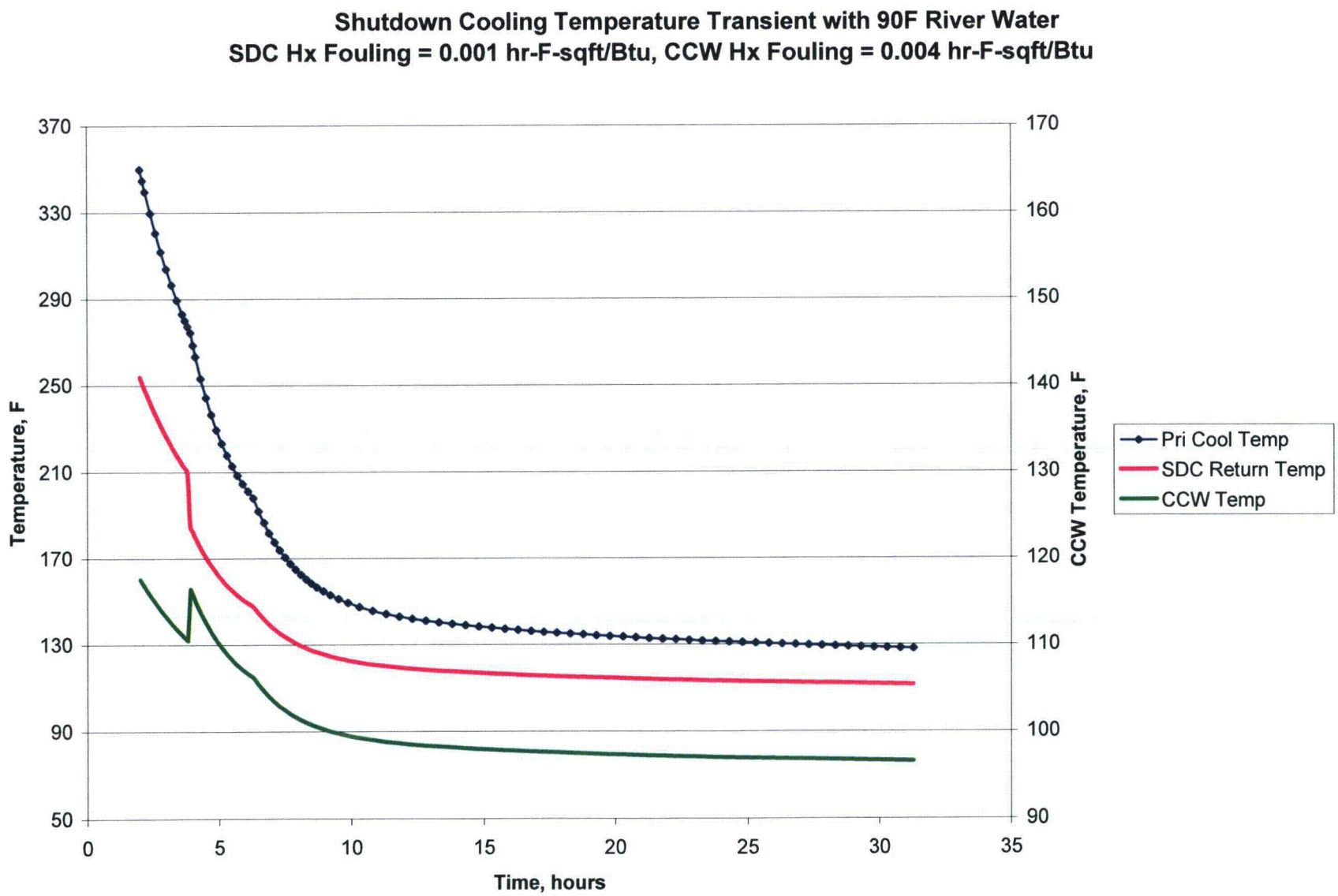
								SDCHx							
Time	Step	Q(D)	P(pp)	P(lp)	Psdc	Total Q	dTrc	Tube				Shell			
hrs	hrs	mmBtu/hr					degF/hr	Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
15.29	0.50	28.491	0	1.5	-31.15	-1.16	-1.05	3000	315	137.70	116.58	4246	95	97.90	112.70
15.79	0.50	28.196	0	1.5	-30.79	-1.09	-0.99	3000	315	137.18	116.30	4246	95	97.83	112.46
16.29	0.50	27.913	0	1.5	-30.45	-1.04	-0.94	3000	315	136.68	116.03	4246	95	97.76	112.23
16.79	0.50	27.642	0	1.5	-30.13	-0.98	-0.90	3000	315	136.21	115.78	4246	95	97.69	112.01
17.29	0.50	27.381	0	1.5	-29.82	-0.94	-0.85	3000	315	135.76	115.55	4246	95	97.63	111.80
17.79	0.50	27.130	0	1.5	-29.53	-0.90	-0.82	3000	315	135.33	115.32	4246	95	97.57	111.60
18.29	0.50	26.889	0	1.5	-29.25	-0.86	-0.78	3000	315	134.93	115.10	4246	95	97.52	111.41
18.79	0.50	26.655	0	1.5	-28.98	-0.83	-0.75	3000	315	134.53	114.89	4246	95	97.46	111.23
19.29	0.50	26.430	0	1.5	-28.72	-0.79	-0.72	3000	315	134.16	114.69	4246	95	97.41	111.06
19.79	0.50	26.213	0	1.5	-28.48	-0.77	-0.70	3000	315	133.80	114.50	4246	95	97.36	110.89
20.29	0.50	26.002	0	1.5	-28.24	-0.74	-0.67	3000	315	133.45	114.32	4246	95	97.31	110.73
20.79	0.50	25.798	0	1.5	-28.01	-0.71	-0.65	3000	315	133.11	114.14	4246	95	97.27	110.57
21.29	0.50	25.601	0	1.5	-27.79	-0.69	-0.63	3000	315	132.79	113.97	4246	95	97.22	110.42
21.79	0.50	25.410	0	1.5	-27.58	-0.67	-0.61	3000	315	132.48	113.80	4246	95	97.18	110.28
22.29	0.50	25.224	0	1.5	-27.37	-0.64	-0.59	3000	315	132.17	113.64	4246	95	97.14	110.14
22.79	0.50	25.044	0	1.5	-27.17	-0.62	-0.57	3000	315	131.88	113.48	4246	95	97.10	110.00
23.29	0.50	24.869	0	1.5	-26.98	-0.61	-0.55	3000	315	131.60	113.33	4246	95	97.06	109.87
23.79	0.50	24.699	0	1.5	-26.79	-0.59	-0.53	3000	315	131.32	113.18	4246	95	97.02	109.74
24.29	0.50	24.534	0	1.5	-26.60	-0.57	-0.52	3000	315	131.05	113.04	4246	95	96.98	109.62
24.79	0.50	24.373	0	1.5	-26.43	-0.55	-0.50	3000	315	130.80	112.90	4246	95	96.95	109.50
25.29	0.50	24.216	0	1.5	-26.26	-0.54	-0.49	3000	315	130.54	112.77	4246	95	96.91	109.38
25.79	0.50	24.063	0	1.5	-26.09	-0.52	-0.48	3000	315	130.30	112.64	4246	95	96.88	109.27
26.29	0.50	23.915	0	1.5	-25.93	-0.51	-0.46	3000	315	130.06	112.51	4246	95	96.84	109.16
26.79	0.50	23.770	0	1.5	-25.77	-0.50	-0.45	3000	315	129.83	112.38	4246	95	96.81	109.05
27.29	0.50	23.628	0	1.5	-25.61	-0.48	-0.44	3000	315	129.60	112.26	4246	95	96.78	108.95
27.79	0.50	23.490	0	1.5	-25.46	-0.47	-0.43	3000	315	129.38	112.15	4246	95	96.75	108.84
28.29	0.50	23.355	0	1.5	-25.32	-0.46	-0.42	3000	315	129.17	112.03	4246	95	96.72	108.75
28.79	0.50	23.223	0	1.5	-25.17	-0.45	-0.41	3000	315	128.96	111.92	4246	95	96.69	108.65
29.29	0.50	23.094	0	1.5	-25.03	-0.44	-0.40	3000	315	128.75	111.81	4246	95	96.66	108.55
29.79	0.50	22.968	0	1.5	-24.90	-0.43	-0.39	3000	315	128.55	111.70	4246	95	96.64	108.46
30.29	0.50	22.845	0	1.5	-24.76	-0.42	-0.38	3000	315	128.36	111.60	4246	95	96.61	108.37
30.79	0.50	22.725	0	1.5	-24.63	-0.41	-0.37	3000	315	128.17	111.50	4246	95	96.58	108.28
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20
31.29	0.00	22.607	0	1.5	-24.51	-0.40	-0.36	3000	315	127.98	111.40	4246	95	96.56	108.20

