac{204048}{1304464} \right)^2 + 0.00036 = 0.03434 \text{ cm}^2$$

$$f = 0.99784 \quad ; \quad \frac{1}{f} = 1.00216 \quad ; \quad w = 0.00269$$

SAFE FOR ANY MUD/TPU > 25

$$\text{CRIT. CONC.} = \frac{7659406}{0.00216} = 3515 \text{ g/l}$$

2) J-2 —

$$B = \left(\frac{204048}{13099058} \right)^2 + 0.00036 = 0.03411$$

$$f = 0.99459 \quad ; \quad \frac{1}{f} = 1.00544 \quad ; \quad w = 0.00675$$

SAFE FOR ANY MUD/TPU > 75

$$\text{CRIT. CONC.} = \frac{7659406}{0.00544} = 1395 \text{ g/l}$$

TITLE OF PROJ.

Reflux - B. J. Jorgensen

PROJ. NO.

SUBJECT

Cd Shielding

COMPUTER

219

WORKS

DATE

Sept. 29, 1954

CALC. - WITH 0.0175" 5.5% OUTSIDE CADMIUM SHEATH

G-47 NEW REFL. TH. =

$$\text{NEW } L_R = 3.947 \text{ cm}$$

$$B = \left(\frac{3.4048}{13.35661} \right)^2 + 0.00029 = 0.03320 \text{ cm}^{-2}$$

$$f = 0.98174 ; \frac{1}{f} = 1.01860 ; w = 0.03369$$

SAFE FOR ANY MUDD/TPU > 300

$$\text{CRIT. CONC.} = \frac{7.59406}{0.01860} = 408 \text{ g/l}$$

G-48 NEW L.R. = 3.947 cm

$$B = \left(\frac{3.4048}{13.30110} \right)^2 + 0.00029 = 0.03298 \text{ cm}^{-2}$$

$$f = 0.97863 ; \frac{1}{f} = 1.02184 ; w = 0.03654$$

SAFE FOR ANY MUDD/TPU > 350

$$\text{CRIT. CONC.} = \frac{7.59406}{0.03184} = 247 \text{ g/l}$$

TITLE OF PROJ.

Complex - B. G. Hudson

PROJ. No.

218

SUBJECT

Cd Shielding

COMPUTER

WORKS

DATE Sept. 7, 1954

218

H-9 NEW $L_R = 3.967 \text{ cm}$

$$B = \left(\frac{2.4048}{13.78644} \right)^2 + 0.00044 = 0.03320 \text{ cm}^{-2}$$

$$f = 0.98174 \quad ; \quad \frac{1}{f} = 1.01870 \quad ; \quad w = 0.03282$$

SAFE FOR ANY MWD/T Pu > 300

$$\text{CRIT. CONC.} = \frac{7.59406}{0.01870} = 406 \text{ g/l}$$

H-10 NEW $L_R = 3.875 \text{ cm}^+$

$$B = \left(\frac{2.4048}{13.38118} \right)^2 + 0.00069 = 0.03299 \text{ cm}^{-2}$$

$$f = 0.97877 \quad ; \quad \frac{1}{f} = 1.02169 \quad ; \quad w = 0.02687$$

SAFE FOR ANY MWD/T Pu > 350

$$\text{CRIT. CONC.} = \frac{7.59406}{0.02169} = 350 \text{ g/l}$$

APRIL 29, 1954 - RECUPLEX

1.

HW 37346 RD

1. TANK G-16

$$\begin{aligned} \text{EFF}_0 / D_0 &= 70.56072 \\ \text{EFF}_0 \text{ REFL}_0 \text{ TH}_0 &= 0.326 \text{ IN.} \end{aligned}$$

218

DECLASSIFIED

$$\begin{aligned} R &= 9060148 \\ H &= 460355 \end{aligned}$$

$$\begin{aligned} \text{g } l_R &= 30.5 \text{ cm} \\ \text{g } l_T = l_B &= 60.1 \text{ cm} \end{aligned}$$

$$B = \left(\frac{204048}{13010148} \right)^2 + \left(\frac{\pi}{580555} \right)^2 = 0.03369 + 0.00288$$

$$\bar{B} = 0.03657$$

SAFE FOR ANY MWD

2. TANK G-28

$$\begin{aligned} \text{EFF}_0 / D_0 &= 70.39572 \\ \text{EFF}_0 \text{ REFL}_0 \text{ TH}_0 &= 0.326 \text{ IN.} \end{aligned}$$

$$\begin{aligned} R &= 9039256 \\ H &= 460355 \end{aligned}$$

$$\begin{aligned} \text{g } l_R &= 30.5 \text{ cm} \\ \text{g } l_T = l_B &= 60.1 \text{ cm} \end{aligned}$$

$$B = \left(\frac{204048}{10089256} \right)^2 + 0.00288 = 0.03479 + 0.00288$$

$$\bar{B} = 0.03767$$

SAFE FOR ANY MWD

APRIL 29, 1954

3. TANK G-51

219

$$EFF_{0.10 D_0} = 8.24832$$

$$EFF_{REFL TH} = 0.105$$

HW 37.34521

DECLASSIFIED

$$R = 10.47537$$

$$l_R = 2.660 \text{ cm}$$

$$H = 60.96$$

$$l_T = l_B = 6.1 \text{ cm}$$

$$P_0 = \left(\frac{2.4048}{14.13537} \right)^2 + 0.00184 = 0.02894 + 0.00184$$

$$P_0 = 0.03078 \quad \text{; } f = 0.94754$$

$$\frac{1}{f} = 1.05536$$

$$\frac{1}{f} - 1.02435 = 0.03101$$

$$\text{CRIT. CONC.}_0 = \frac{7.59406}{0.05536} = 137.2 \text{ g/l}$$

$$\text{CRIT. CONC.}_{400} = \frac{7.82490}{0.03101} = 252.3 \text{ g/l}$$

4. TANK G-54

$$EFF_{0.10 D_0} = 6.546016948$$

$$EQ_{REFL TH}_0 =$$

$$R = 7.83524$$

$$l_R =$$

$$H = 51.425$$

$$l_T = l_B = 6.1 \text{ cm}$$

$$P_0 = \left(\frac{2.4048}{7.83524 + l_R} \right)^2 - \left(\frac{\pi}{6.30635} \right)^2 - \left(\right) + 0.00244$$

a) FOR 40 MWD/T

$$l_R = \frac{2.4048}{7.83524} = 5.96324$$

$$EQ_{REFL TH}_0 = \frac{10.03205}{30.44} \text{ IN.} \leftarrow \text{SAFE}$$

b) FOR 10 MWD/T

$$l_R = \frac{2.4048}{10.03205} - 7.83524 = 5.59714$$

$$EQ_{REFL TH}_0 = \frac{10.17903}{10.84} \text{ IN.} \leftarrow \text{SAFE}$$

APRIL 29, 1954

30

50 TANK J-5

221

W 37:346 R

45096

$$EFF_{0.10 D_0} = 60.34854$$

$$EQ_{REFL. TH_0} =$$

DECLASSIFIED

$$T_R = 70.93565$$

$$\frac{1}{2} d_R =$$

$$H =$$

$$\frac{1}{2} L_T = L_R = 60.1 \text{ cm}$$

$$P_0 = \left(\frac{20.4048}{A + d_R} \right)^2 + 0.00344$$

a) FOR 0 MWD/T

$$L_R = \frac{20.4048}{100.03205} \quad 70.93565 = 50.49673$$

$$EQ_{REFL. TH_0} = 10.71 \text{ IN.}$$

SAFE

b) FOR 400 MWD/T

$$L_R = \frac{20.4048}{100.03037} \quad 70.93565 = 50.86383$$

$$EQ_{REFL. TH_0} = 20.25 \text{ IN.}$$

SAFE

60 TANK H-11

$$ACT_{0.10 D_0} = 60.4 \text{ IN.}$$

$$EFF_{0.10 D_0} = 70.06738$$

$$EQ_{REFL. TH_0} = 10.305$$

$$A = 80.97557$$

$$\frac{1}{2} L_R = 50.08 \text{ cm}$$

$$H = 224.79$$

$$\frac{1}{2} L_T = L_R = 60.1 \text{ cm}$$

$$60.635 \text{ O.D.}$$

$$0.134 \text{ WALLS}$$

$$60.357 \text{ net}$$

$$10 D$$

$$P_0 = \left(\frac{20.4048}{14.05557} \right)^2 + 0.00018 = 0.003945$$

$$f = 0.92876$$

$$\frac{1}{2} F = 10.07670$$

$$\frac{1}{2} F - 10.2435 = 0.05235$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.07670} = 920.0 \text{ g/l}$$

$$\text{CRIT. CONC}_{100} = \frac{70.82490}{0.05235} = 149.5 \text{ g/l}$$

70 TANK J-31 SAFE FROM VOL CONSIDERATIONS ALONE

APRIL 29, 1954

221

HW 37346 KD

MIN. CRIT. CONCENTRATIONS

DECLASSIFIED

<u>TANK NO.</u>	<u>0 MWD/T IN g/L</u>	<u>400 MWD/T IN g/L</u>
→ G-42	<u>90</u>	<u>135</u>
G-46	∞	∞
✓ G-47	110	175
✓ G-48	100	155
→ G-50	<u>85</u>	<u>120</u>
H-9	105	170
H-10	100	150
✓ J-1	240	∞
✓ J-2	140	370
✓ J-3	130	330
J-4	∞	∞
J-6	∞	∞
J-7	675	∞
J-17	80	110
J-25	∞	∞

APRIL 28, 1954 - RECUPLEX

1.

CALCULATION OF MINIMUM CRITICAL CONCENTRATION FOR RECUPLEX TANKS
(ACCOUNTING FOR REFLECTORS, PROCESS PIPING AND INTERACTION)

37346 RD
DECLASSIFIED

1. TANK H-9

EFF. I.D. = 7.835 IN. ; 54.375 IN. HIGH
EQ. REFL. TH. = 0.63 IN.

R = 9.95045 ; $l_R = 4.0625$ CM
H = 138.1125 ; $l_T = l_B = 60.1$ CM

$$B_2 = \left(\frac{20.4048}{140.01295} \right)^2 + 0.00044 = +0.00044$$

$\bar{B} = 0.03989$; $\bar{f} = 0.93498$

$\frac{1}{\bar{f}} = 1.06954$; $\frac{1}{\bar{f}} - 1.02435 = 0.04519$

$$\text{CONC}_{\text{crit}(0)} = \frac{70.59406}{0.06954} = 1013.7 \text{ g/l}$$

$$\text{CRIT. CONC}_{400} = \frac{70.82490}{0.04519} = 1567.2 \text{ g/l}$$

APRIL 28, 1954 - RECUPLEX

DECLASSIFIED

2. TANK H-10

HJ 37346 RD

$$EFF_0 \cdot 10 \cdot D_0 = 8.057 \text{ IN}_0$$

$$EQ_0 \cdot REF_0 \cdot TH_0 = 0.56 \text{ IN}_0$$

$$R = 10.33604 \quad ; \quad L_T = 30.93 \text{ CM}$$

$$H = 107.6335 \quad ; \quad L_T = L_B = 601 \text{ CM}$$

$$B_0 = \left(\frac{20.4048}{14.15604} \right)^2 + 0.000069 = 0.02886 + 0.000069$$

$$B_0 = 0.02955 \quad ; \quad f = 0.93017$$

$$\frac{1}{f} = 1.07507$$

$$\frac{1}{f} - 1.07435 = 0.05072$$

$$\text{CRIT}_0 \text{ CONC}_0 = \frac{7.89406}{0.07507} = 10.12 \text{ g/l}$$

$$\text{CRIT}_0 \text{ CONC}_{400} = \frac{7.82490}{0.05072} = 154.3 \text{ g/l}$$

APRIL 28, 1954 - RECUMPLEX

DECLASSIFIED

3. TANK J-17

225 37346 RD

$$EFF_{0.10} D_0 = 8.11R$$

$$EQ_{REFL} TH_0 = 0.600$$

$$B = 10.30224 \quad ; \quad l_R = 4.021m$$

$$H = 2270125 \quad ; \quad l_T = l_B = 6.10m$$

$$B_0 = \left(\frac{204048}{14037734} \right)^2 + 0.00017 = 0.02819 + 0.00017$$

$$B_0 = 0.02836 \quad ; \quad f = 0.91336$$

$$\frac{1}{f} = 1.09486 \quad ; \quad \frac{1}{f} - 1.02435 = 0.07051$$

$$CRIT. CONC_0 = \frac{7059406}{0.09486} = 80.1 \text{ g/l}$$

$$CRIT. CONC_{400} = \frac{7082490}{0.07051} = 111.0 \text{ g/l}$$

4. TANK G-42

$$EFF_{0.10} D_0 = 8.11R \quad 7.620$$

$$EQ_{REFL} TH_0 = 0.880$$

$$R = 9.67740 \quad ; \quad l_R = 4.500m$$

$$H = 152040m \quad ; \quad l_T = l_B = 6.10m$$

$$B_0 = \left(\frac{204048}{14017740} \right)^2 + 0.00036 = 0.02877 + 0.00036$$

$$B_0 = 0.02913 \quad ; \quad f = 0.97424$$

$$\frac{1}{f} = 1.028197 \quad ; \quad \frac{1}{f} - 1.02435 = 0.003847$$

$$CRIT. CONC_0 = \frac{7059406}{0.08197} = 86.1 \text{ g/l}$$

$$CRIT. CONC_{400} = \frac{7082490}{0.05762} = 122.9 \text{ g/l}$$

APRIL 28, 1954 - RECURREX

DECLASSIFIED

40

50 TANK G-50

QAR

$$EFF_{0.10 D_0} = 70.635$$

W 37346 RD

$$EQ_{0. REFL. TH_0} = 0.0920$$

$$R = 90.69645 \quad ; \quad l_R = 4.56 \text{ cm}$$

$$H = 1520.4 \text{ mm} \quad ; \quad l_T = l_B = 60.1 \text{ cm}$$

$$P_2 = \left(\frac{20.4048}{147.5645} \right)^2 + 0.00036 = 0.02845 + 0.00036$$

$$P_2 = 0.02881 \quad ; \quad f = 0.91972$$

$$\frac{1}{f} = 1.08729 \quad ; \quad \frac{1}{f} - 1.02435 = 0.06294$$

$$\text{CRIT. CONC.}_0 = \frac{70.59406}{0.08729} = \underline{87.0 \text{ g/l}}$$

$$\text{CRIT. CONC.}_{400} = \frac{70.82490}{0.06294} = \underline{124.2 \text{ g/l}}$$

60 TANK G-47

$$EFF_{0.10 D_0} = 70.818$$

$$EQ_{0. REFL. TH_0} = 0.0610$$

$$R = 90.92886 \quad ; \quad l_R = 4.040 \text{ cm}$$

$$H = 1710.1335 \quad ; \quad l_T = l_B = 60.1 \text{ cm}$$

$$P_2 = \left(\frac{20.4048}{130.96886} \right)^2 + 0.00029 = 0.02964 + 0.00029$$

$$P_2 = 0.02993 \quad ; \quad f = 0.92554$$

$$\frac{1}{f} = 1.06890 \quad ; \quad \frac{1}{f} - 1.02435 = 0.04455$$

$$\text{CRIT. CONC.}_0 = \frac{70.59406}{0.06890} = \underline{110.2 \text{ g/l}}$$

$$\text{CRIT. CONC.}_{400} = \frac{70.82490}{0.04455} = \underline{175.6 \text{ g/l}}$$

APRIL 28, 1954 - RECUMEX

DECLASSIFIED

5

70 TANK G-48

37346 RD

$$EFF_0 \cdot I_0 D_0 = 70.884$$

$$EQ_0 \cdot REFL_0 \cdot TH_0 = 00.610$$

$$R = 100.01268 \quad ; \quad l_R = 40.040 \text{ CM}$$

$$H = 1710.1375 \quad ; \quad l_T = l_B = 601 \text{ CM}$$

$$P_0 = \left(\frac{20.4048}{140.05268} \right)^2 + 0.000029 = 0.02929 + 0.000029$$

$$\bar{P} = 0.02958 \quad ; \quad \bar{f} = 0.93060$$

$$\frac{1}{\bar{f}} = 1.07458 \quad ; \quad \frac{1}{\bar{f}} - 1.02435 = 0.05023$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.007458} = \underline{10108 \text{ g/l}}$$

$$\text{CRIT. CONC}_{400} = \frac{70.82490}{0.005023} = \underline{15508 \text{ g/l}}$$

80 TANK J-A

$$EFF_0 \cdot I_0 D_0 = \cancel{70.1555} 70.270$$

$$EQ_0 \cdot REFL_0 \cdot TH_0 = 00.70 \text{ IN.}$$

$$90.23290$$

$$R = 90.46848 \quad ; \quad l_R = 4.20$$

$$H = 450.72 \quad ; \quad l_T = l_B = 601$$

$$P_0 = \left(\frac{20.4048}{130.66848} \right)^2 + \left(\frac{11}{570.92} \right)^2 = 0.03095 + \cancel{0.0000} 0.00029$$

$$P_0 = \cancel{0.03289} 0.03500 \quad ; \quad \bar{f} = \cancel{0.99148}$$

$$\frac{1}{\bar{f}} = \cancel{1.00859} \quad ; \quad \frac{1}{\bar{f}} - 1.02435 =$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.00859} = \underline{\infty \text{ g/l}}$$

$$\text{CRIT. CONC}_{400} = \frac{70.82490}{\infty} = \underline{\infty \text{ g/l}}$$

APRIL 28, 1954 - RECUPLEX

DECLASSIFIED 60

9. TANK G-46

#W 37346 RD

$$EFF_0 I_0 D_0 = 7.4515$$

$$EQ_0 REFL_0 TH_0 = 0.427$$

$$R = 9.46340$$

$$\frac{1}{2} L_R = 3.700$$

$$H = 76.825$$

$$\frac{1}{2} L_T = L_B = 6.1 \text{ cm}$$

$$B_0 = \left(\frac{20.4048}{13.1634} \right)^2 + 0.000124 = 0.03338 + 0.000124$$

$$B_0 = 0.03462$$

SAFE FOR ANY MWD/T Fu

10. TANK J-2

$$EFF_0 I_0 D_0 = 7.45075$$

$$EQ_0 REFL_0 TH_0 = 0.759$$

$$R = 9.46346$$

$$\frac{1}{2} L_R = 4.290$$

$$H = 152.40$$

$$\frac{1}{2} L_T = L_B = 6.1 \text{ cm}$$

$$B_0 = \left(\frac{20.4048}{13.075346} \right)^2 + 0.00036 = 0.03058 + 0.00036$$

$$B_0 = 0.03094$$

$$\frac{1}{2} F = 0.94981$$

$$\frac{1}{2} F = 1.05284$$

$$\frac{1}{2} F - 1.02435 = 0.02849$$

$$\text{CRIT. CONC}_0 = \frac{7.59406}{0.02849} = 148.7 \text{ g/l}$$

$$\text{CRIT. CONC}_{400} = \frac{7.82490}{0.02849} = 87.46 \text{ g/l}$$

APRIL 29, 1954 - RECUPLEX

DECLASSIFIED

70

110 TANK J-3

KW 37346 AD

$$EFF_0 \text{ to } D_0 = 70.5050$$

$$EQ. REFL. TH_0 = 0.759$$

$$R = 9.53135 \quad ; \quad d_R = 4.0790$$

$$H = 1570.10 \text{ mm} \quad ; \quad d_T = d_R = 60.1 \text{ cm}$$

$$P_0 = \left(\frac{20.4048}{13.87135} \right)^2 + 0.00026 = 0.03027 + 0.00005$$

$$P_0 = 0.03063 \quad ; \quad f = 0.94543$$

$$\frac{1}{f} = 1.05772 \quad ; \quad \frac{1}{f} - 1.02435 = 0.03337$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.05772} = 1210.6 \text{ g/l}$$

$$\text{CRIT. CONC}_{400} = \frac{70.82490}{0.03337} = 2124.5 \text{ g/l}$$

170 TANK J-7

0.185" DUE TO INT + (PIPS)

$$EFF_0 \text{ to } D_0 = 70.42488$$

$$EQ. REFL. TH_0 = 0.48 \text{ IN}$$

$$R = 9.44230 \quad ; \quad d_R = 2.74$$

$$H = 1290.7 \quad ; \quad d_T = d_R = 60.1 \text{ cm}$$

$$P_0 = \left(\frac{20.4048}{13.18230} \right)^2 + 0.00043 = 0.03328 + 0.000043$$

$$P_0 = 0.03371 \quad ; \quad f = 0.98894$$

$$\frac{1}{f} = 1.01118$$

$$\text{CRIT. CONC}_0 = \frac{70.59406}{0.01118} = 6299 \text{ g/l}$$

$$\text{CRIT. CONC}_{400} = \infty$$

Where safe

APRIL 29, 1954

229

DECLASSIFIED

8.

13. TANK J-1

$$EFF_0 \cdot I_0 D_0 = 7043925$$

$$EQ. REFL. TH_0 = 00520$$

HW 37346 R1

$$R = 9044783$$

$$l_r = 3086$$

$$H = 17101325$$

$$l_r = l_B = 601 \text{ cm}$$

$$B = \left(\frac{704048}{17070783} \right)^2 + 0.000029 = 0.03266 + 0.000029$$

$$B = 0.003295$$

$$f = 0.97820$$

$$\frac{1}{f} = 1003229$$

$$\text{CRIT. CONC}_0 = \frac{7059406}{0003229} = 340.79/l$$

$$\text{CRIT. CONC}_{400} = \infty$$

14. TANK J-6

$$EFF_0 \cdot I_0 D_0 = 7008925$$

$$EQ. REFL. TH_0 =$$

$$R = 9000323$$

$$l_r =$$

$$H = 460355$$

$$l_r = l_B = 601 \text{ cm}$$

SAFE FOR OMWD FOR REFL. < 008 TH₀

" " 400 MW " " < 101 TH₀

FROM COMPARISON TO J-4, SAFE FOR ANY MW

APRIL 29, 1954 - RECUPLEX

DECLASSIFIED

9

15. TANK J-25

234

$$EFF_0 \text{ to } D_0 = 7.5320$$

W 373460

$$EQ_0 REFL_0 TH_0 =$$

$$R =$$

$$\frac{1}{2} d_R =$$

$$H = 42.68$$

$$\frac{1}{2} d_T = d_B = 6.1 \text{ cm}$$

$$P_0 = \left(20.4048 \right)^2 + 0.00542$$

a) ~~FOR~~ FOR 400 MWDT Pu

$$L_R = \frac{20.4048}{10007392} - 9.56564 = 4.96399$$

6016551

$$EQ_0 REFL_0 TH_0 = 1.03 \text{ IN}_0$$

b) ~~FOR~~ FOR 0 MWDT Pu

$$L_R = \frac{20.4048}{10007392} - 9.56564 = 4.53793$$

70017051

$$EQ_0 REFL_0 TH_0 = 0.90 \text{ IN}_0$$

SAFE FOR ANY MWDT Pu

APRIL 29, 1954

2.12

10.

1. 5-46

$$\Delta L = 1.0568 \left(\frac{R}{C_0} \right) = 1.0568 \left(\frac{30.5}{19675} \right) = 0.018247$$

DECLASSIFIED

$$EQ. REFL. TH_0 = 0.100$$

$$TOT. EQ. REFL. TH_0 = 0.427$$

W 37346 RY

$$L_R = 3.700$$

2. TANK J-2

$$\Delta L = 1.0568 \left(\frac{30.5}{110875} \right) = 0.021148$$

$$EQ. REFL. TH_0 = 0.180$$

$$TOT. EQ. REFL. TH = 0.759$$

$$L_R = 4.390$$

3. TANK J-7

$$\Delta L = 1.0568 \left(\frac{30.675}{12} \right) = 0.31924$$

30.675
12

$$EQ. REFL. TH_0 = 0.180$$

$$TOT. EQ. REFL. TH_0 = 0.4490$$

$$L_R = 3.74$$

DECLASSIFIED

INTERACTION BETWEEN PRODUCT-BEARING TANKS

238

3734610

TANK NO. TANK HAVING EFFECT ON IT SEPARATION WALL TH. (IN. 120) EFF. % INCREASE IN DIAMETER OF TANK (EFFECTING DIAMETER)

✓ H-9	H-10	28 IN.	3.40	2.125	
0.125 WALL	J-17	38 IN.	2.20	1.375	
7.0 act ID	H-11 0.8	26 IN.	3.75	2.350	8.174
				10.000	
				4.500	
			9.35	(7.654)	

✓ H-10	H-9	28 IN.	3.40	2.125	
0.125 WALL	H-11 0.8	38 IN.	2.20	1.375	0.675
7.0 act ID	J-17	26 IN.	3.75	2.350	
	J-2	60 IN.	1.00	0.650	8.451
	J-25	31 IN.	2.95	1.850	
			13.30	(7.971)	7.600

✓ J-17	J-25	41 IN.	1.90	1.225	
0.125 WALL	H-9	38 IN.	2.15	1.375	
7.0 act ID	H-10	26 IN.	3.75	2.350	
	H-11 0.8	28 IN.	3.40	2.125	0.95
	J-2	54 IN.	1.20	0.800	8.577
	J-3	54 IN.	1.20	0.800	
	J-4	48 IN.	1.50	0.930	8.450
			15.10	(12.057)	

✓ J-1	NVV	J-6	40 IN.	2.00	1.275	
0.125 WALL		J-25	38 IN.			7.490
7.0 act ID						

✓ J-2	VVV	J-3	26 IN.	3.75	2.350	
0.125 WALL		J-25	49 IN.	1.40	0.925	
7.0 act ID		J-17	54 IN.	1.20	0.800	7.634
		J-20	60 IN.	1.00	0.650	
					4.725	
				7.35	(7.514)	

✓ J-3	VVV	J-2	26 IN.	3.75	2.350	
0.125 WALL		J-25	33 IN.	2.50	1.700	
7.0 act ID		J-17	54 IN.	1.20	0.800	7.726
		H-10	60 IN.	1.00	0.650	
					5.50	
				8.65	(7.444)	

DECLASSIFIED

2

INTERACTION BETWEEN PROXIMATE BEARING SURFACES

37346 RD

| TANK NO. | TANK HAVING
EFFECT ON IT | Q TO Q
SEPARATION | EFF % INCREASE
IN DIAMETER
OF TANK | NEW
(EFFECTIVE
DIAMETER) |
|------------|-----------------------------|----------------------|--|--------------------------------|
| ✓ J-4 | J-17 | 43 IN. | 1.50 | 0.950 |
| 0.125 WALL | J-9 | 39 IN. | 2.10 | 1.175 |
| 700 alt ID | H-10 | 55 IN. | 1.10 | 0.700 |
| | H-11 0.08 | 55 IN. | 1.15 | 0.375 |
| | | | 3.200 | |
| | | | 5.85 | (7.410) |

✓ J-6	J-1	40 IN.	2.00	1.275
0.125 WALL				7.140
700 alt ID			3.00	(7.140)

✓ J-7	J-1			
0.125 WALL	J-5	38 IN.	2.20	1.375
7 1/4 alt ID	J-9	42 IN.	1.85	1.175
			4.05	(7.281)

✓ J-25	J-2	49 IN.	1.40	0.925
0.125 WALL	J-3	33 IN.	2.70	1.200
700 alt ID	H-10	31 IN.	2.90	1.850
	H-11	60 IN.	1.50	0.675
	J-17	41 IN.	1.90	1.225
	J-4	41 IN.	1.90	1.225
			7.060	
			11.8%	(7.826)

1 - 1" 2 J-25
2 - 1/2" (J-4)

m. 064 50.5

7.05

DECLASSIFIED

INTERACTION BETWEEN ROCKET-BEARING TANKS

HW 37346 RD

TANK NO	TANK HAVING EFFECT ON IT	Q TO Q SEPARATION	EFF % INCREASE IN DIAMETER OF TANK	NEW DIAMETER

✓ G-42	✓ G-46	27 IN	3.55%	2.20
0.125 WALL	G-50	32 IN	2.80	1.0775
7.00 alt ID	G-47	53 IN	1.25	0.0775 7.861
	G-48	44 IN	1.70	1.0100
				5.850
				9.70 (7.651)

✓ G-50	G-42	32 IN	2.80	1.0775
7 1/4 ID	G-46	58 IN	1.10	0.700
0.125 WALL	G-47	53 IN	1.25	0.0775 7.817
7.25 alt ID	G-48	44 IN	1.70	1.0100
				4.0350
				6.45 (7.747)

✓ G-46	G-42	27 IN	3.55	2.200
0.125 WALL	G-47	53 IN	1.25	0.0775 7.647
	G-48	45 IN	1.65	1.0075
	G-50	58 IN	1.10	0.700
				4.0750
				7.55 (7.528)

✓ G-47	✓ G-42	53 IN	1.25	0.0775
0.125 WALL	G-46	53 IN	1.25	0.0775
7.0 alt ID	G-48	30 IN	2.05	1.925 7.996
	G-50	53 IN	1.25	0.0775
				4.0250
				6.8 (7.476)

✓ G-48	✓ G-42	44 IN	1.70	1.0100
0.125 WALL	G-46	45 IN	1.65	1.0075
7.00 alt ID	G-47	30 IN	2.05	1.925 8.087
	G-50	44 IN	1.70	1.0100
				5.0200
				8.10 (7.567)

APRIL 28, 1954 - RECUPLED

DECLASSIFIED 2.

PN 37346 R0

TANK NO.

TOTAL EFFECTIVE I.D.

✓H-9

70835

NEW INTERACTION
FIGURED IN

✓H-10

80052

✓J-17

80112

J-1

J-2

70451

J-3

70505

J-4

J-6

J-7

J-25

✓G-42

70620

✓G-50

70625

G-46

✓G-47

70818

✓G-48

70884

SECRET

35346 KD

REFLECTOR TO ACCOUNT FOR PERSONS OBSERVING

RECUPLEX INSTALLATION IN OPERATION (STANDING)

JUST OUTSIDE OF LUCITE WOOD PANELS)

REFLECTOR THICKNESS

Q. 610 IN.

D. 610 IN.

0.680 M.
3

0.560 W.

0.600 IN.

0.880 IN

0.420 W.

$$\Delta l = 1.0568 \left(\frac{R}{L_0} \right)$$

#w 37846 R0
52

(1) 6-47 $\Delta l = \frac{1.0568(3.5)}{12} = 0.30823 \text{ cm}$
12.33 DIV

(2) 6-48 — same as 6-47 = 0.30823 cm
12.33 DIV

12.5 DIV (3) H-9 $\Delta l = \frac{1.0568(3.5)}{14} = 0.2642 \text{ cm}$
10.57 DIV

(4) H-10 $\Delta l = \frac{1.0568(3.5)}{14} = 0.2642 \text{ cm}$
10.57 DIV

(5) J-17 $\Delta l =$ = 0.2642 cm
(same as H-10) 10.57 DIV

(6) 6-42 $\Delta l = \frac{3.5(1.0568)}{12} = 0.30823 \text{ cm}$
12.33 DIV

(7) 6-50 $\Delta l = \frac{1.0568(3.625)}{12} = 0.31924 \text{ cm}$
12.77 DIV

0.716

0.691

[REDACTED]

RECHECKED 4-28-58

DECLASSIFIED 1

CALCULATION OF MINIMUM CRITICAL CONCENTRATION
FOR RECUMEX TANKS, TAKING INTO ACCOUNT
INTERACTION BETWEEN PRODUCT-BEARING CYLINDERS.

1. TANK H-9 (480 MWD/T PU)

FOR 480 MWD/T PU

$$1 + \frac{w}{1-w} (6.801) = 1.0295$$

$$1-w = .9705$$

$$w = 0.0295$$

$$\text{EFFECTIVE I.D.} = 8.174 \text{ IN.}$$

$$S4.375 \text{ IN CONG.}$$

$$\text{EQ. WALL TH.} = 0.670 \text{ IN.}$$

$$R = 10.38098 \text{ CM} \quad l_R = 4.0625$$

$$C = 138.1125 \text{ CM} \quad l_T + l_B = 6.1 \text{ CM}$$

$$P = \left(\frac{2.1048}{14.44348} \right)^2 + \left(\frac{\pi}{139.3125} \right) = 0.0272222 + 0.0004368$$

$$= 0.0281590$$

$$f = 14.127 (0.0281590) + 0.51372 = 0.91054$$

$$\frac{1}{f} = 1.09825$$

$$C = \frac{320}{28.97 (0.9205) (0.02390)} = 105.88 \text{ grams/liter}$$

7.82489

2. TANK H-10

$$\text{EFF. I.D.} = 8.451 \quad H = 107.6325 \text{ CM}$$

$$R = 12.43277 \text{ CM} \quad l_R = 3.928 \text{ CM}$$

$$P = \left(\frac{2.1048}{14.65777} \right)^2 + 0.0006875 = 0.0249154 + () = 0.02560$$

$$f = 0.90262 \quad ; \quad \frac{1}{f} = 1.10789$$

$$C = \frac{7.82489}{0.08354} = 93.67 \text{ grams/liter}$$

DECLASSIFIED

2.

3. TANK J-17

HW 37346RN

$$EFF. I.D. = 8.577 \text{ in} ; H = 227.0125 \text{ cm}$$

$$R = 10.89279 \text{ cm} ; L_D = 4.000 \text{ cm}$$

$$TB = \left(\frac{2.1048}{14.89279} \right)^2 + 0.0001724 = \frac{0.0260726}{14.89279} + 0.0001724 = 0.001751 + 0.0001724 = 0.0019234$$

$$f = 0.88341 ; \bar{f} = 1.18198$$

$$C = \frac{7.82489}{0.10763} = 72.70 \text{ grams/liter}$$

4. TANK G-42

$$EFF. I.D. = 7.861 \text{ in} ; H = 152.1 \text{ cm}$$

$$R = 9.98347 \text{ cm} ; L_D = 4.4875 \text{ cm}$$

$$TB = \left(\frac{2.1048}{14.17097} \right)^2 + 0.0003644 = 0.0276158 + 0.0003644 = 0.0279802$$

$$f = 0.90799 ; \bar{f} = 1.10133$$

$$C = \frac{7.82489}{0.07698} = 101.65 \text{ grams/liter}$$

5. TANK G-50

$$EFF. I.D. = 8.067 \text{ in} ; H = 152.10 \text{ cm}$$

$$RAD. = 10.74509 \text{ cm} ; L_D = 4.5375 \text{ cm}$$

$$TB = \left(\frac{2.1048}{14.78259} \right)^2 + 0.0003644 = 0.0264648 + 0.0003644 = 0.0268292$$

$$f = 0.89316 ; \bar{f} = 1.11962$$

$$C = \frac{7.82489}{0.09527} = 82.13 \text{ grams/liter}$$

6. TANK G-47

HW 37346 RD
5.5

$$EFF. I.D. = 7.996 \text{ IN.} ; H = 171.1325 \text{ CM}$$

$$RAD. = 10.15492 \text{ CM} ; L_R = 4.0125 \text{ CM}$$

$$R = \left(\frac{2.4048}{14.16742} \right)^2 + 0.0002938 = 0.0288117 + 0.0002938 = 0.0291055$$

$$f = 0.92396 ; \frac{1}{f} = 1.08230$$

$$C = \frac{7.82489}{0.05795} = 135.03 \text{ grams/liter}$$

7. TANK G-48

$$EFF. I.D. = 8.087 \text{ IN.} ; H = 171.1325 \text{ CM}$$

$$RAD. = 10.27049 ; L_R = 4.0125 \text{ CM}$$

$$R = \left(\frac{2.4048}{14.28799} \right)^2 + 0.0002938 = 0.0287485 + 0.0002938 = 0.0286423$$

$$f = 0.91732 ; \frac{1}{f} = 1.09013$$

$$C = \frac{7.82489}{0.06578} = 118.96 \text{ grams/liter}$$

8. TANK J-4

$$EFF. I.D. = \frac{7.4555}{1.2} \text{ IN.} ; H = 45.72 \text{ CM}$$

$$RAD. = 9.54532 \text{ CM} ; L_R = 4.1625$$

$$R = \left(\frac{2.4048}{13.70782} \right)^2 + \left(\frac{\pi}{57.92} \right)^2 = 0.0307757 + 0.0029420 = 0.0337177$$

$$f = 0.98908 ; \frac{1}{f} = 1.01105$$

SAFE FOR ANY 400 MWD/T Pu SOLN. CONC.

DECLASSIFIED

4

9. TANK G-46

242

HW 37346 KD

$$\text{EFF. I.D.} = 7.647 \text{ IN} ; H = 76.835$$

$$\text{RAD.} = 9.71169 \text{ CM} ; r_r = 3.6500 \text{ CM}$$

$$B = \left(\frac{2.4048}{13.36169} \right)^2 + \left(\frac{\pi}{89.0380} \right)^2 = 0.0323928 + 0.0012447$$

$$B = 0.0336375$$

$$f = 0.98795 ; \frac{1}{f} = 1.01220$$

SAFE FOR ANY SOLN CONC. OF 400 MWD/TP Pu

10. TANK J-2

$$\text{EFF. I.D.} = 7.634 \text{ IN.} ; H = 152.40 \text{ CM}$$

$$\text{RAD.} = 9.69518 \text{ CM} ; r_r = 4.2750$$

$$B = \left(\frac{2.4048}{12.97018} \right)^2 + \left(\frac{\pi}{152.40} \right)^2 = 0.0296322 + 0.003644$$

$$B = 0.0299966$$

$$f = 0.93652 ; \frac{1}{f} = 1.06777$$

$$\underline{C} = \frac{7.82489}{0.04342} = \underline{180.21 \text{ grams/liter}}$$

DECLASSIFIED

5

11. TANK J-3

243

3734620

$$EFF. I.D. = 7.726 \text{ IN.} ; H = 152.40 \text{ CM}$$

$$RAD. = 9.81202 \text{ CM} ; R_L = 4.2750$$

$$B = \left(\frac{2.4048}{14.08702} \right)^2 + \left(\frac{\pi}{154.60} \right)^2 = 0.0291419 + 0.0003644$$

$$= 0.0295063$$

$$F = 0.92961 ; \frac{1}{F} = 1.07572$$

$$C = \frac{7.82489}{0.05137} = \underline{\underline{152.32 \text{ grams/liter}}}$$

12. TANK J-7

$$EFF. I.D. = 7.544 \text{ IN.} ; H = 139.7 \text{ CM}$$

$$RAD. = 9.58088 \text{ CM} ; R_L = 3.650 \text{ CM}$$

$$B = \left(\frac{2.4048}{13.23088} \right)^2 + \left(\frac{\pi}{151.90} \right)^2 = 0.0330367 + 0.0004277$$

$$= 0.03346$$

$$F = 0.98541 ; \frac{1}{F} = 1.01481$$

SAFE FOR ANY CONC OF 400 MWDT PL 5000

TOTAL REFLECTOR THICKNESS
(USING $\bar{\epsilon}$ REFLECTOR)
217

DECLASSIFIED

W 37346 KD

$$\Delta l = 1.0568 \left(\frac{R}{L_0} \right)$$

1. TANK G-46

$$\Delta l = 1.0568 \left(\frac{3.5}{19.675} \right) = 0.18847 \text{ cm}$$

$$L_R = 3.6500 \text{ cm}$$

2. TANKS J-2 & J-3

0.579

$$\Delta l = 1.0568 \left(\frac{3.5}{11.875} \right) = 0.31147 \text{ cm}$$

$$L_R = 4.2750 \text{ cm}$$

3. TANK J-7

$$\Delta l = 1.0568 \left(\frac{3.625}{11.675} \right) = 0.32952$$

(13 DIO)

$$L_R = 3.650 \text{ cm}$$

DECLASSIFIED

7.

13.

240
TANK J-1

HW 37346 KD

wall th = 0.520 in

$$EFF. I.D. = 7.490 \text{ IN.} ; H = 171.1325 \text{ CM.}$$

$$RAD. = 9.5122 ; l_R = 2.8625 \text{ CM}$$

$$R_b = \left(\frac{2.4048}{13.3748} \right)^2 + \left(\frac{\pi}{183.3325} \right)^2 = 0.0323280 + 0.0002938$$

$$= 0.0326218$$

$$f = 0.97354 ; \frac{1}{f} = 1.02718$$

$$C = \frac{7.82489}{0.00283} = 2764.98 \text{ g/liter}$$

(117.48 kg)

DUE TO THE POSITION (UNACCESSABILITY)
OF J-1 & THE EXTREMELY HIGH CONC.,
IT APPEARS SAFE FOR 400 MWD/T PU.

4249 liters

14. TANK J-6

$$EFF. I.D. = 7.140 ; H = 46.355$$

$$RAD. = 9.0678 ; l_R \text{ (TO BE SAFE)} =$$

$$0.002878 \quad f = 0.97623$$

$$R_b = \frac{0.97623 - 0.51272}{14.127} = 0.032810$$

$$0.032810 = \left(\frac{2.4048}{9.0678 + l_R} \right)^2 + \left(\frac{\pi}{58.555} \right)^2$$

$$l_R = \left(\frac{2.4048}{\sqrt{0.029932}} \right) - \frac{9.0678}{2.4048} = 9.0678 = 4.8320$$

201

CORR. TO BEFL. TH. OF 1.11 IN. IT IS SEEN BY

(J-4 FCIR > COMPARISON WITH OTHER TANKS THAT EFF. RE. EXCHANGE) IS < 1.11 IN & ∴ J-6 IS SAFE FOR 400 MWD/T PU.

216
15. TANK J-25

DECLASSIFIED
KW 37346 RO
F 2

$$\text{EFF. I.D.} = 7.826 \text{ IN.} ; H = 30.48 \text{ CM}$$

$$RAD = 9.93902 \text{ CM} ; R_L =$$

$$P_{\text{REFL}} (400 \text{ MW/D/T Pu}) = 0.032810$$

ASSUMING ENDS OF TANK COMPLETELY TAMPED ($L = 6.1 \text{ CM}$)

$$\frac{0.032810}{0.05418} = \left(\frac{2.4048}{9.93902 + R_L} \right)^2 + \left(\frac{\pi}{42.68} \right)^2$$

$$R_L = \frac{2.4048}{\sqrt{1.024392} - 9.93902} = 4.59061$$

(0.16551)

$$\text{EQ. REFL THICKNESS} = 0.95 \text{ IN}$$

THIS IS RADIAL REFLECTOR THICKNESS,
CONSIDERING THE CYLINDER ENDS TO BE
COMPLETELY TAMPED.

SAFE FOR ANY CONC OF 400 MW/D/T Pu
SOLN. (SAFE WHEN 6-1" PROD LINES MIDDEN)

240

HW 3734620

REFLECTORS NEAR TANK J-2

DECLASSIFIED

(7.00" I.D., 12" HIGH)

REFLECTOR

L=

EQ. REFL TH

TANK WALLS

L=

0.175 IN.

 $\frac{1}{2}$ REFLECTOR

12"

(AL=0.3083)

12.3 DIV.

(FACE OF WOOD)

SUPPORTING

FRAMEWORK

L 0.0348

$$\begin{array}{r} 24 \\ + 2 \\ \hline 26 \end{array}$$

L 0.1598

L 0.3 IN.

REFL. TH.

6, 1" PIPES

4.7124 IN²

6.6

42.194

9.37567

126.36

7.56

13.625

0.19121

3.69121

$$\left(\frac{11}{10.424694} \right)$$

4.10494

DECLASSIFIED

fw 37346 RD

CE
248
$$Al = 10768 \left(\frac{2.5}{12} \right) = 0.2083 \text{ cm}$$

- ✓ 1-2" PIPE at 12 IN. < 0.0155
- ✓ 1-2" PIPE at 23.19 IN. < 0.005
- ✓ 1-3" I at 21.375 IN. < 0.0143
- X SCALLES ? - INCLUDED IN $\frac{1}{2}$ REFLECTOR
- X NO FLANGES ON TANK SIDES

537.89

APRIL 30, 1954

209

DECLASSIFIED

MIN. CRIT. CONC.

2w 373 ± 680

TANK NO.

0 MWD/T

400 MWD/T

G-16

SAFE

SAFE

G-28

SAFE

SAFE

G-51

137

252

G-54

SAFE

SAFE

J-5

SAFE

SAFE

H-11

99

149

J-31

SAFE

SAFE

J-70

SAFE

SAFE

H-1,2,3-TDS

73 100

98 150

H-1,2,3-BDS

~~103~~ 70

~~160~~ 95

RECHECKED
4-28-54

213 DECLASSIFIED

MINIMUM CRITICAL MASS OF LARGE

DIAMETER RECUPLEX TANKS

HW 3734649

TANK NUMBER

0 MWD/7

MIN. CRIT. MASS

FOR 400 MWD/7 Pu

D-1	1300	1350 GRAMS	1450
D-2	1300	1350 GRAMS	1450
D-5	1300	1350 GRAMS	1400
D-6	1500	1700 GRAMS	1700
D-7	1500	1700 GRAMS	1700
D-8	1450	1400 GRAMS	1600
D-9	1450	1400 GRAMS	1600
D-10	675	775 GRAMS	775
D-11	675	775 GRAMS	775
D-27	750	850 GRAMS	850
D-28	1300	1450 GRAMS	1450
G-9	1600	1650 GRAMS	1750
G-10	1800	1675 GRAMS	1950
G-15	1800	1700 GRAMS	1950
G-58	1450
1450	1450 GRAMS	1600

OK CHECK

accounting for
curved bottoms

DECLASSIFIED

1.

TANKS D-1 & D-2

$LD_1 = 27.875$ IN. ; NEARLY COMPLETELY TAMPED ON SIDES

$$B = \left(\frac{2.4048}{41.50125} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.003357 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

I. FOR $R' = 25$ CM, $B = 0.01579$

$CSA = 3.9372$

$$H_c = \frac{\pi}{\sqrt{0.01243}} - 12.2 = 15.978$$

0.11149

$V_L = 62.90$ LITERS

$M_C = 1470$ GRAMS

II. FOR $R' = 26$ CM, $B = 0.01460$

$$H_c = \frac{\pi}{\sqrt{0.01124}} - 12.2 = 17.43214$$

0.10602

$V_L = 68.634$ LITERS

$M_C = 1465$ GRAMS

III. FOR $R' = 27$ CM, $B = 0.01354$

$$H_c = \frac{\pi}{\sqrt{0.01018}} - 12.2 = 18.93577$$

0.10090

$V_L = 74.554$ LITERS

$M_C = 1472$ GRAMS

251

DECLASSIFIED

2.

LW 37346X0

CRITICAL HEIGHT = 17.43 CM.

 $V_c = 68.634 \text{ LITERS}$

$$r_c = \sqrt[3]{\frac{1.5 \times 68.634 \times 10^3}{\pi}} = \sqrt[3]{32.77024 \times 10^3} = 32.00073$$

$$V = \frac{4}{3} \pi r_c^3 = 38.10073$$

$$R = \sqrt[3]{\frac{1.5V}{\pi R_c}} = \left(\frac{4.494}{38.10073} \right)^{\frac{1}{2}} = 0.01891$$

$$f = 0.40923 ; \frac{1}{F} = 1.40998$$

$$\frac{1}{F} - 1.02435 = 0.38563$$

MIN. CRIT. CONC. = 20.29 g/l

MIN. CRIT. MASS = 1392 GRAMS

258

TABLE D-5

DECLASSIFIED

1.

W 37346 R9
F 7

I.D. = 27.275 IN; COMPLETELY TAMPED

/ RAD = 12.6875 IN = 34.76625 CM.

$$B = \left(\frac{2.1048}{40.86625} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00346 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

I. FOR $R' = 25$ CM; $B = 0.01579$

$$H_c = \left(\frac{\pi}{\sqrt{\frac{0.01233}{0.11102}}} \right) - 12.2 = 16.0925$$

$$\frac{6.54 \times 10^{-3}}{3.79723}$$

 $V_c = 61.11$ LITERS $M_c = 1428$ GRAMSII. FOR $R' = 26$ CM; $B = 0.01460$

$$H_c = \frac{\pi}{\sqrt{\frac{0.01114}{0.10555}}} - 12.2 = 17.5641$$

 $V_c = 66.69$ LITERS $M_c = 1424$ GRAMSIII. FOR $R' = 27$ CM; $B = 0.01354$

$$H_c = \frac{\pi}{\sqrt{\frac{0.01008}{0.10040}}} - 12.2 = 19.0908$$

 $V_c = 72.49$ LITERS $M_c = 1431$ GRAMS

DECLASSIFIED

2.

$$H_0 = 17.5641 \text{ CM}$$

253

VW 3734610

$$V_L = 66.69 \text{ LITERS}$$

$$r' = \sqrt{\frac{1.5 \times 66.69 \times 10^3}{\pi}} + 6.1 = \sqrt{31842.05} + 6.1$$

$$r' = 37.79570 \text{ CM}$$

$$P_0 = \left(\frac{4.494}{37.79570} \right)^2 = 0.01414$$

$$f = 0.91248 ; \frac{1}{f} = 1.40355$$

$$\frac{1}{f} - 1.02435 = 0.37920$$

$$\text{MIN. CRIT. CONC} = 20.64 \text{ G/L}$$

$$\text{MIN. CRIT. MASS.} = 1376 \text{ GRAMS}$$

TANKS D-6259-7 40 373468

DECLASSIFIED

I. D = 20.625 IN ; COMPLETELY TAMPED

RAD = 15.3125 IN = 28.89375 CM

$$\overline{R} = \left(\frac{2.4048}{44.99375} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00286 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

I. FOR $R' = 26$ CM ; $\overline{R} = 0.01460$

$$H_c = \frac{\pi}{\sqrt{0.01174}} - 12.2 = 16.795$$

$$\sqrt{0.01174}$$

$$0.10835$$

$$1.54 \times 10^{-3}$$

$$4.75237$$

$$V_c = 79.82 \text{ LITERS}$$

$$M_c = 1704 \text{ GRAMS}$$

II. FOR $R' = 27$ CM ; $\overline{R} = 0.01354$

$$H_c = \frac{\pi}{\sqrt{0.01068}} - 12.2 = 18.201$$

$$\sqrt{0.01068}$$

$$0.10334$$

$$V_c = 86.496$$

$$M_c = 1708$$

III. FOR $R' = 28$ CM ; $\overline{R} = 0.01579$

$$H_c = \frac{\pi}{\sqrt{0.01292}} - 12.2 = 15.428$$

$$\sqrt{0.01292}$$

$$0.11371$$

$$V_c = 73.32$$

$$M_c = 1712$$

TANKS D-8 & D-9

HW 37346 RD

I.D. = 29.50 IN. ; COMPLETELY TAMPED
 RAD = 14.75 IN = 37.465 CM.

$$P_2 = \left(\frac{2.4048}{42.565} \right)^2 + \left(\frac{\pi}{H_0 + 12.2} \right)^2 = 0.00305 + \left(\frac{\pi}{H_0 + 12.2} \right)^2$$

I. R = 25 CM ; $P_2 = 0.01579$

$$H_0 = \frac{\pi}{\sqrt{0.01274}} - 12.2 = 15.634$$

$V_0 = 68.94$ LITERS

$M_0 = 1611$ GRAMS

CSH $\times 10^{-3}$
 4.40963

II. R = 26 CM ; $P_2 = 0.01460$

$$H_0 = \frac{\pi}{\sqrt{0.01155}} - 12.2 = 17.032$$

$V_0 = 75.11$ LITERS

$M_0 = 1603$ GRAMS

III. R = 27 CM ; $P_2 = 0.01354$

$$H_0 = \frac{\pi}{\sqrt{0.01049}} - 12.2 = 18.474$$

$V_0 = 81.46$ LITERS

$M_0 = 1609$ GRAMS

$$V_c = 75.11 \text{ LITERS}$$

$$M_c = 160.3 \text{ GRAMS}$$

HW 37346 RD

$$R' = \sqrt[3]{\frac{1.5 \times 75.11 \times 10^3}{\pi}} + 6.1 = \sqrt[3]{35862.29} + 6.1$$

$$R' = 32.94711 + 6.1 = 39.04711$$

$$B = \left(\frac{4.494}{39.04711} \right)^2 = 0.01322$$

$$f = 0.69948 ; \frac{1}{f} = 1.42963$$

$$\frac{1}{f} - 1.02435 = 0.40528$$

$$\text{CRIT. CONC.} = 19.2074 \text{ g/L}$$

$$\text{MIN. CRIT. MASS} = 1450 \text{ GRAMS}$$

251

TANKS D-10 & D-11

$I.D. = 15.75 \text{ IN.} ; l_e = 4.8 \text{ CM}$

$RAD = 7.875 \text{ IN.} = 20.0025 \text{ CM.}$

$B = \left(\frac{2.4048}{24.1025} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00979 + \left(\frac{\pi}{H_c + 12.2} \right)^2$

I. FOR $R' = 25 \text{ CM} ; B = 0.01579$

$H_c = \frac{\pi}{\sqrt{0.00600}} - 12.2 = 28.258$
 0.04746

0.54×10^{-3}
 1.75695

$V_c = 35.64 \text{ LITERS}$

$M_c = 832 \text{ GRAMS}$

II. FOR $R' = 26 \text{ CM} ; B = 0.01460$

$H_c = \frac{\pi}{\sqrt{0.00481}} - 12.2 = 33.101$
 0.06935

$V_c = 41.61 \text{ LITERS}$

$M_c = 888 \text{ GRAMS}$

III. FOR $R' = 28 \text{ CM} ; B = 0.01866$

$H_c = \frac{\pi}{\sqrt{0.00887}} - 12.2 = 21.15740$
 0.09418

$V_c = 26.59 \text{ LITERS}$

$M_c = 789 \text{ GRAMS}$

DECLASSIFIED

258

HW 37346 RD

IV. $R' = 21 \text{ CM} ; B = 0.02238$

$$H_c = \frac{\pi}{\sqrt{0.01259}} - 12.2 = 15.80$$

0.11221

$V_c = 19.86 \text{ LITERS}$

$M_c = 853 \text{ GRAMS}$

V. $R' = 22 \text{ CM} ; B = 0.02039$

$$H_c = \frac{\pi}{\sqrt{0.01060}} - 12.2 = 18.31$$

0.10296

$V_c = 22.02$

$M_c = 802.$

VI. $R' = 24 \text{ CM} ; B = 0.01713$

$$H_c = \frac{\pi}{\sqrt{0.00734}} - 12.2 = 24.471$$

0.08567

$V_c = 20.76$

$M_c = 800$

DECLASSIFIED

7.

HW 37346 RD

$$V_c = 26.59 \text{ LITERS}$$

$$M_c = 789 \text{ GRAMS}$$

$$R' = \sqrt[3]{\frac{1.5 \times 26.59 \times 10^3}{\pi}} + 4.3 = \sqrt[3]{12695.76} + 4.3$$

$$R' = 27.62847$$

$$B = \left(\frac{4.494}{27.62847} \right)^2 = 0.02646$$

$$f = 0.88652; \bar{f} = 1.12801; \bar{f} - 1.02435 = 0.10366$$

$$\text{CRIT. CONC.} = 75.486 \text{ GRAMS/LITER}$$

$$M_c = 2007 \text{ GRAMS}$$

DECLASSIFIED

I. TANK D-10 260

WOOD FENCES

#W 3734620

(1) 13" $\perp$ TO FACE

(2) 41" $\perp$ TO FACE

(3) 27 5/16" $\perp$ TO FACE

TANK D-23 (O.D. = 22 IN.) ; 34" $\perp$ TO $\perp$

II. TANK D-11

WOOD FENCES

(1) 13" $\perp$ TO FACE

(2) 41" $\perp$ TO FACE

TANK D-26 (O.D. = 20 IN.) 36" $\perp$ TO $\perp$

I. D-10

0.10467

$$A. A. A. = 1.0568 \left(\frac{7.875}{13} \right) = 0.64017$$

$$2. A. A. = 1.0568 \left(\frac{7.875}{41} \right) = 0.20298$$

$$3. A. A. = 1.0568 \left(\frac{7.875}{27.3125} \right) = 0.30470$$

B.

$l = 13.0$ IN FOR WALL

$$\sin \theta = \frac{11}{34} = 0.32353$$

$$\tan \theta = 0.34192$$

$$a = 34 \tan \theta = 7.864$$

$$A. A. = 1.0568 \left(\frac{7.875}{34} \right) \left(\frac{1}{(0.34)^2 + 1} \right)^2 = 1.0568 (0.23239) (0.32353)$$

$$A. A. = 0.11706$$

I. (CONT'D)

261

 $\frac{62}{27} \times 34$
 68
 9
 DECLASSIFIED

$$\underline{l_{TOT} = 4.26 \text{ CM}}$$

HW 37346 RD

$$\text{II. A. 1. } \Delta l = 1.0568 \left(\frac{7.875}{13} \right) = 0.64017$$

$$2. \Delta l = 1.0568 \left(\frac{7.875}{41} \right) = 0.20298$$

B. TANK D-EG

$$\sin \theta = \frac{10}{26} = 0.38462$$

$$\tan \theta = 0.41666$$

$$L = 16 \tan \theta = 6.667$$

$$\Delta l = 1.0568 \left(\frac{7.875}{16} \right) \left(\frac{1}{\left(\frac{16}{6.667} \right)^2 + 1} \right)^{\frac{1}{2}}$$

$$\Delta l = 1.0568 (0.49219) (0.38462)$$

$$\Delta l = 0.20006 \text{ CM}$$

$$\underline{l_{TOT} = 4.04321 \text{ CM}}$$

ASSUME $L_R = 4.3 \text{ CM}$ FOR EACH TANK

DECLASSIFIED

HW 37346 RD

263

TANK D-27

$$I.D. = 17.75 \text{ in.}; L_0 = 4.254 \text{ CM}$$

$$R_{AD} = 8.875 \text{ in.} = 22.5425 \text{ CM}$$

$$B = \left(\frac{2.4048}{26.7965} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00805 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

$$I. R' = 22 \text{ CM}; B = 0.02039$$

$$H_c = \frac{\pi}{\sqrt{0.01234}} - 12.2 = 16.080$$

0.11109

$$\frac{1.59645}{10^{-3}}$$

$$V_c = 25.671 \text{ LITERS}$$

$$M_c = 895 \text{ GRAMS}$$

$$II. R' = 23 \text{ CM}; B = 0.01866$$

$$H_c = \frac{\pi}{\sqrt{0.01061}} - 12.2 = 18.301$$

0.10300

$$V_c = 29.72 \text{ LITERS}$$

$$M_c = 866 \text{ GRAMS}$$

$$III. R' = 24 \text{ CM}; B = 0.01717$$

$$H_c = \frac{\pi}{\sqrt{0.00908}} - 12.2 = 20.769$$

0.09529

$$V_c = 33.16$$

$$M_c = 867$$

264

DECLASSIFIED

W 37346 RD

IV. $R' = 25 \text{ CM}$; $B = 0.01579$

$$A_c = \frac{\pi}{\sqrt{0.00774}} - 12.2 = 23.508$$

$$V_c = 37.52 \text{ LITERS}$$

$$M_c = 877 \text{ GRAMS}$$

263

RECEIVED

NW 3734610

TANK D-27

A. HOOD FACES

$$1. \Delta L = 1.0568 \left(\frac{8.875}{14} \right) = 0.66998$$

9.55399

$$2. \Delta L = 1.0568 \left(\frac{8.875}{40} \right) = 0.23447$$

6.16467

B. TANK D-23 (22 IN OD) & TOP SEPT 23 IN.

$$\sin \theta = \frac{11}{34} = 0.32353$$

$$\tan \theta = 0.34192$$

$$a = 22 \tan \theta = 7.864$$

8.26529

120987

$$\Delta L = 1.0568 \left(\frac{8.875}{23} \right) \left(\frac{1}{\left(\frac{23}{7.864} \right)^2 + 1} \right) =$$

$$= 1.0568 (0.38587) (0.32353) = 0.13193$$

C. TANK D-12 (16 IN OD.) & TOP SEPT 23 IN.

$$\sin \theta = \frac{8}{23} = 0.34783$$

$$\tan \theta = 0.37099$$

$$a = 16 \tan \theta = 5.565$$

$$\Delta L = 1.0568 \left(\frac{8.875}{15} \right) \left(\frac{1}{\left(\frac{15}{5.565} \right)^2 + 1} \right) =$$

$$= 1.0568 (0.59167) (0.34783) = 0.21749$$

ΔL TOT (OD 3. = 4.254 in.

26

DECLASSIFIED

TANK D-28

KW 37346K0

$$ID = 27.625 \text{ IN.} ; L_c \approx 4.8 \text{ CM}$$

$$RAD = 17.8125 \text{ IN} = 35.08375 \text{ CM}$$

$$R = \left(\frac{2.1048}{39.88375} \right)^2 + \left(\frac{\pi}{40+12.2} \right)^2 = 0.00364 + \left(\frac{\pi}{40+12.2} \right)^2$$

$$I. \text{ FOR } R' = 25 ; R = 0.01579$$

$$H_c = \frac{\pi}{\sqrt{0.01215}} - 12.2 = 16.800$$

$$0.11023$$

$$V_c = 68.03 \text{ LITERS}$$

$$M_c = 1473 \text{ GRAMS}$$

$$0.54 \times 10^{-3}$$

$$3.86690$$

$$II. \text{ FOR } R' = 26 ; R = 0.01460$$

$$H_c = \frac{\pi}{\sqrt{0.01096}} - 12.2 = 17.809$$

$$0.10469$$

$$V_c = 68.86 \text{ LITERS}$$

$$M_c = 1470 \text{ GRAMS}$$

$$III. \text{ FOR } R' = 27 ; R = 0.01354$$

$$H_c = \frac{\pi}{\sqrt{0.00990}} - 12.2 = 19.374$$

$$0.09950$$

$$V_c = 74.92 \text{ LITERS}$$

$$M_c = 1479 \text{ GRAMS}$$

266

$$V_c = 68.86 \text{ LITERS}$$

$$M_c = 1470 \text{ GRAMS}$$

 HW 37346 KD
 DECLASSIFIED

$$R' = \sqrt[3]{\frac{1.5 \times 68.86 \times 10^3}{\pi}} + 4.8 = \sqrt[3]{32878.15} + 4.8$$

$$= 32.03582 + 4.8 = 36.83582$$

$$R = \left(\frac{4.494}{36.83582} \right)^2 = 0.01488$$

$$f = 0.72297 ; \frac{1}{f} = 1.38326$$

$$\frac{1}{f} - 1.03435 = 0.35891$$

$$\text{CRIT. COND.} = 21.80184 \text{ G/L}$$

$$\text{MIN. CRIT. MASS} = 1501 \text{ GRAMS}$$

$\frac{3}{16}$ IN. WALLS

26

DECLASSIFIED

1

HW 3734620

TANK G-9

$$I.D. = 31.635 \text{ IN} ; L_R = 4.50 \text{ cm}$$

$$R_{AD} = 15.8175 \text{ IN} = 40.16375 \text{ CM}$$

$$P_z = \left(\frac{2.4048}{44.66375} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00290 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

$$I. R' = 26 \text{ CM} ; P_z = 0.01460$$

$$H_c = \frac{\pi}{\sqrt{0.01170}} - 12.2 = 16.843$$

$$\sqrt{0.01170}$$

$$V_c = 85.36 \text{ LITERS}$$

$$M_c = 1822 \text{ GRAMS}$$

$$154 \times 10^{-3}$$

$$5.06780$$

$$II. R' = 27 \text{ CM} ; P_z = 0.01354$$

$$H_c = \frac{\pi}{\sqrt{0.01064}} - 12.2 = 18.257$$

$$\sqrt{0.01064}$$

$$V_c = 92.52 \text{ LITERS}$$

$$M_c = 1877 \text{ GRAMS}$$

$$III. R' = 25 \text{ CM} ; P_z = 0.01579$$

$$H_c = \frac{\pi}{\sqrt{0.01389}} - 12.2 = 15.472$$

$$\sqrt{0.01389}$$

$$V_c = 78.41 \text{ LITERS}$$

$$M_c = 1832 \text{ GRAMS}$$

DECLASSIFIED

2.