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
15.29	127.14	61.42	0.9977	3.51E-04	0.372	5.609	53,324	3.3844	1553	105.30	61.93	0.9978	4.33E-04	0.364	3.652	112,740	4.2740	1207	8.786	326.03
15.79	126.74	61.43	0.9977	3.52E-04	0.372	5.609	53,139	3.3979	1550	105.14	61.93	0.9978	4.34E-04	0.364	3.652	112,559	4.2817	1207	8.784	325.85
16.29	126.36	61.43	0.9977	3.53E-04	0.372	5.609	52,964	3.4107	1548	104.99	61.93	0.9978	4.34E-04	0.364	3.652	112,388	4.2891	1206	8.782	325.68
16.79	126.00	61.44	0.9976	3.55E-04	0.372	5.609	52,799	3.4229	1546	104.85	61.93	0.9978	4.35E-04	0.364	3.652	112,227	4.2961	1205	8.781	325.52
17.29	125.65	61.45	0.9976	3.56E-04	0.372	5.609	52,642	3.4346	1544	104.72	61.93	0.9978	4.36E-04	0.364	3.652	112,073	4.3027	1205	8.780	325.36
17.79	125.33	61.46	0.9976	3.57E-04	0.372	5.609	52,492	3.4458	1542	104.59	61.94	0.9978	4.36E-04	0.364	3.652	111,927	4.3091	1204	8.778	325.21
18.29	125.01	61.47	0.9976	3.58E-04	0.372	5.609	52,349	3.4566	1540	104.47	61.94	0.9977	4.37E-04	0.364	3.652	111,787	4.3151	1204	8.777	325.07
18.79	124.71	61.47	0.9976	3.59E-04	0.372	5.609	52,212	3.4669	1538	104.35	61.94	0.9977	4.37E-04	0.364	3.652	111,653	4.3210	1203	8.776	324.93
19.29	124.43	61.48	0.9976	3.60E-04	0.372	5.609	52,081	3.4770	1536	104.24	61.94	0.9977	4.38E-04	0.363	3.652	111,525	4.3266	1203	8.775	324.80
19.79	124.15	61.49	0.9976	3.61E-04	0.371	5.609	51,954	3.4866	1535	104.13	61.94	0.9977	4.38E-04	0.363	3.652	111,401	4.3320	1202	8.774	324.67
20.29	123.88	61.49	0.9975	3.62E-04	0.371	5.609	51,833	3.4960	1533	104.02	61.94	0.9977	4.39E-04	0.363	3.652	111,282	4.3373	1202	8.773	324.55
20.79	123.63	61.50	0.9975	3.62E-04	0.371	5.609	51,715	3.5050	1532	103.92	61.95	0.9977	4.39E-04	0.363	3.652	111,167	4.3423	1201	8.772	324.43
21.29	123.38	61.50	0.9975	3.63E-04	0.371	5.609	51,602	3.5138	1530	103.82	61.95	0.9977	4.40E-04	0.363	3.652	111,057	4.3472	1201	8.771	324.32
21.79	123.14	61.51	0.9975	3.64E-04	0.371	5.609	51,493	3.5224	1529	103.73	61.95	0.9977	4.40E-04	0.363	3.652	110,950	4.3519	1201	8.770	324.21
22.29	122.91	61.51	0.9975	3.65E-04	0.371	5.609	51,387	3.5306	1527	103.64	61.95	0.9977	4.41E-04	0.363	3.652	110,846	4.3565	1200	8.769	324.10
22.79	122.68	61.52	0.9975	3.66E-04	0.371	5.609	51,285	3.5387	1526	103.55	61.95	0.9977	4.41E-04	0.363	3.652	110,746	4.3610	1200	8.768	324.00
23.29	122.46	61.52	0.9975	3.66E-04	0.371	5.609	51,186	3.5465	1524	103.46	61.95	0.9977	4.41E-04	0.363	3.652	110,649	4.3653	1199	8.767	323.90
23.79	122.25	61.53	0.9975	3.67E-04	0.371	5.609	51,090	3.5541	1523	103.38	61.95	0.9977	4.42E-04	0.363	3.652	110,555	4.3695	1199	8.766	323.80
24.29	122.05	61.53	0.9975	3.68E-04	0.371	5.609	50,997	3.5616	1522	103.30	61.95	0.9977	4.42E-04	0.363	3.652	110,464	4.3735	1199	8.765	323.70
24.79	121.85	61.54	0.9975	3.68E-04	0.371	5.609	50,906	3.5688	1521	103.22	61.95	0.9977	4.43E-04	0.363	3.652	110,376	4.3775	1198	8.765	323.61
25.29	121.66	61.54	0.9974	3.69E-04	0.371	5.609	50,818	3.5758	1520	103.15	61.96	0.9977	4.43E-04	0.363	3.652	110,290	4.3813	1198	8.764	323.52
25.79	121.47	61.54	0.9974	3.70E-04	0.371	5.609	50,733	3.5827	1518	103.07	61.96	0.9977	4.43E-04	0.363	3.652	110,206	4.3851	1198	8.763	323.43
26.29	121.28	61.55	0.9974	3.70E-04	0.370	5.609	50,650	3.5894	1517	103.00	61.96	0.9977	4.44E-04	0.363	3.652	110,125	4.3887	1197	8.763	323.35
26.79	121.11	61.55	0.9974	3.71E-04	0.370	5.609	50,569	3.5960	1516	102.93	61.96	0.9977	4.44E-04	0.363	3.652	110,046	4.3923	1197	8.762	323.26
27.29	120.93	61.56	0.9974	3.72E-04	0.370	5.609	50,490	3.6024	1515	102.86	61.96	0.9977	4.44E-04	0.363	3.652	109,969	4.3958	1197	8.761	323.18
27.79	120.76	61.56	0.9974	3.72E-04	0.370	5.609	50,414	3.6086	1514	102.80	61.96	0.9977	4.44E-04	0.363	3.652	109,894	4.3991	1197	8.760	323.10
28.29	120.60	61.56	0.9974	3.73E-04	0.370	5.609	50,339	3.6148	1513	102.73	61.96	0.9977	4.45E-04	0.363	3.652	109,821	4.4024	1196	8.760	323.03
28.79	120.44	61.57	0.9974	3.73E-04	0.370	5.609	50,266	3.6208	1512	102.67	61.96	0.9977	4.45E-04	0.363	3.652	109,750	4.4057	1196	8.759	322.95
29.29	120.28	61.57	0.9974	3.74E-04	0.370	5.609	50,195	3.6266	1511	102.61	61.96	0.9977	4.45E-04	0.363	3.652	109,680	4.4088	1196	8.759	322.88
29.79	120.13	61.57	0.9974	3.74E-04	0.370	5.609	50,125	3.6323	1510	102.55	61.96	0.9977	4.46E-04	0.363	3.652	109,612	4.4119	1195	8.758	322.81
30.29	119.98	61.58	0.9974	3.75E-04	0.370	5.609	50,058	3.6380	1509	102.49	61.96	0.9977	4.46E-04	0.363	3.652	109,546	4.4149	1195	8.757	322.74
30.79	119.83	61.58	0.9974	3.75E-04	0.370	5.609	49,991	3.6435	1508	102.43	61.96	0.9977	4.46E-04	0.363	3.652	109,481	4.4179	1195	8.757	322.67
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60
31.29	119.69	61.58	0.9974	3.76E-04	0.370	5.609	49,927	3.6489	1507	102.38	61.97	0.9977	4.46E-04	0.363	3.652	109,418	4.4208	1195	8.756	322.60

Time	SDC HX tube side							SDC HX shell side							SDC Duty	Tt,o Iterate	Ts,o Iterate			Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr					mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
15.29	1,477,841	1,474,440	0.701	1.110	0.531	21.13	116.58	2,108,999	2,104,291	#N/A	#N/A	#N/A	14.80	112.70	31.15	116.58	112.70			7.358	38.51	8,100	3	12.84		97.90
15.79	1,478,066	1,474,635	0.701	1.109	0.531	20.88	116.30	2,109,072	2,104,357	#N/A	#N/A	#N/A	14.63	112.46	30.79	116.30	112.46			7.358	38.15	8,100	3	12.72		97.83
16.29	1,478,277	1,474,819	0.701	1.109	0.530	20.65	116.03	2,109,141	2,104,419	#N/A	#N/A	#N/A	14.47	112.23	30.45	116.03	112.23			7.358	37.81	8,100	3	12.60		97.76
16.79	1,478,476	1,474,993	0.701	1.108	0.530	20.43	115.78	2,109,207	2,104,477	#N/A	#N/A	#N/A	14.32	112.01	30.13	115.78	112.01			7.358	37.48	8,100	3	12.49		97.69
17.29	1,478,665	1,475,158	0.701	1.107	0.530	20.22	115.55	2,109,269	2,104,533	#N/A	#N/A	#N/A	14.17	111.80	29.82	115.55	111.80			7.358	37.18	8,100	3	12.39		97.63
17.79	1,478,845	1,475,314	0.701	1.107	0.530	20.02	115.32	2,109,328	2,104,586	#N/A	#N/A	#N/A	14.03	111.60	29.53	115.32	111.60			7.358	36.89	8,100	3	12.30		97.57
18.29	1,479,016	1,475,464	0.701	1.106	0.530	19.82	115.10	2,109,384	2,104,637	#N/A	#N/A	#N/A	13.90	111.41	29.25	115.10	111.41			7.358	36.61	8,100	3	12.20		97.52
18.79	1,479,180	1,475,607	0.701	1.105	0.530	19.64	114.89	2,109,438	2,104,685	#N/A	#N/A	#N/A	13.77	111.23	28.98	114.89	111.23			7.358	36.34	8,100	3	12.11		97.46
19.29	1,479,337	1,475,744	0.701	1.105	0.530	19.46	114.69	2,109,490	2,104,732	#N/A	#N/A	#N/A	13.65	111.06	28.72	114.69	111.06			7.358	36.08	8,100	3	12.03		97.41
19.79	1,479,488	1,475,875	0.701	1.104	0.530	19.30	114.50	2,109,539	2,104,777	#N/A	#N/A	#N/A	13.53	110.89	28.48	114.50	110.89			7.358	35.84	8,100	3	11.95		97.36
20.29	1,479,632	1,476,001	0.701	1.104	0.529	19.13	114.32	2,109,587	2,104,820	#N/A	#N/A	#N/A	13.42	110.73	28.24	114.32	110.73			7.358	35.60	8,100	3	11.87		97.31
20.79	1,479,771	1,476,123	0.701	1.103	0.529	18.98	114.14	2,109,633	2,104,862	#N/A	#N/A	#N/A	13.31	110.57	28.01	114.14	110.57			7.358	35.37	8,100	3	11.79		97.27
21.29	1,479,905	1,476,240	0.701	1.103	0.529	18.82	113.97	2,109,677	2,104,902	#N/A	#N/A	#N/A	13.20	110.42	27.79	113.97	110.42			7.358	35.15	8,100	3	11.72		97.22
21.79	1,480,035	1,476,353	0.701	1.102	0.529	18.68	113.80	2,109,720	2,104,940	#N/A	#N/A	#N/A	13.10	110.28	27.58	113.80	110.28			7.358	34.93	8,100	3	11.64		97.18
22.29	1,480,159	1,476,462	0.701	1.102	0.529	18.54	113.64	2,109,762	2,104,978	#N/A	#N/A	#N/A	13.00	110.14	27.37	113.64	110.14			7.358	34.73	8,100	3	11.58		97.14
22.79	1,480,280	1,476,568	0.701	1.102	0.529	18.40	113.48	2,109,802	2,105,014	#N/A	#N/A	#N/A	12.91	110.00	27.17	113.48	110.00			7.358	34.53	8,100	3	11.51		97.10
23.29	1,480,396	1,476,670	0.701	1.101	0.529	18.27	113.33	2,109,840	2,105,049	#N/A	#N/A	#N/A	12.81	109.87	26.98	113.33	109.87			7.358	34.33	8,100	3	11.44		97.06
23.79	1,480,509	1,476,768	0.702	1.101	0.529	18.14	113.18	2,109,878	2,105,083	#N/A	#N/A	#N/A	12.72	109.74	26.79	113.18	109.74			7.358	34.15	8,100	3	11.38		97.02
24.29	1,480,618	1,476,864	0.702	1.100	0.529	18.01	113.04	2,109,914	2,105,116	#N/A	#N/A	#N/A	12.64	109.62	26.60	113.04	109.62			7.358	33.96	8,100	3	11.32		96.98
24.79	1,480,724	1,476,957	0.702	1.100	0.529	17.89	112.90	2,109,950	2,105,148	#N/A	#N/A	#N/A	12.55	109.50	26.43	112.90	109.50			7.358	33.79	8,100	3	11.26		96.95
25.29	1,480,827	1,477,047	0.702	1.100	0.529	17.78	112.77	2,109,984	2,105,179	#N/A	#N/A	#N/A	12.47	109.38	26.26	112.77	109.38			7.358	33.61	8,100	3	11.20		96.91
25.79	1,480,926	1,477,134	0.702	1.099	0.528	17.66	112.64	2,110,017	2,105,209	#N/A	#N/A	#N/A	12.39	109.27	26.09	112.64	109.27			7.358	33.45	8,100	3	11.15		96.88
26.29	1,481,023	1,477,219	0.702	1.099	0.528	17.55	112.51	2,110,049	2,105,239	#N/A	#N/A	#N/A	12.31	109.16	25.93	112.51	109.16			7.358	33.28	8,100	3	11.09		96.84
26.79	1,481,117	1,477,301	0.702	1.098	0.528	17.44	112.38	2,110,081	2,105,267	#N/A	#N/A	#N/A	12.24	109.05	25.77	112.38	109.05			7.358	33.13	8,100	3	11.04		96.81
27.29	1,481,208	1,477,382	0.702	1.098	0.528	17.34	112.26	2,110,111	2,105,295	#N/A	#N/A	#N/A	12.17	108.95	25.61	112.26	108.95			7.358	32.97	8,100	3	10.99		96.78
27.79	1,481,297	1,477,460	0.702	1.098	0.528	17.23	112.15	2,110,141	2,105,322	#N/A	#N/A	#N/A	12.09	108.84	25.46	112.15	108.84			7.358	32.82	8,100	3	10.94		96.75
28.29	1,481,384	1,477,536	0.702	1.098	0.528	17.13	112.03	2,110,170	2,105,349	#N/A	#N/A	#N/A	12.02	108.75	25.32	112.03	108.75			7.358	32.67	8,100	3	10.89		96.72
28.79	1,481,468	1,477,610	0.702	1.097	0.528	17.04	111.92	2,110,199	2,105,375	#N/A	#N/A	#N/A	11.96	108.65	25.17	111.92	108.65			7.358	32.53	8,100	3	10.84		96.69
29.29	1,481,551	1,477,682	0.702	1.097	0.528	16.94	111.81	2,110,226	2,105,400	#N/A	#N/A	#N/A	11.89	108.55	25.03	111.81	108.55			7.358	32.39	8,100	3	10.80		96.66
29.79	1,481,631	1,477,752	0.702	1.097	0.528	16.85	111.70	2,110,253	2,105,424	#N/A	#N/A	#N/A	11.83	108.46	24.90	111.70	108.46			7.358	32.26	8,100	3	10.75		96.64
30.29	1,481,709	1,477,821	0.702	1.096	0.528	16.76	111.60	2,110,279	2,105,448	#N/A	#N/A	#N/A	11.76	108.37	24.76	111.60	108.37			7.358	32.12	8,100	3	10.71		96.61
30.79	1,481,785	1,477,888	0.702	1.096	0.528	16.67	111.50	2,110,305	2,105,472	#N/A	#N/A	#N/A	11.70	108.28	24.63	111.50	108.28			7.358	31.99	8,100	3	10.66		96.58
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56
31.29	1,481,860	1,477,954	0.702	1.096	0.528	16.58	111.40	2,110,330	2,105,494	#N/A	#N/A	#N/A	11.64	108.20	24.51	111.40	108.20			7.358	31.87	8,100	3	10.62		96.56


Shutdown Cooling Temperature Transient with 90F River Water
SDC Hx Fouling = 0.001 hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu
Temperature, F
CCW Temperature, F
Time, hours
370
330
290
250
210
170
130
90
50
170
160
150
140
130
120
110
100
90
0
5
10
15
20
25
30
35
Pri Cool Temp
SDC Return Temp
CCW Temp

Shutdown Cooling Temperature Transient with 90F River Water **SDC**

Hx Fouling = 0.00418 hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu

Initial RC Temperature, F	350				SDC HX / CCW HX
Initial Time	2		2754	Shell Film Multiplier	0.09751
RCS Temperature after 8 hours	226.53			Shell Film Re power	0.61709
Time after trip to 130F Primary Coolant Temp	#NUM!	Initial CCW to SDCHx	1850	Shell Film Pr power	0.333
Time after SDC initiation to 130F PC Temp	#NUM!	CCW Flow Step Temp	275	Fouling (total = tube side)	0.00418 / 0.004
Decary heat equilibrium at 90F river temp	74.85				0.00418 / 0.004

Time	Step	Q(D)	P(pp)	P(lp)	Psdc	Total Q	dTrc	SDCHx Tube				SDCHx Shell			
hrs	hrs	mmBtu/hr					degF/hr	Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
2.00	0.1	54.966	18	1.5	-104.433	-29.97	-27.24	3000	315	350.00	274.34	1850	95	112.29	227.91
2.10	0.10	54.107	18	1.5	-103.325	-29.72	-27.02	3000	315	347.28	272.48	1850	95	112.08	226.44
2.20	0.10	53.300	18	1.5	-102.226	-29.43	-26.75	3000	315	344.57	270.65	1850	95	111.87	224.99
2.30	0.10	52.540	18	1.5	-101.137	-29.10	-26.45	3000	315	341.90	268.83	1850	95	111.66	223.55
2.40	0.10	51.822	18	1.5	-100.060	-28.74	-26.13	3000	315	339.25	267.02	1850	95	111.45	222.13
2.50	0.10	51.143	18	1.5	-98.997	-28.35	-25.78	3000	315	336.64	265.24	1850	95	111.25	220.73
2.60	0.10	50.500	18	1.5	-97.947	-27.95	-25.41	3000	315	334.06	263.48	1850	95	111.04	219.35
2.70	0.10	49.888	18	1.5	-96.912	-27.52	-25.02	3000	315	331.52	261.75	1850	95	110.85	217.98
2.80	0.10	49.305	18	1.5	-95.893	-27.09	-24.63	3000	315	329.02	260.04	1850	95	110.65	216.64
2.90	0.10	48.749	18	1.5	-94.890	-26.64	-24.22	3000	315	326.56	258.36	1850	95	110.46	215.32
3.00	0.20	48.218	18	1.5	-93.903	-26.18	-23.80	3000	315	324.14	256.70	1850	95	110.27	214.02
3.20	0.40	47.223	18	1.5	-91.962	-25.24	-22.94	3000	315	319.38	253.44	1850	95	109.89	211.46
3.60	0.50	45.460	18	1.5	-88.220	-23.26	-21.15	3000	315	310.20	247.14	1850	95	109.17	206.54
4.10	0.50	43.590	18	1.5	-83.907	-20.82	-18.93	3000	315	299.62	239.86	1850	95	108.34	200.87
4.60	0.50	41.999	18	1.5	-80.046	-18.55	-16.86	3000	315	290.16	233.32	1850	95	107.59	195.80
5.10	0.50	40.622	18	1.5	-76.606	-16.48	-14.99	3000	315	281.73	227.49	1850	95	106.92	191.28
5.60	0.50	39.413	18	1.5	-90.255	-31.34	-28.49	3000	315	274.24	210.40	4246	95	109.56	152.69
6.10	0.50	38.339	18	1.5	-83.117	-25.28	-22.98	3000	315	259.99	201.49	4246	95	108.18	147.87
6.60	0.50	37.375	18	1.5	-77.362	-20.49	-18.62	3000	315	248.50	194.26	4246	95	107.06	143.98
7.10	0.50	36.504	18	1.5	-72.700	-16.70	-15.18	3000	315	239.19	188.38	4246	95	106.15	140.83
7.60	0.50	35.710	18	1.5	-68.904	-13.69	-12.45	3000	315	231.60	183.56	4246	95	105.41	138.27
8.10	0.50	34.983	18	1.5	-65.792	-11.31	-10.28	3000	315	225.38	179.60	4246	95	104.80	136.16
8.60	0.50	34.312	18	1.5	-63.223	-9.41	-8.56	3000	315	220.24	176.32	4246	95	104.30	134.43
9.10	0.50	33.692	18	1.5	-61.086	-7.89	-7.18	3000	315	215.96	173.59	4246	95	103.87	132.98
9.60	0.50	33.114	18	1.5	-59.295	-6.68	-6.07	3000	315	212.37	171.29	4246	95	103.52	131.77
10.10	0.50	32.576	18	1.5	-57.780	-5.70	-5.19	3000	315	209.33	169.34	4246	95	103.22	130.74
10.60	0.50	32.071	18	1.5	-56.487	-4.92	-4.47	3000	315	206.74	167.67	4246	95	102.97	129.87
11.10	0.50	31.597	18	1.5	-55.373	-4.28	-3.89	3000	315	204.51	166.24	4246	95	102.75	129.12
11.60	0.53	31.150	18	1.5	-54.404	-3.75	-3.41	3000	315	202.56	164.99	4246	95	102.55	128.46
12.13	0.61	30.702	18	1.5	-53.498	-3.30	-3.00	3000	315	200.74	163.81	4246	95	102.37	127.85
12.74	0.50	30.221	0	1.5	-52.592	-20.87	-18.97	3000	315	198.93	162.64	4246	95	102.19	127.23
13.24	0.50	29.848	0	1.5	-47.870	-16.52	-15.02	3000	315	189.44	156.51	4246	95	101.25	124.04
13.74	0.50	29.493	0	1.5	-44.138	-13.15	-11.95	3000	315	181.93	151.63	4246	95	100.51	121.51
14.24	0.50	29.154	0	1.5	-41.174	-10.52	-9.56	3000	315	175.95	147.74	4246	95	99.92	119.50
14.74	0.50	28.831	0	1.5	-38.805	-8.47	-7.70	3000	315	171.17	144.62	4246	95	99.44	117.90
15.24	0.50	28.522	0	1.5	-36.899	-6.88	-6.25	3000	315	167.32	142.10	4246	95	99.06	116.60
15.74	0.50	28.226	0	1.5	-35.353	-5.63	-5.12	3000	315	164.19	140.05	4246	95	98.75	115.56
16.24	0.50	27.942	0	1.5	-34.090	-4.65	-4.22	3000	315	161.64	138.37	4246	95	98.49	114.70
16.74	0.52	27.670	0	1.5	-33.047	-3.88	-3.52	3000	315	159.52	136.99	4246	95	98.28	113.99
17.26	0.62	27.400	0	1.5	-32.150	-3.25	-2.95	3000	315	157.71	135.79	4246	95	98.10	113.38
17.87	0.75	27.091	0	1.5	-31.253	-2.66	-2.42	3000	315	155.89	134.59	4246	95	97.92	112.77
18.62	0.94	26.733	0	1.5	-30.358	-2.12	-1.93	3000	315	154.07	133.40	4246	95	97.74	112.17
19.56	1.21	26.311	0	1.5	-29.462	-1.65	-1.50	3000	315	152.25	132.20	4246	95	97.56	111.56
20.77	1.58	25.805	0	1.5	-28.567	-1.26	-1.15	3000	315	150.43	131.00	4246	95	97.38	110.95
22.36	2.00	25.200	0	1.5	-27.673	-0.97	-0.89	3000	315	148.62	129.80	4246	95	97.20	110.35
24.36	2.00	24.512	0	1.5	-26.803	-0.79	-0.72	3000	315	146.85	128.63	4246	95	97.02	109.75
26.36	2.00	23.895	0	1.5	-26.096	-0.70	-0.64	3000	315	145.41	127.68	4246	95	96.88	109.28
28.36	2.00	23.337	0	1.5	-25.470	-0.63	-0.58	3000	315	144.13	126.83	4246	95	96.75	108.85
30.36	2.00	22.829	0	1.5	-24.905	-0.58	-0.52	3000	315	142.98	126.07	4246	95	96.64	108.47
32.36	2.00	22.363	0	1.5	-24.391	-0.53	-0.48	3000	315	141.93	125.37	4246	95	96.53	108.12
34.36	2.00	21.934	0	1.5	-23.920	-0.49	-0.44	3000	315	140.97	124.74	4246	95	96.44	107.80
36.36	2.00	21.537	0	1.5	-23.487	-0.45	-0.41	3000	315	140.09	124.15	4246	95	96.35	107.50