269

HW 37346R0

$$V_L = \underline{\underline{85.36 \text{ LITERS}}}$$

$$M_c = 1822 \text{ GRAMS}$$

$$R' = \sqrt[3]{\frac{1.5 \times 85.36 \times 10^3}{\pi}} + 4.5 = \sqrt[3]{40756.30} + 4.5$$

$$R' = 38.91372 \text{ cm}$$

$$P_r = \left(\frac{4.494}{38.91372} \right)^2 = 0.013338$$

$$f = 0.701146 ; \bar{f} = 1.42624 ; \bar{f} - 1.02435 = 0.40189$$

$$\text{CRIT. CONC.} = 19.47 \text{ GRAMS/LITER}$$

$$\text{MIN. } M_c = 1661 \text{ GRAMS}$$

290

DECLASSIFIED
HW 37346R

TANK 6-10

$$I.D. = 33.625 \text{ IN.} ; L_R = 5.05 \text{ CM.}$$

$$RAD. = 16.8125 \text{ IN.} = 42.70375 \text{ CM}$$

$$R = \left(\frac{2.4048}{42.70375} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00254 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

$$I. R' = 25 \text{ CM} ; R = 0.01579$$

$$H_c = \frac{\pi}{\sqrt{0.01579}} - 12.2 = 15.092$$

$$V_c = 86.46 \text{ LITERS}$$

$$M_c = 2020 \text{ GRAMS}$$

$$15.4 \times 10^{-3}$$

$$5.72905$$

$$II. R' = 26 \text{ CM} ; R = 0.01460$$

$$H_c = \frac{\pi}{\sqrt{0.01460}} - 12.2 = 16.407$$

$$V_c = 94.00 \text{ LITERS}$$

$$M_c = 2006 \text{ GRAMS}$$

$$III. R' = 27 \text{ CM} ; R = 0.01354$$

$$H_c = \frac{\pi}{\sqrt{0.01354}} - 12.2 = 17.754$$

$$V_c = 101.71 \text{ LITERS}$$

$$M_c = 2008 \text{ GRAMS}$$

DECLASSIFIED

KW 37846X0

$$V_C = 94.00 \text{ LITERS}$$

270

$$M_C = 2006 \text{ GRAMS}$$

$$R' = \sqrt[3]{\frac{1.5 \times 94.0 \times 10^3}{\pi}} + 5.05 = \sqrt[3]{4481.58} + 5.05$$

$$= 40.58770$$

$$T_2 = \left(\frac{4.494}{40.58770} \right)^2 = 0.01226$$

$$f' = 0.68592; \bar{f}' = 1.45790; \bar{f}' - 1.02435 = 0.43355$$

$$\text{CRIT. CONC.} = 18.04843 \text{ g/l}$$

$$\text{MIN. } M_C = 1696 \text{ GRAMS}$$

HW 37346 RD

272
TANK G-15

$$I.D. = 33.625 \text{ IN.} ; L_R = 4.80 \text{ CM}$$

$$R.A.D. = 16.8125 \text{ IN.} = 42.70375 \text{ CM}$$

$$T_B = \left(\frac{2.4048}{42.70375} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00256 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

I. $R' = 22 \text{ CM} ; T_B = 0.01579$

$$H_c = \frac{\pi}{\sqrt{0.01579}} - 12.2 = 15.114$$

$$V_c = 86.59 \text{ LITERS}$$

$$M_c = 2023 \text{ GRAMS}$$

MAX 10^{-3}

5.72905

II. $R' = 26 \text{ CM} ; T_B = 0.01460$

$$H_c = \frac{\pi}{\sqrt{0.01460}} - 12.2 = 16.430$$

$$V_c = 94.13 \text{ LITERS}$$

$$M_c = 2009 \text{ GRAMS}$$

III. $R' = 27 \text{ CM} ; T_B = 0.01354$

$$H_c = \frac{\pi}{\sqrt{0.01354}} - 12.2 = 17.780$$

$$V_c = 101.86 \text{ LITERS}$$

$$M_c = 2011 \text{ GRAMS}$$

DECLASSIFIED

W 3734620

2.

$$V_c = 94.13 \text{ LITERS}$$

$$M_c = 2009 \text{ GRAMS}$$

273

$$R' = \sqrt[3]{\frac{1.8 \times 94.13 \times 10^3}{\pi}} + 4.80 = \sqrt[3]{44943.65} + 4.80$$

$$= 40.35408$$

$$P_c = \left(\frac{4.494}{40.35408} \right)^2 = 0.01240$$

$$f = 0.68789; \frac{1}{f} = 1.45372; \frac{1}{f} - 1.02435 = 0.42937$$

$$\text{CRIT. CONC.} = 18.77 \text{ GRAMS/LITER}$$

$$\text{MIN. } M_c = 1712 \text{ GRAMS}$$

RECEIVED

HW 37346 RP

278

TANK G-758

$$I.D. = 29.75 \text{ in.} ; l_p = 6.1 \text{ cm}$$

$$RAD = 14.875 \text{ in.} = 37.7825 \text{ cm.}$$

$$P_r = \left(\frac{3.4048}{43.8825} \right)^2 + \left(\frac{\pi}{H_c + 12.2} \right)^2 = 0.00200 + \left(\frac{\pi}{H_c + 12.2} \right)^2$$

$$I. R' = 25 \text{ cm} ; P_r = 0.01579$$

$$H_c = \frac{\pi}{\sqrt{0.01279}} - 12.2 = 15.580$$

$$V_c = 69.87 \text{ LITERS}$$

$$M_c = 1632 \text{ GRAMS}$$

$$0.52 \times 10^{-3}$$

$$4.48469$$

$$II. R' = 26 \text{ cm} ; P_r = 0.01460$$

$$H_c = \frac{\pi}{\sqrt{0.01160}} - 12.2 = 16.97$$

$$V_c = 76.10$$

$$M_c = 1624$$

$$III. R' = 27 \text{ cm} ; P_r = 0.01354$$

$$H_c = \frac{\pi}{\sqrt{0.01054}} - 12.2 = 18.402$$

$$V_c = 82.53$$

$$M_c = 1629$$

DECLASSIFIED

274

KW 37346 RD

$$V_c = 76.10 \text{ LITERS}$$

$$M_c = 1624 \text{ GRAMS}$$

$$R' = \sqrt[3]{\frac{1.5 \times 76.10 \times 10^3}{\pi}} + 6.1 = \sqrt[3]{36334.98} + 6.1$$

$$R' = 39.22137$$

$$B = \left(\frac{4.494}{39.22137} \right)^2 = 0.01313$$

$$f = 0.69821 ; \frac{1}{f} = 1.43223 ; \frac{1}{f} - 1.02435 = 0.40788$$

$$\text{CRIT. CONC.} = 19.18 \text{ LITERS}$$

$$\text{MIN } M_c = 1459 \text{ GRAMS}$$

$$\Delta L = 1.0568 \left(\frac{1}{20} \right)$$

RECEIVED
JAN 31 3 34 PM '60

$$(1) \Delta L = 1.0568 \left(\frac{13.8125}{33.1875} \right) = 0.43984 \text{ CM}$$

$$(2) \Delta L = 1.0568 \left(\frac{13.8125}{18.125} \right) = 0.80536 \text{ CM}$$

$$(3) \Delta L = 1.0568 \left(\frac{13.8125}{35.875} \right) = 0.40689 \text{ CM}$$

$$\text{TOTAL } \Delta L = 1.65209 \text{ CM}$$

$$\text{FLAT WALL TH.} = 0.1875 \text{ IN.}$$

$$= 3.1250 \text{ CM}$$

$$\text{TOTAL} = 4.77409 \text{ CM}$$

1.0625 IN. WALL THICKNESS

276
TANK G-58

DECLASSIFIED
14-3-346 RD

1) TANK WALLS & JACKET 1.0625 IN $l = 4.75$
53 DIV.

2) HOOD FACES

$$(a) \Delta l = 1.0568 \left(\frac{14.875}{33.125} \right) = 0.64947$$

$$(b) \Delta l = 1.0568 \left(\frac{14.875}{30.875} \right) = 0.50914$$

3) TANK G-36

$$\Delta l = 1.0568 \left(\frac{14.875}{34} \right) \left(\frac{17}{51} \right) = 0.15411$$

$$\begin{array}{r} 34 \\ 51 \\ 34 \\ \hline 170 \\ 1734 \end{array}$$

$$\text{TOT } \Delta l = 6.09 \text{ CM}$$

TANK G-15

1) TANK WALLS = 0.1875 IN. $l = 3.25 \text{ CM}$

$$2) \text{ HOOD FACES; } \Delta l = 2(1.0568) \left(\frac{16.8125}{27} \right) = 1.31610 \text{ CM}$$

$$3) \text{ TANK G-36; } \Delta l = 1.0568 \left(\frac{16.8125}{35} \right) \left(\frac{17}{52} \right) = 0.16595 \text{ CM}$$

1820

$$\text{TOT } \Delta l = 4.73205 \text{ CM}$$

278

RECEIVED

HW 3734680

TANK G-9 (98.510)

WALL THICKNESS 0.1875 IN.

L = 3.75 CM

REFLECTION FROM HOOD FACES

$$1) \Delta L = 1.0568 \left(\frac{15.8125}{24.625} \right) = 0.67860 \text{ CM}$$

$$2) \Delta L = 1.0568 \left(\frac{15.8125}{29.375} \right) = 0.56887 \text{ CM}$$

$$L_{\text{TOTAL}} = 4.49747 \text{ IN.}$$

$$= 1.50 \text{ LILL}$$

TANK G-10

1) WALL. TH. = 0.1875 IN.

L = 3.75 CM

HOOD. FACES

$$2) \Delta L = 2(1.0568) \left(\frac{16.8125}{37.0} \right) = 1.21610 \text{ CM}$$

TANK G-8 - ϕ TO ϕ SEP. OF 50" (42" O.D.)TANK G-52 - ϕ TO ϕ SEP. OF 46" (34" O.D.)

$$3) \Delta L = 1.0568 \left(\frac{16.8125}{29} \right) \left(\frac{21}{50} \right) = 0.25732$$

$$4) \Delta L = 1.0568 \left(\frac{16.8125}{29} \right) \left(\frac{17}{46} \right) = 0.22642$$

$$L_{\text{TOTAL}} = 5.04984 \text{ CM}$$

APRIL 21, 1954

RECUPLEX

HW 3534601

M. L. L. C. FOR ADDITIONAL RECUPLEX TANKS

TANK NO.

I.O.D.

WALL TH.

BOTTOM

DECLASSIFIED

4-400			
650 750 ✓ D-2	13.75	0.125	14 RAD. CUR., 0.1875 THK.
(725, 825)
650 750 ✓ D-4	13.75	0.125	14 RAD. CUR., 0.1875 THK.
(725, 825)
700 775 ✓ D-12	15.75	0.125	16 RAD. CUR., 0.1875 THK.
(750, 850)
950 1050 ✓ D-23	21.75	0.125	22 RAD. CUR., 0.1875 THK.
(975, 1075)
850 950 ✓ D-26	19.625	0.1875	20 RAD. CUR., 0.1875 THK.
(775, 975)
SAFE ✓ D-31	30.918
30.918 MAX	0.132 MAX	FLAT - THK. 20.25 HIGH
SAFE G-17	7.094 MAX	0.141 MAX	FLAT - THK. 18.25 HIGH
1800 1950 G-36	33.625	0.1875	34 RAD. CUR., 0.1875 THK.
(1800, 1950)
150 850 G-44	17.625	0.1875	FLAT (500, 900)
1800 1950
1800 1950 G-52	33.625	0.1875	34 RAD. CUR., 0.1875 THK.
(1800, 1950)
1200 1300 H-1	25.75	0.125	26 RAD. CUR., 0.1875 THK.
(1200, 1350)
1200 1300 H-2	25.75	0.125	26 RAD. CUR., 0.1875 THK.
(1200, 1350)
650 750 H-9	16.5625	0.09375	FLAT (750, 775)
2600 2800 L-2	41.75	0.125	42 RAD. CUR., 0.1875 THK.
(2600, 2800)
2600 2800 L-3	41.75	0.125	42 RAD. CUR., 0.1875 THK.
(2600, 2800)
2600 2800 L-8	41.75	0.125	42 RAD. CUR., 0.1875 THK.
(2600, 2800)

APRIL 27, 1954 - RECUMEX

1.

289

4033460

D-31 - 5.918 I.D. - 0.138" WALL - 20.75" HIGH
(MAX) (MAX)

EQ. REFL. TH. = 0.360

DECLASSIFIED

ACT. REFL. TH. = 0.138 IN. MAX.

% INTERACTION = 2.15

EFFECTIVE DIA. = 6.29206

ACTUAL I.D. = 5.918 IN. MAX.

SAFE FOR ANY HAND/TPA

1. INTERACTION = 2.15%

D-3 128" E TO E $\pm$ 0.263 REFL. BET.

2. REFLECTORS

- a) D-1 - 44.80 E TO E, $L_0 = 27.75$, $R' = 160.75$
- b) D-3 - 27.75 E TO E, $L_0 = 20.75$, $R' = 7$
- c) D-7 - 33.5 E TO E, $L_0 = 16.5$, $R' = 17$
- d) FRONT OF HOOD 10" = L_0 ; $R = \infty$
- e) TANK WALLS 0.138

3. PIPING

3900226351761

ASSUME 4 - 1" DIA PIPES

390022724

INC. IN DIA. = 0.24682 IN.

6-451

APRIL 27, 1954 — RECUPLEX

289

D-21 (CONT'D)

R = 2.959

HW 37346 RD

DECLASSIFIED

REFLECTORS —

R/L_0

$\frac{R}{L_0 + R}$

a) $1.0568 (0.10663) (0.37640)$

$\Delta L = 0.04741$

b) $1.0568 (0.14260) (0.75375)$

$\Delta L = 0.03801$

c) $1.0568 (0.17933) (0.50746)$

$\Delta L = 0.09617$

d) $1.0568 (0.29590) (1.00000)$

$\Delta L = 0.31370$

e)

$L = 3.06$

$L_{TOT} = 3.54979$

REFL. TH. = 0.360 IN

APRIL 22, 1954 — RECUPLEX

1

$$\Delta L = 1.0568 \left(\frac{R}{C_0} \right) \left(\left(\frac{C_0}{2} \right)^2 + \dots \right)$$

HW 37346R0

DECLASSIFIED

1. D-3 — 17.75

<u>$M_{C_0} = 650$</u>	a)	1.0568	(0.52885)	(1.0)
	b)	"	(0.49107)	(0.74193) (0.55303)
<u>$M_{C_{100}} = 750$</u>	c)	"	(0.28646)	(0.57802) (0.41986)
	d)	"	(0.30556)	(0.21693) (0.18491)
	e)			

$$\begin{aligned}\Delta L &= 0.55888 \\ \Delta L &= 0.40059 \\ \Delta L &= 0.13218 \\ \Delta L &= 0.04005 \\ l &= 3.02 \\ l_{TOT} &= 4.05268 \\ \text{REFLECT} &= 0.750 \\ &\rightarrow 0.640\end{aligned}$$

2. D-4 — 17.75

<u>$M_{C_0} = 650$</u>	a)	1.0568	(0.52885)	(1.0)
	b)	"	(0.37801)	(1.0)
<u>$M_{C_{100}} = 750$</u>	c)	"	(0.49107)	(0.76251) (0.53676)
	d)			

$$\begin{aligned}\Delta L &= 0.55888 \\ \Delta L &= 0.39948 \\ \Delta L &= 0.29570 \\ \Delta L &= 3.02 \\ l_{TOT} &= 4.05268 \\ \text{REFLECT} &= 0.860 \\ &\rightarrow 0.780\end{aligned}$$

3. D-12 — 15.75

<u>$M_{C_0} = 700$</u>	a)	1.0568	(0.37500)	(0.58124) (0.41471)
	b)	"	(0.54310)	(0.58651) (0.46625)
<u>$M_{C_{100}} = 750$</u>	c)	"	(0.60577)	(1.00000)
	d)			

$$\begin{aligned}\Delta L &= 0.16435 \\ \Delta L &= 0.33662 \\ \Delta L &= 0.64017 \\ l &= 3.02 \\ l_{TOT} &= 4.05268 \\ \text{REFLECT} &= 0.760 \\ &\rightarrow 0.710\end{aligned}$$

4. D-23 — 21.75

<u>$M_{C_0} = 850$</u>	a)	1.0568	(0.43500)	(0.30478) (0.23873)
	b)	"	(0.47382)	(0.41530) (0.31387)
<u>$M_{C_{100}} = 1050$</u>	c)	"	(0.67969)	(1.0)
	d)			

$$\begin{aligned}\Delta L &= 0.12374 \\ \Delta L &= 0.20433 \\ \Delta L &= 0.71829 \\ l &= 3.02 \\ l_{TOT} &= 4.05268 \\ \text{REFLECT} &= 0.660 \\ &\rightarrow 0.610\end{aligned}$$

5. D-26 — 19.625

<u>$M_{C_0} = 850$</u>	a)	1.0568	(0.54514)	(0.40614) (0.30746)
	b)	"	(0.23363)	(0.21672) (0.27100)
<u>$M_{C_{100}} = 950$</u>	c)	"	(0.70089)	(1.0)
	d)			

$$\begin{aligned}\Delta L &= 0.23397 \\ \Delta L &= 0.07807 \\ \Delta L &= 0.74069 \\ l &= 3.02 \\ l_{TOT} &= 4.05268 \\ \text{REFLECT} &= 0.750 \\ &\rightarrow 0.710\end{aligned}$$

6. D-31 — 21.75

APRIL 21, 1954

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W 37346 R

20

REFLECTORS NEAR ADDITIONAL RECURREX TANKS -

1. D-3

- a) HOOD FACE 18 IN = L_0 ; $a = \infty$
b) D-1 30.74 IN. $\in$ TO $\in$; $L_0 = 14$ " ; $a = 17$ "
c) D-7 40.49 IN. $\in$ TO $\in$; $L_0 = 24$ " ; $a = 17$ "
d) D-31 27.04 IN. $\in$ TO $\in$; $L_0 = 22.5$; $a = 5$ "
e) TANK WALLS

DECLASSIFIED

2. D-4

- a) REAR HOOD FACE 18 IN. = L_0 ; $a = \infty$
b) END OF HOOD 18 IN. = L_0 ; $a = \infty$
c) D-2 30.74 IN. $\in$ TO $\in$; $L_0 = 14$ " ; $a = 16.5$
d) TANK WALLS

3. D-12

- $R = 7.875$
a) D-5 36.17 IN. $\in$ TO $\in$; $L_0 = 21$ " ; $a = 15$ "
b) D-27 27.52 IN. $\in$ TO $\in$; $L_0 = 14.5$ " ; $a = 10.5$
c) REAR HOOD FACE 18 IN. = L_0 ; $a = \infty$
d) WALLS OF TANK

4. D-23

- $R = 10.875$
a) D-10 33.51 IN. $\in$ TO $\in$; $L_0 = 15$ " ; $a = 8$ "
b) D-27 33.56 IN. $\in$ TO $\in$; $L_0 = 23$ " ; $a = 10.5$
c) REAR HOOD FACE 16 IN. = L_0 ; $a = \infty$
d) TANK WALLS

5. D-26

- $R = 9.8175$
a) D-11 26.02 IN. $\in$ TO $\in$; $L_0 = 18$ " ; $a = 8$ "
b) D-28 31.66 IN. $\in$ TO $\in$; $L_0 = 12$ " ; $a = 14$ "
c) REAR HOOD FACE 14 IN. = L_0 ; $a = \infty$
d) TANK WALLS

6. D-31

- a) D-1 43.62 IN. $\in$ TO $\in$; $L_0 = 28$ " ; $a = 17$ " ; $\Delta L = 0.0070$
b) D-3 27.04 IN. $\in$ TO $\in$; $L_0 = 20.5$ " ; $a = 7$ " ; $\Delta L = 0.0058$
c) D-7 33.94 IN. $\in$ TO $\in$; $L_0 = 16.5$ " ; $a = 17$ " ; $\Delta L = 0.0062$
d) FRONT HOOD FACE 10 IN. ; $a = \infty$; $\Delta L = 0.0063$
e) TANK WALLS (0.138 IN.) ; $L = 3.015$

$L_{TOT} = 3.003$
EQ. REFLECTHO = 0.049

RECEIVED

APR 26 1954

$$\Delta d = 1.0568 \left(\frac{h}{L_0} \right) \left(\frac{L_0}{L_0} + 1 \right)$$

EXCURSION - 26, 1954

1. H-1 - 75075 - R = 170875

a) TRUNK WALLS

b) REAR WOOD FACE - 19110 = L_0 ; $a = \infty$

b) TRUNK H-2 32" ϵ to ϵ ; $L_0 = 18075$; $R = 13$ "

c) FRONT WOOD FACE - 35110 = L_0 ; $a = \infty$

2. H-2 - 75075 - R = 170875

a) TRUNK WALLS

b) REAR WOOD FACE - 19110 = L_0 ; $a = \infty$

b) TRUNK H-1 32" ϵ to ϵ ; $L_0 = 18075$; $R = 13$ "

c) FRONT WOOD FACE - 35110 = L_0 ; $a = \infty$

3. H-9 - 1605675 - R = 8028175

a) TRUNK WALLS

b) REAR WOOD FACE 20110 = L_0 ; $a = \infty$

b) FRONT WOOD FACE 34110 = L_0 ; $a = \infty$

c) TRUNK J-230, 31" ϵ to ϵ ; $L_0 = 76075$; $R = 5075$ "

APRIL 26, 1954

HW 3734620

UNCLASSIFIED

1. K-1 & K-2 — 250.75

a.)

$$L = 3.02$$

$$a) 10568 (0.67763) (1.00000)$$

$$\Delta L = 0.71611$$

$$b) 100568 (0.68667) (0.40675)$$

$$\Delta L = 0.29480$$

$$c) 100568 (0.36786) (1.00000)$$

$$\Delta L = 0.38875$$

$$M_{C_0} = 1200$$

$$L_{TOT} = 4.41966 \text{ cm}$$

$$M_{C_{400}} = 1300$$

$$\Rightarrow R_{EFL. TH.} = 0.90 \text{ IN}$$

2. K-9 — 1605625

a.)

$$L = 4.59$$

$$a) 100568 (0.41406) (1.00000)$$

$$\Delta L = 0.43757$$

$$b) 100568 (0.24357) (1.00000)$$

$$\Delta L = 0.25940$$

$$c) 100568 (0.31548) (0.16935)$$

$$\Delta L = 0.05646$$

$$M_{C_0} = 650$$

$$L_{TOT} = 5.34143$$

$$M_{C_{400}} = 750$$

$$\Rightarrow R_{EFL. TH.} = 1.67 \text{ IN}$$

APRIL 27, 1954 - RECUPLEX

$$\Delta L = \left(\frac{R}{L_0}\right) \left(\frac{R'}{L_0 + R'}\right)$$

286

KW 37346 RD
DECLASSIFIED

1. L-2 — 41.75 in D₀ — 20.875 RAD — 0.175 WALLS

L-2 — " " "

L-8 — " " "

$$M_{C_0} = 2600$$

$$M_{C_{400}} = 2800$$

2. G-5A — 33.675 in D₀ — 16.8675 RAD — 0.1875 WALLS

a) FRONT HOOD FACE — 27" = L₀

b) REAR HOOD FACE — 27" = L₀

c) TANK G-10 — 46" E TO E , R' = 17", L₀ = 29"

d) TANK WALLS

a) 10.568 (0.67454) (1.00000)

$$\Delta L = 0.66001$$

b) 10.568 (0.67454) (1.00000)

$$\Delta L = 0.66001$$

c) 10.568 (0.58146) (0.36956)

$$\Delta L = 0.22709$$

d) 29.5

$$L = 2.18$$

$$L_{TOT} = 4.72711$$

$$M_{C_0} = 1900$$

$$REFL. TH. = 1018 \text{ IN}$$

$$M_{C_{400}} = 1900$$

APRIL 27, 1954 - REC'D

9-44 - 1706.75% D. - 8.8135" RAD

288

W 373.46 X

RECEIVED

a) TRUNK WALLS 0.1875"

b) REAR WOOD FACE 18" = L_0 ; $a = \infty$

c) FRONT WOOD FACE 36" = L_0 ; $a = \infty$

d) END OF WOOD 79" = L_0 ; $a = 36$

200-15 a)

b) 1.0568 (0.48957) (1.0)

c) 1.0568 (0.24479) (1.0)

d) 1.0568 (0.30388) (0.11875)

$\Delta L = 0.075028$

$\Delta L = 0.075869$

$\Delta L = 0.051738$

$L = 3.18$

$L_{TOT} = 4.070615$

REFLECT. $T_{H_0} = 0.74$

$M_{C_0} = 750$

$M_{C_{1000}} = 850$

APRIL 27, 1954 - RECURRENCE

284

HW 3:346 R0

G-36 - 33.675 I.D. - 16.8125 R.H.D. - 0.1875 WALLS

DECLASSIFIED

- TANK WALLS
- FRONT & REAR HOOD FACES - $L_0 = 27"$
- G-15, 57" ± 10 , $L_0 = 35"$, $R' = 17"$
- G-58, 51" ± 10 , $L_0 = 35"$, $R' = 16"$

~~28~~

- $L = 30.18$
 - $2 (1.0568) (0.063268) (1.0) \quad \Delta L = 1.031608$
 - $1.0568 (0.48035) (0.32692) \quad \Delta L = 0.16595$
 - $1.0568 (0.48036) (0.1372) \quad \Delta L = 0.15925$
- $L_{TOT} = 4.08128$

$MC_0 = 1800$

$MC_{400} = 1980$

$REEL_{TH0} = 10.20$

289

DECLASSIFIED

346 RD

MINIMUM CRITICAL CONCENTRATION FOR
RECUPLEX TANKS
(400 MMD/TP PL)

TANK NUMBER MIN. CRIT. CONC. IN g/l.

(19) H-9	105
(20) H-10	90
(3) G-42	100
(4) G-46	SAFE
(5) G-47	135
(6) G-48	115
(7) G-50	80
(21) J-1	SAFE
(22) J-2	180
(23) J-3	150
(24) J-4	SAFE
(26) J-6	SAFE
(27) J-7	SAFE
(28) J-17	70
(29) J-25	SAFE
(9) G-54	SAFE
(25) J-5	SAFE
(30) J-30	SAFE
(8) G-51	220
(1) G-16	SAFE
(2) G-28	SAFE

240

DECLASSIFIED 346R

TANK NO.

MIN. CRIT. CONC IN G/L
FOR 400 MAND/T PL

(11) COL H-1	SAFE
(14) COL H-2	SAFE
(14) COL H-3	SAFE
(12) H-1 BDS	100
(10) H-1 TDS	150
(15) H-2 BDS	100
(13) H-2 TDS	150
(18) H-3 BDS	100
(16) H-3 TDS	150
(21) H-11	90 GRAMS/LITER
(31) J-31	SAFE

UNCLASSIFIED

Rev 32346.10

DECLASSIFIED

$$\overline{a} = \left(\frac{\pi}{a+7.3} \right)^2 + \left(\frac{\pi}{23.3} \right)^2 = 0.032804$$

HW 37346 RD

$$\left(\frac{\pi}{a+7.3} \right)^2 = 0.014625$$

$$\pi = 0.12094a + 0.88286$$

$$\frac{2.2587}{0.12094} = 18.68 \text{ CM} = 7.35 \text{ IN}$$

$$7.35 - 3 = 4.35"$$

4.35" wide

2.00" deep

2

SECRET

HW 3734620
DECLASSIFIED

$$B = \left(\frac{\pi}{a + 10.6} \right)^2 + \left(\frac{\pi}{20} \right)^2 = 0.032804$$

$7.3 \quad 12.7 + 10.6 = 23.3$

$$\left(\frac{\pi}{a + 10.6} \right)^2 = 0.032804 - 0.024674 = 0.00813$$

$$0.09017 \quad \pi = 0.09017a + 0.95580$$

$$a = \frac{2.18578}{0.09017} - 74.24 \text{ CM} = 9.54 \text{ IN}$$

$9.54 - 3 = 6.54 \text{ IN SAFE WIDTH FOR } 3" \text{ DEEP GROOVE}$

THEREFORE THE ILLUSTRATED ASSEMBLY IS SAFE

SECRET

298

HW 373460
DECLASSIFIED

4.72

~~1200~~
~~1416~~

1200
1416
1840
1778

$\pi = (0.4 + 10.6) \text{ SM}$

$\pi =$

12.0
1811 / 2.18175
1811
3707
3622
855

9961
6981
0902
4981
2670
1681
8681
266
511
637
013
862

6.06
2.54
2.54
14.20

3.14158
95983
2.18175

2888721
13416
10
1776891810
67479
40407
53916
94856
118181
64810
66810

1.2098
1.2098
65139
60490
46490
36294
101960

1811
5.3
5433
9055
95983

288218191
E

$\left(\frac{\pi}{R+L}\right)^2$

12.70
5.3

12.097
10.04636

$\frac{\pi}{R+L} = 0.1811$
 $\pi = 0.1811R +$

18 / 3.14158

$\left(\frac{\pi}{R+L}\right)^2 = 0.032804$

32
2409
24187

46
44
23600
21681
191900
169309
22591

$R = \frac{2.18175}{0.1811}$

1811
10.032804
1
28
228
274
361
362
404
361
4300
3.14158
1.28079
1.86119

0.12098
10.6
72588
120980
1280388

M =

(1)
299

HW 37346

DECLASSIFIED

$$B = 0.032804$$

$$B = \left(\frac{\pi}{a+2L} \right)^2 + \left(\frac{\pi}{b+2L} \right)^2 + \left(\frac{\pi}{c+2L} \right)^2$$

FOR LONG D, $c \rightarrow \infty$, $\frac{\pi}{c+2L} \rightarrow 0$

$$\left(\frac{\pi}{a+2L} \right)^2 \rightarrow 0$$

$$B = \left(\frac{\pi}{a+10.6} \right)^2 + \left(\frac{\pi}{b+10.6} \right)^2$$

(COMPLETELY TAMPED)

$$\text{let } b = 12.7$$

$$B = \left(\frac{\pi}{a+10.6} \right)^2 + \left(\frac{\pi}{23.3} \right)^2 = 0.032804$$

$$\left(\frac{\pi}{a+10.6} \right)^2 = 0.032804 - 0.018168 = 0.014636$$

$$\pi = 0.12098a + 1.280388$$

$$a = \frac{2.14158 - 1.28038}{0.12098} = \frac{0.86119}{0.12098} = 7.1179 \text{ CM} = 2.798 \text{ IN.}$$

$a - 3 = 3.03$ WIDTH FOR 2" DEEP CROOK

TAMPED ON ONE SIDE ONLY

$$B = \left(\frac{\pi}{a+10.6} \right)^2 + \left(\frac{\pi}{12.7+5.3+2.0} \right)^2$$

THIS WILL GIVE LARGER (a) THAN TAMPED CASE

4-3-58

H FOR SAFE SCABS INTERSECTING AT RT. L. $\mu B 37.34610$

(1) $B = \left(\frac{2.4048}{H+2L} \right)^2 + \left(\frac{\pi}{H+2L} \right)^2$ ONE TAMPED ON ONE SIDE ONLY
(2) OTHER TAMPED ON BOTH SIDES

(2) $f = [54.68 - 36.24H(10)^{-2}]B + 3.812(10)^{-3}H + 0.08616$

(3) $\frac{1}{f} = 1 + \left(\frac{w}{1-w} \right) \left(\frac{0.40}{0.39} \right) \left(\frac{239}{2.40} \right) = 1.02434$ FOR 400 MWD,
 $f = 0.97624$

FOR 100 SCABS,

DECLASSIFIED

(4) $B = \left(\frac{\pi}{H+2L} \right)^2$

COMBINING (2) & (4) & SOLVING FOR B, WE GET—

$0.97624 = [54.68 - 40.55]B + 0.42656 + 0.08616$

(5) $B = \frac{0.46352}{14.13} = 0.032804$

COMBINING 4 & 5, WE GET

$H = \frac{\pi}{0.001076} - 2L = 17.345 - 2L$
~~0.001076~~
~~0.18112~~

FOR 100% WATER TAMPED,

$H = 17.345 - \frac{70.6}{5.19} = 6.74$
~~70.6~~
~~5.19~~
~~11.28~~
~~4.54~~
~~2.65~~

OVERFLOW

IF TANK IS TO BE 3" DEEP, DIAMETER OF CHANNEL MUST NOT EXCEED 0"

CONSIDERING COMPLETE TAMPING

IF OVERFLOW PIPE WERE LOWERED 1" (IE, A 2" LIQUID DEPTH IN THE OVERFLOW TRAY) A 2.82" CHANNEL WOULD BE PERMISSABLE.

TO WED ON 1 SIDE
 $B = 10.045 = 3.95$ IN ≈ 0.95 DIA CHANNEL

WALL TH = 0.134 INCHES

1.0 = 6.357 INCHES

0.0 = 6.675 INCHES

6 INCH. SCHEDULE 10S STAINLESS STEEL PIPE

SAFE	PRESSURE	1.0	0.0	6.39"	✓
SAFE	PRESSURE	1.0	0.0	6.56"	✓
SAFE	PRESSURE	1.0	0.0	6.50"	✓
SAFE	PRESSURE	1.0	0.0	6.88"	✓
SAFE	PRESSURE	1.0	0.0	6.44"	✓
SAFE	PRESSURE	1.0	0.0	6.38"	✓

DECLASSIFIED

NEW REPUBLIC SAFE VESSEL DETECTION

37346A

OCTOBER 1954

298

SEPTEMBER 30, 1954
HW 3:34 PM RD

298
NEW RECUPLEX VESSEL DETERMINATION

DECLASSIFIED

1. G-42

HEIGHT = 60 IN.

~~700 IN. auto 10 D.~~
700 IN. auto
10 D.

BETO 6074 & 6084 always safe

2. J-2

HEIGHT = 60 IN.

700 IN. auto 10 D.

BETO 6087 & 6097 always safe

3. J-3

HEIGHT = 60 IN.

700 IN. auto 10 D.

BETO 6087 & 6097

4. G-47

670.375 IN. HEIGHT

700 IN. auto 10 D.

BETO 7005 & 7015

5. G-48

670.375 IN.

BETO 7005 & 7015

700 IN. auto 10 D.

6. J-1

670.375 IN.

BETO 7017 & 7027

700 IN. auto 10 D.

SEPTEMBER 20, 1954

HW 37346R

298

NEW RECUPLEX SAFE VESSEL DETERMINATION

INTERACTION —

DECLASSIFIED

G-42 5.850%

G-47 4.250%

C.S.A. TANKS = ?

G-48 5.200%

J-1 1.275%

J-2 4.725%

J-3 5.500%

PRODUCT LINES —

			C.S.A.
G-42	1	1" LINE	0.7854 IN ²

G-47	5	3/4" LINES	2.2090 IN ²

G-48	5	3/4" LINES	2.2090 IN ²

J-1	5	3/4" LINES	2.2090 IN ²

J-2	3	3/4" LINES	1.0325 IN ²

J-3	3	3/4" LINES	1.0325 IN ²

SEPTEMBER 20, 1954

HW 37346R

NEW SAFE VESSEL DETERMINATION FOR PEOPLE

DECLASSIFIED

Let x = always safe dia. (act.)