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
2.00	312.17	55.59	1.0319	1.18E-04	0.395	5.609	143,945	1.1066	2331	170.10	60.78	1.0014	2.49E-04	0.384	1.591	83,939	2.3344	869	9.551	159.16
2.10	309.88	55.69	1.0310	1.19E-04	0.395	5.609	142,918	1.1152	2325	169.26	60.80	1.0014	2.50E-04	0.384	1.591	83,463	2.3494	867	9.542	159.06
2.20	307.61	55.78	1.0302	1.20E-04	0.395	5.609	141,893	1.1239	2320	168.43	60.82	1.0013	2.52E-04	0.384	1.591	82,991	2.3645	865	9.533	158.97
2.30	305.36	55.88	1.0294	1.21E-04	0.395	5.609	140,872	1.1327	2315	167.61	60.84	1.0012	2.53E-04	0.384	1.591	82,524	2.3795	864	9.525	158.87
2.40	303.14	55.97	1.0286	1.22E-04	0.396	5.609	139,857	1.1416	2309	166.79	60.85	1.0012	2.55E-04	0.383	1.591	82,062	2.3946	862	9.516	158.78
2.50	300.94	56.06	1.0278	1.23E-04	0.396	5.609	138,849	1.1506	2304	165.99	60.87	1.0011	2.56E-04	0.383	1.591	81,607	2.4096	860	9.507	158.69
2.60	298.77	56.15	1.0270	1.24E-04	0.396	5.609	137,849	1.1597	2298	165.20	60.89	1.0010	2.58E-04	0.383	1.591	81,158	2.4246	859	9.498	158.59
2.70	296.64	56.24	1.0263	1.25E-04	0.396	5.609	136,858	1.1688	2293	164.41	60.90	1.0009	2.59E-04	0.383	1.591	80,717	2.4396	857	9.490	158.50
2.80	294.53	56.33	1.0256	1.26E-04	0.396	5.609	135,877	1.1780	2287	163.65	60.92	1.0009	2.61E-04	0.383	1.591	80,282	2.4545	856	9.481	158.40
2.90	292.46	56.41	1.0249	1.27E-04	0.396	5.609	134,908	1.1873	2282	162.89	60.93	1.0008	2.62E-04	0.382	1.591	79,855	2.4693	854	9.472	158.31
3.00	290.42	56.50	1.0243	1.29E-04	0.396	5.609	133,950	1.1966	2276	162.14	60.95	1.0008	2.64E-04	0.382	1.591	79,435	2.4840	853	9.464	158.22
3.20	286.41	56.66	1.0230	1.31E-04	0.396	5.609	132,055	1.2154	2265	160.68	60.98	1.0006	2.66E-04	0.382	1.591	78,611	2.5133	850	9.447	158.03
3.60	278.67	56.96	1.0206	1.35E-04	0.396	5.609	128,359	1.2540	2242	157.85	61.04	1.0004	2.72E-04	0.381	1.591	77,028	2.5716	844	9.415	157.67
4.10	269.74	57.31	1.0181	1.41E-04	0.396	5.609	124,037	1.3024	2215	154.60	61.10	1.0002	2.79E-04	0.380	1.591	75,213	2.6417	837	9.377	157.23
4.60	261.74	57.61	1.0160	1.46E-04	0.396	5.609	120,116	1.3497	2189	151.69	61.16	1.0000	2.85E-04	0.380	1.591	73,597	2.7073	831	9.343	156.82
5.10	254.61	57.87	1.0142	1.51E-04	0.396	5.609	116,588	1.3953	2164	149.10	61.21	0.9998	2.91E-04	0.379	1.591	72,165	2.7680	826	9.312	156.44
5.60	242.32	58.10	1.0114	1.61E-04	0.395	5.609	110,056	1.4824	2114	131.13	61.53	0.9987	3.39E-04	0.373	3.652	143,272	3.2604	1312	9.220	167.76
6.10	230.74	58.52	1.0090	1.71E-04	0.394	5.609	104,293	1.5756	2070	128.03	61.58	0.9986	3.48E-04	0.372	3.652	139,500	3.3602	1300	9.176	167.18
6.60	221.38	58.85	1.0073	1.80E-04	0.393	5.609	99,607	1.6602	2032	125.52	61.62	0.9985	3.56E-04	0.371	3.652	136,475	3.4445	1290	9.141	166.68
7.10	213.78	59.10	1.0061	1.88E-04	0.392	5.609	95,792	1.7357	2001	123.49	61.66	0.9984	3.63E-04	0.371	3.652	134,035	3.5154	1282	9.112	166.25
7.60	207.58	59.31	1.0051	1.95E-04	0.392	5.609	92,676	1.8024	1974	121.84	61.68	0.9983	3.68E-04	0.370	3.652	132,055	3.5750	1276	9.088	165.89
8.10	202.49	59.47	1.0044	2.01E-04	0.391	5.609	90,118	1.8609	1951	120.48	61.70	0.9982	3.73E-04	0.370	3.652	130,437	3.6251	1270	9.069	165.58
8.60	198.28	59.60	1.0038	2.06E-04	0.390	5.609	88,005	1.9120	1932	119.36	61.72	0.9982	3.77E-04	0.369	3.652	129,104	3.6674	1266	9.053	165.32
9.10	194.77	59.71	1.0034	2.11E-04	0.390	5.609	86,247	1.9565	1916	118.43	61.74	0.9982	3.80E-04	0.369	3.652	127,999	3.7032	1262	9.040	165.10
9.60	191.83	59.80	1.0030	2.15E-04	0.389	5.609	84,772	1.9955	1902	117.65	61.75	0.9981	3.83E-04	0.369	3.652	127,073	3.7337	1259	9.028	164.91
10.10	189.34	59.88	1.0027	2.18E-04	0.389	5.609	83,525	2.0295	1890	116.98	61.76	0.9981	3.86E-04	0.368	3.652	126,292	3.7598	1256	9.019	164.75
10.60	187.21	59.94	1.0024	2.22E-04	0.388	5.609	82,461	2.0595	1880	116.42	61.77	0.9981	3.88E-04	0.368	3.652	125,625	3.7823	1254	9.011	164.61
11.10	185.37	60.00	1.0022	2.24E-04	0.388	5.609	81,545	2.0860	1871	115.93	61.77	0.9981	3.89E-04	0.368	3.652	125,052	3.8019	1252	9.004	164.49
11.60	183.77	60.05	1.0021	2.27E-04	0.388	5.609	80,749	2.1095	1863	115.51	61.78	0.9981	3.91E-04	0.368	3.652	124,554	3.8191	1250	8.998	164.38
12.13	182.28	60.09	1.0019	2.29E-04	0.387	5.609	80,004	2.1320	1856	115.11	61.79	0.9980	3.93E-04	0.368	3.652	124,088	3.8353	1249	8.991	164.28
12.74	180.78	60.13	1.0017	2.31E-04	0.387	5.609	79,260	2.1549	1849	114.71	61.79	0.9980	3.94E-04	0.368	3.652	123,624	3.8516	1247	8.985	164.17
13.24	172.97	60.36	1.0009	2.44E-04	0.385	5.609	75,387	2.2819	1810	112.65	61.82	0.9980	4.02E-04	0.367	3.652	121,207	3.9384	1238	8.952	163.61
13.74	166.78	60.53	1.0004	2.55E-04	0.384	5.609	72,335	2.3924	1778	111.01	61.85	0.9979	4.09E-04	0.366	3.652	119,305	4.0094	1232	8.927	163.15
14.24	161.85	60.66	0.9999	2.64E-04	0.383	5.609	69,917	2.4872	1751	109.71	61.87	0.9979	4.14E-04	0.366	3.652	117,799	4.0673	1226	8.906	162.77
14.74	157.90	60.76	0.9996	2.72E-04	0.382	5.609	67,991	2.5679	1730	108.67	61.88	0.9978	4.18E-04	0.365	3.652	116,598	4.1147	1222	8.890	162.45
15.24	154.71	60.84	0.9994	2.79E-04	0.381	5.609	66,444	2.6363	1713	107.83	61.89	0.9978	4.22E-04	0.365	3.652	115,635	4.1534	1218	8.877	162.20
15.74	152.12	60.91	0.9992	2.85E-04	0.380	5.609	65,194	2.6942	1699	107.15	61.90	0.9978	4.25E-04	0.365	3.652	114,855	4.1852	1215	8.867	161.98
16.24	150.01	60.96	0.9990	2.89E-04	0.380	5.609	64,173	2.7432	1687	106.60	61.91	0.9978	4.27E-04	0.364	3.652	114,218	4.2116	1213	8.859	161.80
16.74	148.26	61.00	0.9989	2.94E-04	0.379	5.609	63,332	2.7848	1677	106.14	61.92	0.9978	4.29E-04	0.364	3.652	113,693	4.2336	1211	8.852	161.65
17.26	146.75	61.04	0.9988	2.97E-04	0.379	5.609	62,609	2.8215	1669	105.74	61.92	0.9978	4.31E-04	0.364	3.652	113,242	4.2526	1209	8.846	161.52
17.87	145.24	61.08	0.9987	3.01E-04	0.378	5.609	61,889	2.8591	1660	105.35	61.93	0.9978	4.33E-04	0.364	3.652	112,792	4.2718	1208	8.840	161.39
18.62	143.73	61.11	0.9986	3.04E-04	0.378	5.609	61,169	2.8975	1652	104.95	61.93	0.9978	4.35E-04	0.364	3.652	112,343	4.2911	1206	8.834	161.26
19.56	142.23	61.15	0.9985	3.08E-04	0.377	5.609	60,451	2.9368	1643	104.56	61.94	0.9978	4.36E-04	0.364	3.652	111,894	4.3105	1204	8.828	161.13
20.77	140.72	61.18	0.9984	3.12E-04	0.377	5.609	59,735	2.9770	1634	104.17	61.94	0.9977	4.38E-04	0.363	3.652	111,446	4.3301	1202	8.822	160.99
22.36	139.21	61.22	0.9983	3.16E-04	0.376	5.609	59,020	3.0182	1625	103.77	61.95	0.9977	4.40E-04	0.363	3.652	110,998	4.3498	1201	8.817	160.85
24.36	137.74	61.25	0.9983	3.20E-04	0.376	5.609	58,326	3.0592	1617	103.39	61.95	0.9977	4.42E-04	0.363	3.652	110,563	4.3691	1199	8.811	160.72
26.36	136.54	61.28	0.9982	3.23E-04	0.376	5.609	57,763	3.0933	1610	103.08	61.96	0.9977	4.43E-04	0.363	3.652	110,210	4.3849	1198	8.807	160.61
28.36	135.48	61.30	0.9981	3.26E-04	0.375	5.609	57,264	3.1240	1604	102.80	61.96	0.9977	4.44E-04	0.363	3.652	109,898	4.3990	1197	8.803	160.51
30.36	134.52	61.32	0.9981	3.29E-04	0.375	5.609	56,815	3.1521	1598	102.55	61.96	0.9977	4.46E-04	0.363	3.652	109,616	4.4117	1196	8.799	160.42
32.36	133.65	61.34	0.9980	3.31E-04	0.375	5.609	56,407	3.1782	1593	102.33	61.97	0.9977	4.47E-04	0.363	3.652	109,360	4.4234	1195	8.796	160.34
34.36	132.85	61.36	0.9980	3.34E-04	0.374	5.609	56,034	3.2023	1588	102.12	61.97	0.9977	4.48E-04	0.363	3.652	109,125	4.4341	1194	8.793	160.26
36.36	132.12	61.37	0.9980	3.36E-04	0.374	5.609	55,690	3.2249	1584	101.93	61.97	0.9977	4.49E-04	0.363	3.652	108,910	4.4441	1193	8.790	160.19