" a = " " " (EFFECTIVE)

$$a = (x) \times 1 + \% \text{ INTERACTION } + \left\{ \left(\frac{x}{2} \right)^2 + \frac{0.54 \times \text{PIPS}}{\pi} - \frac{x}{2} \right\}$$

1. TANK G-42

$$60.74 = 10585x + 2 \left\{ \sqrt{\left(\frac{x}{2} \right)^2 + 0.75} - \frac{x}{2} \right\}$$

$$a = bx + 2 \left\{ \sqrt{\frac{x^2}{4} + c} - \frac{x}{2} \right\}$$

$$\frac{a - bx + x}{2} = \sqrt{\frac{x^2}{4} + c}$$

$$a^2 - 2abx + 2ax + b^2x^2 - 2bx^2 + x^2 = 4 \left(\frac{x^2}{4} + c \right)$$

$$x^2(b^2 - 2b) + x(2a(1-b)) + (a^2 - 4c) = 0$$

$$x = \frac{2a(b-1) \pm \sqrt{[2a(1-b)]^2 - 4(b^2 - 2b)(a^2 - 4c)}}{2(b^2 - 2b)}$$

$$b = 10585$$

$$a = 60.74$$

$$c = 0.75$$

$$x = 0.78858 \pm \sqrt{0.62186 + 4(0.99658)(44.42760)}$$

$$= 0.78858 \pm 1.254276 = 2.042856 - 0.99316 = 1.049696$$

OCTOBER 19, 1954

NO TANK G-4800

HW 373460

DECLASSIFIED

$$a = 7.05$$

$$b = 1.0475$$

$$c = \cancel{2.8090} \quad 0.70314$$

$$\underline{\underline{x}} = \frac{0.59975 \pm \sqrt{0.75910 + 4(0.99819)(40.86650)}}{-1.99638}$$

$$= \frac{0.59975 - \sqrt{16.3052923}}{-1.99638} = \frac{-12.018860}{-1.99638}$$

$$= \underline{\underline{6.010575}}$$

CHECKS

NO TANK G-48

$$a = 7.05$$

$$b = 1.0520$$

$$c = 2.2090$$

$$\underline{\underline{x}} = \frac{0.73320 \pm \sqrt{0.53758 + 4(0.99730)(40.86650)}}{-1.99460}$$

$$= \frac{0.73320 - \sqrt{16.3056222}}{-1.99460} = \frac{-12.05594}{-1.99460}$$

$$= \underline{\underline{6.04479}}$$

60

OCTOBER 19, 1954

NEW RECUPLEX SAFE VESSEL DETERMINATION ^{HW} 37346R9

40 TANK J-1

$$a = 70.17$$

$$b = 1001875$$

$$c = 202090$$

$$x = \frac{0.18284 - \sqrt{0.05343 + 4(0.99984)(420.57790)}}{1.99968}$$

$$= \frac{0.18284 - \sqrt{170.29778}}{1.99968} = \frac{-120.86698}{-1.99968}$$

$$= 60.43451$$

CHECKS

50 TANK J-2

$$a = 60.87$$

$$b = 1004725$$

$$c = 103358$$

$$x = \frac{0.64922 - \sqrt{0.42149 + 4(0.99777)(410.89570)}}{-1.99554}$$

$$x = \frac{0.64922 - \sqrt{170.94722}}{-1.99554} = \frac{-120.29800}{-1.99554}$$

$$x = 60.16774$$

CHECKS

30%

OCTOBER 19 1954

HW 3:34:60

NEW RECUPLEX SAFE VESSEL DETERMINATION

60 TANK J-3

DECLASSIFIED

$$a = 60.87$$

$$b = 1005500$$

$$c = 107753$$

$$x = 0075570 - \sqrt{0.57108 + 4(0.99698)(410.89570)}$$
$$-10.99396$$

$$= 0075570 - \sqrt{120.94789}$$
$$= 0075570 - \sqrt{167.64778} = -120.19219$$
$$-10.99396 \quad -10.99396$$

$$x = 6011456$$

CHECKS

$$a - bx + x$$

$$a - bx + x$$

$$a^2 - abx + ax$$

$$-abx$$

$$+b^2x^2 - bx^2$$

$$+ax$$

$$-bx^2 + x^2$$

$$a^2 - 2abx + 2ax + b^2x^2 - 2bx^2 + x^2$$

DECLASSIFIED

4052382

2026191

4078847 +

7095628

6068854

6029290

60

3034427

3014645

11042414

~~10015015~~

3038144

10015015

6011456

1006722

3018593

3002728

3026684

6010525

11052779

6042451

1205597

3002267

3039526

3021725

3054397

6004429

11034222

6016274

10082014

3002214

3026784

3008137

3028941

304

OCTOBER 4, 1954

W 37346 RD

NEW RECIPLEX SHFE VESSEL DETERMINATION

DECLASSIFIED

G-47

$C = 0.70314$

$$X = \frac{0.59975 - \sqrt{0.35910 + 4(0.99819)(46.88994)}}{-1.99638}$$

$$= \frac{0.59975 - \sqrt{187.57938}}{-1.99638} = \frac{-12.09671}{-1.99638}$$

$$\rightarrow X = 6.056 \text{ INCHES} \leftarrow \ll$$

G-48

$C = 0.70314$

$$X = \frac{0.73320 - \sqrt{4(0.99730)(46.88994) + 0.53788}}{-1.99460}$$

$$= \frac{0.73320 - \sqrt{186.9638}}{-1.99460} = \frac{-12.96318}{-1.99460}$$

$$\rightarrow X = 6.50 \text{ INCHES} \leftarrow \ll$$

J-1

$C = 0.70314$

$$X = \frac{0.18284 - \sqrt{0.03343 + 4(0.99984)(48.59634)}}{-1.99968}$$

$$= \frac{0.18284 - \sqrt{194.38769}}{-1.99968} = \frac{-12.75946}{-1.99968}$$

$$X = 6.38 \text{ INCHES}$$

DECLASSIFIED

OCTOBER 4, 1984

300

NEW BECOMPLEX SAFE VESSEL DETERMINATION

J-2

$$C = 0.42186$$

$$X = 6.44 \text{ INCHES}$$

$$X = \frac{0.64932 - \sqrt{0.42186 + 4(0.9977)(45.50946)}}{0.9954} = \frac{0.64932 - \sqrt{18.0537}}{0.9954} = \frac{0.64932 - 4.25}{0.9954} = -1.9954$$

J-2

$$C = 0.42186$$

$$X = 6.44 \text{ INCHES}$$

$$X = \frac{0.75570 - \sqrt{0.57108 + 4(0.99698)(45.50946)}}{0.99396} = \frac{0.75570 - \sqrt{182.0591}}{0.99396} = \frac{0.75570 - 13.4953}{0.99396} = -1.99396$$

$$X = 6.38 \text{ INCHES}$$

OCTOBER 14, 1954

NEW RECUPLEX SAFE VESSEL DETERMINATION

DISMISSED

BOTTOM DISBURGING

SECTIONS

13735610

INTERSECTION 57%

306

NEW RECUPLEX SAFE VESSEL DETERMINATION

ACTUAL I.D. = 6.357 IN. (6 IN. 54.105)

EFFECTIVE I.D. =

E.Q. REF. TH. =

HEIGHT = 18.3125 IN. = 46.5175 CM

LOT REFLECTION = 4.3%

$$B = \left(\frac{0.4048}{H + 3.46} + 0.00390 \right) \times 0.02286 = 0.034493$$

$$R = 0.4048 - 3.46 = 10.8878 \text{ IN.}$$

$$\frac{10.06074 \text{ CM}}{0.0031633} = 3177.6$$

$$DIA. = 8.10140 \text{ INCHES} \quad ; \quad DIA. (COR.) = 7.92184$$

$$\left(\sqrt{40.1115 + B^2} \right) \times 1.043 = 8.10140$$

$$D = 4.46330 \text{ IN.} \quad ; \quad D. (COR.) = 4.15647$$

19.92105

17.27622

36" CONG

36" CONG MARKS LONGITUDINAL H = 0.60993

CM

Bot diam 6"

$$R = 0.4048 - 3.46 = 10.8878$$

$$; DIA. = 7.60983$$

TOP UP 24"

10.033573

0.18333

1.

OCTOBER 15, 1954

308

NEW RECUPLEX SAFE VESSEL DETERMINATION

DECLASSIFIED

$$A. TOTAL EFF. REFL. TH. = 10.3415 IN.$$

$$INTERACTION = 4.5 \% \quad \text{HEIGHT} = 88.5 \text{ INCHES}$$

$$SAFE EFFECTIVE ID. = 60.30 \text{ INCHES}$$

$$a = 60.30$$

$$L = \Sigma r^2 \text{ OF PROCESS LINES}$$

$$b = 10.045$$

$$L = 0.8125$$

$$X = ACT. SAFE VESSEL SIZE$$

$$X = \frac{0.56700 - \sqrt{0.32149 + 4(0.99798)(36.44000)}}{-1.99596} = \frac{0.56700 - \sqrt{145.78705}}{-1.99596}$$

$$= \frac{0.56700 - \sqrt{145.78705}}{-1.99596} = \frac{-11.50722}{-1.99596}$$

$$X = \underline{\underline{5.76526 \text{ INCHES WITH WALLS 'AS IS'}}$$

CHECK

$$a = 5.76526 \times 10.045 + 2\sqrt{9.12206} = 60.03470 + 0.24528 = 60.29998$$

CHECKS

$$2. \text{ USING } b = 10.026$$

$$X = \frac{0.4536 - \sqrt{0.20575 + 4(0.99870)(36.44000)}}{-1.99740} = \frac{0.4536 - \sqrt{145.776262}}{-1.99740}$$

$$= \frac{0.4536 - \sqrt{145.776262}}{-1.99740} = \frac{-11.62018}{-1.99740}$$

$$X = 5.81765$$

OCTOBER 13, 1954

NEW REQUIRED SAFE VESSEL DETERMINATION

DECLASSIFIED

TRUCK H-11 → 0.5. NO PB & OUTER SHELL.

ACTUAL LD OF VESSEL = 6.857 M.

HEIGHT = 88.5 M. = 334.8 CM

ALL WALL THICKNESS = 0.87650 M.

INTERACTION = 4.5% ; 5 - 1 M. REVD. LINES (WALLS & PB, HS IS)

THICKNESS OF WALLS PLUS PB = 0.87650 M.

INSIDE WALL TH. = 0.134 M.

OUTSIDE WALL TH. = 0.175 M.

PB THICKNESS = 0.5775 M.

TOTAL = 0.8765 M.

EQ. LD. - TRUCK + 5" LINES = 6.60768

45.411449

TOTAL EFF. REFL. TH. = 1.3415 INCHES

A. CRITICAL LIMIT WITH PB & OUTER SHELL REMOVED

NEW INTERACTION = 7.20% (5.8%)

NEW EFF. LD. = 7.06338 M. (6.97639)

NEW REFL. TH. = 0.6390 M. (REH = 3.45815 M.)

RL = 4.09 CM

RAD. = 3.57835 M. = 3.13956 M

$R = \left(\frac{3.4048}{2} + 0.00018 \right) = 0.003407$
 $f = \frac{0.99403}{1.00607}$
 $f = 0.99403$

CRIT. COLL. = 7.59402 = 7.59402 g/l SAFE FOR

202 MMS

CRIT. COLL. = 7.82490 = 7.82490 SAFE

310

OCTOBER 14, 1954

NEW RECUPLEX SAFE VESSEL DETECTION

B. 0.5 IN. LEAD & OUTERSHELL

DECLASSIFIED

INTERACTION =

$$\text{NEW EFF}_{0.10D_0} = \frac{7.02486}{1.02486}$$

$$\text{NEW REFL}_{0.10D_0} = 1.264$$

$$R_{0.10D_0} = 5.04 \text{ CM}$$

$$R_{AD_0} = 3.51243 \text{ IN}_0 = 8.93157 \text{ CM}$$

$$B_0 = \left(\frac{7.04048}{1.096157} \right)^2 + 0.00018 = 0.02985 \text{ CM}^{-2}$$

$$f = 0.93441 \quad \frac{1}{f} = 1.07019$$

$$\text{CRIT}_{0.10D_0} \text{ CONC}_{0.10D_0} = \frac{7.59406}{0.07019} = 108 \text{ g/l}$$

$$\text{CRIT}_{0.10D_0} \text{ CONC}_{0.400} = \frac{7.82490}{0.04584} = 170 \text{ g/l}$$

C. 0.75 IN. LEAD AND OUTER SHELL

INTERACTION =

NEW EFF_{0.10D_0} =

NEW REFL_{0.10D_0} =

R_{0.10D_0} =

R_{AD_0} = \text{IN}_0 = \text{CM}

$$B_0 = \left(\frac{7.04048}{1.096157} \right)^2 + 0.00018 = \text{CM}^{-2}$$

$$f = \quad \frac{1}{f} =$$

$$\text{CRIT}_{0.10D_0} \text{ CONC}_{0.10D_0} = \frac{7.59406}{0.07019} = \text{g/l}$$

$$\text{CRIT}_{0.10D_0} \text{ CONC}_{0.400} = \frac{7.82490}{0.04584} = \text{g/l}$$

0000029
0000018

3

may the REFL TH₀ = 0.61 ~~mm~~

HW 5.346 A

R₂ = 4.04 cm ←

$$B = \left(\frac{204048}{13017936} \right) +$$

DECLASSIFIED

0.034493 ← SAFE FOR 0 MUND / 712

REFL. TH₀ = 0.63 IN.

0.63

0.134

0.134

0.5775

0.5775

1.3415

1.3325

63

125

505

63

10135

4.5% INTERACTION

~~6.357~~

3.35

~~9.607~~

$$\sqrt{43.661449} = 6.60768$$

[Redacted]

JUNE 15, 1954

312

RECUPLEX

HW 3734620

1. TANK J-1 — NOT SAFE FOR 100 OR 200 MWD/TPU

$$\frac{1}{f} = 1.03379$$

DECLASSIFIED

a) FOR 200 MWD/TPU SOLUTIONS

$$\text{CRIT. CONC.} = \frac{7.70750}{0.01042} = \underline{739 \text{ GRAMS/LITER}}$$

b) FOR 100 MWD/TPU SOLUTIONS

$$\text{CRIT. CONC.} = \frac{7.64851}{0.01664} = \underline{459 \text{ g/l}}$$

2. TANK G-50 152.4 CM = H = 60 IN

$$\text{a-100) } \underline{175 \text{ g/l}} = \frac{7.83490}{x} \quad ; \quad x = 0.044714 = \frac{1}{f} - 1.0343$$

$$\frac{1}{f} = 1.06906 \quad f = 0.93540 = 14.137 B + 0.5127$$

$$B = 0.039920 = 0.03845 + \left(\frac{\pi}{H+12.02} \right)^2$$

$$\underline{H_c} = \frac{\pi}{\frac{0.00147}{0.03834}} - 12.02 = \underline{70 \text{ CM}} = \underline{27.5 \text{ IN.}}$$

b-200)

$$\underline{\text{CRIT. CONC.}} = \frac{7.70750}{0.05719} = \underline{135 \text{ g/l}}$$

JUNE 15, 1954

313

2

RECUPLEX (CONT'D)

HW 37346 R0

DECLASSIFIED

30 TANK G-42 60" H16H

$$a-400) 200 \text{ g/L} = \frac{70.82490}{x} \text{ g} \quad x = 0.039124 = \frac{1}{f} - 1.02435$$

$$\frac{1}{f} = 1.06347 \text{ g} \quad f = 0.94032 = 14.127 B + 0.51272$$

$$B = 0.03027 = 0.03877 + \left(\frac{\pi}{H_c + 17.2} \right)^2$$

$$\underline{H_c} = \frac{\pi}{\sqrt{\frac{0.00150}{0.03873}}} - 13.02 = \underline{6.9 \text{ cm}} = \underline{27 \text{ in.}}$$

$$b-200) \text{ CRIT. CONC.} = \frac{70.20750}{0.05160} = \underline{150 \text{ g/L}}$$

RECUPLEX

ROUGH DRAFT

C: 1. WH Reas
2. GM Muller
→ 3. RP Raftery - DD Lanning

DECLASSIFIED

W. H. Reas
23425 Bldg.
200-W Area

314

The following estimates are in confirmation of the results of our discussion concerning the nuclear safety of certain process vessels in the Recuplex installation with respect to thermal chain reactions.

The maximum safe inside diameter of the top disengaging sections of the extraction columns is estimated to be: a) 7.1 inches for 0 MWD/T plutonium solutions and b) 7.4 inches for 400 MWD/T Pu, on the basis of thermal neutron reflectors near the vessels as shown in the Recuplex installation prints. This estimate is also based on the vessel wall thickness as indicated on print No. H-2-15426 and is not to be considered valid if the wall thickness of the proposed safe tank is greater than the maximum value indicated.

The following are estimated minimum critical concentrations in tanks G-42 and J-7 for 100 and 200 MWD/T Pu solutions.

<u>Tank</u>	<u>ESTIMATED MINIMUM CRITICAL CONCENTRATION</u>	
	<u>a) 100 MWD/T Pu</u>	<u>b) 200 MWD/T pu</u>
G-42	100 grams/liter	110 grams/liter
J-7	> 150 grams/liter	Safe from thermal chain reaction

RP Raftery:as

Physics Unit
Technical Section

ROUGH DRAFT

FOR REAS

TANK G-42

HW 373460

DECLASSIFIED

$$\frac{\text{CRIT. CONC.}_{200}}{0.07010} = \frac{7.70750}{0.07010} = 109.95$$

~~CRIT. CONC.~~

$$\text{CRIT. CONC.}_{100} = \frac{7.64851}{0.07632} = 100.21$$

TANK J-7

$$\frac{\text{CRIT. CONC.}}{5} = \frac{7.70750}{5} = \infty$$

SAFE FOR 200 MWD/T Pu

$$\begin{aligned} \frac{1}{f_{\text{CRIT}}} &= 1 + \frac{w}{1-w} (0.801) \\ &= 1 + \frac{0.007}{0.993} (0.801) = 1.00562 \end{aligned}$$

NOT SAFE FOR 100 MWD/T Pu

FOR REAS

1. H-3TDS — MAX SAFE I.D.

hw 37346

DECLASSIFIED

a) $L_R = 4.446$, $EQ.$ REFL TH = 0.91 IN.

$$R = \left(\frac{2.4048}{R + 4.446} \right)^2 + \left(\frac{\pi}{58.2375} \right)^2 = 0.034493$$

0.00391

$$R = \frac{2.4048}{0.00391} - 4.446 = 9.08539 \text{ cm}$$

$$DIA_0 = \frac{2.4048}{0.00391} = 7.154 \text{ INCHES FOR } 0 \text{ MWD/T}$$

b) $0.032810 = 0.00391 + \frac{2.4048}{R + 4.446} + \left(\frac{2.4048}{R + 4.446} \right)^2$

$$R = \frac{2.4048}{0.032810 - 0.00391} - 4.446 = 9.46100 \text{ cm}$$

$$DIA_0 = \frac{2.4048}{0.032810 - 0.00391} = 7.150 \text{ IN. FOR } 400 \text{ MWD/T}$$

July 1954

3734610

Cd Shielding Effect

We know $L_T = 6.1$

$$L_B = 2.68$$

DECLASSIFIED

each ${}^{235}_{92}\text{U}$ has a certain Buckling which can be determined by either the water tamped or the Bare reactor experiments

$$B_{\frac{H}{235}}^2 = \left(\frac{2.4048}{R + L_R} \right)^2 + \left(\frac{\pi}{H + 2L_H} \right)^2$$

using the Cd covered data and knowing B for the ${}^{235}_{92}\text{U}$ the new critical height will give a value of L_R

$$L_{R_d} = \sqrt{\frac{2.4048}{B_{\frac{H}{235}} - \left(\frac{\pi}{H + 2L_H} \right)^2}} - R$$

The effect of the Cd is given by

$$\frac{L_{R_T} - L_{R_d}}{L_{R_T} - L_{R_B}} = 330$$

70
35
20
50
165
165
330

JULY 8, 1954 - Cd SHIELDING

DECLASSIFIED

REACTOR
DIAMETER

2" #125
RATIO

CD EFF. DATA
FROM a) BARUSS & b) TAMPED

12"	174	0.6032	0.4386
12"	226	0.6349	0.3175
12"	199	0.5556	0.3175
10"	43.9	0.3651	0.4762
10"	86.4	0.5714	0.4603

avg = 0.5460 ± 0.11 avg = 0.4000 ± 0.11
43 17

WHERE

$$Cd \text{ Eff.} = \frac{l_T - l_{cd}}{l_T - l_B}$$

DONE FOR 20 MIL Cd SHEATH

REDUCES REFLECTION & INTERACTION

~ 1/3

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July 3, 1954 - Effect of Cd shielding

HW 37346R

A. (CONT'D)

2. 499 TO 1 H TO U-235 RATIO

$$a) B = \left(\frac{2.4048}{21.24} \right)^2 + \left(\frac{\pi}{38.3} \right)^2 = 0.01282 + 0.00673 \\ = 0.01955 \text{ cm}^{-2} \quad (55, \text{ TAMPED})$$

$$b) B = \left(\frac{2.4048}{18.09} \right)^2 + \left(\frac{\pi}{54.60} \right)^2 = 0.01767 + 0.00331 \\ = 0.02098 \text{ cm}^{-2} \quad (55 - \text{BARE})$$

$$c) B = \left(\frac{2.4048}{15.24 + l} \right)^2 + \left(\frac{\pi}{37.08 + 2.1} \right)^2 = 0.0 \dots + 0.0 \dots$$

l

B

5 cm

$$0.01412 + 0.00539 = 0.01951$$

4.8 cm

$$0.01440 + 0.00549 = 0.01989$$

4 cm

$$0.01562 + 0.00593 = 0.02155$$

4.2 cm

$$0.01530 + 0.00581 = 0.02111$$

4.25 cm

$$0.01532 + 0.00579 = 0.02111$$

$$a) \underline{C_d \text{ EFF.} = 0.3175}$$

$$b) \underline{C_d \text{ EFF.} = 0.5556}$$

July 7, 1954 - Cd shielding effect HW 37346 R

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13" REACTORS — 226 TO 1 ATOMIC RATIO

a) SS-TAMPED

$$B = \left(\frac{2.4048}{21.024} \right)^2 + \left(\frac{\pi}{28.5} \right)^2 = 0.01282 + 0.01215$$

$$= 0.02497 \text{ cm}^{-2}$$

b) S.S. - BARE

$$B = \left(\frac{2.4048}{18.09} \right)^2 + \left(\frac{\pi}{38.2} \right)^2 = 0.01767 + 0.00976$$

$$= 0.02743 \text{ cm}^{-2}$$

$$= 0.02727 \text{ cm}^{-2}$$

$$c) B = \left(\frac{2.4048}{15.024 + l} \right)^2 + \left(\frac{\pi}{20.90 + 2l} \right)^2$$

$l \text{ (cm)}$	B
a) $\rightarrow 5$	$0.01413 + 0.01034 = 0.02447$
5.1	$0.01398 + 0.01020 = 0.02418$
b) 4.8	$0.01440 + 0.01061 = 0.02501$

a) Cd Eff. = 0.3175

b) Cd Eff. = 0.6249

$l \text{ (cm)}$	B
4.5	$0.01484 + 0.01104 = 0.02588$
3.5	$0.01647 + 0.01368 = 0.02915$
3.8	$0.01595 + 0.01315 = 0.02810$
4.0	$0.01562 + 0.01182 = 0.02744$

$$5'' = 12.70 \text{ cm}$$

322

July 8, 1954 - Cd Shielding - B.F. Juettner 346R

10" REACTORS - 86.4 TO 1 ATOMIC RATIO

a) S.S. - TAMPED

$$B = \left(\frac{2.4048}{12.70} \right)^2 + \left(\frac{\pi}{27.4} \right)^2 = 0.01654 + 0.01315 \\ = 0.03969 \text{ cm}^{-2}$$

b) S.S. - BARE

$$B = \left(\frac{2.4048}{15.55} \right)^2 + \left(\frac{\pi}{27.6} \right)^2 = 0.02392 + 0.00690 \\ = 0.03090 \text{ cm}^{-2}$$

$$c) B = \left(\frac{2.4048}{\cancel{12.70} + l} \right)^2 + \left(\frac{\pi}{\cancel{27.4} + 2l} \right)^2 =$$

$l \text{ (cm)}$	$B \text{ (cm}^{-2}\text{)}$
4	$0.02074 + 0.01097 = 0.03171$
4.5	$0.01955 + 0.01037 = 0.02992$
4.4	$0.01978 + 0.01040 = 0.03018$
(B) $\rightarrow$ 4.2	$0.02035 + 0.01068 = 0.03103$
a) $\rightarrow$ 4.55	$0.01944 + 0.01026 = 0.02970$

a) Cd Eff. = 0.4603

b) Cd Eff. = 0.5714

5" = 12.70 cm

16. ~~REDACTED~~ $l = 2.8323$ #w 37.346

July 8, 1954. — Cd Effect — B. F. Johnson

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10" REACTORS — 43.9 TO 1 ATOMIC RATIO

a) 2.5. — TAMPED

$$B = \left(\frac{204048}{12.70} \right)^2 + \left(\frac{\pi}{26.19} \right)^2 = 0.01654 + 0.01364 = 0.03018 \text{ cm}^{-2}$$

b) 5.5. — BARE

$$B = \left(\frac{204048}{15.55} \right)^2 + \left(\frac{\pi}{44.7} \right)^2 = 0.02392 + 0.0050 = 0.02895 \text{ cm}^{-2}$$

c) $B = \left(\frac{204048}{12.70 + d} \right)^2 + \left(\frac{\pi}{21.4 + 2d} \right)^2$

12.70
40.85
17.55
21.4
9.7
31.1

	$l \text{ (cm)}$	$B \text{ (cm}^{-2}\text{)}$
	4	$0.02074 + 0.01142 = 0.03216$
	5	$0.01845 + 0.01001 = 0.02846$
	4.9	$0.01867 + 0.01014 = 0.02881$
b) →	4.85	$0.01877 + 0.01020 = 0.02897$
a) →	4.5	$0.01955 + 0.01068 = 0.03023$
	4.35	$0.01989 + 0.01089 = 0.03078$
	4.40	$0.01978 + 0.01082 = 0.03060$
	4.45	$0.01966 + 0.01075 = 0.03041$

a) Cd Eff. = 0.4762

b) Cd Eff. = 0.3651

~~REDACTED~~

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27 JW 3734640

37346 RD

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$$NO_3 = 0.83 P_4 = 0.83 C$$

$$H = 11.787 - (0.0535) NO_3 = 11.787 - (0.0441) (C)$$

$$NO_3^{EFF} = \frac{V_{EFF}}{(NO_3)(V_L)} = (0.83 C) \frac{V_L}{V_{EFF}} \quad V_L = \text{effective volume} \quad V_L = \text{volume liquid}$$

$$P_4^{EFF} = C \left(\frac{V_L}{V_{EFF}} \right)$$

$$H^{EFF} = H \left[\frac{V_L}{V_{EFF}} \right] + 11.9 \left(\frac{V_{EFF} - V_L}{V_{EFF}} \right)$$

$$= (11.787 - 0.0441 C) \left(\frac{V_L}{V_{EFF}} \right) + 11.9 \left(\frac{V_{EFF} - V_L}{V_{EFF}} \right)$$

for PR: volume steel + lead = 1434 liters

Let steel be equivalent to $\frac{1}{2}$ volume water molecules
 $\frac{1434}{2} = 717$ liters water equivalent of steel.
 $V_L = 10.04$ liters, $V_{EFF} = 10.04 + 7.17 = 17.21$ liters

$$\frac{V_L}{V_{EFF}} = \frac{10.04}{17.21} = 0.58338$$

$$\frac{V_{EFF} - V_L}{V_{EFF}} = \frac{7.17}{17.21} = 0.41662$$

$$(0.83) \left(\frac{V_L}{V_{EFF}} \right) = 0.48421$$

$$-(11.9) \left(\frac{V_{EFF} - V_L}{V_{EFF}} \right) = -4.662$$

37346

923

01835C 0044412 H H H -4662 H NO₃ P_u EFF EFF EFF

70	58.1	3.109	108.68	63.40	110.02	33.89	40.8 ✓
100	83.0	4.491	107.35	62.63	109.25	48.42	58.3 ✓
150	124.5	6.642	105.13	61.33	107.95	72.63	87.5 ✓
200	166.0	8.882	102.91	60.04	106.66	96.84	116.7 ✓
250	207.5	11.103	100.68	58.73	105.35	121.05	145.8 ✓
300	249.0	13.323	98.46	57.44	104.06	145.26	175.0 ✓
400	332.0	17.764	94.02	54.85	101.47	193.68	233.4 ✓
500	415.0	22.205	89.58	52.26	98.88	242.10	291.7 ✓

$$\frac{1}{1-f} = \frac{1}{1-\frac{1}{10}} = \frac{10}{9} = 1.111$$
[illegible]

327 NW 37346 R1

P_4	$36.24(10^{-3})H^{EFF}$	A	$3.812(10^{-3})H^{EFF}$	AB	B
70	39.87	14.81	0.41940	0.33900	0.0228899
100	39.59	15.09	0.41646	0.38285	0.0253711
150	39.12	15.56	0.41151	0.42249	0.0271523
200	38.65	16.03	0.40659	0.44577	0.0278084
250	38.18	16.50	0.40159	0.46211	0.0280066 $\frac{2}{2.5} = \frac{a}{1.5}$
300	37.71	16.97	0.39668	0.47476	0.0279764
400	36.77	17.91	0.38680	0.49449	0.0276097
500	35.83	18.85	0.37693	0.51036	0.0270748

$$\alpha = \frac{17.21}{258.67} = 0.066532$$

Cal HT' = 235" 5.02' in ht.
 $\frac{2575-235}{2} = 1.13$ cover ht
 $\frac{(0.25)(14)}{(2)} = 0.25$ container ht

$$\alpha^2 = 0.0044265$$

1.9" for polychem tray
 $\frac{2.5}{2} = 1.8$ for clamps

$$H_T^{EFF}/cell = 28.58" = 72.6 \text{ cm}$$

$$V_{cell} = \frac{(23.5)^2 (1.54)^2 (72.6)}{(1.0006)} = (3.5629)(72.6) = 258.667 \text{ LITER}$$

For 1 layer $H_c = (0.066532)(72.6) = 4.83 \text{ cm}$

$$\left(\frac{1.84474}{4.83 + 12.2} \right)^2 = 0.034031$$

$\therefore$ infinite array of 1 layer sys.

For 2 layer array $H_c = 9.66 \text{ cm}$

$$B = 0.020654 + \left(\frac{2.4048}{R+6.1} \right)^2$$

$$\left(\frac{1.43714}{11} \right)^2 = 0.020654$$

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K 37346 RD

P_4	b_{mean}	$\left(\frac{2,4048}{R_c+6.1}\right)^2$	$\frac{2,4048}{R_c+6.1}$	$R_c+6.1$	R_c	R_c^2	V_c
70	0.022890	0.002236	0.04725	50.9	44.8	200.7	60.91
100	0.025371	0.004717	0.06868	35.0	28.9	835.2	25.35
150	0.027152	0.006498	0.08055	29.9	23.8	566.4	17.19
200	0.027808	0.007154	0.08455	28.4	22.3	497.3	15.09
250	0.028007	0.007353	0.08577	28.0	21.9	479.6	14.55
300	0.027976	0.007322	0.08558	28.1	22.0	484.0	14.69
400	0.027610	0.006956	0.08340	28.8	22.7	515.3	15.64
500	0.027075	0.006421	0.08013	30.0	23.9	571.2	17.33

$$\pi H_c = 30,348$$

P_4	M_s	M_T	M_{cell}	$N_0 \text{ cells}$
70	2.4851	561.4	1.406	399
100	1.4779	333.9	2.008	166
150	1.5041	339.8	3.012	113
200	1.7610	397.8	4.016	99
250	2.1214	479.2	5.020	95.5
300	2.5708	580.8	6.024	96.4
400	3.6504	824.7	8.032	102.7
500	5.0552	1142	10.04	113.7

350-14 KEUFFEL & ESSER CO.
 Millimeters, 5 mm. lines accented, cm. lines heavy.
 MADE IN U. S. A.

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PUREX PR CAN

HW 37346 R

$$\text{TOP COVER} = \frac{(\pi)(6.625)^2(0.4325)}{(4)} + \frac{(\pi)(23.5)^2(0.5625)}{(4)}$$

$$= 14.92 + 108.8 = 123.7 \text{ in}^3$$

volume steel top.

$$V_{\text{STEEL CAN}} = \frac{(\pi)(6.19)(0.4325)(23.5)}{(4)} + \frac{(\pi)(6.625)^2(0.4325)}{(4)}$$

$$= 198 + 14.93 = 212.9 \text{ in}^3$$

SOLN CAN

$$V_{\text{OUTER STEEL CAN}} = \frac{(\pi)(7.815)(0.065)(24.495)}{(4)} + \frac{(\pi)(7.880)^2(0.065)}{(4)}$$

$$= 39.1 + 3.57 = 42.3 \text{ in}^3$$

alloy can

$$V_{\text{STEEL CAN + ALLOY CAN}} = 212.9 + 42.3 = 255.2 \text{ in}^3$$

STEEL VOLUME

$$V_{\text{ALLOY}} = \frac{(\pi)(7.188)(0.5625)(23.93)}{(4)} + \frac{(\pi)(7.750)^2(0.5625)}{(4)}$$

$$= 304.1 + 26.5 = 330.5 \text{ in}^3$$

Vol. ALLOY

$$V_{\text{STEEL JACKET}} = \frac{(\pi)(23.38)(0.25)(40)}{(4)} + \frac{(\pi)(23)^2(0.25)}{(4)}$$

$$= 735 + 104 = 839 \text{ in}^3$$

STEEL VOLUME OF JACKET

$$V_{\text{STEEL TAIL}} = 1094.2 \text{ in}^3$$

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R.F. PR CAN

KW 37346 R2

$$\begin{array}{r} 5.56 \\ 5.31 \\ \hline 10.87 \end{array}$$

6" blind flange
 1/4" thick
 1/2" pipe dply
 cap - 8" 10"
 x 1/4" stud

6" flange
 O.D. = 10

$$V_{CAN} = \frac{(2)(5.435)(0.125)(54)}{(4)} + \frac{(2)(5.56)^2(0.125)}{(4)} = 115.3 + 30.3 = 118.3$$

steel volume

wood box plywood, 5 sheets @ 2' x 2' x 3/8"

4 sheets @ 2' x 6' x 3/4"

$$V_P = \frac{(5)(2)(2)(44)(0.75)}{(4)} + \frac{(4)(2)(6)(0.75)}{(4)}$$

$$V_P = 2160 + 36 = 2196 \text{ in}^3 \text{ plywood volume} \leftarrow$$

$$\text{Top FLANGE} = \frac{(2)(10)^2(0.25)}{(4)} = 12.5 \text{ in}^3 \text{ volume top flange} \leftarrow$$

$$\text{CAP} = \text{Top FLANGE} = 12.5 \text{ in}^3$$

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W37346 RD

Slowing Down Power and Moderating Ratio

A	Element	Σ	Σ_s	Σ_a	$\frac{\Sigma_s}{\Sigma_a}$	σ_s	σ_a	σ_T
	H ₂ O	1.00	0.140	1.416	0.69	0.41	0.32	-
	207Pb	0.0096	0.274	0.00263	0.399	8.3	0.2	-
	55.8Fe	0.0354	0.915	0.0324	0.156	11.0	2.5	-
	112Cd	0.0177	0.301	0.00533	0.000328	6.5	3500	-

$$\Sigma_s = \frac{(6.04)(10^{-23})(888.1)(4.2)(10^{-24})}{(1000)(16)} = 0.140$$

for O

$$\frac{(1000)(16)}{(18)(19)}$$

$$\Sigma_s = \frac{N_0 \rho \sigma_s}{A \cdot W}$$

$$S = \frac{2}{A+3}$$

probably should use inelastic scattering cross-sections instead for H₂O

$$\Sigma_s = \frac{(6.02)(10^{23})(111.9)(20)(10^{-24})}{(1000)(16)} = 0.132$$

$$\Sigma_a = \frac{(6.02)(10^{23})(111.9)(0.36)(10^{-24})}{(1000)(16)} = 0.02107$$

for H₂O

$$\Sigma_s = \frac{(6.02)(10^{23})(11.34)(8.3)(10^{-24})}{(207.2)} = 0.274$$

for Pb

$$\Sigma_a = \frac{(6.02)(10^{23})(11.34)(0.2)(10^{-24})}{(207.2)} = \text{[redacted]}$$

for Pb

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HW 37346 X1

$$\Sigma_s = \frac{(6.02)(10^{23})(7.7)(1.0)^{-14}}{(55.8)} = 0.915 \quad \text{for Fe}$$

$$\Sigma_a = \frac{(6.02)(10^{23})(7.7)(2.5)^{-14}}{(55.8)} = 0.208 \quad \text{for Fe}$$

$$\Sigma_s = \frac{(6.02)(10^{23})(8.65)(6.5)^{-14}}{(112.4)} = 0.301 \quad \text{for Cd}$$

$$\Sigma_a = \frac{(6.02)(10^{23})(8.65)(3.84)^{-14}}{(112.4)} = 1.622 \quad \text{for Cd}$$

from Annual Rep Report HW-27353 Jan 1953

Inelastic collisions

MEV	0.4	3
Fe	0.27	1.3
Pb	0.25	2.24

$$\Sigma_{\text{INELAST}} = \frac{(6.02)(10^{23})(7.7)(1.3)^{-14}}{(55.8)} = 0.108 \quad \text{for Fe}$$

Σ_{INELAST}	Σ_a
	0.52

$$\Sigma_{\text{INELAST}} = \frac{(6.02)(10^{23})(8.65)(2.24)^{-14}}{(207.2)} = 0.0737 \quad \text{for Pb}$$

	11.2

4-11-55 ①

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W 37346 10

PR can storage (cont'd)

Infinite slab

$$B = \left(\frac{\pi}{H+12.2} \right)^2$$

H-INCHES	H-cm	H+12.2	(H+12.2) ²	B	FOR f = 1,000
0.5	1.27	13.47	181.44	0.0543962	H = 111.9
1.0	2.54	14.74	217.27	0.0454257	B = 0.0344928
1.5	3.81	16.01	256.32	0.0385051	
2.0	5.08	17.28	298.60	0.0330530	B _{max} = 0.0280211
2.5	6.35	18.55	344.10	0.0286825	[P ₀ (N ₀) ₄
3.5	8.89	21.09	444.79	0.0221894	
3.0	7.62	19.82	392.83	0.0251244	
4.0	10.16	22.36	499.97	0.0197404	

for can 3 cans / 7 cans (2 layers)

$$A = (3)(23.5)(7)(23.5) = 11,597.25 \text{ in}^2 = 74,820.8 \text{ cm}^2$$

$$= \frac{\pi D^2}{4}$$

$$D^2 = (1.27323)(74,820.8) = 95,264.09$$

D = 308.65 cm (effective diameter)

$$B = \left(\frac{2.408P}{154.33+6.1} \right)^2 + \left(\frac{\pi}{H+12.2} \right)^2 = 0.00022469 + \left(\frac{\pi}{H+12.2} \right)^2$$

4.0	0.0251244	0.0251652
3.5	0.0286825	0.02872362
3.0	0.0330536	0.03309412
2.5	0.0385051	0.03854622
2.0	0.0454257	0.04546682
1.5	0.0543962	0.05443732
1.0	0.064128	0.06416942
0.5	0.0746128	0.07465402
0.0	0.08574257	0.08578412

$H = 1.11$
 $\left(\frac{H}{1.11} \right)^2$
 $B = 0.0251244 + 0.0286825 + 0.0330536 + 0.0385051 + 0.0454257 + 0.0543962 + 0.064128 + 0.0746128 + 0.08574257$
 $B = 0.36890$
 $R = 3.689 \text{ cm}$
 $D = 7.378 \times 10^{-2} \text{ cm}$
 $D^2 = 5.4436694 \times 10^{-4}$
 $A = (1.20)(23.5)(2.54) = 4.27548 \times 10^{-5}$
 $\frac{A}{D^2} = \frac{4.27548 \times 10^{-5}}{5.4436694 \times 10^{-4}} = 0.0785$
 $(1.20 \text{ cm} \text{ for } \text{cm}) - 10.955 \times 10.955 \text{ cm}$
 $8 \text{ ft } H + 240 \text{ cm in } 2 \text{ days can be delay}$
 $7 \text{ new } \text{p. 35} \text{ ftu } 397$

4.0	0.0197404	0.01996509
3.5	0.0221894	0.02241409
3.0	0.0251244	0.02534909
2.5	0.0286825	0.02890719
2.0	0.0330536	0.03327769
1.5	0.0385051	0.0387298
1.0	0.0454257	0.0456504
0.5	0.0543962	0.0546209
0.0	0.064128	0.06416942

$H = 1.11$
 $\left(\frac{H}{1.11} \right)^2$
 $B = 0.0251244 + 0.0286825 + 0.0330536 + 0.0385051 + 0.0454257 + 0.0543962 + 0.064128 + 0.0746128 + 0.08574257$
 $B = 0.36890$
 $R = 3.689 \text{ cm}$
 $D = 7.378 \times 10^{-2} \text{ cm}$
 $D^2 = 5.4436694 \times 10^{-4}$
 $A = (1.20)(23.5)(2.54) = 4.27548 \times 10^{-5}$
 $\frac{A}{D^2} = \frac{4.27548 \times 10^{-5}}{5.4436694 \times 10^{-4}} = 0.0785$
 $(1.20 \text{ cm} \text{ for } \text{cm}) - 10.955 \times 10.955 \text{ cm}$
 $8 \text{ ft } H + 240 \text{ cm in } 2 \text{ days can be delay}$
 $7 \text{ new } \text{p. 35} \text{ ftu } 397$

37346 R9
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PW 3734680

PR can: $\frac{D(5.76)(23.5)(0.016387)}{(V)} = 10.0346 \text{ liters/can}$
 (broken units)

$\frac{(10.0346)(31)}{(23.5)} = 13.237 \text{ liters/can (based on outside)}$

$V_{EFF} = 17.92 \text{ liters (AFW-397 p. 37)}$

| V | HEIGHT IN INCHES
PER LAYER (SLAB-CELL) |
|---------|---|
| 10.0346 | 1.1432 - |
| 13.237 | 1.463 |
| 17.92 | 1.980 |

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actual conc. used (not ~~of~~ ⁴⁰ 37-34610

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 $8 M H^+$

$$NO_3 = 62 H^+ + 1.3 P_4$$

$$H = 111.787 - 0.0535 NO_3 + H^+$$

P_4	$1.3 P_4$	NO_3	$0.0535 NO_3$	$H - 111.787$	H	$0.165 N$	$191.1 H$
70	91.0	587	31.405	- 23.405	88.382	96.86	168.91
100	130	626	33.491	- 25.491	86.296	103.29	164.920
150	195	691	36.969	- 28.968	82.819	114.02	158.28
200	260	756	40.446	- 32.446	79.341	124.74	151.63
250	325	821	43.924	- 35.924	75.863	135.47	144.98
300	390	886	47.401	- 39.401	72.386	146.19	138.34
400	520	1016	54.356	- 46.356	65.431	167.64	125.05

P_4	$\sum P_{1200}$	$10^4 \sum P$	$\frac{1}{P} - 1$	f	$(36.24)(10^{-3})(H)$	$3812(10^{-3})(H)$
		28.97				
70	(0.0323504)	(11.1468)	(0.15952)	(0.86243)		
	0.026577	9.1738	0.131054	0.88413	32.03	0.33691
	(0.0325944)	(11.2510)	(0.112510)	(0.89887)		
100	0.026821	9.2581	0.092581	0.91526	31.27	0.32896
	(0.0330034)	(11.3922)	(0.075948)	(0.92941)		
150	0.027230	9.3993	0.062662	0.94103	30.01	0.31571
	(0.0334104)	(11.5327)	(0.057663)	(0.94548)		
200	0.027637	9.5400	0.047700	0.95511	28.75	0.30295
	(0.0338184)	(11.6735)	(0.046694)	(0.95539)		
250	0.028045	9.6806	0.038722	0.96272	27.49	0.28919
	(0.0342264)	(11.8144)	(0.039381)	(0.96211)		
300	0.028453	9.8214	0.032738	0.96830	26.23	0.27594
	(0.0350424)	(12.0960)	(0.030240)	(0.97065)		
400	0.029269	10.1031	0.025257	0.97537	23.71	0.24942

EXCLUDING $\sum Cd = 0.0057734$

() INCLUDING Cd EFFECT

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RW37346 R

Pg	A	AB	B
		(0.43936)	(0.0193977)
70	22.65	0.46106	0.0203558
		(0.48375)	(0.0206642)
100	23.41	0.50014	0.0213643
		(0.52754)	(0.0213838)
150	24.67	0.53916	0.0218548
		(0.55687)	(0.0214758)
200	25.93	0.56650	0.0218472
		(0.58004)	(0.0213328)
250	27.19	0.58737	0.0216024
		(0.60001)	(0.0210899)
300	28.45	0.60626	0.0213075
		(0.62507)	(0.0205059)
400	30.97	0.63979	0.0204583

4-12-55

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HW 37346 R1

Base O - H⁺ - No credit for Cd poisoning

$$\begin{array}{r} 17.92 \\ 20.0346 \\ \hline 17.92 \end{array} \quad \begin{array}{r} 0.55996 \\ - 0.57734 \\ \hline \end{array}$$

$$NO_3 = 62H^+ + 0.83P_4 = 0.83P_4$$

P_4	NO_3	$0.0535NO_3$	H	NO_3 EFF	P_4 EFF	H EFF	H EFF
						49.24	
						-47.27	
70	58.1	3.108	108.68	32.53 (0.114)	39.20	60.86	110.10
				33.54	40.41	62.75	110.02
				46.48 (0.234)	56.00	60.11	109.35
100	83.0	4.441	107.35	47.92	57.73	61.98	109.25
				69.72 (0.351)	83.99	58.87	108.11
150	124.5	6.661	105.13	71.88	86.60	60.70	107.97
				92.95 (0.469)	111.99	57.63	106.87
200	166.0	8.881	102.91	95.84	115.47	59.41	106.68
				116.19 (0.586)	129.99	56.38	105.62
250	207.5	11.101	100.69	119.80	144.34	58.13	105.40
				139.43 (0.703)	167.99	55.14	104.38
300	249.0	13.322	98.47	143.76	173.20	56.85	104.12
				185.9 (0.937)	223.98	52.65	101.89
400	332.0	17.762	94.03	191.68	230.94	54.29	101.56

(111.9)(7.57)

$$17.92 = 47.27$$

P_4	$0.165N$	$1.911H$	$10 \sum$	$10^4 P$	$\frac{1}{F} - 1$	f
70	5.367	210.412	215.779	7.4483	0.190007	0.84033
	5.534	210.259	215.793	7.4487	0.184328	0.844359
	7.669	208.979	216.648	7.4783	0.133541	0.88219
100	7.807	208.788	216.695	7.4799	0.129566	0.885292
	11.504	206.609	218.113	7.5288	0.089639	0.91773
150	11.860	206.341	218.201	7.5319	0.086973	0.919988
	15.337	204.239	219.576	7.5793	0.067678	0.93661
200	15.814	203.876	219.670	7.5833	0.0656753	0.938376
	19.171	201.850	221.021	7.6292	0.054498	0.94831
250	19.767	201.420	221.197	7.6353	0.0528980	0.949759
	23.006	199.481	222.487	7.6798	0.045716	0.95628
300	23.720	198.984	222.704	7.6873	0.0443839	0.957502
	30.675	194.722	225.397	7.7803	0.034737	0.96642
400	31.627	194.091	225.718	7.7913	0.0337373	0.967364

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NW 37346

P_0	$(36.24)(10^{-2})(H^{EFF})$	A	$3.812(10^{-3})(H^{EFF})$	AB	B
	39.90	14.78	0.41970	0.33447	0.0226299
70	39.87	14.81	0.41940	0.33880	0.0228764
	39.63	15.05	0.41684	0.37919	0.0251953
100	39.59	15.09	0.41646	0.38267	0.0253591
	39.18	15.50	0.41212	0.41945	0.0270612
150	39.13	15.55	0.41158	0.42235	0.0271543
	38.73	15.95	0.40739	0.44306	0.0277780
200	38.66	16.02	0.40666	0.44556	0.0278127
	38.28	16.40	0.40262	0.45953	0.0280201
250	38.20	16.48	0.40178	0.46182	0.0280230
	37.83	16.85	0.39790	0.47222	0.0280249
300	37.73	16.95	0.39691	0.47443	0.0279849
	36.92	17.76	0.38840	0.49186	0.0276948
400	36.81	17.87	0.38715	0.49405	0.0276468

P_0	H^{EFF}	H^{EFF}
P_0^{EFF}	P_0^{ACTUAL}	
70	671	375
	651	
100	467	261
	451	
150	308	172
	298	
200	228	127
	221	
250	180	101
	175	
300	148	83
	144	
400	109	61
	105	

EFFECTIVE HEIGHT = 61.03 cm

EFFECTIVE VOL. = 17,920 cm³

$$\frac{\pi b^2 (61.03)}{(4)} = 17,920$$

$$\alpha = \frac{\pi b^2}{452} = \frac{(\pi)(2612)}{(4)(23.5)} = 0.0824$$

$$b^2 = 373,85$$

$$b = 19.335 \text{ cm} = 7.612'' \text{ EFFECTIVE DIA. OF CELL OF SOL'N}$$

$$N = \frac{5.519}{304.13} = 55.1 \text{ cells/array}$$

$$M_{\text{cell}} = (2)(17.92)(154) = 5.519 \text{ g/m}$$

$$M_T = \frac{2.065}{(0.0824)} = 304.13 \text{ kg}$$

$$154 \text{ g/g etc} = 2.75 \text{ g/g etc}$$

$$M_S = (13.409)(154) = 2.065 \text{ kg/m etc}$$

$$R_c = 20.6 \text{ cm}^3; V_c = (17)(20.6)(10.058) = 13,409 \text{ cm}^3$$

$$R_c + 6.1 = \frac{2.065}{0.09017} = 26.77$$

$$\left(\frac{R_c + 6.1}{2.065} \right)^2 = 0.008132$$

$$B_{\text{min}} = 0.02805 = \left(\frac{2.226}{11} \right)^2 + \left(\frac{R_c + 6.1}{2.065} \right)^2 = 0.019918 + \left(\frac{R_c + 6.1}{2.065} \right)^2$$

for 2 layers array $H = 122.06 \text{ cm}$

INFINITELY SAFE IN 1 LAYER ARRAY

$$B_{\text{min}} = 0.02805 = \left(\frac{5.029 + 12.2}{11} \right)^2 + \left(\frac{R_c + 6.1}{2.065} \right)^2 = 0.0332453 + \left(\frac{R_c + 6.1}{2.065} \right)^2$$

$$B_{\text{max}} = 0.02805$$

$$H = 66.03 \text{ cm for 1 layer}$$

$$H_c = \alpha H$$

$$H_c = 5.029 \text{ cm}$$

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KW 37346 R1

| P_4 | β_{calc} | $\left(\frac{2.8048}{R_{\text{calc}}}\right)$ | $\frac{2.8048}{R_{\text{calc}}}$ | R_{calc} | R_c | R_c^2 | I_c | K_c
M_s |
|-------|-----------------------|---|----------------------------------|-------------------|-------|---------|-------|----------------|
| 70 | 0.0226299 | 0.0627119 | 0.05207 | 46.2 | 40.1 | 1608 | 50.81 | 1.9918 |
| 100 | 0.0251953 | 0.0052773 | 0.07264 | 33.1 | 27.0 | 729 | 23.04 | 1.2902 |
| 150 | 0.0270612 | 0.0071432 | 0.0845 | 28.5 | 22.4 | 501.8 | 15.86 | 1.3321 |
| 200 | 0.0277780 | 0.007860 | 0.08865 | 27.1 | 21.0 | 441 | 13.93 | 1.560 |
| 250 | 0.0280201 | 0.0081021 | 0.09002 | 26.7 | 20.6 | 424.4 | 13.41 | 1.8773 |
| 300 | 0.0280245 | 0.0081065 | 0.09004 | 26.7 | 20.6 | 424.4 | 13.41 | 2.252 |
| 400 | 0.0276948 | 0.0077768 | 0.0882 | 27.3 | 21.2 | 449.4 | 14.20 | 3.1805 |

P_4	M_T	$M_{\text{CELL}} = \frac{(2)(0.794)(P_4^{\text{EFF}})}{1000} = 0.03584 P_4^{\text{EFF}}$	N
70	293.3	1.405	208
100	190.0	2.007	94.7
150	196.18	3.010	65.2
200	229.74	4.014	57.2
250	276.47	5.017	55.1
300	331.76	6.021	55.1
400	468.39	8.027	58.4

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Inv 3: 346

PR can metal volume.

$$V_1 = \frac{(\pi) \left(\frac{44.0}{2} - \frac{33.2}{2} \right)^2 (23.5)}{(4)} + \frac{(\pi) \left(\frac{84.1}{2} - \frac{71.1}{2} \right)^2 (6.625 - 5.761)}{(4)} = 0.432''$$

$$V_1 = 199.1 + 14.0 = 213.1 \text{ in}^3 \text{ can without exp.} \leftarrow$$

outer can leaden middle.
COVER - 16 gauge = 0.065" thick

$$\text{lit} = 16 \frac{3}{4} + 4 \frac{1}{16} + 4 \frac{15}{16} = 25 \frac{3}{4}''$$

$$V_2 = \frac{(\pi) \left(\frac{62.2}{2} - \frac{60.2}{2} \right)^2 (25.75)}{(4)} + \frac{(\pi) \left(\frac{64.1}{2} - \frac{60.2}{2} \right)^2 (6.025)}{(4)}$$

$$= 40.4 + 31.7 = 72.1 \text{ in}^3 \leftarrow$$

Pb-Al alloy

$$V_3 = \frac{(\pi) \left(\frac{60.2}{2} - \frac{44.0}{2} \right)^2 (24)}{(4)} + \frac{(\pi) \left(\frac{64.1}{2} - \frac{60.2}{2} \right)^2 (1.75)}{(4)}$$

$$= 305 + 82.5 = 387.5 \text{ in}^3 \leftarrow$$

Outer Jacket

$$V_4 = \frac{(\pi) \left(\frac{70.4}{2} - \frac{62.2}{2} \right)^2 (31.5)}{(4)} + \frac{(\pi) \left(\frac{64.1}{2} - \frac{62.2}{2} \right)^2 (0.25)}{(4)}$$

$$= 20.3 + 27.5 = 47.8 \text{ in}^3 \leftarrow$$

$$V_{\text{TOTAL-STEEL}} = 487.1 \text{ in}^3$$

LITERS

$\frac{1}{2}$ METAL VOL.

$$V_{\text{Vol - Pb-alloy}} = \frac{388}{875}$$

$$= \frac{6.36}{14.34}$$

$$= \frac{3.48}{12.48}$$

(7.88 liters more)

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W 37346 R

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LITERS SOLN/can = 10.04

LITERS STEEL Pb-Cd = 14.34

14.34

24.38 = 0.58818

$V_{OL}^{EFF} = 24.38 \text{ LITERS}$

$(111.9)(0.58818) = 65.82$

$NO_5 = 0.83 P_u$

$\frac{10.04}{24.38} = 0.41181$

P_u	NO_3	NO_3^{EFF}	P_u^{EFF}	$0.0535 NO_3$	H	H^{EFF}	H^{EFF}
70	58.1	23.93	✓28.83	3.108	108.68	44.76	✓110.58
100	83.0	34.18	✓41.18	4.441	107.35	44.21	✓110.03
150	124.5	51.27	✓61.77	6.661	105.13	43.29	✓109.11
200	166.0	68.36	✓82.36	8.881	102.91	42.38	✓108.20
250	207.5	85.45	✓102.45	11.101	100.69	41.47	✓107.29
300	249.0	102.54	✓123.54	13.322	98.47	40.55	✓106.37
400	332.0	136.72	✓164.72	17.762	94.03	38.72	✓104.54
500	415	170.90	✓205.91	22.203	89.58	36.89	✓102.71
	1.9111 H	0.165 NO ₃	10 Σ P _u MIN	2.897	F	F	F
70	211.33		215.28	7.4310	0.257752	0.79506	✓
	197.95	3.95	201.90	6.9692	0.241734	0.80532	✓
	210.28		215.92	7.4531	0.180988	0.84674	✓
100	196.90	5.64	202.54	6.9913	0.169774	0.85486	✓
	208.52		216.98	7.4800	0.121256	0.89185	✓
150	195.14	8.46	203.60	7.0279	0.113275	0.87892	✓
	206.78		218.06	7.5270	0.091391	0.91626	✓
200	193.40	11.28	204.68	7.0651	0.085783	0.92099	✓
	205.04		219.14	7.5643	0.0734754	0.93155	✓
250	191.66	14.10	205.76	7.1024	0.0689888	0.93546	✓
	203.28		220.20	7.6009	0.0615258	0.94204	✓
300	189.91	16.92	206.83	7.1394	0.0577901	0.94453	✓
	199.79		222.35	7.6751	0.0465948	0.95547	✓
400	186.41	22.56	208.97	7.2132	0.0437906	0.95804	✓
500	194.29	28.20	224.49	7.7490	0.037633	0.96373	✓

corrected 4-13-55

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P_0	$36.24(10^{-2})H^{eff}$	A	$2812(N^{-3})H^{eff}$	AB	θ
	40.07	14.61	0.42153	0.28737	0.019669
70	37.54	17.14	0.39485	0.32431	0.018921
	39.87	14.81	0.41943	0.34115	0.023035
100	37.34	17.34	0.39275	0.37595	0.021681
	39.54	15.14	0.41593	0.38976	0.025744
150	37.00	17.68	0.38924	0.40352	0.0218235
	39.21	15.47	0.41246	0.41764	0.026997
200	36.67	18.01	0.38577	0.44906	0.0249334
	38.88	15.80	0.40899	0.43640	0.027620
250	36.35	18.33	0.38231	0.46679	0.0254768
	38.55	16.13	0.40548	0.45046	0.027923
300	36.01	18.67	0.378798	0.48040	0.0257311
	37.89	16.79	0.39851	0.47080	0.028041
400	35.35	19.37	0.37182	0.50006	0.0258696
	37.22	17.46	0.39153	0.48604	0.027837
500					
EFFECTIVE HT = (305)(2.54) = 77.47 EFFECT VOL. = 24.38 LITERS					

$$\left(\frac{\pi b^2 (27.47)}{(4)} \right) = 24.380, \quad \frac{\pi b}{4} = 314.70$$

$$b^2 = 400.685, \quad b = 20.02 \text{ cm}; \quad b = 7.8818$$

$$\alpha = \frac{(F)(7.8818)}{(4)(23.5)} = (0.7854)(0.112490) = 0.08835$$

$$H_c = \alpha H = (0.08835)(77.47) = 6.84 \text{ cm}$$

$$\left(\frac{\pi}{684 + 12.2} \right)^2 = 0.027225 \quad \text{not safe in infinite array}$$

for 24 layers $H_c = 13.68$

$$\left(\frac{\pi}{13.7 + 12.2} \right)^2 = 0.014713$$

$$V_{CELL} = (2)(24.38) = 48.76 \text{ liters}$$

$$M_{CELL} = (48.76)(P_0^{eff})$$

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P_4	B_{seen}	$\left(\frac{2.4048}{R_{c+6.1}}\right)^2$	$R_{c+6.1}$	$R_{c+6.1}$	R_c	R_c	V_c
70	0.019669	0.004956	0.07048	34.15	28.05	786.8	33.78 ✓
	0.018921	0.004208	0.06488	37.1	31.0	961	41.50 ✓
	0.023035	0.008322	0.09123	24.34	20.26	410.5	17.64 ✓
100	0.021681	0.006968	0.08345	28.8	22.7	515.3	22.15 ✓
	0.025144	0.011031	0.1051	22.88	16.78	281.6	12.10 ✓
150	0.022824	0.008114	0.09007	26.7	20.6	424.4	18.24 ✓
	0.026997	0.012294	0.1108	21.70	15.60	243.4	10.46 ✓
200	0.024734	0.010221	0.1011	23.8	17.7	313.3	13.46 ✓
	0.027620	0.012907	0.1136	21.17	15.07	227.1	9.76 ✓
250	0.025477	0.010764	0.1037	23.2	17.1	292.4	12.57 ✓
	0.027923	0.013210	0.1149	20.93	14.83	219.9	9.45 ✓
300	0.025731	0.011018	0.1050	22.9	16.8	282.2	13.13 ✓
	0.028041	0.013328	0.1155	20.82	14.72	216.7	9.31 ✓
400	0.025870	0.01157	0.1056	22.8	16.7	278.9	11.99 ✓
500	0.027837	0.013124	0.1146	20.98	14.88	221.4	9.52

$$V_c = \pi R_c H_c$$

$$\pi H_c \left(\frac{1}{13.68} \right) = 42.977$$

$$\alpha^2 = 0.0078057$$

P_4	M_c	M_T	M_{cell}	N_c	N_{cells}
70	0.9739	124.77	1.406		
	1.1907	119.07	1.406	84.7	88.7
100	0.7264	93.06	2.008		
	0.9121	116.85	2.008	58.2	46.3
150	0.7474	95.75	3.012		
	1.1267	144.34	3.012	47.9	31.8
200	0.8615	110.37	4.016		
	1.1086	142.02	4.016	35.4	27.5
250	1.0048	128.72	5.020		
	1.2441	165.79	5.020	33.03	25.6
300	1.1475	149.57	6.024		
	1.4985	191.97	6.024	31.9	24.8
400	1.5335	196.46	8.032		
	1.9250	253.02	8.032	31.5	24.5
500	1.9603	251.13	10.040		

can stack 2 layers 3×7 each layer

can replace PR cans by cubicles.

Cubicle on top cubicle

not PR can on top cubicle

KE 10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

JW 347 R1

37346
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GM/LITERS 14

4-14-55

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HW 373462

assume cell height = 24" = 60.96 cm

$$V_{\text{cell, rounded}} = \frac{(2.57)^2 (6.54) (60.96)}{1000} = 217.19 \text{ liters}$$

$$\alpha = \frac{17.2}{217.69} = 0.079239, \alpha^2 = 0.0062788$$

For 1 layer $H_c = (60.96)(0.07924) = 4.83 \text{ cm}$

safe infinite array - 1 layer

For 2 layers: $\beta = 0.020654 + \left(\frac{2.4048}{R_c + 6.1} \right)^2$

see page 4 for V_c calc and M_s calc.

R_c	M_s	M_T	M_{CELL}	$N_s \text{ cells}$
20	2,485.1	395.8	1.406	282
100	1,477.9	235.4	2.008	117
250	1,504.1	239.5	3.012	80
500	1,761.0	280.5	4.016	70
750	2,121.4	337.9	5.020	67
1000	2,570.8	409.4	6.024	68
1500	3,650.4	581.4	8.032	72
5000	5,055.2	805.1	10.04	80

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KWS 60-000

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New approach to expanded case

$$\text{LET } B_{\alpha} = B_g \alpha^2 = 0.0062788 B_g^2 \quad 2 \text{ layers.}$$

R_4	B_g	B_{α}	$\left(\frac{2.418}{R+72.0}\right)^2$	$\frac{2.418}{R+72.0}$	$R+72.0$	R	Plot next page
70	0.022890	0.00014372	0.00001408	0.001187	2,025.9	1948.9	
100	0.025371	0.00015930	0.00002966	0.001723	1395.7	1318.7	
150	0.027152	0.00017048	0.00004084	0.002021	1189.9	1112.9	
200	0.027808	0.00017460	0.00004496	0.002119	1134.9	1057.9	
250	0.028007	0.00017585	0.00004621	0.002150	1118.5	1041.5	
300	0.027976	0.00017566	0.00004602	0.002145	1121.1	1044.1	
350	0.027610	0.00017336	0.00004372	0.002091	1150.1	1073.1	
400	0.027025	0.00017000	0.00004036	0.002009	1192.0	1120	

$$\lambda_{\alpha} = \frac{12.2}{\alpha} = \frac{62.2}{0.07923} = 784.0, \quad H_1 = 60.96 \text{ cm}$$

$$H_2 = 121.9 \text{ cm}$$

$$\left(\frac{11}{60.96 + 154.0}\right) = 0.00029510$$

$$\left(\frac{11}{21.92 + 154.0}\right) = 0.00012964$$

$$\text{Area/cell} = \frac{23.5^2}{552.25} = 552.25$$

$$R_{\text{min}} = 103.5 \text{ cm} = 407.48"$$

$$N = \frac{(11)(407.48)}{552.25} = \frac{5,216.31}{552.25} = 9.45$$

$$N = 94.5 \text{ cells}$$

compared to 67 cells by other method

RADIUS IN CM

350

37346

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3734680

for ppt. cont. $B = 0.034493$

$B = 0.00021657$: 1. approx 1 layer

for 2 layers
 $B = 0.00021657 = 0.00012964 + \left(\frac{2.1448}{R+77.0} \right)^2$

$$\left(\frac{2.1448}{R+77.0} \right)^2 = 0.00008693$$

$$R+77.0 = \frac{2.1448}{0.009324} = 25.79$$

$$R = 180.9 \text{ cm} = 71.22''$$

$$N = \frac{(17)(71.22)^2}{552.25} - (0.0056887)(5072.3) = 28.85 \text{ cells}$$

4
use 25 cells of 2 layers, 25 cells/layer

for car (3)(23.5)(26)(12.5) = 70.5 ^{4w 3435 R} _{12.5}
 = 17907 cm x 417.83 cm

$$B = \left(\frac{\pi}{191.27} \right)^2 + \left(\frac{\pi}{430.03} \right)^2 + \left(\frac{\pi}{1412.2} \right)^2$$

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$$= 0.000269777 + 0.0000533703 + \left(\frac{\pi}{1412.2} \right)^2$$

$$= 0.00032315 + \left(\frac{\pi}{1412.2} \right)^2$$

| H - INCHES | $\left(\frac{\pi}{1412.2} \right)^2$ | B | $\Sigma \frac{P}{cd} = 0.0100 \left(\frac{V_L}{V_{EFT}} \right)$
= 0.0057734 |
|------------|---------------------------------------|------------|--|
| 0.5 | 0.0543962 | 0.05471935 | |
| 1.0 | 0.0454257 | 0.04574885 | |
| 1.5 | 0.0385051 | 0.03882825 | |
| 2.0 | 0.0330536 | 0.03337615 | |
| 2.5 | 0.0286825 | 0.02900565 | |
| 3.0 | 0.0251244 | 0.02544755 | |
| 3.5 | 0.0221894 | 0.02251255 | |
| 4.0 | 0.0197404 | 0.02006355 | |

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HW 37346 R0
DECLASSIFIED

Sol'n Building - 8 M H⁺ + Cd poison

47.30

$$H_{EF} = H \left(\frac{10.0346}{1292} \right) + \frac{(111.9)(7.37)}{17.92}$$

<u>P₄ CONC</u>	<u>EFFECTIVE</u>	<u>EFFECTIVE</u>	<u>H^{EFF}</u>	<u>H^{EFF}</u>	<u>0.165 N</u>	<u>1.911 H</u>	<u>POISON</u>
<u>ACTUAL</u>	<u>EFFECTIVE</u>	<u>IND₃</u>	<u>H - 47.30</u>	<u>H^{EFF}</u>			<u>Σ CONC. Cd</u>
70(0.293) 40.41		338.90	51.03	98.33	55.92	187.92	0.030157
100(0.418) 57.73		341.41	49.82	97.12	59.63	185.61	0.030297
150(0.628) 86.60		398.94	47.81	95.11	65.83	181.76	0.030532
200(0.837) 115.47		436.47	45.81	93.11	72.02	177.94	0.030769
250(1.046) 144.34		474.00	43.80	91.10	78.21	174.10	0.031004
300(1.255) 173.20		511.52	41.79	89.09	84.40	170.26	0.031239
400(1.674) 230.94		586.58	37.78	85.08	96.79	162.60	0.031712
50(288.67							
$= \frac{10.4}{28.97} \times \frac{1}{f-1} = \frac{10.0346}{1292} \times \frac{1}{f-1} = 0.0057734 = 57.734 \times 10^{-4}$							
<u>P₄ (EFF) M</u>	<u>10.4</u>	<u>1</u>	<u>f</u>	<u>36.24(10⁻²)(H)</u>	<u>3812(10⁻³)(H)</u>	<u>AB</u>	
40.41(0.169) 10.4096		0.25974	0.793814	35.63	0.37483	0.33282	
57.73(0.242) 10.4579		0.181151	0.84663	35.20	0.37022	0.39025	
86.60(0.362) 10.5390		0.121697	0.89151	34.47	0.36256	0.44279	
115.47(0.493) 10.6208		0.091979	0.91577	33.74	0.35494	0.47467	
144.34(0.604) 10.7020		0.0741443	0.93097	33.01	0.34727	0.49754	
173.20(0.725) 0.7831		0.062258	0.94139	32.29	0.33961	0.51562	
230.94(0.966) 0.9463		0.047399	0.95475	30.83	0.32432	0.54427	

ND₃

⑤

2734680
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$\frac{H}{P_0} \text{ (Effective)}$