CCW HX Fouling 0.004

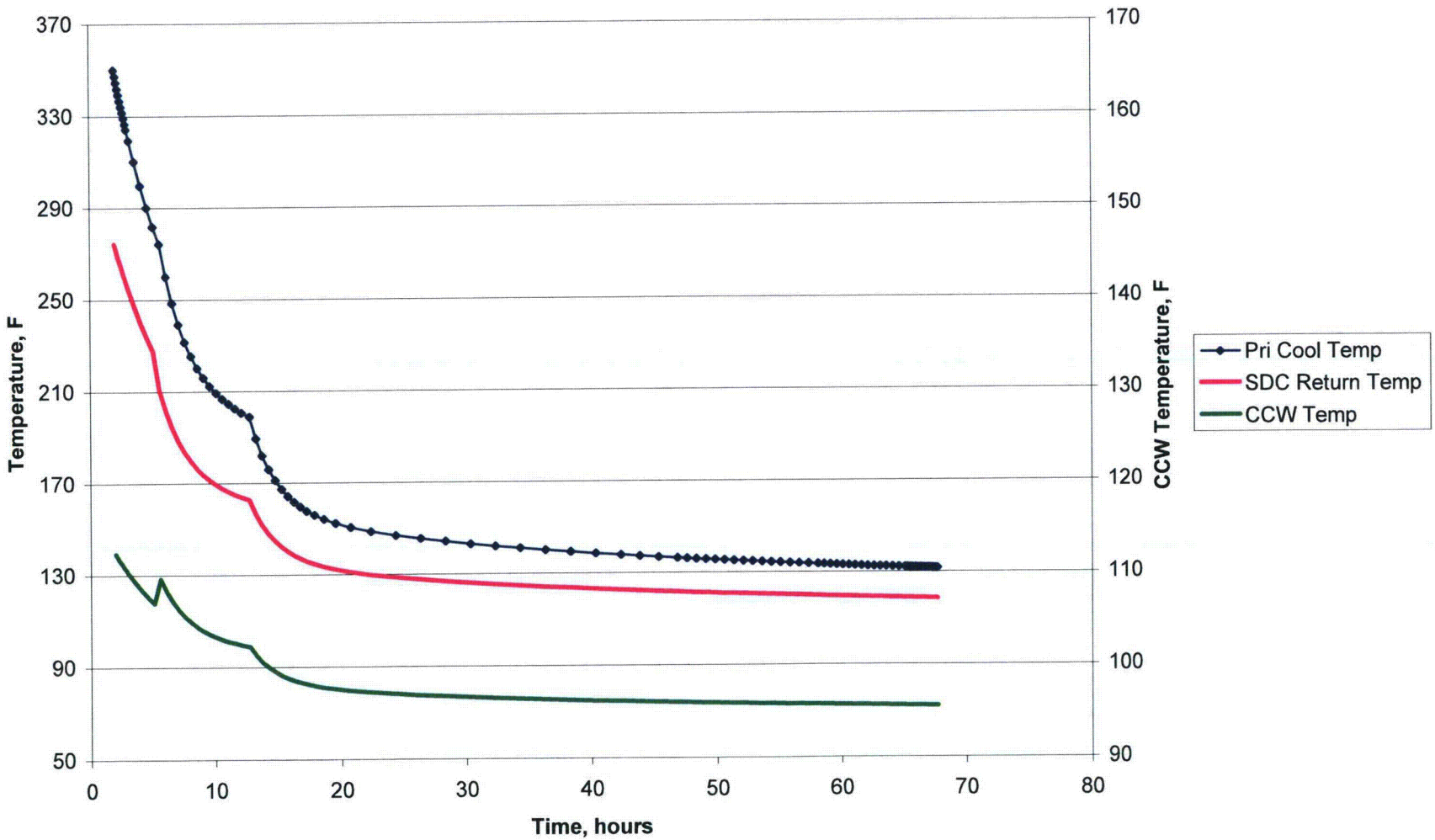
Time	SDC HX tube side							SDC HX shell side							SDC Duty	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX	CCW Temp
hrs	W	WCp	Cr	NTU	effectivenes	DT	Tt,o	W	WCp	Cr	NTU	effectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr	Ts,o
2.00	1,337,560	1,380,222	#N/A	#N/A	#N/A	75.66	274.34	901,948	903,255	0.654	0.885	0.486	115.62	227.91	104.43	274.34	227.91	7.358	111.79	8,100	3	37.26	112.29
2.10	1,339,934	1,381,514	#N/A	#N/A	#N/A	74.79	272.48	902,211	903,449	0.654	0.884	0.486	114.37	226.44	103.32	272.48	226.44	7.358	110.68	8,100	3	36.89	112.08
2.20	1,342,272	1,382,795	#N/A	#N/A	#N/A	73.93	270.65	902,471	903,642	0.653	0.883	0.486	113.13	224.99	102.23	270.65	224.99	7.358	109.58	8,100	3	36.53	111.87
2.30	1,344,572	1,384,062	#N/A	#N/A	#N/A	73.07	268.83	902,727	903,832	0.653	0.882	0.486	111.90	223.55	101.14	268.83	223.55	7.358	108.50	8,100	3	36.17	111.66
2.40	1,346,831	1,385,314	#N/A	#N/A	#N/A	72.23	267.02	902,980	904,020	0.653	0.882	0.486	110.68	222.13	100.06	267.02	222.13	7.358	107.42	8,100	3	35.81	111.45
2.50	1,349,049	1,386,549	#N/A	#N/A	#N/A	71.40	265.24	903,228	904,205	0.652	0.881	0.486	109.48	220.73	99.00	265.24	220.73	7.358	106.35	8,100	3	35.45	111.25
2.60	1,351,223	1,387,766	#N/A	#N/A	#N/A	70.58	263.48	903,472	904,388	0.652	0.880	0.486	108.30	219.35	97.95	263.48	219.35	7.358	105.31	8,100	3	35.10	111.04
2.70	1,353,353	1,388,965	#N/A	#N/A	#N/A	69.77	261.75	903,712	904,567	0.651	0.880	0.485	107.14	217.98	96.91	261.75	217.98	7.358	104.27	8,100	3	34.76	110.85
2.80	1,355,437	1,390,144	#N/A	#N/A	#N/A	68.98	260.04	903,948	904,744	0.651	0.879	0.485	105.99	216.64	95.89	260.04	216.64	7.358	103.25	8,100	3	34.42	110.65
2.90	1,357,477	1,391,304	#N/A	#N/A	#N/A	68.20	258.36	904,178	904,918	0.650	0.878	0.485	104.86	215.32	94.89	258.36	215.32	7.358	102.25	8,100	3	34.08	110.46
3.00	1,359,470	1,392,444	#N/A	#N/A	#N/A	67.44	256.70	904,404	905,088	0.650	0.878	0.485	103.75	214.02	93.90	256.70	214.02	7.358	101.26	8,100	3	33.75	110.27
3.20	1,363,355	1,394,682	#N/A	#N/A	#N/A	65.94	253.44	904,846	905,423	0.649	0.876	0.485	101.57	211.46	91.96	253.44	211.46	7.358	99.32	8,100	3	33.11	109.89
3.60	1,370,716	1,398,987	#N/A	#N/A	#N/A	63.06	247.14	905,689	906,064	0.648	0.874	0.484	97.37	206.54	88.22	247.14	206.54	7.358	95.58	8,100	3	31.86	109.17
4.10	1,378,990	1,403,931	#N/A	#N/A	#N/A	59.77	239.86	906,645	906,797	0.646	0.870	0.484	92.53	200.87	83.91	239.86	200.87	7.358	91.27	8,100	3	30.42	108.34
4.60	1,386,212	1,408,344	#N/A	#N/A	#N/A	56.84	233.32	907,486	907,448	0.644	0.868	0.483	88.21	195.80	80.05	233.32	195.80	7.358	87.40	8,100	3	29.13	107.59
5.10	1,392,500	1,412,266	#N/A	#N/A	#N/A	54.24	227.49	908,223	908,023	0.643	0.865	0.483	84.37	191.28	76.61	227.49	191.28	7.358	83.96	8,100	3	27.99	106.92
5.60	1,397,975	1,413,909	0.676	0.596	0.388	63.83	210.40	2,095,526	2,092,849	#N/A	#N/A	#N/A	43.13	152.69	90.26	210.40	152.69	7.358	97.61	8,100	3	32.54	109.56
6.10	1,408,088	1,420,829	0.678	0.591	0.385	58.50	201.49	2,097,298	2,094,302	#N/A	#N/A	#N/A	39.69	147.87	83.12	201.49	147.87	7.358	90.48	8,100	3	30.16	108.18
6.60	1,415,961	1,426,357	0.681	0.587	0.383	54.24	194.26	2,098,699	2,095,460	#N/A	#N/A	#N/A	36.92	143.98	77.36	194.26	143.98	7.358	84.72	8,100	3	28.24	107.06
7.10	1,422,155	1,430,799	0.683	0.583	0.382	50.81	188.38	2,099,816	2,096,389	#N/A	#N/A	#N/A	34.68	140.83	72.70	188.38	140.83	7.358	80.06	8,100	3	26.69	106.15
7.60	1,427,078	1,434,389	0.684	0.581	0.381	48.04	183.56	2,100,713	2,097,139	#N/A	#N/A	#N/A	32.86	138.27	68.90	183.56	138.27	7.358	76.26	8,100	3	25.42	105.41
8.10	1,431,032	1,437,312	0.685	0.578	0.380	45.77	179.60	2,101,440	2,097,750	#N/A	#N/A	#N/A	31.36	136.16	65.79	179.60	136.16	7.358	73.15	8,100	3	24.38	104.80
8.60	1,434,238	1,439,710	0.686	0.576	0.379	43.91	176.32	2,102,035	2,098,251	#N/A	#N/A	#N/A	30.13	134.43	63.22	176.32	134.43	7.358	70.58	8,100	3	23.53	104.30
9.10	1,436,866	1,441,693	0.687	0.575	0.378	42.37	173.59	2,102,525	2,098,665	#N/A	#N/A	#N/A	29.11	132.98	61.09	173.59	132.98	7.358	68.44	8,100	3	22.81	103.87
9.60	1,439,042	1,443,347	0.688	0.574	0.377	41.08	171.29	2,102,933	2,099,012	#N/A	#N/A	#N/A	28.25	131.77	59.30	171.29	131.77	7.358	66.65	8,100	3	22.22	103.52
10.10	1,440,863	1,444,739	0.688	0.572	0.377	39.99	169.34	2,103,277	2,099,304	#N/A	#N/A	#N/A	27.52	130.74	57.78	169.34	130.74	7.358	65.14	8,100	3	21.71	103.22
10.60	1,442,403	1,445,923	0.689	0.571	0.376	39.07	167.67	2,103,568	2,099,552	#N/A	#N/A	#N/A	26.90	129.87	56.49	167.67	129.87	7.358	63.84	8,100	3	21.28	102.97
11.10	1,443,719	1,446,939	0.689	0.571	0.376	38.27	166.24	2,103,818	2,099,766	#N/A	#N/A	#N/A	26.37	129.12	55.37	166.24	129.12	7.358	62.73	8,100	3	20.91	102.75
11.60	1,444,855	1,447,819	0.689	0.570	0.376	37.58	164.99	2,104,035	2,099,951	#N/A	#N/A	#N/A	25.91	128.46	54.40	164.99	128.46	7.358	61.76	8,100	3	20.59	102.55
12.13	1,445,910	1,448,640	0.690	0.569	0.375	36.93	163.81	2,104,237	2,100,124	#N/A	#N/A	#N/A	25.47	127.85	53.50	163.81	127.85	7.358	60.86	8,100	3	20.29	102.37
12.74	1,446,959	1,449,458	0.690	0.569	0.375	36.28	162.64	2,104,438	2,100,297	#N/A	#N/A	#N/A	25.04	127.23	52.59	162.64	127.23	7.358	59.95	8,100	3	19.98	102.19
13.24	1,452,315	1,453,675	0.692	0.565	0.373	32.93	156.51	2,105,476	2,101,191	#N/A	#N/A	#N/A	22.78	124.04	47.87	156.51	124.04	7.358	55.23	8,100	3	18.41	101.25
13.74	1,456,416	1,456,949	0.693	0.562	0.372	30.30	151.63	2,106,283	2,101,892	#N/A	#N/A	#N/A	21.00	121.51	44.14	151.63	121.51	7.358	51.50	8,100	3	17.17	100.51
14.24	1,459,588	1,459,508	0.694	0.560	0.371	28.21	147.74	2,106,916	2,102,445	#N/A	#N/A	#N/A	19.58	119.50	41.17	147.74	119.50	7.358	48.53	8,100	3	16.18	99.92
14.74	1,462,068	1,461,523	0.695	0.558	0.370	26.55	144.62	2,107,416	2,102,885	#N/A	#N/A	#N/A	18.45	117.90	38.80	144.62	117.90	7.358	46.16	8,100	3	15.39	99.44
15.24	1,464,026	1,463,124	0.696	0.556	0.369	25.22	142.10	2,107,815	2,103,237	#N/A	#N/A	#N/A	17.54	116.60	36.90	142.10	116.60	7.358	44.26	8,100	3	14.75	99.06
15.74	1,465,589	1,464,408	0.696	0.555	0.369	24.14	140.05	2,108,136	2,103,521	#N/A	#N/A	#N/A	16.81	115.56	35.35	140.05	115.56	7.358	42.71	8,100	3	14.24	98.75
16.24	1,466,850	1,465,448	0.697	0.554	0.368	23.26	138.37	2,108,397	2,103,753	#N/A	#N/A	#N/A	16.20	114.70	34.09	138.37	114.70	7.358	41.45	8,100	3	13.82	98.49
16.74	1,467,879	1,466,300	0.697	0.553	0.368	22.54	136.99	2,108,612	2,103,944	#N/A	#N/A	#N/A	15.71	113.99	33.05	136.99	113.99	7.358	40.40	8,100	3	13.47	98.28
17.26	1,468,756	1,467,027	0.697	0.553	0.368	21.91	135.79	2,108,795	2,104,108	#N/A	#N/A	#N/A	15.28	113.38	32.15	135.79	113.38	7.358	39.51	8,100	3	13.17	98.10
17.87	1,469,625	1,467,749	0.698	0.552	0.367	21.29	134.59	2,108,978	2,104,272	#N/A	#N/A	#N/A	14.85	112.77	31.25	134.59	112.77	7.358	38.61	8,100	3	12.87	97.92
18.62	1,470,486	1,468,466	0.698	0.551	0.367	20.67	133.40	2,109,160	2,104,435	#N/A	#N/A	#N/A	14.43	112.17	30.36	133.40	112.17	7.358	37.72	8,100	3	12.57	97.74
19.56	1,471,338	1,469,177	0.698	0.551	0.367	20.05	132.20	2,109,341	2,104,598	#N/A	#N/A	#N/A	14.00	111.56	29.46	132.20	111.56	7.358	36.82	8,100	3	12.27	97.56
20.77	1,472,181	1,469,883	0.698	0.550	0.366	19.44	131.00	2,109,521	2,104,761	#N/A	#N/A	#N/A	13.57	110.95	28.57	131.00	110.95	7.358	35.93	8,100	3	11.98	97.38
22.36	1,473,016	1,470,583	0.699	0.549	0.366	18.82	129.80	2,109,701	2,104,923	#N/A	#N/A	#N/A	13.15	110.35	27.67	129.80	110.35	7.358	35.03	8,100	3	11.68	97.20
24.36	1,473,821	1,471,259	0.699	0.548	0.366	18.22	128.63	2,109,875	2,105,080	#N/A	#N/A	#N/A	12.73	109.75	26.80	128.63	109.75	7.358	34.16	8,100	3	11.39	97.02
26.36	1,474,469	1,471,804	0.699	0.548	0.365	17.73	127.68	2,110,015	2,105,208	#N/A	#N/A	#N/A	12.40	109.28	26.10	127.68	109.28	7.358	33.45	8,100	3	11.15	96.88
28.36	1,475,038	1,472,285	0.699	0.547	0.365	17.30	126.83	2,110,140	2,105,321	#N/A	#N/A	#N/A	12.10	108.85	25.47	126.83	108.85	7.358	32.83	8,100	3	10.94	96.75
30.36	1,475,549	1,472,716	0.699	0.547	0.365	16.91	126.07	2,110,252	2,105,423	#N/A	#N/A	#N/A	11.83	108.47	24.91	126.07	108.47	7.358	32.26	8,100	3	10.75	96.64
32.36	1,476,010	1,473,106	0.700	0.546	0.365	16.56	125.37	2,110,353	2,105,515	#N/A	#N/A	#N/A	11.58	108.12	24.39	125.37	108.12	7.358	31.75	8,100	3	10.58	96.53
34.36	1,476,430	1,473,462	0.700	0.546	0.365	16.23	124.74	2,110,446	2,105,600	#N/A	#N/A	#N/A	11.36	107.80	23.92	124.74	107.80	7.358	31.28	8,100	3	10.43	96.44
36.36	1,476,815	1,473,788	0.700	0.546	0.364	15.94	124.15	2,110,531	2,105,678	#N/A	#N/A	#N/A	11.15	107.50	23.49	124.15	107.50	7.358	30.84	8,100	3	10.28	96.35