70	1905	0.0174708	582	336
100	1948	0.0206333	401	232
150	2021	0.0219094	263	151
200	2094	0.0226680	193	111
250	2167	0.0229600	151	87
300	2239	0.0230290	123	71
400	2385	0.0228205	88	51

$P_0(N_0)_y - N_0 H_p +$
 $P_0(N_0)_y + 8M H^T$
 $P_0(N_0)_y + 8M H^T$
 (Effective Pressure)

Attention - cylinder @ 23.1° point - 0.92% moisture
 assume 12% moisture / 0.92%
 $\alpha = -5.76$

$$B = 0.034493 = \left(\frac{H}{H+1.2} \right)$$

$$H+1.2 = \frac{0.1857}{B} = 16.9$$

$$H = 4.70 \text{ cm} = 1.85 \text{ "}$$

$$(20 \times 20)(1.54)^2 = 2580 \text{ cm}^2$$

$$\frac{2.000}{1.5} = 1.33 \text{ cm}^3 / 2000 \text{ gm}$$

$$20 \times 20 \times 2.0 = 46296 \text{ ft}^3$$

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HW 37346 R0

$$B = 0.02305 = \left(\frac{\pi}{22.26} \right)^2 + \left(\frac{2.4048}{R_c + 6.1} \right)^2$$

$$\left(\frac{2.4048}{R_c + 6.1} \right)^2 = 0.003132$$

2.09u = 1689k off.

$$R_c + 6.1 = \frac{2.4048}{0.05595} = 42.98$$

$$R_c = 36.9 \text{ cm} \quad V_c = \frac{1361.61}{\pi (36.9)^2 (1.058)} = 43.024 \text{ liters}$$

$$M_S = \frac{(43.024)(168)}{2.400} = 7.228 \text{ kg/cell}$$

$$M_T = \frac{7.228}{(0.0824)^2} = 1064.53 \text{ kg}$$

$$M_{\text{cell}} = \frac{(2)(17.42)(168)}{2.400} = 6021$$

$$N = \frac{1064.53}{6.021} = 177 \text{ cans}$$

effective conc. not react

3-18-55 ①

HW 37346 R0

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Derivation of Pb reflector effect on extrapolation

$$dL = 0.6$$

$$L_{\infty} = 6.1 + 0.6 = 6.7 \text{ cm}$$

$$\text{Thickness reactor} = 0.44$$

$$\Sigma_{\text{poison}} = (111.9)(1.11 \times 10^{-4}) = 0.021385$$

$$f = 14.1278 + 0.51272$$

$$M = \frac{(239)(10^4)(V)}{(1150)(6.02)(1-w)} \left[\frac{\Sigma_{\text{poison}}}{\frac{1}{f} - 1 - \left(\frac{w}{1-w}\right)\left(\frac{239}{240}\right)\left(\frac{925}{1150}\right)} \right]$$

$$@ 200 \text{ MW/T}, w = 0.0146$$

$$M = \frac{(239)(10^4)(V)}{(1150)(6.02)(0.9854)} \left[\frac{0.021385}{\frac{1}{f} - 1 - \left(\frac{0.0146}{0.9854}\right)\left(\frac{239}{240}\right)\left(\frac{925}{1150}\right)} \right]$$

$$M = \frac{7.4920 V}{\frac{1}{f} - 1.01187}$$

$$B = \left(\frac{\frac{1.67668}{2.4048}}{7.64 + 6.7} \right)^2 + \left(\frac{\pi}{H + 12.2} \right)^2 = 0.028123 + \left(\frac{\pi}{H + 12.2} \right)^2$$

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$$\pi^2 = 9.86965$$

HW 3: 346 R1

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H	$H+12.2$	$(H+12.2)^3$	$\left(\frac{\pi}{H+12.2}\right)^2$	B	14.1270	F	$\frac{1}{F}$
30	42.2	1780.8	.005542	.033665	0.47559	0.98831	1.01182
35	47.2	2227.8	.004430	.032553	0.45988	0.97260	1.02817
40	52.2	2724.8	.003622	.031745	0.44846	0.96118	1.04038
45	57.2	3271.8	.003017	.031140	0.43991	0.95263	1.04972
50	62.2	3868.8	.002551	.030674	0.43333	0.94605	1.05702
55	67.2	4515.8	.002186	.030309	0.42818	0.94090	1.06281
60	72.2	5212.8	.001893	.030016	0.42404	0.93676	1.06750
63	75.2	5,455.0	.001745	.029868	0.42195	0.93467	1.06989
65	77.2	5,959.8	.001656	.029779	0.42069	0.93341	1.07134
70	82.2	6,756.8	.001461	.029584	0.41793	0.93065	1.07451
75	87.2	7,603.8	.001298	.029421	0.41563	0.92835	1.07717

H	V(LITERS)	$F - 1.01187$	$\frac{1}{F - 1.01187}$	M_c
30	5.501	—	—	—
35	6.418	0.01630	393.74	2,950
40	7.335	0.02851	257.28	1,928
45	8.252	0.03785	218.62	1,633
50	9.169	0.04515	203.08	1,521
55	10.085	0.05094	197.97	1483
60	11.002	0.05563	197.77	1482
63	11.552	0.05802	199.10	1492
65	11.919	0.05947	200.42	1502
70	12.836	0.06264	204.47	1535
75	13.753	0.06530	210.61	1578

$$\frac{A}{\pi R^2} = 0.563$$

$$\frac{29}{32} = 0.906$$

$$A = \pi R^2 = 183.37 \text{ cm}^2$$

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$$W = 2 \pi R \cdot \frac{2}{3} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}$$

$$I \cdot D = 5 \frac{29}{32} \frac{15}{64} \text{ min.}$$

REFLECTORS

DECLASSIFIED

VESSEL

I.D.

HEIGHT

WALL

REACTOR

6.015"

63" (160 cm)

Pb Tumped

R = 7.64 cm

THI

6.016"

32"

SNCT

6.015" (max)

75"

FILTER

$$f = 14.127B + 0.51272$$

$$B = \left(\frac{.167698}{2.4048} \right) + \left(\frac{.0182439}{11} \right) = 0.0281226 + 0.0003328$$

$$= 0.028455$$

$$f = 0.401984 + 0.51272 = 0.914704, \frac{1}{f} = 1.0932$$

$$M = \frac{(239)(10^4)V}{(1.50)(6.02)} \left(\frac{\Sigma_{poison}}{\frac{1}{f} - 1} \right)$$

$$\Sigma_{poison} = (1.9115 \times 10^{-4})(11.9)$$

$$= 0.021385$$

$$M = \frac{7.3826V}{\frac{1}{f} - 1}$$

$$\frac{M}{V} = \frac{7.3826}{0.0932} = 79.212$$

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W37346 RD

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<u>H</u>	<u>H+12.2</u>	<u>(H+12.2)²</u>	<u>($\frac{1}{H+12.2}$)</u>	<u>B</u>	<u>14.127B</u>	<u>F</u>
35	47.2	2227.8	.004430	.032553	0.45988	0.97260
40	52.2	2724.8	.003622	.031745	0.44846	0.96118
25	37.2	1383.8	.007132	.035255	0.49805	1.0108
30	42.2	1780.8	.005542	.033665	0.47559	0.98831
50	62.2	3868.8	.002551	.030674	.43333	0.94605
45	57.2	3271.8	.003017	.031140	0.43991	0.95263
75	87.2	7603.8	.001298	.029421	.41563	0.92835
60	72.2	5212.8	.001893	.030016		0.93676
100	112.2	12588.8	.000784	.028907	.40837	0.92109
125	132.2	17436.8	.000524	.028647	.40470	0.91742
150	162.2	26308.8	.000375	.028498	.40259	0.91531

<u>H</u>	<u>V (LITERS)</u>	<u>$\frac{1}{F} - 1$</u>	<u>($\frac{V_{12}}{F - 1}$)</u>	<u>M</u>
25	4.584	-0.01069	466.18	34.42
30	5.501	0.0118	160.86	118.8
50	9.169	0.0570	178.37	1317
75	13.753	0.0771	214.46	1581
100	18.337	0.0856	254.67	1880
125	22.921	0.0900	297.36	2195
150	27.506	0.0925		

361 HW 37346 R0

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<u>4</u>	<u>V</u>	<u>$\frac{1}{f-1}$</u>	<u>$\frac{V}{f-1}$</u>	<u>M_c</u>
35	6.418	0.0281	228.40	1,686

40	7.335	0.0403	182.01	1,344

45	8.252	0.0497	166.04	1,226

60	11.002	0.06750	142.99	1203

1

Mc, in Grams

350-14 RUFFLE & LASSER CO.
Millimeters, 5 mm. It is accepted, cm. lines heavy.
MADE IN U.S.A.

W 3346 R0

3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000

Ref. relay coil as occupying annular space
Reflection due to MT coil constant (0.17")
Field coil is 0.38"

HEIGHT IN CM.

5.50 6.42 7.34 8.25 9.17 10.00 10.85 11.92 12.84 13.75

VOLUME IN LITERS

5-5-55
#W37346 RD

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Lough

CAV - assume cylinder 20' dia. - calc.
minimum critical mass.

$$R = (10)(12)(2.54) = 304.8 \text{ cm}$$

$$B_R = \left(\frac{2.4048}{304.8 + 6.11} \right)^2 = 0.000060$$

$$A = (\pi) (304.8)^2 = 291,86.41 \text{ cm}^2$$

H	H+12.2	(H+12.2) ²	$\left(\frac{B}{H+12.2}\right)^2$	B	14.127B	f	$\frac{1}{f}-1$	V	$\frac{V}{f-1}$
4	16.2	262.44	0.0376072	0.037667	0.53212				
5	17.2	295.84	0.0333614	0.033421	0.47214	0.98486	0.01537	145.9	94930
6	18.2	331.24	0.029796	0.029856	0.42178	0.93450	0.07009	175.1	24980
7	19.2	368.64	0.026773	0.026833	0.37907	0.89179	0.12134	204.3	16840
8	20.2	408.04	0.0241879	0.024248	0.34255	0.85527	0.16922	233.5	13800
9	21.2	449.44	0.021966	0.022026	0.31108	0.82380	0.21388	262.7	12280
10	22.2	492.84	0.020026	0.020286	0.28658	0.79930	0.25709	291.9	11630
12	24.2	585.64	0.016853	0.016913	0.23893	0.75165	0.33040	350.2	10590
14	26.2	686.44	0.014378	0.014438	0.20397	0.71669	0.39530	408.6	10340
16	28.2	795.24	0.012411	0.012471	0.17618	0.68890	0.45158	467.0	10340
18	30.2	912.04	0.010822	0.010882	0.15373	0.66645	0.50048	525.4	10500
20	32.2	1036.84	0.009519	0.009579	0.13532	0.64804	0.54311	583.7	10750
1-14	78180	221							
14	76340	19							
16	76340	16							
18	77520	15							

$$\left(\frac{H}{P_{a,p}}\right) = \frac{32.06}{0.019} - 9.16 = 1687 - 9 = 1678$$

5-6-55

④

HW 3734620

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assume cylinder 10' dia. - CFW

$$R = (5)(1.2)(2.54) = 152.4 \text{ cm}$$

$$B_R = \left(\frac{\frac{0.0151722}{2.4048}}{152.4 + 6.1} \right)^2 = 0.000230$$

$$A = \frac{23,225.75}{(152.4)} = 72,966. \text{ cm}^2$$

H	H+12.2	(H+12.4)	B _H	B	19,127B	F	$\frac{1}{F-1}$	V
20	32.2	1036.84	0.009519	0.009749	0.13772	0.65044	0.53742	1459.3
25	37.2	1583.84	0.007132	0.007362	0.10400	0.61672	0.62148	1824.2
30	42.2	1784.84	0.005542	0.005772	0.08154	0.59426	0.68276	2189.0
35	47.2	2227.84	0.004430	0.004660	0.06583	0.57855	0.72845	2553.8
40	52.2	2724.84	0.003622	0.003852	0.05442	0.56714	0.76323	2918.6
50	62.2	3868.84	0.002551	0.002781	0.03929	0.55201	0.81156	3648.3
10			0.020026	0.020256	0.28616	0.79888	0.25175	729.66
16			0.012411	0.012641	0.17858	0.69130	0.44654	1167.5

H	$\frac{1}{F-1}$	$\frac{1}{F}$	$\frac{1}{V}$

20 2715.3 29,046 13.7

25 29352 2,669

30 32061 23,669

35

4.

50 2898.4 21,398

10 2898.4

16 2614.5

21,398

19,302

16.5

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HW 37346 R
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assume cylinder 5' diameter - GA

$$R = (2.5)(12)(2.54) = 76.2 \text{ cm}; \quad A = \frac{5806.04}{(76.2)^2} = 18,241.51$$

$$B_R = \left(\frac{2.4048}{76.2+6.1} \right)^2 = 0.000854$$

H	B _m	B	14.127B	f	$\frac{1}{f}-1$	V	$\frac{V}{f-1}$	M	$\frac{M}{V}$
10	0.020026	0.020880	0.29497	0.80769	0.23809	183.42	766.2	5457	31
16	0.012411	0.013265	0.18739	0.70011	0.42834	291.86	681.4	5031	17
20	0.009519	0.010373	0.14654	0.65926	0.51685	364.83	705.9	5211	14
5	0.007132	0.007986	0.11282	0.62554	0.59861	456.04	761.8	5624	12
30	0.005542	0.006396	0.09036	0.66308	0.65815	547.25			
35	0.004430	0.005284	0.07465	0.58737	0.70250	638.45			
40	0.003622	0.004476	0.06323	0.57595	0.73626	729.66			
50	0.002551	0.003405	0.04810	0.56082	0.78310	912.08			

soil absorption max of 18 grams/liter

$$= \frac{(18)}{0.035316} = 509 \text{ grams/ft}^3$$

$$\frac{(333)}{1.8} = H = 37.0$$

$$\frac{-18}{239} = P_H = -0.0753$$

$$\frac{H}{P_H} = 493$$

water retention of soil 30% by volume
 1 liter soil - 333 ml H₂O

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W 37346 K1

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Wessel Vol. - CONCENTRATION

G-16	12.0	458	
G-17	12.0	458	
G-28	12.0	458	
G-42	34.0	162	
G-46	19.0	289	
G-47	47.0	117	
G-48	47.0	117	
G-4	8.0	688	
J-1	47.0	117	
J-2	34.0	162	
J-3	34.0	162	
J-4	16.0	500	
J-5	8.0	688	
J-6	12.0	458	
J-7		250	@ 250
J-30	22.0	250	
J-31	1.3	4230	

$$(2000)(360)(0.01) = 7200 \text{ gm/yr}$$

$$(230)(1.00) = 5.75 \text{ gm/ft}^2$$

$$(241)(1.00) = 602 \text{ gm/ft}^2$$

$$(0.26)(929) = 241 \text{ gm/ft}^2 \text{ based on water table}$$

for and 30-wells and by ref. water.

$$(1.1)(7.25)(1.1)(0.016)(371)$$

7 1/2" x 12" 816mm

- 813

5-6-55
 3:34 PM
 387

$$H/P_u = 1000$$

$$P_u = \frac{10}{239} = 0.0418 \text{ mols/liter}$$

$$H = 41.8 \text{ atmos/liter} \left[(20.9)(18.016) = 376.5 \text{ gm H}_2\text{O/liter} \right]$$

$$\frac{H}{P_{u, \text{max}}} = \frac{111.9}{0.0418} = 2677$$

$$\frac{H(239)}{(500)} = 50$$

$$H = 104.6$$

$$\frac{H}{P_u} = 50$$

$$H = 2.09$$

$$\frac{129}{239} = 0.07113 \text{ mols/liter}$$

$$\frac{111.9}{0.07113} = 1573$$

$$\frac{H}{P_u} = 50 = \frac{32.06}{C} - 9.16 =$$

$$C = \frac{32.06}{59.16} = 0.541 \text{ (541 g/l)}$$

$$\frac{H}{C} = 1000 = \frac{32.06}{C} - 9.16$$

$$C = \frac{32.06}{1009.16} = 0.0318 \text{ (318 g/l)}$$

5-9-55

$$\begin{array}{r} 0.125 \\ 0.13 \\ \hline 0.112 \end{array}$$

37346 R

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Check of Remyx Safe Tanks:

DECLASSIFIED

	D-31	G-54	J-5
I.D.	5.806"	5.806"	5.806"
THK	0.112"	0.112"	0.112"
HT ϕ_H	20.25"	20.25"	20.25"
Vol.	8.0 L	8.0 L	8.0 L
I.D. EFFECTIVE	1.16	6.1695"	6.24854
R-eff. (cm)		7.8352	7.9356
Reflector thk.			0.52" + frame work supports.
(assume 1.0")
$l_{eff} = 5.3 \text{ cm}$		$l_{eff} = 3.87 \text{ cm}$	assume $l = 1.0 \text{ cm}$
$B_R = \left(\frac{2.4008}{7.936 + 5.3} \right)^2 = 0.03301$		equiv Reflect = 1.7"	
$B_R = \left(\frac{2.187786}{7.936 + 4.83} \right)^2 = 0.035264$			
			$f = 1.0109$ safe OK

D-31, G-54, J-5 safe @ 5.5 Kg
J-7 R+l = 13.59 cm

$$\begin{array}{r} 5.58 \\ 5.3 \\ \hline 28 \end{array} \quad \begin{array}{r} 13.6 \\ 1.0 \\ \hline 13.5 \end{array}$$

6-16, 17, 28

17/128

$$\theta = \frac{2.4048}{9.13+3.20} + 0.002944 = 0.03309 + 0.002944 = 0.036034$$

$$L = 4.43 \text{ cm} \approx 0.8'' \text{ approx} \therefore 5-6 \text{ OK}$$

$$\theta_{5.6} = \frac{2.4048}{9.124+L} + 0.002944 = 0.034293$$

$$9.124+L = \frac{2.4048}{0.1775} = 13.55$$

$$L = 3.49 \text{ cm}$$

0.326

89

6-28 2.094

89

6-16 2.094

89

6-17 2.094

1.275

5-6 2.094

7.1949"

1/2" Mark

18.25"

OK

$$\theta_4 = \frac{2.4048}{9.17+4.2} = 0.002944$$

$$\theta_2 = \frac{2.4048}{9.17+4.2} = 0.032353$$

$$\theta_R = \frac{2.4048}{9.30+4.2} = 0.03173 \text{ cm}^{-2}$$

$$0.034674$$

B

0.17813 2.72240 9.17

Nominal 7"

5-4 2.094" 3.20 7.3210" 9.30 0.70" 4.2cm 18"

DECLASSIFIED

REF ID: A6748

3734670

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5-9-55

5

$$V_{\text{atrad}} = (\pi) (9.525)^2 = 285.02 \text{ cm}^2$$

$$= 390 \text{ W} \quad 37340 \text{ K}$$

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	I.D.	INTERACTION	I.D. EFF.	R-cm	EFF. Reflect	L	H.T.
J-50	6.00"	7.408%	6.4445	8.1845	0.756"	4.3cm	48"
J-50 JACKET	7.50"	"	8.0556	10.231	"	4.3cm	47"

$$B_H = \left(\frac{0.023424}{\pi} \right)^2 = 0.000549$$

$$B_1 = \left(\frac{0.192692}{2.4048} \right)^2 + 0.000549 = 0.037130 + 0.000549 \therefore \text{safe.}$$

$$B_2 = \left(\frac{0.21408}{10.23+4.3} \right)^2 + 0.000557 = 0.027392 + 0.000557 = 0.027949$$

$$f = 0.39484 + 0.51272 - 0.90756 \quad \frac{1}{f} = 1.7018$$

$$@ 0 \text{ mwd/T} \quad C_0 = \frac{7.59406}{0.1018} = 75.6 \text{ GM/L}$$

$$@ 400 \text{ mwd/T} \quad C_{400} = \frac{7.82890}{0.07745} = 101 \text{ GM/L}$$

H	θ_H	B	14.127B	f	$\frac{1}{f}-1$	V	$\frac{V}{\frac{1}{f}-1}$	M
25	0.007132	0.034524	0.48772	1.00044				∞
30	0.005542	0.032934	0.46526	0.97798	0.02251	8.551	379.88	2804
35	0.004430	0.031822	0.44955	0.96227	0.03920	9.976	254.23	1877
40	0.003622	0.031014	0.43813	0.95085	0.05169	11.401	220.56	1628
50	0.002551	0.029943	0.42300	0.93572	0.06869	14.251	207.46	1532
60	0.001893	0.029285	0.41371	0.92643	0.07941	17.101	215.35	1590
65	0.001656	0.029048	0.41036	0.92308	0.08332	18.526	222.34	1641

safe old mwo / T

$$B = \left(\frac{9.38 + 1.70}{2.4028} \right) + \left(\frac{76.84 + 1.2}{11} \right) = 0.033801 + 0.001245 = 0.035046$$

7.049" 0.141" 4.75% 7.384 9.378 3.70 30 1/2"

G-46 I.O. T.K. 2.4028 I.O. R.cm

$L = 4.41 \text{ cm @ } 0.55 \text{ " reflection$

$$9.69 + L = \frac{2.4028}{0.1705} = 14.10$$

$$\frac{9.69 + L}{2.4028} = 0.029075$$

$$B = 0.034493 = \left(\frac{9.69 + L}{2.4028} \right) + 0.005418$$

$$B_H = \left(\frac{30.48 + 1.2}{11} \right) = 0.005418$$

$L = 3.26 \text{ cm}$ infinite height angle @ 0.25"

$$9.69 + L = \frac{1.1857}{2.4028} = 12.95$$

$$9 = 0.034493 = \left(\frac{9.69 + L}{2.4028} \right)$$

$L = 306$

5.5 7.094 0.141" 7.67 7.633" 9.694

9 1/2" safe

I.O. T.K. 2.4028 I.O. R.cm

391 3734640

12-4-55
 12-4-55
 12-4-55

$R = (5)(1.2)(2.54) = 15.27 \text{ cm}$

$(17)(152.5) = 73061 \text{ cm}^2$

$B_a = \left(\frac{52.94753}{2.408} \right) = 0.0002056$

Calc - γ NO_3 - m^2/L $H = 11.9 \text{ g/L} = 11.01 \text{ moles/L}$

and m^2/L H_2O } 1000 g/L H_2O

$\frac{10}{28.97} \frac{f}{f-1}$ $\frac{36.24 \text{ H}_2\text{O}}{3.812 \times 10^{-3}}$ $\frac{A}{AB}$

5 0.021556 7.4408 1.48816 0.40190 40.55 0.42656 14.13

7.83 0.95038 0.51272 0.74408 0.57337 0.06665

15 0.496053 0.66843 0.37204 0.72884 0.21612

25 0.297632 0.77064 0.28854 0.31196 0.33044

30 0.248026 0.80126 0.28854 0.31196 0.33044

45 0.165351 0.85811 0.34539 0.34539 0.34539

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5-10-55 ①

RECEIVED

HW 37346 K0

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H ₂ O	Size			
P ₄	P ₄	H-cm	V	Mass
7.83	3.13	∞		
10	4.00	112.5	8219.36	32,880
15	6.00	49.0	3580.0	21,480
20	8.00	35.7	2,608	20860
25	10.00	29.7	2170	21700
30	12.00	26.2	1914	22970
35	14.00	23.9	1746	24440
40	16.00	22.2	1622	25950
45	18.00	21.0	1534	27610
50	20.00	20.1	1468	29360

$$(0.26)(73,061) = 18,996 \text{ grams}$$

$$(230)(75) = 17,250 \text{ grams}$$

Basis: 2000 liters / day C4H @ 0.01 g/L = 20 grams / day

$$\frac{2000 \text{ p}}{20} = 1000 \text{ days}$$

@ 3/6, 3 gm / liter

$$D_{\text{dilute}} = (6.1)(3.163) = 19.3$$

Pu	$\frac{B_{\text{SOIL}}}{D_{\text{DILUTE}}}$	B_R	B_H	$\frac{B_R}{B_H} = \frac{\left(\frac{0.0140058}{2.4048}\right)}{\left(\frac{153.4+19.3}{4.7+2.2}\right)} = 0.00019.6$	Soil	H	V	Pu	Mass
203	0.0004292	0.000196	0.0002332	0.01528	205.6	167.0	12,201	316	38,555
15	0.001102	"	0.0009060	0.0301	104.4	65.8	4,807	474	22,785
10	0.0015295	"	0.0013335	0.03652	86.0	47.4	3,463	6.32	21,886
25	0.0018253	"	0.0016293	0.04036	72.8	39.2	2864	7.91	22,654
30	0.0020420	"	0.001846	0.04297	73.1	34.5	2521	9.49	23,924
35	0.0022078	"	0.0020118	0.04485	70.0	31.4	2294	11.07	
40	0.0023386	"	0.0021426	0.04629	67.9	29.3	2141	12.65	
45	0.002444	"	0.0022484	0.04742	66.3	27.7	2024	14.23	
50	0.0025318	"	0.0023358	0.04833	65.0	26.4	1928	15.81	

KG
CRITICAL
MASS

K&E 10 X 10 TO THE 1/2 INCH
KEUFFEL & ESSER CO.
MADE IN U.S.A. 358-11

KW 3734620

C4W

396

DELETED

MASS

10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

32,500
32,000
31,000
30,000
29,000
28,000
27,000
26,000
25,000
24,000
23,000
22,000
21,000
20,000

P4 CONC IN SOIL (GM/LIT-R)

$$BR = \frac{2.42 - 0}{13.59} \cdot 13.70$$

5-10-55 (17)

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W 37346R0

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	I.D.	% INTERACT	EFF I.D.	LR	Rm
G-42	6.357"	5.85	6.729	4.49cm	8.55

$$B = \left(\frac{.18441}{\frac{2.4048}{8.55+4.49}} \right) + \left(\frac{.019086}{\frac{75}{152.4+11.4}} \right)$$

13.04 164.6

$$= 0.034007 + 0.0003643 = 0.034371$$

safe @ 5.5 KG.

	I.D.	% INTERACT	LR	EFF I.D.
J-2	5.3473%		4.29	6.357"

J-3	5.50%	"	"	"

J-2 & J-3 safer than G-42

	I.D.	% INTERACT	LR	EFF I.D.	THK	H.T.
J-1	1.357	1.3%	3.86			67.38"

safer than G-42

	I.D.	% INTERACT
G-47	6.357"	4.15%

G-48	6.357"	5.10%

G-47 and G-48 safer than G-42 (based on BR)

	I.D.	% INTERACT	REF THK	LR	LR	EFF I.D.	Rm	THK	H.T.
H-11	6.36	4.5	0.134"	5.12	5.23	6.65	8.45	STEEL	0.359" 88.5"

$$BR = \left(\frac{.174513}{\frac{2.4048}{8.45+5.23}} \right) = 0.030455$$

13.78

$$B_H = \left(\frac{.0133668}{\frac{22.479+10.24}{235.03}} \right) + \left(\frac{2 Ph}{2.578} \right) = 0.00178$$

B = 0.030634; f = 0.94549

$$(4.063) + (4.063) = 33.02 = 5.75" \quad 6.36" \text{ limiting I.D.}$$

LR = 3.25 cm for 0.134" [REDACTED] $(4.23 - 3.25) \times 0.18 = 0.21$ in increase des 4 Ph

LR = 4.23 cm [REDACTED] $LR = 4.44 \text{ cm} + 0.125" \text{ steel} = 4.67 \text{ cm}$

HW 5-11-35 37346

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COLUMNS H-1 & H-2 B.D.S. 4" sch 10 I.D. = 4.26

6" sch 10 I.D. = 6.357

$R = \sqrt{18.75 + 4041} = 7.65$ safe the H-3 B.D.S.
 I.D. EFF. R-cm l_R

T.D.S assume 10% interaction 6.6 8.38 4.45

$R = \frac{0.187435}{\left(\frac{2.4048}{8.38 + 4.45} \right)} = 0.35130$

H-1 & H-2 safe > 5.5 Kg

COLUMN H-3 6" dia glass top x 18" long

assume 2 1/2% interaction (frank vessels 2% apart - actually just for H-2)

I.D.	INTERACT.	EFF. I.D.	R	l	H
Top 6"	2.5	6.15	7.81	4.47 cm	18"

$R = \frac{19583}{\left(\frac{2.4048}{2844.47} \right)} = 0.0383434$ safe > 5.5 Kg

Bottom: $V = \frac{(0.16753)(6.357)(4562)(0.016387)}{(4)} = 3.413$ liters in bellows

section of B.D.S.
 Put volume around B.D.S - assume HT same = 6.562"

$3.413 = (0.16753)(6.625)(W)(6.562)(0.016387)$
 $W = \frac{3.413}{(20.813)(0.10753)} = 1.525$ width of sol'n band

$C_3 = l \left(1 - \frac{D_1^2}{D_2^2} \right) + l_5 \frac{D_1^2}{D_2^2}$, $l_5 = \frac{C}{D_2^2 - D_1^2}$ & $C = 15.3(D_2^2 - D_1^2)$

$\frac{(2.4048)}{(R + 3.8)} = 0.04493$; $R_5 + 3.46 = 12.95$
 $R_5 = 9.49$ cm
 $D_5 = 7.47$ "

OK OK

16.67 24.87 833.48 .011841 .034601 0.48881 1.2015

$\theta = \lambda_T = 6.1 \text{ cm}$

45 52.44 2749.5 .003589 .024349 .37223 .88495 .13000 92.2 70.9 523
 40 47.44 2250.5 .004385 .027145 .38348 .89620 .11582 82.0 76.8 523
 35 42.44 1801.5 .005480 .028246 .39895 .91167 .09688 71.7 74.0 526
 30 37.44 1407.5 .007041 .029801 .42000 .93372 .07098 61.5 86.6 639
 25 32.44 1052.5 .009379 .03139 .45403 .96675 .03939 51.2 148.9 1049
 20 27.44 726.59 .010652 .03342 .47201 .98473 .01550 4.71 303.9 2244

18 25.44 647.19 .015250 .038010 .53697 1.04969

16.67 24.11 581.29 0.016979

15 22.44 503.55 0.019600

12 19.44 377.91 0.026116

10 17.44 304.15 0.032450

8 15.44 238.39 0.041401

5 12.44 154.75 0.063778

H H+7.44 (H+7.44) B B+ f f-1 V f-1 M

$\therefore B = \left(\frac{2.4048}{12.48+3.46} \right) = 0.022760$
 $\theta = 9.83'' = R = 12.48 \text{ cm}$

$\theta = 3.26 \left(1 - \frac{44.2}{44.2} \right) + 4.03 \left(\frac{44.2}{44.2} \right) = 3.96 (0.5424) + 4.84 = 1.88 + 1.84 = 3.72$

$\theta = \left(\frac{46.8}{65.8-44.2} \right) = \frac{46.8}{21.6} = 2.17$

$\therefore C = 15.3 \left(\frac{74.7}{2} - 9 \right) = 15.3 = 46.8$

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A = 0

3734600

H-1 21.6
 H-2 21.6
 L1-3 27.4

} middle section

5.0 = 4.063"
 THK = 0.15"

Old dimensions 6" x 10" pipe 88 1/2" long
 wall 8" O.D. 1/2" thick

2 1.125
 0.0 = 6.625
 1.0144 = 7.75

H-11 38 Lbs
 G-47 47 Lbs
 G-44 47 Lbs
 J-1 47 Lbs
 -2 34"
 -3 34"
 C-42 34"
 H-3 805 9.9 Lbs
 TOS 8.4"
 H-11 5.7 Lbs
 H-11 2 BPS
 TOS 15.8 Lbs

15361

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5-11-55
 3734640
 (16)

14-11 critical mass

$$A = (\pi)(8.077) = 204.95 \text{ cm}$$

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H	β_m	B	$14.127B$	F	$\frac{1}{F} - 1$	V	$\frac{1}{F} - 1$	M
50	0.002551	0.33006	44629	0.97900	0.2145	10.25	477.85	3529
60	0.001893	0.32348	45698	0.96970	0.3124	12.30	393.72	2907
65	0.001656	0.32111	45363	0.96635	0.3482	13.32	382.53	2824
75	0.001298	0.31753	44857	0.96129	0.4026	15.37	381.76	2818
80	0.001161	0.31616	44664	0.95936	0.4236	16.40	387.15	2858
85	0.001045	0.31500	44500	0.95772	0.4414	17.42	394.65	2914
100	0.000784	0.31239	44131	0.95403	0.4818	20.50		
125	0.000524	0.30979	43764	0.95036	0.5223	25.62		
150	0.000375	0.30830	43554	0.94826	0.5456	30.74		

$\therefore$ giving extra credit for Pb reflector good to only 2900gms
no extra " " " " " " for 5500gms

0.000857 difference in Buckling for the 0.2 cm³ increase in radial term

$$f_1 = 0.94549 \text{ (see p. 14)} \quad \frac{1}{f} - 1 = 0.05765$$

$$\frac{1}{f} - 1.02435 = 0.03330$$

$$\frac{1}{f} - 1,02435 = 0,03330$$

$$C_0 = \frac{7.59406}{0.05765} = 132 \text{ g/K}$$

$$C_{\text{exp}} = \frac{7.82490}{0.03330} = 2359/L$$

Based on radial term alone $f = 0.94296$, $\frac{1}{f} - 1 = 0.06049$
 $\frac{1}{f} - 1.06415 = 0.03614$

$$\frac{1}{F} = 1.06415 \therefore 0.03614$$

$$C_0 = 125 \text{ g/L}$$

$$C_{\text{Cu}} = 217 \text{ g/L}$$

$f = 0.32430 + 0.51272 - 0.83702, \pm -1 = 0.19471, C = 39 \text{ g/L}$
 $\text{Max I.O.} = 8.063 - 0.009 = 7.954, B = \left(\frac{16.20}{2.4028} \right) = 0.022036, \theta = 0.022956$
 $C = 38 \text{ g/L}$

$f = 0.32201 + 0.51272 - 0.83473, \pm -1 = 0.19799$

$\text{I.O.} = 10.16$
 $R = 10.16$
 $B = \left(\frac{14.786}{2.4028} \right) + 0.000920 - 0.021874 + 0.000920 = 0.022794$

$C = 42 \text{ g/L}$
 $f = 0.33453 + 0.51272 - 0.84725, \pm -1 = 0.18028$

$\text{I.O.} = 7 \frac{1}{2}$
 $H.T. = 36$
 $R = 9.84$
 $B = \left(\frac{9.84 + 6.11}{2.4028} \right) + 0.022760 + 0.000920 = 0.023680$
 $f = 0.33453 + 0.51272 - 0.84725, \pm -1 = 0.18028$

after 5.5 kg

$B_R = \left(\frac{2.4028}{7.76 + 5.33} \right) = 0.033750$
 13.09

Total 5.844 4.572 6.11 7.76 5.33

I.O. DIRECT I.O. R R

H-11 6.002 - 5844
 7.1" 0.0. x 1/8" wall
 1.3415" wall

37346
 0.474" P6
 0.125
 109

Judson 5-5-55

37346

1

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Process specifications for nuclear safety

1) Subia Storage 8' dia x 40' on side

5/16" steel underground

Pu density 0.01 gm Pu/cc of solids

2) CAW crib -

120'

90'

60'

18'

HW 37346 R

404

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3) Limits for J-7 fast vs thermal
max safe mass.

Max limits for fast chain reaction
"thermal" "

Pot density

J-1, B-47, G-48

[Redacted]

5-11-55 ①

KW 37346 R0
40-DECLASSIFIED

SAFE DIARY BASED ON SOLUBILITY OF P_4 IN HNO_3 SOLN

HCL - 32100

P_4	H^+	$0.83 P_4$	NO_3	$0.0535 NO_3$	H	$1.9264 H$	$0.165 NO_3$	$10 \sum$	$\frac{10 \sum}{28.97}$
20	0.65	16.6	56.9	3,044	109,393	210,735	9,389	229,124	7.5982
40	0.94	33.2	91.5	4,895	107,832	207,723	15,098	222,821	7.6913
60	1.09	49.8	117.4	6,281	104,596	205,347	19,371	224,718	7.7568
80	1.17	66.4	138.9	7,431	105,526	203,285	22,919	226,204	7.8081
100	1.22	83.0	158.6	8,485	104,522	201,351	26,169	227,520	7.8535
120	1.24	99.60	176.5	9,443	103,584	199,544	29,123	228,667	7.8931
140	1.25	116.2	193.7	10,363	102,674	197,791	31,961	229,752	7.9306
160	1.26	132.8	210.9	11,283	101,764	196,038	34,799	230,837	7.9680
180	1.26	149.4	227.5	12,171	100,876	194,328	37,538	231,866	8.0036
200	1.26	166.0	244.1	13,059	99,988	192,617	40,277	232,894	8.0390
300	1.26	249.0	327.1	17,500	95,547	184,042	53,972	238,034	8.2165
400	1.26	332.	410.1	21,940	91,107	175,509	67,667	243,176	8.3939
500	1.26	415.	493.1	26,381	86,666	166,953	81,362	248,315	8.5713
1000	1.26	830	908.1	48,583	64,464	124,183	149,837	274,020	9.4586
2000	1.26	1660	1738.1	92,988	20,059	38,642	286,787	325,429	11.2332

5-12-55
#W37346R²

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P_u	$\frac{1}{F}-1$	F	$36.24(10^{-2})H$	$3812(10^{-3})H$	A	AB	B	$\sqrt{B}$	$R+2.68$
20	0.37991	0.72468	39.64	0.41701	15.04	0.22151	0.014728	0.1214	19.81
40	0.19228	0.83873	39.08	0.41106	15.60	0.34151	0.021892	0.1479	16.26
60	0.12928	0.88552	38.63	0.40634	16.05	0.39302	0.024487	0.1565	15.37
80	0.09760	0.91108	38.24	0.40227	16.44	0.42265	0.025709	0.1604	14.99
100	0.07854	0.92718	37.88	0.39844	16.80	0.44258	0.026344	0.1623	14.82
120	0.06578	0.93828	37.54	0.39486	17.14	0.45726	0.026678	0.1633	14.73
140	0.05665	0.94639	37.21	0.39139	17.47	0.46884	0.026837	0.1639	14.67
160	0.04980	0.95256	36.88	0.38792	17.80	0.47848	0.026881	0.1640	14.66
180	0.04446	0.95743	36.56	0.38454	18.12	0.48673	0.026861	0.1639	14.67
200	0.04020	0.96135	36.24	0.38115	18.44	0.49404	0.026792	0.1637	14.69
300	0.02739	0.97334	34.63	0.36423	20.05	0.52295	0.026082	0.1615	14.89
400	0.02098	0.97945	33.02	0.34730	21.66	0.54599	0.025207	0.1587	15.15
500	0.01714	0.98315	31.41	0.33037	23.27	0.56662	0.024350	0.1561	15.41
1000	0.00946	0.99063	23.36	0.24574	31.32	0.65873	0.021032	0.1451	16.57
2000	0.00562	0.99441	7.27	0.07646	47.41	0.83179	0.017545	0.1325	18.15

5-12-55-3
 #W 34346 RD
 DECLASSIFIED

407

P_4	R	$D_{s,p}$	$P_4(M)$	H/P_4
20	17.13	13.49	0.0837	1307
40	13.58	10.69	0.1474	694
60	12.69	9.92	0.2510	425
80	12.31	9.69	0.3347	315
100	12.14	9.56	0.4184	250
120	12.05	9.49	0.5021	206
140	11.99	9.44	0.5858	175
160	11.98	9.43	0.6694	152
180	11.99	9.44	0.7531	134
200	12.01	9.46	0.8368	119
300	12.21	9.61	1.2552	76
400	12.47	9.82	1.6736	54
500	12.73	10.02	2.0920	41
1000	13.89	10.94	4.1840	15
2000	15.47	12.18	8.3680	2

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408 2734672

Suppose 1 gm Pu has associated it with it a minimum of 100 cc of inert material.

Suppose to have x gms Pu / liter water;

(at least)

then x gms Pu occupies a volume of $1 + .1x$ liters.

If only Pu metal were present (no inert material), then in a solution having x gms Pu/liter water, x gms Pu would occupy $1 + \frac{1}{16,000}x$ liters ~ 1 liter.

Ratio of ^{effective} densities is $1 + .1x$, hence ratio of critical masses is $(1 + .1x)^2$

For dilute metal-water mixture, x gms Pu/liter water $\sim x$ gms Pu/liter solution.

Hw 37346R

409

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From Plot of M_c vs sphere Radius

$R+6.1$	R	R^3	V	M_c	$\frac{M}{V}$	$\frac{X}{(1+1X)}$	$M_{155} = M_c \left(\frac{d_2}{d_1} \right)$
21.3	15.2	3512	14.71	508	34.5	19.80	10,058
22	15.9	4020	16.84	513	30.5	16.46	8,413
23	16.9	4827	20.22	532	26.3	13.18	7,012
24	17.9	5735	24.02	560	23.3	11.09	6210
25	18.9	6751	28.28	597	21.1	9.67	5773
26	19.9	7881	33.01	640	19.4	8.64	5530
27	20.9	9129	38.24	690	18.0	7.84	5410
28	21.9	10,503	43.99	744	16.9	7.24	5387

(746)

WHERE $X = \text{gm } P_4 / \text{liter } H_2O$ $d_1 = 1.000$

30	23.9	13,652	57.18	872	15.25	6.38	5563
32	25.9	17,374	72.77	1021	14.03	5.77	5891
34	27.9	21,718	90.97	1193	13.11	5.34	6371
36	29.9	26,739	111.97	1389	12.41	5.02	6973

AW37346 RD

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$R+6.1$	$(R+6.1)^2$	B	14.1270	f	$\frac{1}{f}-1$	$\frac{V}{\frac{1}{f}-1}$	M
28	784	0.012589	0.17784	0.69056	0.44810	98.17	746
30	900	0.010966	0.15492	0.66764	0.49781	114.86	872
32	1024	0.009638	0.13616	0.64888	0.54111	134.48	1021
34	1156	0.008538	0.12062	0.63339	0.57893	157.13	1193
36	1296	0.007615	0.10758	0.62030	0.61212	182.92	1389

[REDACTED]

FOR SILICA SLURRY TANK - RECUPLEX

HW 3:34:00

DELETED

KE 10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.
CRITICAL MASS

R+G.1

GENERAL ELECTRIC
COMPANY

[REDACTED] 2

pw 35346R0

May 17, 1955

DECLASSIFIED

J. M. Smith, Manager
Radiological Engineering Section

NUCLEAR SAFETY IN THE RECUPLEX
UNDERGROUND DISPOSAL BASIN

Recent calculations made by personnel in the Physics Research Sub-Section indicate that additional data concerning the ion exchange properties of the soil east of the 234-5 Building are necessary to determine criticality control requirements for the Recuplex underground disposal basin.

The maximum amount of plutonium that may be safely discharged to the basin without possibly approaching a critical mass condition is dependent upon the plutonium absorption capacity of the soil and the volume percentage of retained water. If it is assumed that the plutonium absorption capacity of the soil is equal to the total ion exchange capacity, the resulting criticality control requirements limit the volume of plutonium-bearing wastes discharged to the crib to approximately 70 per cent of the minimum volume originally anticipated (i.e. with no water percolation through the soil). The presence of large amounts of salts in the waste solutions, however, will presumably reduce the plutonium absorption capacity of the soil to some value appreciably lower than the total exchange capacity and may thus relieve the criticality control limitations.

Since the absorption capacity under process conditions is not presently known, the severe restrictions on the use of the disposal basin have been adopted.

It would be of great assistance to the Recuplex program if suitable laboratory tests would be made by Earth Sciences personnel to determine the plutonium absorption capacity of the basin soil under process conditions. Your cooperation in this matter would be appreciated.

KM Harmon

Head, 234-5 Development
Separations Technology Section
ENGINEERING DEPARTMENT

KM Harmon/BFJ:efg

cc: RE Brown - DW Rhodes
KM Harmon
OF Hill
GM Muller - N. Ketzlach

[REDACTED]

$$A_1 = (\pi) (7.315)^2 = 468.1$$

$$A_2 = (\pi) (23.445)^2 = 1734.21 \text{ cm}^2$$

6-27-55
HW 57346 RR

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Interaction of low PR can with fair RC can

$$l_1 = 4.45 \text{ cm}; l_2 = 3.02 \text{ cm}$$

$$L = 2.88 + 9.25 + 0.125 + 1.06 = 13.32''$$

$$\sin \frac{\theta}{2} = \frac{9.25}{13.32} = 0.6944; \frac{\theta}{2} = 43.98^\circ; \theta = 87.96^\circ; \alpha = 0.2443; \frac{1}{2}\alpha = 0.12215$$

$$\sin \frac{\phi}{2} = \frac{2.88}{13.32} = 0.2162; \frac{\phi}{2} = 12.48^\circ; \phi = 24.96^\circ; \beta = 0.0693; \frac{1}{2}\beta = 0.03465$$

$$\alpha = \frac{\frac{1}{2}\alpha}{\frac{1}{2}\alpha + \frac{1}{2}\beta}; \beta = \frac{\frac{1}{2}\beta}{\frac{1}{2}\alpha + \frac{1}{2}\beta}; \alpha \beta = \frac{0.12215 \cdot 0.03465}{0.12215 + 0.03465} = 0.004254$$

$$@ H = 6 \text{ cm}; \beta_H = 0.029796; \beta_r = \frac{0.0693}{1.64} = 0.036139; \alpha \beta = \frac{0.12215 \cdot 0.036139}{0.12215 + 0.036139} = 0.004254$$

$$l_r = \frac{0.087288}{2.1048} = 0.04147; \alpha = \frac{0.036139}{0.065935} = 0.54810; \beta = \frac{0.036139}{0.065935} = 0.54810; \alpha \beta = \frac{0.036139 \cdot 0.54810}{0.036139 + 0.54810} = 0.065935$$

$$\alpha \beta = 0.004254; \left\{ 1 - \frac{0.034493}{0.065935} \right\} \left\{ 1 - \frac{0.037415}{0.065935} \right\} = 0.004254$$

$$(0.47687) (1 - 26.727 \beta_{mat}) = 0.004254$$

$$1 - 26.727 \beta_{mat} = 0.0089206$$

$$26.727 \beta_{mat} = 0.9910794$$

$$\beta_{mat} = 0.0370815$$

$$\text{assume } H = 8 \text{ cm}; \beta_H = 0.024188; \alpha = \frac{0.0693}{0.060327} = 0.59905; \beta = \frac{0.0693}{0.060327} = 0.59905; \alpha \beta = \frac{0.0693 \cdot 0.59905}{0.0693 + 0.59905} = 0.21955$$

$$\beta = \frac{0.034493}{0.060327} = 0.02491; \alpha \beta = 0.005469$$

$$(1 - \frac{0.034493}{0.060327}) (1 - \frac{\beta_{mat}}{0.031807}) = 0.005469; (0.42824) (1 - \frac{\beta_{mat}}{0.031807}) = 0.005469$$

$$1 - 31.439 \beta_{mat} = 0.012771; 31.439 \beta_{mat} = 0.987229$$

$$\beta_{mat} = 0.031401; C_p = 166 \text{ g/L}; M_c^p = 2303$$

414

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1A

1437376 RD

Cor PR can = 5 KG

H	VOL	C	ρ_{MAT}	β_1	$\frac{\rho_{MAT}}{\beta_1}$
34	5.718	874	0.03389	0.036735	0.92255
36	6.054	826	0.03385	0.03659	0.93099
38	6.391	782	0.033813	0.03627	0.93854
40	6.727	743	0.033775	0.035733	0.94520
50	8.409	595	0.03360	0.03462	0.96936
60.96	10.089	496	0.033432	0.033955	0.98459

$$\left\{ \begin{matrix} 0.01541 \\ 1 - 0.98459 \end{matrix} \right\} \left\{ 1 - \frac{\rho_{MAT}}{\beta_2} \right\} = 0.01254$$

$$1 - \frac{\rho_{MAT}}{\beta_2} = 0.64892 \alpha \beta$$

$$\frac{\rho_{MAT}}{\beta_2} = 1 - 0.64892 \alpha \beta$$

$$\text{use } \alpha \beta; \frac{\rho_{MAT}}{\beta_2} = 1 - 0.32.446 \alpha \beta$$

H	$\alpha \beta$	$32.446 \alpha \beta$	$\frac{\rho_{MAT}}{\beta_2}$	β_2	ρ_{MAT}	V _L	C	M ₀
10	0.006759	0.21930	0.78070	0.027645	0.021582	17.342	325	581
12	0.008093	0.26259	0.73741	0.024472	0.018046	20.811	244	508
14	0.009444	0.30642	0.69358	0.021997	0.015257	24.299	19.8	481
16	0.010792	0.35016	0.64984	0.020030	0.013016	27.747	17.0	472
18	0.012179	0.39321	0.60679	0.018441	0.011190	31.216	15.1	471
20	0.013414	0.43523	0.56477	0.017138	0.009679	34.684	13.6	472
22	0.014663	0.47576	0.52424	0.016057	0.0084177	38.153	12.6	481
24	0.015861	0.51463	0.48537	0.015151	0.007354	41.621	11.8	491

$$f = 14.1276 + 0.51272$$

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(10)

H	B	f	$\frac{f-1}{V}$	$\frac{f-1}{M}$
14	0.015257	0.21554	0.72826	0.37313
16	0.013016	0.18388	0.69660	0.43554
18	0.011190	0.15808	0.67040	0.49075
20	0.009679	0.13674	0.64946	0.53974
22	0.0084177	0.11892	0.63164	0.58318
24	0.007354	0.10389	0.61661	0.62177
26	0.006431	0.09047	0.60364	0.6542
28	0.005687	0.07948	0.5926	0.684
30	0.005087	0.07040	0.58318	0.71747
32	0.0045388	0.06204	0.5742	0.7507
34	0.0040367	0.0542	0.5653	0.7831
36	0.003587	0.047354	0.5564	0.8153
38	0.003190	0.04117	0.5474	0.8471
40	0.002827	0.03554	0.5384	0.8794
42	0.002490	0.030389	0.5294	0.9121
44	0.002173	0.02554	0.5204	0.9453
46	0.001887	0.02117	0.5114	0.9784
48	0.001627	0.01721	0.5024	1.0117
50	0.001392	0.01361	0.4934	1.0453
52	0.001181	0.01039	0.4844	1.0784
54	0.001000	0.00735	0.4754	1.1117
56	0.000841	0.00490	0.4664	1.1453
58	0.000704	0.00282	0.4574	1.1784
60	0.000587	0.00158	0.4484	1.2117
62	0.000490	0.00084	0.4394	1.2453
64	0.000403	0.00047	0.4304	1.2784
66	0.000327	0.00024	0.4214	1.3117
68	0.000257	0.00013	0.4124	1.3453
70	0.000190	0.00007	0.4034	1.3784
72	0.000139	0.00004	0.3944	1.4117
74	0.000096	0.00002	0.3854	1.4453
76	0.000064	0.00001	0.3764	1.4784
78	0.000045	0.00000	0.3674	1.5117
80	0.000031	0.00000	0.3584	1.5453
82	0.000021	0.00000	0.3494	1.5784
84	0.000014	0.00000	0.3404	1.6117
86	0.000009	0.00000	0.3314	1.6453
88	0.000006	0.00000	0.3224	1.6784
90	0.000004	0.00000	0.3134	1.7117
92	0.000003	0.00000	0.3044	1.7453
94	0.000002	0.00000	0.2954	1.7784
96	0.000001	0.00000	0.2864	1.8117
98	0.000000	0.00000	0.2774	1.8453
100	0.000000	0.00000	0.2684	1.8784

H	B	f	$\frac{f-1}{V}$	$\frac{f-1}{M}$
14	0.015257	0.21554	0.72826	0.37313
16	0.013016	0.18388	0.69660	0.43554
18	0.011190	0.15808	0.67040	0.49075
20	0.009679	0.13674	0.64946	0.53974
22	0.0084177	0.11892	0.63164	0.58318
24	0.007354	0.10389	0.61661	0.62177
26	0.006431	0.09047	0.60364	0.6542
28	0.005687	0.07948	0.5926	0.684
30	0.005087	0.07040	0.58318	0.71747
32	0.0045388	0.06204	0.5742	0.7507
34	0.0040367	0.0542	0.5653	0.7831
36	0.003587	0.047354	0.5564	0.8153
38	0.003190	0.04117	0.5474	0.8471
40	0.002827	0.03554	0.5384	0.8794
42	0.002490	0.030389	0.5294	0.9121
44	0.002173	0.02554	0.5204	0.9453
46	0.001887	0.02117	0.5114	0.9784
48	0.001627	0.01721	0.5024	1.0117
50	0.001392	0.01361	0.4934	1.0453
52	0.001181	0.01039	0.4844	1.0784
54	0.001000	0.00735	0.4754	1.1117
56	0.000841	0.00490	0.4664	1.1453
58	0.000704	0.00282	0.4574	1.1784
60	0.000587	0.00158	0.4484	1.2117
62	0.000490	0.00084	0.4394	1.2453
64	0.000403	0.00047	0.4304	1.2784
66	0.000327	0.00024	0.4214	1.3117
68	0.000257	0.00013	0.4124	1.3453
70	0.000190	0.00007	0.4034	1.3784
72	0.000139	0.00004	0.3944	1.4117
74	0.000096	0.00002	0.3854	1.4453
76	0.000064	0.00001	0.3764	1.4784
78	0.000045	0.00000	0.3674	1.5117
80	0.000031	0.00000	0.3584	1.5453
82	0.000021	0.00000	0.3494	1.5784
84	0.000014	0.00000	0.3404	1.6117
86	0.000009	0.00000	0.3314	1.6453
88	0.000006	0.00000	0.3224	1.6784
90	0.000004	0.00000	0.3134	1.7117
92	0.000003	0.00000	0.3044	1.7453
94	0.000002	0.00000	0.2954	1.7784
96	0.000001	0.00000	0.2864	1.8117
98	0.000000	0.00000	0.2774	1.8453
100	0.000000	0.00000	0.2684	1.8784

C

$$\text{Let } \frac{\theta_R}{\theta_R + \theta_H} = \frac{\theta_R}{\theta} = F$$

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6-27-55

HW 37346 RB

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H	θ_H	θ_1	θ_2	F_1	F_2	α	$\bar{\theta}$	$\alpha\bar{\theta}$	$\frac{0.034403}{\theta_1}$
10	0.020026	0.056165	0.027645	0.643344	0.27560	0.23582	0.02866	0.006759	0.61413
12	0.016853	0.052992	0.024472	0.68197	0.31134	0.24994	0.03238	0.008093	0.65090
14	0.014378	0.050517	0.021997	0.71538	0.34637	0.26219	0.03602	0.009444	0.68279
16	0.012411	0.048550	0.020030	0.74436	0.38038	0.27281	0.03956	0.010792	0.71046

18	0.010822	0.046961	0.018441	0.76955	0.41316	0.28204	0.04297	0.012119	0.73450
20	0.009519	0.045658	0.017138	0.79151	0.44457	0.29009	0.04624	0.013414	0.75546
22	0.008438	0.044577	0.016057	0.81070	0.47450	0.29712	0.04935	0.014663	0.77378
24	0.007532	0.043671	0.015151	0.82752	0.50287	0.30329	0.052298	0.015861	0.78983

H	T_1	T_2	$\frac{\theta_{HNT}}{\theta_2}$	θ_{HNT}	C^P	C_0	V_1	V_2	M_2
8						106			2303
10	0.8587	0.017516	0.982484	0.027161	65	87.5	1.681	17.342	1272
12	0.34910	0.023182	0.976818	0.023905	42.5		2.017	20.811	884
14	0.31721	0.029772	0.970228	0.021342	32.8		2.353	24.279	796
16	0.28954	0.037272	0.962728	0.019283	27.2		2.690	27.747	754
18	0.26550	0.045645	0.954355	0.017599	23.6		3.026	31.216	737
20	0.24454	0.054854	0.946146	0.016198	21.2		3.362	34.684	735
22	0.22622	0.064817	0.936183	0.015016	19.5			38.153	744
24	0.21017	0.075467	0.924533	0.014008	18.3			41.621	762

7.59406

$\frac{1}{f} - 1$

7.82490

$\frac{1}{f} - 1.02435$

$$C = \left(\frac{A}{1-w} \right) \left[\frac{\sum P_{153W}}{\frac{1}{f} - 1 - \left(\frac{w}{1-w} \right) D} \right]$$

6-27-55

③

$$A = \frac{81.848}{(7)(2.047)^2} = 257.13 \text{ cm}^2$$

$$H = 30.48 \text{ cm} \quad V_T = 7.84 \text{ liters}$$

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Interaction vacuum traps

$$I.D. = 7\frac{1}{8}"; \quad O.D. = 8"$$

$$\phi \text{ to } \phi = 18^\circ$$

$$\text{rod dia} = \frac{1}{4}'' @ \frac{8.875 - 7.125}{2} = 0.88'' \text{ from sol'n (6 rods)}$$

$$\text{flange } 8'' \text{ with } @ 6'' \text{ from vessel } \phi \quad \phi_1 = 0.40 \text{ cm}$$

$$9'' \phi \text{ vessel to 1st bond wall}$$

$$\phi_2 = 0.40 \text{ cm}$$

$$(27'' \phi \text{ " " 2nd bond wall}$$

$$\phi_3 = 0.14 \text{ cm}$$

for rods

$$\phi_4 = 0.70 \text{ cm}$$

$$\phi_5 = 1.14 \text{ cm}$$

$$\text{for pyrex 73% of mentioned reflected back; } \phi = (1.14)(0.73) = 0.83 \text{ cm}$$

$$L = 2.68 + 0.83 = 3.51 \text{ cm}$$

$$\text{with no credit for pyrex: } L = 2.68 + 1.14 = 3.82 \text{ cm}$$

$$B_R = \left(\frac{2.4048}{9.64 + 3.82} \right)^2 = 0.034913$$

6.5% interaction based on bond cylinders

$$R^{EFF} = (2.047)(1.065) = 2.198662$$

$$B_H^{MAX} = 0.005418$$

$$B_R = \left(\frac{2.4048}{9.64 + 3.82} \right)^2 = 0.031922 \text{ (safe)}$$

$$B_R^{MAX} = 0.029075$$

for completely lamped

$$L = 14.10 - 9.64 = 4.46 \text{ cm (max)}$$

$$\frac{2.4048}{9.64 + L} = 0.1706$$

$$B_R = \left(\frac{2.4048}{9.64 + 6.1} \right)^2 = 0.023342$$

$$\phi = (6.1 - 2.68)(0.73) = 2.50'' \quad L = 5.18 \text{ cm}$$

$$B_R = \left(\frac{2.4048}{9.64 + 5.18} \right)^2 = 0.026331$$

+18

HW 37346

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(Isdn complete stamping $B_2 = 0.02334$)

H	B	14.1278	f	$\frac{1}{f}-1$	V	$\frac{V}{f-1}$	M ₀	$\frac{1}{f-0.1187}$	$\frac{1}{f-0.1181}$	M ₁₀₀
18	0.039164	0.48263	0.99535	0.00467	4.628	991.00				
20	0.032861	0.46423	0.97695	0.02359	5.143	218.02				
22	0.031780	0.44896	0.96168	0.03984	5.657	141.99				
24	0.030874	0.43614	0.94888	0.05387	6.171	114.55				
26	0.030106	0.42531	0.93803	0.06606	6.685	101.20				
28	0.029449	0.41603	0.92875	0.07671	7.200	93.86				
30	0.028884	0.40804	0.92076	0.08605	7.714	89.65	681	0.07418	103.99	801
30.48	0.028760	0.40629	0.91901	0.08812	7.837	88.94	675	0.07625	102.78	792
32	0.028394	0.40112	0.91384	0.09428	8.228	87.27	663	0.08241	99.84	769

Based on total reflecta - giving credit for Pyrex $B = 0.026331$

H	B	14.1278	f	$\frac{1}{f}-1$	V	$\frac{V}{f-1}$	M ₀	$\frac{1}{f-1.03687}$	$\frac{1}{f-1.03151}$	M ₁₀₀
24	0.033863	0.47838	0.99110	0.00897	6.171					
26	0.033095	0.46753	0.98025	0.02014	6.685					
28	0.032438	0.45825	0.97097	0.02989	7.200					
30	0.031873	0.45027	0.96299	0.03843	7.714	200.73	1524	0.00156	4945	39,280
30.48	0.031749	0.44852	0.96124	0.04032	7.837	194.37	1476	0.00345	2271.6	18,044
32	0.031383	0.44335	0.95607	0.04594	8.228	179.10	1360	0.00907	907.16	7206

$$(500)(7.837) = 3919 \text{ gm @ } 500 \text{ g/L}$$

3000

6-27-55

419

410 37346

Completely tapered basis (cont'd)

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H	$\frac{1}{F} = 0.02435$	$\frac{V}{F} = 0.02435$	M_{400}	$\frac{1}{F} = 0.03687$	$\frac{V}{F} = 0.02435$	M_{600}
30	0.06170	125.02	978	0.04918	156.85	1246
30.48	0.06377	122.89	962	0.05125	152.92	1215
32	0.06993	117.66	921	0.05741	143.32	1138

$$B_R = 0.007619$$

H	B	14.127B	F	$\frac{1}{F} - 1$	V	$\frac{V}{F} - 1$	M_0	$\frac{1}{F} = 0.01187$	$\frac{V}{F} = 0.0087$	M_{100}
8	0.031807	0.44934	0.96206	0.03943	13.874	35186				
10	0.027645	0.39054	0.90326	0.10710	17.342	161.92				
12	0.024472	0.34572	0.85844	0.16490	20.811	126.20				
14	0.021997	0.31075	0.82347	0.21437	24.279	113.26				
16	0.020030	0.28296	0.79568	0.25678	27.747	108.06	821	0.24491	113.29	873
18	0.018441	0.26052	0.77324	0.29325	31.216	106.45	808	0.28138	110.94	855
20	0.017138	0.24211	0.75483	0.32480	34.684	106.29	811	0.31293	110.84	854
22	0.016057	0.22684	0.73956	0.35215	38.153	108.34	823	0.34028	112.12	864
24	0.015150	0.21404	0.72676	0.37597	41.621			0.36410		
26	0.014383	0.20319	0.71591	0.39682	45.089					
28	0.013726	0.19391	0.70663	0.41516	48.558					
30	0.013161	0.18593	0.69865	0.43133	52.026					
32	0.012671	0.17900	0.69172	0.44567	55.495					

H	$\frac{1}{F} = 0.02435$	$\frac{V}{F} = 0.02435$	M_{400}	$\frac{1}{F} = 0.03687$	$\frac{V}{F} = 0.03687$	M_{600}
16	0.23243	119.38	934	0.21991	126.17	1002
18	0.26890	116.09	908	0.25638	121.76	967
20	0.30045	115.44	903	0.28793	120.46	957
22	0.32780	116.39	911	0.31528	121.01	961
24	0.35162	118.37	926	0.33910	122.76	975
26	0.37247			0.35995		
27	0.39081			0.35994		
30	0.40698			0.37011		

18.5" I.D. $l = 4.05 \text{ cm}$

42/

Summary

#2 37376 #

(NO INTERACTION)

% INCREASE

OVER DENSITY

COMPLETELY TAMPERED

% INCREASE

OVER DENSITY

N 3/4

GM

0

800

0

740

DECLASSIFIED

200

850

6.25%

775

4.73%

400

900

12.5%

825

11.49%

600

950

18.75%

875

18.24%

$l = 4.05 \text{ cm}$

with PR can interaction (same can $l = 4.05 \text{ cm}$)

MWD

GM (5 KG IN PR CAN)

3 KG IN PR CAN

1.5 KG IN PR CAN

5 KG IN SOLN (NO)

0

470

630

720

750

200

490

660

760

790

400

560

700

800

840

600

530

730

850

880

from HW-25374: AC can in jacket - annulus
fully in water $l = 5.75 \text{ cm}$

PR can 5000 grams

SN Hold Tank $M_0 = 630$; $M_{200} = 680$; $M_{400} = 735$
 $M_{600} = 800$

2 VAC TRAPS ∇ 3000 gms

Filter Boat Cleaning and Testing Hood
Sink Mass

MWD

MASS / 2 SINKS

0

750

200

790

400

840

600

890

6-29-55 E

NA 37346A

4L

DECLASSIFIED

Interaction bar RC can with bar PR can

assume 3 Kg in PR can.