								SDCHx							
Time	Step	Q(D)	P(pp)	P(lp)	Psdc	Total Q	dTrc	Tube				Shell			
hrs	hrs	mmBtu/hr					degF/hr	Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
38.36	2.00	21.167	0	1.5	-23.086	-0.42	-0.38	3000	315	139.27	123.61	4246	95	96.27	107.23
40.36	2.00	20.823	0	1.5	-22.713	-0.39	-0.36	3000	315	138.51	123.10	4246	95	96.19	106.98
42.36	1.50	20.500	0	1.5	-22.365	-0.37	-0.33	3000	315	137.80	122.63	4246	95	96.12	106.74
43.86	1.50	20.271	0	1.5	-22.121	-0.35	-0.32	3000	315	137.30	122.30	4246	95	96.07	106.58
45.36	1.50	20.051	0	1.5	-21.887	-0.34	-0.31	3000	315	136.82	121.98	4246	95	96.02	106.42
46.86	0.75	19.842	0	1.5	-21.663	-0.32	-0.29	3000	315	136.36	121.68	4246	95	95.98	106.26
47.61	0.75	19.740	0	1.5	-21.556	-0.32	-0.29	3000	315	136.14	121.53	4246	95	95.96	106.19
48.36	0.75	19.641	0	1.5	-21.451	-0.31	-0.28	3000	315	135.93	121.39	4246	95	95.94	106.12
49.11	0.75	19.543	0	1.5	-21.347	-0.30	-0.28	3000	315	135.72	121.25	4246	95	95.91	106.05
49.86	0.75	19.448	0	1.5	-21.246	-0.30	-0.27	3000	315	135.51	121.11	4246	95	95.89	105.98
50.61	0.75	19.354	0	1.5	-21.147	-0.29	-0.27	3000	315	135.31	120.97	4246	95	95.87	105.91
51.36	0.75	19.263	0	1.5	-21.049	-0.29	-0.26	3000	315	135.11	120.84	4246	95	95.85	105.85
52.11	0.75	19.173	0	1.5	-20.954	-0.28	-0.26	3000	315	134.91	120.71	4246	95	95.83	105.78
52.86	0.75	19.084	0	1.5	-20.860	-0.28	-0.25	3000	315	134.72	120.58	4246	95	95.82	105.72
53.61	0.75	18.998	0	1.5	-20.768	-0.27	-0.25	3000	315	134.53	120.46	4246	95	95.80	105.66
54.36	0.75	18.913	0	1.5	-20.678	-0.27	-0.24	3000	315	134.35	120.34	4246	95	95.78	105.60
55.11	0.75	18.829	0	1.5	-20.590	-0.26	-0.24	3000	315	134.17	120.22	4246	95	95.76	105.54
55.86	0.75	18.747	0	1.5	-20.503	-0.26	-0.23	3000	315	133.99	120.10	4246	95	95.74	105.48
56.61	0.75	18.666	0	1.5	-20.418	-0.25	-0.23	3000	315	133.81	119.98	4246	95	95.72	105.42
57.36	0.75	18.587	0	1.5	-20.334	-0.25	-0.22	3000	315	133.64	119.87	4246	95	95.71	105.36
58.11	0.50	18.509	0	1.5	-20.252	-0.24	-0.22	3000	315	133.47	119.75	4246	95	95.69	105.31
58.61	0.50	18.458	0	1.5	-20.198	-0.24	-0.22	3000	315	133.36	119.68	4246	95	95.68	105.27
59.11	0.50	18.408	0	1.5	-20.145	-0.24	-0.22	3000	315	133.25	119.61	4246	95	95.67	105.23
59.61	0.50	18.358	0	1.5	-20.092	-0.23	-0.21	3000	315	133.15	119.54	4246	95	95.66	105.20
60.11	0.50	18.308	0	1.5	-20.040	-0.23	-0.21	3000	315	133.04	119.47	4246	95	95.65	105.16
60.61	0.50	18.259	0	1.5	-19.988	-0.23	-0.21	3000	315	132.94	119.40	4246	95	95.64	105.13
61.11	0.50	18.211	0	1.5	-19.938	-0.23	-0.21	3000	315	132.83	119.33	4246	95	95.63	105.09
61.61	0.50	18.163	0	1.5	-19.887	-0.22	-0.20	3000	315	132.73	119.26	4246	95	95.62	105.06
62.11	0.50	18.116	0	1.5	-19.837	-0.22	-0.20	3000	315	132.63	119.19	4246	95	95.61	105.02
62.61	0.50	18.069	0	1.5	-19.788	-0.22	-0.20	3000	315	132.53	119.12	4246	95	95.60	104.99
63.11	0.50	18.022	0	1.5	-19.739	-0.22	-0.20	3000	315	132.43	119.06	4246	95	95.59	104.96
63.61	0.50	17.976	0	1.5	-19.691	-0.21	-0.20	3000	315	132.33	118.99	4246	95	95.58	104.93
64.11	0.50	17.931	0	1.5	-19.643	-0.21	-0.19	3000	315	132.23	118.93	4246	95	95.57	104.89
64.61	0.50	17.886	0	1.5	-19.596	-0.21	-0.19	3000	315	132.13	118.86	4246	95	95.56	104.86
65.11	0.20	17.842	0	1.5	-19.549	-0.21	-0.19	3000	315	132.04	118.80	4246	95	95.55	104.83
65.31	0.20	17.824	0	1.5	-19.531	-0.21	-0.19	3000	315	132.00	118.77	4246	95	95.54	104.82
65.51	0.20	17.806	0	1.5	-19.512	-0.21	-0.19	3000	315	131.96	118.75	4246	95	95.54	104.80
65.71	0.20	17.789	0	1.5	-19.494	-0.21	-0.19	3000	315	131.92	118.72	4246	95	95.54	104.79
65.91	0.20	17.771	0	1.5	-19.475	-0.20	-0.19	3000	315	131.89	118.70	4246	95	95.53	104.78
66.11	0.20	17.754	0	1.5	-19.457	-0.20	-0.18	3000	315	131.85	118.67	4246	95	95.53	104.77
66.31	0.10	17.737	0	1.5	-19.439	-0.20	-0.18	3000	315	131.81	118.65	4246	95	95.53	104.75
66.41	0.10	17.728	0	1.5	-19.430	-0.20	-0.18	3000	315	131.79	118.63	4246	95	95.52	104.75
66.51	0.10	17.719	0	1.5	-19.421	-0.20	-0.18	3000	315	131.78	118.62	4246	95	95.52	104.74
66.61	0.10	17.711	0	1.5	-19.412	-0.20	-0.18	3000	315	131.76	118.61	4246	95	95.52	104.74
66.71	0.10	17.702	0	1.5	-19.403	-0.20	-0.18	3000	315	131.74	118.60	4246	95	95.52	104.73
66.81	0.10	17.694	0	1.5	-19.394	-0.20	-0.18	3000	315	131.72	118.59	4246	95	95.52	104.72
66.91	0.10	17.685	0	1.5	-19.385	-0.20	-0.18	3000	315	131.70	118.57	4246	95	95.51	104.72
67.01	0.10	17.677	0	1.5	-19.376	-0.20	-0.18	3000	315	131.69	118.56	4246	95	95.51	104.71
67.11	0.10	17.668	0	1.5	-19.367	-0.20	-0.18	3000	315	131.67	118.55	4246	95	95.51	104.71
67.21	0.10	17.660	0	1.5	-19.358	-0.20	-0.18	3000	315	131.65	118.54	4246	95	95.51	104.70
67.31	0.10	17.651	0	1.5	-19.349	-0.20	-0.18	3000	315	131.63	118.52	4246	95	95.51	104.69
67.41	0.10	17.643	0	1.5	-19.340	-0.20	-0.18	3000	315	131.61	118.51	4246	95	95.51	104.69
67.51	0.10	17.634	0	1.5	-19.331	-0.20	-0.18	3000	315	131.60	118.50	4246	95	95.50	104.68
67.61	0.10	17.626	0	1.5	-19.322	-0.20	-0.18	3000	315	131.58	118.49	4246	95	95.50	104.68
67.71	0.10	17.617	0	1.5	-19.313	-0.20	-0.18	3000	315	131.56	118.48	4246	95	95.50	104.67

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
38.36	131.44	61.39	0.9979	3.38E-04	0.374	5.609	55,372	3.2459	1580	101.75	61.97	0.9977	4.49E-04	0.362	3.652	108,710	4.4533	1192	8.788	160.13
40.36	130.80	61.40	0.9979	3.40E-04	0.374	5.609	55,077	3.2657	1576	101.59	61.98	0.9977	4.50E-04	0.362	3.652	108,525	4.4619	1191	8.785	160.07
42.36	130.21	61.42	0.9979	3.42E-04	0.374	5.609	54,803	3.2844	1572	101.43	61.98	0.9977	4.51E-04	0.362	3.652	108,352	4.4699	1191	8.783	160.01
43.86	129.80	61.42	0.9978	3.43E-04	0.373	5.609	54,610	3.2976	1570	101.32	61.98	0.9977	4.51E-04	0.362	3.652	108,231	4.4755	1190	8.782	159.97
45.36	129.40	61.43	0.9978	3.44E-04	0.373	5.609	54,425	3.3104	1568	101.22	61.98	0.9977	4.52E-04	0.362	3.652	108,114	4.4810	1190	8.780	159.93
46.86	129.02	61.44	0.9978	3.45E-04	0.373	5.609	54,248	3.3227	1565	101.12	61.98	0.9977	4.52E-04	0.362	3.652	108,003	4.4862	1189	8.779	159.89
47.61	128.84	61.44	0.9978	3.46E-04	0.373	5.609	54,164	3.3286	1564	101.07	61.98	0.9977	4.53E-04	0.362	3.652	107,950	4.4887	1189	8.778	159.88
48.36	128.66	61.45	0.9978	3.46E-04	0.373	5.609	54,080	3.3344	1563	101.03	61.98	0.9977	4.53E-04	0.362	3.652	107,897	4.4911	1189	8.778	159.86
49.11	128.48	61.45	0.9978	3.47E-04	0.373	5.609	53,999	3.3402	1562	100.98	61.98	0.9977	4.53E-04	0.362	3.652	107,846	4.4936	1189	8.777	159.84
49.86	128.31	61.46	0.9978	3.47E-04	0.373	5.609	53,919	3.3458	1561	100.94	61.98	0.9977	4.53E-04	0.362	3.652	107,796	4.4959	1188	8.776	159.82
50.61	128.14	61.46	0.9977	3.48E-04	0.373	5.609	53,841	3.3514	1560	100.89	61.98	0.9977	4.54E-04	0.362	3.652	107,746	4.4982	1188	8.776	159.81
51.36	127.97	61.46	0.9977	3.48E-04	0.373	5.609	53,764	3.3568	1559	100.85	61.99	0.9977	4.54E-04	0.362	3.652	107,698	4.5005	1188	8.775	159.79
52.11	127.81	61.47	0.9977	3.49E-04	0.373	5.609	53,689	3.3622	1558	100.81	61.99	0.9977	4.54E-04	0.362	3.652	107,651	4.5028	1188	8.775	159.78
52.86	127.65	61.47	0.9977	3.49E-04	0.373	5.609	53,615	3.3674	1557	100.77	61.99	0.9977	4.54E-04	0.362	3.652	107,604	4.5050	1188	8.774	159.76
53.61	127.49	61.47	0.9977	3.50E-04	0.373	5.609	53,542	3.3726	1556	100.73	61.99	0.9977	4.54E-04	0.362	3.652	107,559	4.5071	1188	8.774	159.74
54.36	127.34	61.48	0.9977	3.50E-04	0.373	5.609	53,472	3.3777	1555	100.69	61.99	0.9977	4.55E-04	0.362	3.652	107,514	4.5092	1187	8.773	159.73
55.11	127.19	61.48	0.9977	3.51E-04	0.372	5.609	53,402	3.3827	1554	100.65	61.99	0.9977	4.55E-04	0.362	3.652	107,470	4.5113	1187	8.772	159.71
55.86	127.04	61.48	0.9977	3.51E-04	0.372	5.609	53,334	3.3877	1553	100.61	61.99	0.9977	4.55E-04	0.362	3.652	107,427	4.5134	1187	8.772	159.70
56.61	126.90	61.48	0.9977	3.52E-04	0.372	5.609	53,266	3.3925	1553	100.57	61.99	0.9977	4.55E-04	0.362	3.652	107,385	4.5154	1187	8.771	159.68
57.36	126.75	61.49	0.9977	3.52E-04	0.372	5.609	53,201	3.3973	1552	100.53	61.99	0.9977	4.55E-04	0.362	3.652	107,343	4.5173	1187	8.771	159.67
58.11	126.61	61.49	0.9977	3.53E-04	0.372	5.609	53,136	3.4020	1551	100.50	61.99	0.9977	4.55E-04	0.362	3.652	107,302	4.5193	1187	8.770	159.66
58.61	126.52	61.49	0.9977	3.53E-04	0.372	5.609	53,094	3.4051	1550	100.47	61.99	0.9977	4.56E-04	0.362	3.652	107,276	4.5205	1186	8.770	159.65
59.11	126.43	61.49	0.9977	3.53E-04	0.372	5.609	53,052	3.4082	1550	100.45	61.99	0.9977	4.56E-04	0.362	3.652	107,249	4.5218	1186	8.770	159.64
59.61	126.34	61.50	0.9977	3.54E-04	0.372	5.609	53,010	3.4112	1549	100.43	61.99	0.9977	4.56E-04	0.362	3.652	107,223	4.5230	1186	8.769	159.63
60.11	126.25	61.50	0.9977	3.54E-04	0.372	5.609	52,970	3.4142	1549	100.41	61.99	0.9977	4.56E-04	0.362	3.652	107,197	4.5243	1186	8.769	159.62
60.61	126.17	61.50	0.9977	3.54E-04	0.372	5.609	52,929	3.4172	1548	100.38	61.99	0.9977	4.56E-04	0.362	3.652	107,172	4.5255	1186	8.769	159.61
61.11	126.08	61.50	0.9976	3.54E-04	0.372	5.609	52,889	3.4201	1548	100.36	61.99	0.9977	4.56E-04	0.362	3.652	107,147	4.5267	1186	8.768	159.60
61.61	125.99	61.50	0.9976	3.55E-04	0.372	5.609	52,849	3.4230	1547	100.34	61.99	0.9977	4.56E-04	0.362	3.652	107,122	4.5279	1186	8.768	159.59
62.11	125.91	61.51	0.9976	3.55E-04	0.372	5.609	52,810	3.4259	1547	100.32	61.99	0.9977	4.56E-04	0.362	3.652	107,097	4.5290	1186	8.768	159.59
62.61	125.82	61.51	0.9976	3.55E-04	0.372	5.609	52,772	3.4288	1546	100.29	61.99	0.9977	4.56E-04	0.362	3.652	107,073	4.5302	1186	8.768	159.58
63.11	125.74	61.51	0.9976	3.55E-04	0.372	5.609	52,733	3.4316	1546	100.27	61.99	0.9977	4.57E-04	0.362	3.652	107,048	4.5314	1186	8.767	159.57
63.61	125.66	61.51	0.9976	3.56E-04	0.372	5.609	52,696	3.4344	1545	100.25	61.99	0.9977	4.57E-04	0.362	3.652	107,025	4.5325	1186	8.767	159.56
64.11	125.58	61.51	0.9976	3.56E-04	0.372	5.609	52,658	3.4372	1545	100.23	61.99	0.9977	4.57E-04	0.362	3.652	107,001	4.5336	1185	8.767	159.55
64.61	125.50	61.51	0.9976	3.56E-04	0.372	5.609	52,621	3.4399	1544	100.21	61.99	0.9977	4.57E-04	0.362	3.652	106,978	4.5348	1185	8.766	159.55
65.11	125.42	61.52	0.9976	3.56E-04	0.372	5.609	52,585	3.4427	1544	100.19	61.99	0.9977	4.57E-04	0.362	3.652	106,954	4.5359	1185	8.766	159.54
65.31	125.39	61.52	0.9976	3.57E-04	0.372	5.609	52,570	3.4437	1543	100.18	61.99	0.9977	4.57E-04	0.362	3.652	106,945	4.5363	1185	8.766	159.53
65.51	125.36	61.52	0.9976	3.57E-04	0.372	5.609	52,556	3.4448	1543	100.17	61.99	0.9977	4.57E-04	0.362	3.652	106,936	4.5367	1185	8.766	159.53
65.71	125.32	61.52	0.9976	3.57E-04	0.372	5.609	52,541	3.4459	1543	100.16	61.99	0.9977	4.57E-04	0.362	3.652	106,927	4.5372	1185	8.766	159.53
65.91	125.29	61.52	0.9976	3.57E-04	0.372	5.609	52,527	3.4470	1543	100.16	61.99	0.9977	4.57E-04	0.362	3.652	106,918	4.5376	1185	8.766	159.52
66.11	125.26	61.52	0.9976	3.57E-04	0.372	5.609	52,513	3.4480	1543	100.15	61.99	0.9977	4.57E-04	0.362	3.652	106,909	4.5380	1185	8.766	159.52
66.31	125.23	61.52	0.9976	3.57E-04	0.372	5.609	52,499	3.4491	1542	100.14	61.99	0.9977	4.57E-04	0.362	3.652	106,900	4.5385	1185	8.766	159.52
66.41	125.22	61.52	0.9976	3.57E-04	0.372	5.609	52,492	3.4496	1542	100.14	61.99	0.9977	4.57E-04	0.362	3.652	106,896	4.5387	1185	8.765	159.52
66.51	125.20	61.52	0.9976	3.57E-04	0.372	5.609	52,485	3.4501	1542	100.13	61.99	0.9977	4.57E-04	0.362	3.652	106,891	4.5389	1185	8.765	159.52
66.61	125.19	61.52	0.9976	3.57E-04	0.372	5.609	52,478	3.4507	1542	100.13	61.99	0.9977	4.57E-04	0.362	3.652	106,887	4.5391	1185	8.765	159.51
66.71	125.17	61.52	0.9976	3.57E-04	0.372	5.609	52,471	3.4512	1542	100.12	61.99	0.9977	4.57E-04	0.362	3.652	106,882	4.5393	1185	8.765	159.51
66.81	125.15	61.52	0.9976	3.57E-04	0.372	5.609	52,464	3.4517	1542	100.12	61.99	0.9977	4.57E-04	0.362	3.652	106,878	4.5395	1185	8.765	159.51
66.91	125.14	61.52	0.9976	3.57E-04	0.372	5.609	52,457	3.4522	1542	100.12	61.99	0.9977	4.57E-04	0.362	3.652	106,873	4.5397	1185	8.765	159.51
67.01	125.12	61.52	0.9976	3.57E-04	0.372	5.609	52,450	3.4528	1542	100.11	62.00	0.9977	4.57E-04	0.362	3.652	106,869	4.5400	1185	8.765	159.51
67.11	125.11	61.52	0.9976	3.57E-04	0.372	5.609	52,443	3.4533	1542	100.11	62.00	0.9977	4.57E-04	0.362	3.652	106,865	4.5402	1185	8.765	159.51
67.21	125.09	61.52	0.9976	3.58E-04	0.372	5.609	52,436	3.4538	1542	100.10	62.00	0.9977	4.57E-04	0.362	3.652	106,860	4.5404	1185	8.765	159.50
67.31	125.08	61.52	0.9976	3.58E-04	0.372	5.609	52,429	3.4543	1541	100.10	62.00	0.9977	4.57E-04	0.362	3.652	106,856	4.5406	1185	8.765	159.50
67.41	125.06	61.52	0.9976	3.58E-04	0.372	5.609	52,422	3.4548	1541	100.10	62.00	0.9977	4.57E-04	0.362	3.652	106,851	4.5408	1185	8.765	159.50
67.51	125.05	61.52	0.9976	3.58E-04	0.372	5.609	52,415	3.4553	1541	100.09	62.00	0.9977	4.57E-04	0.362	3.652	106,847	4.5410	1185	8.765	159.50
67.61	125.03	61.52	0.9976	3.58E-04	0.372	5.609	52,408	3.4559	1541	100.09	62.00	0.9977	4.57E-04	0.362	3.652	106,843	4.5412	1185	8.765	159.50
67.71	125.02	61.52	0.9976	3.58E-04	0.372	5.609	52,401	3.4564	1541	100.09	62.00	0.9977	4.57E-04	0.362	3.652	106,838	4.5414	1185	8.765	159.50