H	Vol	C	β_{MAT}	β_1	$\frac{\beta_{MAT}}{\beta_1}$
34	5.718	524.7	0.03349	0.036735	0.91166
36	6.054	496	0.033432	36359	0.91949
38	6.391	469	0.033375	36027	0.92638
40	6.727	446	0.033328	35733	0.93269
50	8.409	357	0.03304	34662	0.95320
60.56	10.089	297	0.03272	33955	0.96362

$$\left\{ \begin{array}{c} -2+1 \\ 0.3638 \\ 1-0.96362 \end{array} \right\} \left\{ 1 - \frac{\beta_{MAT}}{\beta_1} \right\} = \frac{\alpha\beta}{2}$$

Divided by 2 because of Pb and Cd
reflected - only $\frac{1}{2}$ of neutrons go in
forward direction

$$1 - \frac{\beta_{MAT}}{\beta_1} = \frac{27.49}{2} \alpha\beta = 13.75 \alpha\beta$$

$$\frac{\beta_{MAT}}{\beta_1} = 1 - 13.75 \alpha\beta$$

H	$\alpha\beta$	$13.75 \alpha\beta$	$\frac{\beta_{MAT}}{\beta_1}$	β_1	β_{MAT}	141250	f	$\frac{1}{f} - 1$
10	0.006759	0.09294	0.90706	0.027645	0.025076	0.35425	0.86697	0.15344
12	0.008093	0.11128	0.88872	0.024472	0.021749	0.30725	0.81997	0.21955
14	0.009444	0.12986	0.87014	0.021997	0.019140	0.27039	0.78311	0.27695
16	0.010792	0.14839	0.85161	0.020030	0.017058	0.24098	0.75370	0.32678
18	0.012119	0.16664	0.83336	0.018441	0.015368	0.21710	0.72982	0.37020
20	0.013414	0.18444	0.81556	0.017138	0.013977	0.19745	0.71017	0.40811
22	0.014663	0.20162	0.79838	0.016057	0.012820	0.18111	0.69383	0.44127
24	0.015861	0.21809	0.78191	0.015151	0.011847	0.16736	0.68008	0.47041

2-29-55

423

6-29-55 ②

270 37346

RECEIVED

H	V	$\frac{V}{F-1}$	M_0	$\frac{1}{F-1.0187}$	$\frac{V}{F-1.01187}$	M_{200}	$\frac{1}{F-1.02435}$	$\frac{1}{F-1.02435}$	M_{400}
10	17.342	113.02		0.14157	122.497		0.12909	134.340	
12	20.811	94.789		0.20768	100.207		0.19520	106.613	
14	24.279	87.665	666	0.26508	91.591	706	0.25260	96.116	752
16	27.747	84.916	645	0.31491	88.110	679	0.30243	91.746	718
18	31.216	84.321	640	0.35833	87.115	671	0.34585	90.258	706
20	34.684	84.986	645	0.39624	87.532	675	0.38376	90.579	707
22	38.153	86.461	657	0.42940	88.851	685	0.41692	91.511	716
24	41.621	88.478	672	0.45854			0.44606		

H	$\frac{1}{F-1.03687}$	$\frac{V}{F-1.03687}$	M_{600}
10	0.11657	148.768	
12	0.18268	113.920	
14	0.24008	101.128	803
16	0.28991	95.709	760
18	0.33333	93.648	744
20	0.37124	93.427	742
22	0.40440	94.344	749
24	0.43354		

RECEIVED

6-29-55

②

424

HW 37346RR

DECLASSIFIED

Assume 1.5 K₀ in PR can

H	VOL	C	B _{MAT}	B ₁	$\frac{B_{MAT}}{B_1}$
34	5.718	262	0.03252	0.036735	0.88525
36	6.054	248	0.03241	0.036759	0.89138
38	6.391	235	0.03230	0.036827	0.89654
40	6.727	223	0.03218	0.036933	0.90056
50	8.409	178	0.03162	0.037662	0.91223
6096	10.089	149	0.03106	0.038955	0.91474

$$\left\{ \begin{array}{l} 0.08526 \\ 1 - 0.91474 \end{array} \right\} \left\{ 1 - \frac{B_{MAT}}{B_2} \right\} = \alpha \beta$$

$$1 - \frac{B_{MAT}}{B_2} = \frac{11.73}{2} \alpha \beta = 5.87 \alpha \beta$$

$$\frac{B_{MAT}}{B_2} = 1 - 5.87 \alpha \beta$$

H	$\alpha \beta$	$5.87 \alpha \beta$	$\frac{B_{MAT}}{B_2}$	B ₂	B _{MAT}	14.1215	f	$\frac{1}{f} - 1$	$\frac{V}{f} - 1$	M.
10	0.006759	0.03968	0.96032	0.027645	0.026548	0.37504	0.88776	0.12643	132.17	
12	0.008093	0.04751	0.95249	0.024472	0.023309	0.32929	0.84201	0.18763	110.92	
14	0.009444	0.05544	0.94456	0.021997	0.020777	0.29352	0.80624	0.24032	101.03	767
16	0.010792	0.06335	0.93665	0.020030	0.018761	0.26504	0.77776	0.28574	97.105	737
18	0.012119	0.07114	0.92886	0.018441	0.017129	0.24198	0.75470	0.32502	96.043	729
20	0.013414	0.07874	0.92126	0.017138	0.015789	0.22305	0.73577	0.35912	96.580	733
22	0.014663	0.08607	0.91393	0.016057	0.014675	0.20731	0.72003	0.38883	98.122	745
24	0.015861	0.09310	0.90690	0.015151	0.013740	0.19410	0.70682	0.41478		

RC reflector as is

425

DECLASSIFIED

H	$\frac{1}{F-1.01187}$	$\frac{V}{F-1.01187}$	M_{200}	$\frac{1}{F-1.02435}$	$\frac{V}{F-1.02435}$	M_{400}
10	0.11456	151.38		0.10208	169.89	
12	0.17576	118.41		0.16328	127.46	
14	0.22845	106.28	819	0.21597	112.42	880
16	0.27387	101.314	781	0.26139	106.15	831
18	0.31315	99.683	768	0.30067	103.82	812
20	0.34725	99.881	770	0.33477	103.605	811
22	0.37696	101.21		0.36448	104.68	819
24	0.40291			0.39043		

H	$\frac{1}{F-1.03687}$	$\frac{V}{F-1.03687}$	M_{600}
10	0.08956	193.63	
12	0.15076	138.04	
14	0.20345	119.34	948
16	0.24887	111.491	886
18	0.28815	108.332	861
20	0.32225	107.630	855
22	0.35196	108.401	861
24	0.37791		

426

DECLASSIFIED

Assume 5 kg in PR can - in sol'n ($H^+ = 0.11$)

H	C	β_{MAT}	β_1	$\frac{\beta_{MAT}}{\beta_1}$
34	874	0.02215	0.036735	0.60296
36	826	0.02250	0.036359	0.61882
38	782	0.02285	0.036027	0.63424
40	743	0.02313	0.035733	0.64730
50	595	0.02430	0.034662	0.70105
60.96	496	0.02512	0.033955	0.73980
60.96	150	(MAX)
0.02800	0.033955	0.82462

$$\left\{ \begin{matrix} 0.17538 \\ 1 - 0.82462 \end{matrix} \right\} = \left\{ 1 - \frac{\beta_{MAT}}{\beta_2} \right\} = \frac{\alpha \beta}{2}$$

$$\left\{ 1 - \frac{\beta_{MAT}}{\beta_2} \right\} = \frac{5.702}{2} \alpha \beta = 2.851 \alpha \beta$$

$$\frac{\beta_{MAT}}{\beta_2} = 1 - 2.851 \alpha \beta$$

H	$\alpha \beta$	$2.851 \alpha \beta$	$\frac{\beta_{MAT}}{\beta_2}$	β_2	β_{MAT}	14.1276	f	$\frac{1}{f}-1$	$\frac{V}{f-1}$	M_c
10	0.006759	0.019270	0.98073	0.027645	0.027112	0.38301	0.89573	0.11646	148.99	
12	0.008093	0.023073	0.976927	0.024472	0.023907	0.33773	0.85045	0.17584	118.35	
14	0.009444	0.026925	0.973075	0.021997	0.021405	0.30239	0.81511	0.22682	107.041	813
16	0.010792	0.030768	0.969232	0.020030	0.019414	0.27426	0.78698	0.27068	102.508	778
18	0.012119	0.034551	0.965449	0.018441	0.017804	0.25152	0.76424	0.30848	101.193	768
20	0.013414	0.038243	0.961757	0.017138	0.016483	0.23286	0.74558	0.34123	101.644	772
22	0.014663	0.041804	0.958196	0.016057	0.015386	0.21736	0.73008	0.36971	103.197	784
24	0.015861	0.045220	0.95478	0.015151	0.014466	0.20436	0.71708	0.39454		

428

6-29-55
HW 37346 RD

DECLASSIFIED

Filter Boat Cleaning and Testing Hood

Sink Dimensions - $17\frac{1}{2}" \times 8" \times 5"$ deep

$$B = \left(\frac{\pi}{R+6.1} \right)^2 = 0.034493$$

$$\frac{\pi}{R+6.1} = 0.1857$$

$$R+6.1 = 16.92$$

$$R = 10.82 \text{ cm}, D = 8.50"$$

assume ppt in shape of cylinder $D_{ia} = 8"$ 2 sinks side by side = $17\frac{1}{2}" \times 16" \times 5"$

$$A = (17.5)(16) = 280 \text{ in}^2 = \frac{\pi D^2}{4}$$

$$D^2 = 356.50$$

$$D^{\text{EQUIV}} = 18.88" \quad R = 2398 \text{ cm}$$

$$B_R = \left(\frac{\frac{0.074946}{2.4048}}{2398+6.1} \right)^2 = 0.006391$$

$$A = (\pi) \left(\frac{575.04}{2398} \right)^2 = 1806.55 \text{ cm}^2$$

H	B	14.1275	f	$\frac{1}{F}-1$	V	$\frac{V}{F-1}$	M ₀	$\frac{1}{F-1.01157}$	$\frac{V}{F-1.01157}$	M ₀₀
4	0.036187	1								
8	0.030579	0.43199	1.94471	0.05852	14.45	246.92				
10	0.026417	0.37319	0.88591	0.12878	18.07	140.32	1.64	0.11691	154.56	1191
12	0.023244	0.32837	0.84109	0.18893	21.68	114.75	871	0.1706	122.44	944
14	0.020769	0.29340	0.80612	0.24051	25.29	105.15	799	0.22864	114.61	552
16	0.018802	0.26562	0.77834	0.28478	28.90	101.48	771	0.27291	105.80	816
18	0.017213	0.24317	0.75589	0.32294	32.52	100.70	765	0.31107	104.54	806
20	0.015910	0.22476	0.73748	0.35596	36.13	101.5	740.9	0.34009	105.00	809
22	0.014829	0.20949	0.72221	0.38463	37.74					

429

HW 37386

EXHAUSTED

#	$\frac{1}{F-1.02435}$	$\frac{V}{F-1.02435}$	M_{600}	$\frac{1}{F-1.03687}$	$\frac{V}{F-1.03687}$	M_{600}
10	0.10443	173.03	1354	0.09191	196.60	1562
12	0.16458	131.73	1031	0.15206	142.58	1133
14	0.21616	112.00	914	0.20364	124.19	986
16	0.26043	110.97	868	0.24791	116.57	926
18	0.29859	108.91	852	0.28607	113.68	903
20	0.33161	108.95	853	0.31909	113.23	899
22				0.34776	114.27	908

430

7-6-55 ②
HW 37346 RB

DECLASSIFIED

In-line filters

Type I 5" O.D. x 4" I.D. x 4 $\frac{5}{8}$ "
6 $\frac{1}{8}$ " dia outer flange

Type II 4 $\frac{1}{2}$ " O.D. x 3 $\frac{15}{16}$ " I.D. x 4 $\frac{9}{16}$ "
6 $\frac{1}{8}$ " dia outer flange

Type III 5" O.D. x 4" I.D. x 4 $\frac{5}{8}$ "
6 $\frac{1}{8}$ " dia outer flange

0.075790

$$V_{MAX} = \frac{(17)(4)}{CAT} (4.625)(0.016387) = 0.952 \text{ liters}$$

$$\text{Let } \bar{\alpha} = \frac{(0.2714) \bar{B}_R}{(\bar{B}_R + \bar{B}_H)}, \quad \bar{\beta} = \frac{(0.1867) \bar{B}_R}{\bar{B}_R + \bar{B}_H}$$

$$\frac{\bar{B}_{MAT}}{\bar{B}_R} = 1 - 3.9292 \bar{\alpha} \bar{\beta}$$

#	$\bar{B}_H + \bar{B}_R$	$\bar{B}_R$	$\bar{B}_H + \bar{B}_R'$	F_1	$\bar{\alpha}$	$\bar{\beta}$	$\bar{\alpha} \bar{\beta}$	$3.9292 \bar{\alpha} \bar{\beta}$	$\frac{\bar{B}_{MAT}}{\bar{B}_R}$	$\bar{B}_{MA}$
10	0.41790	0.70301	0.58679	0.78849	0.2140	0.1031	0.02206			
18	0.40201	0.73080	0.57090	0.81043	0.2200	0.1072	0.02358			
20	0.38898	0.75528	0.55787	0.82936	0.2251	0.1108	0.02494			
22	0.37817	0.77687	0.54706	0.84575	0.2295	0.1140	0.02616			
24	0.36911	0.79594	0.53800	0.86000	0.2334	0.1168	0.02726			
26	0.36143	0.81285	0.53032	0.87245	0.2368	0.1192	0.02823			
28	0.35486	0.82790	0.52375	0.88339	0.2398	0.1215	0.02914			
30	0.34921	0.84129	0.51810	0.89303	0.2424	0.1234	0.02991			

[illegible]

~~_____~~ 7 27, 21. 1900

~~|						
108	87.13	2160.0	0.0	85.58	0.0760	87.13
108	100.0	6592.0	87.13	2160.0	0.0760	87.13
108	100.0	6592.0	87.13	2160.0	0.0760	87.13 |~~

16	0.50017	0.98267	0.01763	4.631	2.6268
18	0.46995	0.96194	0.03956	5.146	1.3908
20	0.44982	0.94972	0.05851	5.661	9.675
22	0.43200	0.93019	0.07504	6.175	8.229
24	0.41747	0.91787	0.08947	6.690	7.477
26	0.40515	0.90715	0.10235	7.204	70.39
28	0.39443	0.89810	0.11346	7.719	68.03
30	0.38538	0.89606	0.11599	7.843	67.62
32	0.38334	0.89606	0.11599	7.843	67.62
34	0.38334	0.89606	0.11599	7.843	67.62
36	0.38334	0.89606	0.11599	7.843	67.62
38	0.38334	0.89606	0.11599	7.843	67.62
40	0.38334	0.89606	0.11599	7.843	67.62
42	0.38334	0.89606	0.11599	7.843	67.62
44	0.38334	0.89606	0.11599	7.843	67.62
46	0.38334	0.89606	0.11599	7.843	67.62
48	0.38334	0.89606	0.11599	7.843	67.62
50	0.38334	0.89606	0.11599	7.843	67.62
52	0.38334	0.89606	0.11599	7.843	67.62
54	0.38334	0.89606	0.11599	7.843	67.62
56	0.38334	0.89606	0.11599	7.843	67.62
58	0.38334	0.89606	0.11599	7.843	67.62
60	0.38334	0.89606	0.11599	7.843	67.62
62	0.38334	0.89606	0.11599	7.843	67.62
64	0.38334	0.89606	0.11599	7.843	67.62
66	0.38334	0.89606	0.11599	7.843	67.62
68	0.38334	0.89606	0.11599	7.843	67.62
70	0.38334	0.89606	0.11599	7.843	67.62
72	0.38334	0.89606	0.11599	7.843	67.62
74	0.38334	0.89606	0.11599	7.843	67.62
76	0.38334	0.89606	0.11599	7.843	67.62
78	0.38334	0.89606	0.11599	7.843	67.62
80	0.38334	0.89606	0.11599	7.843	67.62
82	0.38334	0.89606	0.11599	7.843	67.62
84	0.38334	0.89606	0.11599	7.843	67.62
86	0.38334	0.89606	0.11599	7.843	67.62
88	0.38334	0.89606	0.11599	7.843	67.62
90	0.38334	0.89606	0.11599	7.843	67.62
92	0.38334	0.89606	0.11599	7.843	67.62
94	0.38334	0.89606	0.11599	7.843	67.62
96	0.38334	0.89606	0.11599	7.843	67.62
98	0.38334	0.89606	0.11599	7.843	67.62
100	0.38334	0.89606	0.11599	7.843	67.62

$A = \textcircled{1} (9.05) - 2.57.30 \text{ cm}$

43 [REDACTED]

HW 37346RA
DECLASSIFIED

H	β_2	F_2	β_1	F_1	α	β	$\alpha\beta$	$3.929\alpha\beta$	β_2
26	0.036143	0.8129	0.053032	0.87245	0.1256	0.0634	0.00796	0.03127	0.96873
28	0.035486	0.82790	0.052375	0.88339	0.1272	0.06458	0.00821	0.03226	0.96774
30	0.034921	0.84129	0.05181	0.89303	0.1286	0.06562	0.00844	0.03316	0.96684
30.48	0.034797	0.84429	0.051686	0.89517	0.1289	0.06585	0.008488	0.03335	0.96665

H	β_{MAT}	14.127β	F	$\frac{1}{F}-1$	V	$\frac{V}{F-1}$	M_0	$\frac{M}{V}$

26	0.035013	0.49463						
28	0.034341	0.48514	0.99786	0.00214	7.204	3366.4		
30	0.033763	0.47697	0.98969	0.01031	7.719	741.50		
30.48	0.033637	0.47579	0.98791	0.01209	7.843	641.29	4870	620

@ 12" ϕ τ_0 ϕ 500 g/K OK = 3922 gm

use 3500 gm @ 12" ϕ τ_0 ϕ

ϕ τ_0 ϕ = 5" + $\frac{6.125}{4}$ = 8.06"

$\sin \frac{\theta}{2} = \frac{3.5665}{8.06} = 0.4420$; $\frac{\theta}{2} = 26.23^\circ$; $\theta = 52.46^\circ$; $\alpha = 0.14572$; $\frac{1}{2}\alpha = 0.21858$

$\sin \frac{\gamma}{2} = \frac{2}{8.06} = 0.24813$; $\frac{\gamma}{2} = 14.37^\circ$; $\gamma = 28.74^\circ$; $\beta = 0.07983$; $\frac{1}{2}\beta = 0.11975$

$\beta_{MAT} = 1 - 3.9292\alpha\beta$

H	β_2	F_2	β_1	F_1	α	β	$\alpha\beta$	$3.929\alpha\beta$	$\frac{\beta_{MAT}}{\beta_2}$	β_{MAT}
28	0.035486	0.82790	0.052375	0.88339	0.1431	0.09914	0.01914	0.07520	0.92486	0.032817
30	0.034921	0.84129	0.05181	0.89303	0.1452	0.10074	0.01946	0.07724	0.92276	0.032224
30.48	0.034797	0.84429	0.051686	0.89517	0.1457	0.10110	0.019175	0.0775	0.92225	0.032092

HW 3734622

433

REPI ASSIGNED

H $\frac{1}{f-1}$ $\frac{V}{f-1}$ M_0 $\frac{1}{f-0.01187}$ $\frac{1}{f-0.01187}$ M_2

28 0.46361 0.97633 0.02424 7.204 297.19

30 0.45523 0.96795 0.03311 7.719 233.13 1770 0.02124 363.42 2800

30.48 0.45336 0.96608 0.03511 7.843 223.38 $\frac{1600}{1096}$ 0.02324 337.48 $\frac{2500}{2600}$

H $\frac{1}{f-1.02435}$ $\frac{V}{f-1.02435}$ M_{600} $\frac{1}{f-1.03687}$ $\frac{V}{f-1.03687}$ M_{600}

28

30 0.00876 881.16 6895

30.48 0.01076 728.90 5703 NEGATIVE 3500g/m (446 g/L)
 $\frac{3500}{3500}$

434

7-11-55 ①
2 tons - 12 tons
HW 37346 RD

RR can in jacket - RC Can Bare

DECLASSIFIED

RR can RC can

center to center distance = $11 + 9.25 = 20.25$

$$\sin \frac{\theta}{2} = \frac{9.25}{20.25} = 0.4568, \quad \frac{\theta}{2} = 27.18^\circ, \quad \theta = 54.36^\circ, \quad \alpha = 0.151, \quad \frac{3}{2}\alpha = 0.2265$$

$$\sin \frac{r}{2} = \frac{2.88}{20.25} = 0.1422, \quad \frac{r}{2} = 8.18^\circ, \quad r = 16.36^\circ, \quad \beta = 0.0454, \quad \frac{3}{2}\beta = 0.0681$$

$$B_{R1} = \left(\frac{0.179195}{13.42} \right)^2 = 0.03211, \quad B_{R2} = \left(\frac{0.081243}{29.60} \right)^2 = 0.006600$$

$$\bar{\alpha} = \frac{3}{2}\alpha \frac{B_{R1}}{B_1}, \quad \bar{\beta} = \frac{3}{2}\beta \frac{B_{R2}}{B_2}$$

$$\left\{ 1 - \frac{B_{MAT}}{B_1} \right\} \left\{ 1 - \frac{B_{MAT}}{B_2} \right\} = \frac{\alpha\beta}{2}$$

assume 3 kg - RR Can, $\frac{B_{MAT}}{B_1} = 0.96365 \text{ MAX}$

$$(0.0338) \left(1 - \frac{B_{MAT}}{B_2} \right) = \frac{\alpha\beta}{2}$$

$$1 - \frac{B_{MAT}}{B_2} = \frac{27.51}{2} \alpha\beta = 13.755 \alpha\beta$$

$$\frac{B_{MAT}}{B_2} = 1 - 13.755 \alpha\beta$$

Wt	B ₁	B ₂	f	1/f - 1	V	1/V - 1	M ₀	B _{MAT}	B _{MAT} /B ₁

0.036354 0.033432 0.9195

40 0.035735 0.033328 0.9327

0.034662 0.03304 0.9532

$\frac{B_1}{B_2}$	$\frac{B_3}{B_2}$	$\frac{B_4}{B_2}$	$\frac{B_5}{B_2}$	$\frac{B_6}{B_2}$	$\frac{B_7}{B_2}$	$\frac{B_8}{B_2}$	$\frac{B_9}{B_2}$	$\frac{B_{10}}{B_2}$	
1.0	0.052137	0.6159	0.1395	0.026626	0.2479	0.01688	0.002355	0.032405	0.96759
1.2	0.048964	0.6558	0.1485	0.023453	0.2814	0.01916	0.002845	0.03915	0.96085
1.4	0.046489	0.6907	0.1564	0.020978	0.3146	0.02142	0.003350	0.04610	0.95396
1.6	0.044522	0.7212	0.1634	0.019011	0.3472	0.02364	0.003863	0.05315	0.94685
1.8	0.042933	0.7479	0.1694	0.017422	0.3788	0.02580	0.004370	0.06013	0.93987
2.0	0.041630	0.7713	0.1747	0.016119	0.4095	0.02789	0.004872	0.06704	0.93296
2.2	0.040549	0.7919	0.1794	0.015038	0.4389	0.02989	0.005362	0.07378	0.92622
2.4	0.039643	0.8100	0.1835	0.014132	0.4670	0.03180	0.005835	0.08029	0.91971

435
7-11-55
15373V6
(2)

$$\left(\frac{\pi}{60.46 + 12.1} \right)^2 = 0.001844$$

436

7-12-55 (3)
14037346 RA

DECLASSIFIED

same as KTC in PR can

H	$\alpha\beta$	$\frac{\beta_{MAT}}{\beta_c}$	$\frac{\beta_{MAT}}{\beta_c}$
36	0.036359	0.03241	0.8914
40	0.035733	0.03218	0.9006
50	0.034662	0.03162	0.9122
60.46	0.033955	0.03106	0.91474

$$\left(\frac{0.08526}{1 - 0.91474} \right) \left\{ 1 - \frac{\beta_{MAT}}{\beta_c} \right\} = \frac{\alpha\beta}{2}$$

$$1 - \frac{\beta_{MAT}}{\beta_c} = \frac{11.73}{2} \alpha\beta = 5.87 \alpha\beta$$

$$\frac{\beta_{MAT}}{\beta_c} = 1 - 5.87 \alpha\beta$$

H	$\alpha\beta$	$\frac{\beta_{MAT}}{\beta_c}$	β_c	β_{MAT}	14.1276	f	$\frac{1}{f-1}$	V_2	
10	0.002355	0.01382	0.98418	0.026626	0.026258	0.37095	0.88367	0.13164	17.3
12	0.002845	0.01670	0.98330	0.023453	0.023061	0.32578	0.83850	0.19260	20.8
14	0.003350	0.01966	0.98034	0.020978	0.020566	0.29054	0.80326	0.24492	24.2
16	0.003863	0.02268	0.97732	0.019011	0.018580	0.26248	0.77520	0.28998	27.9
18	0.004376	0.02565	0.97435	0.017422	0.016975	0.23981	0.75253	0.32885	31.2
20	0.004872	0.02860	0.97146	0.016119	0.015658	0.22120	0.73392	0.36254	34.6
22	0.005362	0.03147	0.96853	0.015038	0.014565	0.20576	0.71848	0.39182	38.15
24	0.005855	0.03425	0.96575	0.014132	0.013648	0.19281	0.70553	0.41737	41.62

H	$\frac{V}{f-1}$	M_0	$\frac{1}{f-1.01187}$	$\frac{V}{f-1.01187}$	M_{100}	$\frac{1}{f-1.02425}$	$\frac{V}{f-1.02425}$	M_{200}	$\frac{1}{f-1.0368}$	$\frac{V}{f-1.0368}$
16	95.69	727	0.27811	99.77	769	0.26563	104.46	817	0.25311	109.62
18	94.92	721	0.31698	98.48	759	0.30450	102.52	802	0.29198	106.9
20	95.67	727	0.35067	98.91	762	0.33819	102.56	802	0.32567	106.5
22	7.37	739	0.37995	100.42		0.36747	103.83	812	0.35495	107.46

at M_{100}

18 849 835

846

854

437

DECLASSIFIED

$\sin \frac{\theta}{2} = \frac{9.45}{36} = 0.2569$, $\frac{\theta}{2} = 14.88^\circ$, $\theta = 29.76^\circ$, $\alpha = 0.0827$, $\frac{3}{2}\alpha = 0.1241$
 $\sin \frac{\gamma}{2} = \frac{2.88}{36} = 0.08000$, $\frac{\gamma}{2} = 4.58^\circ$, $\gamma = 9.16^\circ$, $\beta = 0.02544$, $\frac{3}{2}\beta = 0.03816$

assume 3 kg in PR can, $\frac{P_{MAT}}{B_1} = 0.96365$

$\left\{ \begin{matrix} 0.03635 \\ 1 - 0.96365 \end{matrix} \right\} \left\{ 1 - \frac{P_{MAT}}{B_2} \right\} = \frac{\alpha \beta}{2}$
 $1 - \frac{P_{MAT}}{B_2} = 13.76 \alpha \beta$

H	$\frac{B_{PR}}{B_1}$	α	$\frac{B_{MAT}}{B_2}$	β	$\alpha \beta$	$13.76 \alpha \beta$	$\frac{P_{MAT}}{B_2}$	B_2	P_{MAT}	141276
1	0.7212	0.08450	0.3472	0.01325	0.001186	0.01632	0.98368	0.019011	0.018701	0.26419
18	0.7479	0.09281	0.3788	0.01446	0.001342	0.01847	0.98153	0.017422	0.017100	0.24157
20	0.7713	0.09572	0.4095	0.01563	0.001496	0.02058	0.97942	0.016119	0.015787	0.22302
22	0.7919	0.09827	0.4389	0.01675	0.001646	0.02265	0.97735	0.015038	0.014697	0.20762
24	0.8100	0.1005	0.4676	0.01782	0.001791	0.02464	0.97536	0.014132	0.013784	0.19473

H	$\frac{P}{E}$	$\frac{E}{E-1}$	$\frac{V_1}{E-1}$	$\frac{V_2}{E-1}$	M_0	$\frac{E-101687}{E-101687}$	$\frac{V}{E-101687}$	M_{200}	$\frac{E-102435}{E-102435}$	$\frac{V}{E-102435}$
16	0.77691	0.28715	27.747	96.63	724	0.275281	104.80	727	0.26280	105.58
18	0.75429	0.32575	31.216	95.83	715	0.31388	99.45	750	0.30140	103.57
20	0.73574	0.35917	34.684	96.57	733	0.347307	99.87	780	0.33482	103.59
22	0.72034	0.38823	38.153			0.37614			0.36388	104.85
24	0.70745	0.41352	41.621			0.40165			0.38917	
16	716	0.25028		110.816	881					
18	810	0.28588		108.86	858					
20	811	0.32230		107.61	855					
22	820	0.35136		108.59	863					

438

HW 37346RR

DECLASSIFIED

4' to 6'

$\sin \frac{\theta}{2} = \frac{2.25}{4.8} = 0.1927$, $\frac{\theta}{2} = 11.12^\circ$, $\theta = 22.24^\circ$, $\alpha = 0.0618$, $\frac{3}{2}\alpha = 0.0927$
 $\sin \frac{\gamma}{2} = \frac{2.88}{4.8} = 0.0600$, $\frac{\gamma}{2} = 3.45^\circ$, $\gamma = 6.9^\circ$, $\beta = 0.0192$, $\frac{3}{2}\beta = 0.0288$

assume 3 kg in P.R. can

H	α	β	$\alpha\beta$	$13.76\alpha\beta$	$\frac{P_{MAT}}{P_c}$	P_c	P_{MAT}	14.127B	F	$\frac{1}{F}-1$
16	0.04686	0.01000	0.0006686	0.00920	0.9908	0.019011	0.018836	0.26610	0.77882	
18	0.06933	0.01091	0.0007564	0.01041	0.98959	0.017422	0.017241	0.24356	0.75628	
20	0.07150	0.01179	0.0008436	0.01160	0.98840	0.016119	0.015932	0.22507	0.73779	
22	0.07341	0.01264	0.0009279	0.01277	0.98723	0.015038	0.014846	0.20973	0.72245	
24	0.07509	0.01345	0.001010	0.01390	0.98610	0.014132	0.013936	0.19687	0.7096	

R C can tangential - membership

H	P_c	14.127B	F	$\frac{1}{F}-1$	V_c	$\frac{V_c}{F-1}$	M_0	$\frac{1}{F}-1.01187$	$\frac{V_c}{F-1.01187}$
16	0.019011	0.26857	0.78129	0.27993	27.747	99.12	753	0.26806	103.51
18	0.017422	0.246121	0.75884	0.31780	31.216	98.23	746	0.30593	102.04
20	0.016119	0.22771	0.74043	0.35056	34.684	98.94	751	0.33869	102.41
22	0.015038	0.21244	0.72516	0.37906	38.153			0.36713	103.92
24	0.014132	0.19864	0.71236	0.40378	41.621			0.3919	

H	$M_{0.0}$	$\frac{1}{F}-1.02435$	$\frac{V_c}{F-1.02435}$	$M_{0.0}$	$\frac{1}{F}-1.03687$	$\frac{V_c}{F-1.03687}$	$M_{0.0}$
16	798	0.25558	108.56	849	0.24306	114.16	907
18	877	0.29345	106.38	832	0.28093	111.12	880
20	789	0.32621	106.32	836	0.31369	110.57	878
22		0.35465	107.58	842	0.34213	111.52	886
24		0.37943			0.36691		

7-1-55

439

140 37 54

DECLASSIFIED

15 liters / 100 days

DECLASSIFIED

for sphere $B = \left(\frac{\pi}{R+6.1} \right)^2 = 0.034493$

$R+6.1 = \frac{\pi}{0.034493} = 16.92$

$R = 10.82 \text{ cm} = 4.26''$

2 feet away from HF funnels
 possible of 3 Kg in funnels - closest
 Kg 2 feet away from hemisphere

Max bulk density dry powder = 1 gm/cc
 water fills space in between = 4.8 liters in hemi
 if water does not fill $V = 3 + 4.8 = 7.8 \text{ liters}$

Chart 2 feet away - no vessel - interaction = 4%
 (increase in effective dia)

Critical volume of sphere $V = \frac{4}{3}\pi(10.82)^3 \cdot (4.1887)(12.667)$
 $V = 5.3 \text{ liters}$

From Lofanov 6 Kg for bare sphere @ 15 cm radius
 with reflector savings of 3.5 cm, tamped
 sphere is 2700 grams

$B_{\text{sphere}} = \left(\frac{\pi}{R+l} \right)^2$ for given Buckling

$B_{\text{hemisphere}} = \left(\frac{4.494}{R+l} \right)^2$ $\frac{\pi}{R+l} = \frac{4.494}{R+l} = \frac{\pi}{11.5+7.5} = \frac{4.494}{19.0}$

[Redacted]

3

440

HW 3734602

DECLASSIFIED

$$\frac{4.294}{R_1 + 7.5} = 0.1653$$

$$R_1 + 7.5 = 27.19$$

$$R_2 = 19.69 \text{ cm}$$

$$\frac{R_2}{R_1} = \frac{19.69}{11.5} = 1.71$$

$$\frac{M_2}{M_1} = \frac{(R_2)^3}{(R_1)^3} = \frac{M_2}{2700} = (1.71)^3 = 5.00$$

$$M_2 = 13.5 \text{ Kg}$$

$$D_0 = 5'' \quad ; \quad D_0^2 = 25 = 2D_1^2$$

$$D_1^2 = 12.5$$

$$D_1 = 3.53''$$

$$\text{For Safaric } \left(\frac{H}{P_u} \right)_{\text{air}} = 42.45 = \frac{26.53}{C_{P_u}} = 1.529$$

$$C_{P_u}^M = \frac{26.53}{44.13} = 0.60$$

$$\left(\frac{H}{P_u} \right)_R = \frac{32.06}{C_{P_u}^R} - 1.66 = 42.45$$

$$C_{P_u}^R = \frac{32.06}{51.61} = 0.62 \text{ gm/cc}$$

7-13-55

NW 37346 RD

44/

DECLASSIFIED

Hemisphere: 3 Kg on floor - 1600 cc H₂O
max ossoe with each Kg.

$$B = \left(\frac{4.494}{R+6.1} \right)^2$$

$$\frac{1000}{1600} =$$

density based

$$B = \left(\frac{4.494}{R+6.1} \right)^2 = 0.034493$$

$$R+6.1 = \frac{4.494}{0.1857} = 24.2$$

$$R = 18.1 \text{ cm} = 7.126''$$

D = 14.25" critical dia of hemisphere

$$V = \frac{2}{3} \pi R^3 = \frac{2}{3} \pi (18.1)^3 = (2.0944)(5929.7) = 12,419 \text{ cc}$$

V = 12.4 liters critical volume

$$\frac{(3200)}{12,400} = 0.2411 \text{ critical Pu density}$$

Max. bulk density Pu F₂ or oxalate.

$$\frac{V_{600} (2.115)}{(18.016)} = 1177.6 \text{ atoms H} / 1000 \text{ cc}$$

$$\frac{10000}{239} = 4.184 \text{ atoms Pu} / 1000 \text{ cc} \quad \frac{H}{Pu} = \frac{177.6}{4.184} = 42.45$$

442

HW 37346RB

DECLASSIFIED

$$D = 4.5'' \quad A_D = (D)^{5.0625} = 15.904''$$

$$4.5 = 2D_1$$

$$20.25 = 2D_1^2$$

$$D_1^2 = 10.12$$

$$D_1 = 3.18''$$

For Ischit charge assume $H/P_4 = 20$ equiv.

From Safarov base $M_1 = 10 \text{ KG}$ @ 12 cm

reflector spring = 5.5 cm

$$\frac{M_2}{M_1} = \frac{(R_2)^3}{(R_1)^3} = \frac{(8.5)^3}{(12)^3} = \frac{614.13}{1728} = 0.3554$$

$$M_2 = (10)(0.3554) = 3.55 \text{ KG}$$

at $H/P_4 = 10$ Safarov base = 15 KG

$$\frac{M_2}{M_1} = \frac{(7.5)^3}{(11)^3} = \frac{421.88}{1331} = \frac{M_2}{15} = 0.317$$

$$M_2 = 4.75$$

448

HW 37346AR

DECLASSIFIED

Two reduction charges each at 2 kg coming together
in one spot.

Reduction charge container 6.5" O.D. - $\frac{3}{8}$ " THICK
 $\frac{1}{8}$ " THICK MgO + sand

$$I.D. = 6.5 - 0.75 - 0.50 = 5.25"$$

Problem as presented by W. J. OZEROFF 7-13-55

Conversation with S. F. Hill, P. Smith etc. - July 11, 1955

Good 9 3 kg in a hemisphere on floor with
1600 cc of H₂O associated with each Kg. Is this
critical?

Good 13ABC, 14D C, 14CC

4 Kg of PuF₄ in one spot ²¹