Time	SDC HX tube side							SDC HX shell side							SDC Duty	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX	CCW Temp
hrs	W	WCp	Cr	NTU	effectivenes	DT	Tt,o	W	WCp	Cr	NTU	effectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr	Ts,o
38.36	1,477,169	1,474,089	0.700	0.545	0.364	15.66	123.61	2,110,610	2,105,750	#N/A	#N/A	#N/A	10.96	107.23	23.09	123.61	107.23	7.358	30.44	8,100	3	10.15	96.27
40.36	1,477,497	1,474,367	0.700	0.545	0.364	15.41	123.10	2,110,683	2,105,817	#N/A	#N/A	#N/A	10.79	106.98	22.71	123.10	106.98	7.358	30.07	8,100	3	10.02	96.19
42.36	1,477,801	1,474,626	0.700	0.545	0.364	15.17	122.63	2,110,751	2,105,879	#N/A	#N/A	#N/A	10.62	106.74	22.37	122.63	106.74	7.358	29.72	8,100	3	9.91	96.12
43.86	1,478,014	1,474,807	0.700	0.545	0.364	15.00	122.30	2,110,799	2,105,923	#N/A	#N/A	#N/A	10.50	106.58	22.12	122.30	106.58	7.358	29.48	8,100	3	9.83	96.07
45.36	1,478,217	1,474,980	0.700	0.544	0.364	14.84	121.98	2,110,844	2,105,965	#N/A	#N/A	#N/A	10.39	106.42	21.89	121.98	106.42	7.358	29.25	8,100	3	9.75	96.02
46.86	1,478,412	1,475,146	0.700	0.544	0.364	14.69	121.68	2,110,888	2,106,005	#N/A	#N/A	#N/A	10.29	106.26	21.66	121.68	106.26	7.358	29.02	8,100	3	9.67	95.98
47.61	1,478,504	1,475,225	0.700	0.544	0.364	14.61	121.53	2,110,909	2,106,025	#N/A	#N/A	#N/A	10.24	106.19	21.56	121.53	106.19	7.358	28.91	8,100	3	9.64	95.96
48.36	1,478,595	1,475,302	0.701	0.544	0.364	14.54	121.39	2,110,929	2,106,043	#N/A	#N/A	#N/A	10.19	106.12	21.45	121.39	106.12	7.358	28.81	8,100	3	9.60	95.94
49.11	1,478,684	1,475,378	0.701	0.544	0.364	14.47	121.25	2,110,949	2,106,062	#N/A	#N/A	#N/A	10.14	106.05	21.35	121.25	106.05	7.358	28.71	8,100	3	9.57	95.91
49.86	1,478,772	1,475,453	0.701	0.544	0.363	14.40	121.11	2,110,969	2,106,080	#N/A	#N/A	#N/A	10.09	105.98	21.25	121.11	105.98	7.358	28.60	8,100	3	9.53	95.89
50.61	1,478,857	1,475,526	0.701	0.544	0.363	14.33	120.97	2,110,988	2,106,098	#N/A	#N/A	#N/A	10.04	105.91	21.15	120.97	105.91	7.358	28.50	8,100	3	9.50	95.87
51.36	1,478,941	1,475,597	0.701	0.544	0.363	14.26	120.84	2,111,007	2,106,115	#N/A	#N/A	#N/A	9.99	105.85	21.05	120.84	105.85	7.358	28.41	8,100	3	9.47	95.85
52.11	1,479,023	1,475,667	0.701	0.544	0.363	14.20	120.71	2,111,026	2,106,132	#N/A	#N/A	#N/A	9.95	105.78	20.95	120.71	105.78	7.358	28.31	8,100	3	9.44	95.83
52.86	1,479,103	1,475,736	0.701	0.543	0.363	14.14	120.58	2,111,044	2,106,149	#N/A	#N/A	#N/A	9.90	105.72	20.86	120.58	105.72	7.358	28.22	8,100	3	9.41	95.82
53.61	1,479,182	1,475,803	0.701	0.543	0.363	14.07	120.46	2,111,062	2,106,166	#N/A	#N/A	#N/A	9.86	105.66	20.77	120.46	105.66	7.358	28.13	8,100	3	9.38	95.80
54.36	1,479,259	1,475,869	0.701	0.543	0.363	14.01	120.34	2,111,079	2,106,182	#N/A	#N/A	#N/A	9.82	105.60	20.68	120.34	105.60	7.358	28.04	8,100	3	9.35	95.78
55.11	1,479,334	1,475,934	0.701	0.543	0.363	13.95	120.22	2,111,096	2,106,197	#N/A	#N/A	#N/A	9.78	105.54	20.59	120.22	105.54	7.358	27.95	8,100	3	9.32	95.76
55.86	1,479,409	1,475,997	0.701	0.543	0.363	13.89	120.10	2,111,113	2,106,213	#N/A	#N/A	#N/A	9.73	105.48	20.50	120.10	105.48	7.358	27.86	8,100	3	9.29	95.74
56.61	1,479,481	1,476,059	0.701	0.543	0.363	13.83	119.98	2,111,130	2,106,228	#N/A	#N/A	#N/A	9.69	105.42	20.42	119.98	105.42	7.358	27.78	8,100	3	9.26	95.72
57.36	1,479,552	1,476,120	0.701	0.543	0.363	13.78	119.87	2,111,146	2,106,243	#N/A	#N/A	#N/A	9.65	105.36	20.33	119.87	105.36	7.358	27.69	8,100	3	9.23	95.71
58.11	1,479,622	1,476,180	0.701	0.543	0.363	13.72	119.75	2,111,162	2,106,258	#N/A	#N/A	#N/A	9.62	105.31	20.25	119.75	105.31	7.358	27.61	8,100	3	9.20	95.69
58.61	1,479,668	1,476,219	0.701	0.543	0.363	13.68	119.68	2,111,172	2,106,268	#N/A	#N/A	#N/A	9.59	105.27	20.20	119.68	105.27	7.358	27.56	8,100	3	9.19	95.68
59.11	1,479,713	1,476,257	0.701	0.543	0.363	13.65	119.61	2,111,182	2,106,277	#N/A	#N/A	#N/A	9.56	105.23	20.14	119.61	105.23	7.358	27.50	8,100	3	9.17	95.67
59.61	1,479,758	1,476,296	0.701	0.543	0.363	13.61	119.54	2,111,193	2,106,286	#N/A	#N/A	#N/A	9.54	105.20	20.09	119.54	105.20	7.358	27.45	8,100	3	9.15	95.66
60.11	1,479,802	1,476,333	0.701	0.543	0.363	13.57	119.47	2,111,203	2,106,296	#N/A	#N/A	#N/A	9.51	105.16	20.04	119.47	105.16	7.358	27.40	8,100	3	9.13	95.65
60.61	1,479,845	1,476,371	0.701	0.543	0.363	13.54	119.40	2,111,213	2,106,305	#N/A	#N/A	#N/A	9.49	105.13	19.99	119.40	105.13	7.358	27.35	8,100	3	9.12	95.64
61.11	1,479,889	1,476,408	0.701	0.543	0.363	13.50	119.33	2,111,222	2,106,314	#N/A	#N/A	#N/A	9.47	105.09	19.94	119.33	105.09	7.358	27.30	8,100	3	9.10	95.63
61.61	1,479,931	1,476,444	0.701	0.543	0.363	13.47	119.26	2,111,232	2,106,323	#N/A	#N/A	#N/A	9.44	105.06	19.89	119.26	105.06	7.358	27.25	8,100	3	9.08	95.62
62.11	1,479,973	1,476,480	0.701	0.543	0.363	13.44	119.19	2,111,242	2,106,332	#N/A	#N/A	#N/A	9.42	105.02	19.84	119.19	105.02	7.358	27.20	8,100	3	9.07	95.61
62.61	1,480,015	1,476,516	0.701	0.543	0.363	13.40	119.12	2,111,251	2,106,341	#N/A	#N/A	#N/A	9.39	104.99	19.79	119.12	104.99	7.358	27.15	8,100	3	9.05	95.60
63.11	1,480,056	1,476,551	0.701	0.543	0.363	13.37	119.06	2,111,261	2,106,349	#N/A	#N/A	#N/A	9.37	104.96	19.74	119.06	104.96	7.358	27.10	8,100	3	9.03	95.59
63.61	1,480,097	1,476,586	0.701	0.542	0.363	13.34	118.99	2,111,270	2,106,358	#N/A	#N/A	#N/A	9.35	104.93	19.69	118.99	104.93	7.358	27.05	8,100	3	9.02	95.58
64.11	1,480,137	1,476,620	0.701	0.542	0.363	13.30	118.93	2,111,279	2,106,367	#N/A	#N/A	#N/A	9.33	104.89	19.64	118.93	104.89	7.358	27.00	8,100	3	9.00	95.57
64.61	1,480,176	1,476,654	0.701	0.542	0.363	13.27	118.86	2,111,288	2,106,375	#N/A	#N/A	#N/A	9.30	104.86	19.60	118.86	104.86	7.358	26.95	8,100	3	8.98	95.56
65.11	1,480,216	1,476,688	0.701	0.542	0.363	13.24	118.80	2,111,297	2,106,383	#N/A	#N/A	#N/A	9.28	104.83	19.55	118.80	104.83	7.358	26.91	8,100	3	8.97	95.55
65.31	1,480,231	1,476,701	0.701	0.542	0.363	13.23	118.77	2,111,301	2,106,387	#N/A	#N/A	#N/A	9.27	104.82	19.53	118.77	104.82	7.358	26.89	8,100	3	8.96	95.54
65.51	1,480,247	1,476,714	0.701	0.542	0.363	13.21	118.75	2,111,304	2,106,390	#N/A	#N/A	#N/A	9.26	104.80	19.51	118.75	104.80	7.358	26.87	8,100	3	8.96	95.54
65.71	1,480,262	1,476,728	0.701	0.542	0.363	13.20	118.72	2,111,308	2,106,393	#N/A	#N/A	#N/A	9.26	104.79	19.50	118.72	104.79	7.358	26.85	8,100	3	8.95	95.54
65.91	1,480,277	1,476,741	0.701	0.542	0.363	13.19	118.70	2,111,311	2,106,396	#N/A	#N/A	#N/A	9.25	104.78	19.48	118.70	104.78	7.358	26.84	8,100	3	8.95	95.53
66.11	1,480,292	1,476,754	0.701	0.542	0.363	13.18	118.67	2,111,315	2,106,400	#N/A	#N/A	#N/A	9.24	104.77	19.46	118.67	104.77	7.358	26.82	8,100	3	8.94	95.53
66.31	1,480,308	1,476,767	0.701	0.542	0.363	13.16	118.65	2,111,318	2,106,403	#N/A	#N/A	#N/A	9.23	104.75	19.44	118.65	104.75	7.358	26.80	8,100	3	8.93	95.53
66.41	1,480,315	1,476,773	0.701	0.542	0.363	13.16	118.64	2,111,320	2,106,404	#N/A	#N/A	#N/A	9.23	104.75	19.43	118.63	104.75	7.358	26.79	8,100	3	8.93	95.52
66.51	1,480,323	1,476,780	0.701	0.542	0.363	13.15	118.62	2,111,322	2,106,406	#N/A	#N/A	#N/A	9.22	104.74	19.42	118.62	104.74	7.358	26.78	8,100	3	8.93	95.52
66.61	1,480,330	1,476,786	0.701	0.542	0.363	13.15	118.61	2,111,324	2,106,408	#N/A	#N/A	#N/A	9.22	104.74	19.41	118.61	104.74	7.358	26.77	8,100	3	8.92	95.52
66.71	1,480,338	1,476,793	0.701	0.542	0.363	13.14	118.60	2,111,325	2,106,409	#N/A	#N/A	#N/A	9.21	104.73	19.41	118.60	104.73	7.358	26.76	8,100	3	8.92	95.52
66.81	1,480,345	1,476,799	0.701	0.542	0.363	13.13	118.59	2,111,327	2,106,411	#N/A	#N/A	#N/A	9.21	104.72	19.40	118.59	104.72	7.358	26.75	8,100	3	8.92	95.52
66.91	1,480,353	1,476,805	0.701	0.542	0.363	13.13	118.58	2,111,329	2,106,412	#N/A	#N/A	#N/A	9.20	104.72	19.39	118.57	104.72	7.358	26.75	8,100	3	8.92	95.51
67.01	1,480,360	1,476,812	0.701	0.542	0.363	13.12	118.56	2,111,331	2,106,414	#N/A	#N/A	#N/A	9.20	104.71	19.38	118.56	104.71	7.358	26.74	8,100	3	8.91	95.51
67.11	1,480,368	1,476,818	0.701	0.542	0.363	13.12	118.55	2,111,332	2,106,416	#N/A	#N/A	#N/A	9.20	104.71	19.37	118.55	104.71	7.358	26.73	8,100	3	8.91	95.51
67.21	1,480,375	1,476,825	0.701	0.542	0.363	13.11	118.54	2,111,334	2,106,417	#N/A	#N/A	#N/A	9.19	104.70	19.36	118.54	104.70	7.358	26.72	8,100	3	8.91	95.51
67.31	1,480,382	1,476,831	0.701	0.542	0.363	13.10	118.53	2,111,336	2,106,419	#N/A	#N/A	#N/A	9.19	104.69	19.35	118.52	104.69	7.358	26.71	8,100	3	8.90	95.51
67.41	1,480,390	1,476,837	0.701	0.542	0.363	13.10	118.52	2,111,337	2,106,420	#N/A	#N/A	#N/A	9.18	104.69	19.34	118.51	104.69	7.358	26.70	8,100	3	8.90	95.51
67.51	1,480,397	1,476,843	0.701	0.542	0.363	13.09	118.50	2,111,339	2,106,422	#N/A	#N/A	#N/A	9.18	104.68	19.33	118.50	104.68	7.358	26.69	8,100	3	8.90	95.50
67.61	1,480,404	1,476,850	0.701	0.542	0.363	13.09	118.49	2,111,341	2,106,424	#N/A	#N/A	#N/A	9.17	104.68	19.33	118.49	104.68	7.358	26.68	8,100	3	8.89	95.50
67.71	1,480,412	1,476,856	0.701	0.542	0.363	13.08	118.48	2,111,342	2,106,425	#N/A	#N/A	#N/A	9.17	104.67	19.32	118.48	104.67	7.358	26.68	8,100	3	8.89	95.50

Shutdown Cooling Temperature Transient with 90F River Water
SDC Hx Fouling = 0.00418 hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu



Shutdown Cooling Temperature Transient with 90F River Water **SDC**

Hx Fouling = 0. hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu

	Initial RC Temperature, F				350													SDC HX	CCW HX
	Initial Time				2					2754		Shell Film Multiplier						0.09751	
	RCS Temperature after 8 hours				149.30							Shell Film Re power						0.61709	
	Time after trip to 130F Primary Coolant Temp				18.55			Initial CCW to SDCHx		1850		Shell Film Pr power						0.333	
	Time after SDC initiation to 130F PC Temp				16.6			CCW Flow Step Temp		275		Fouling (total = tube side)						0	0.004
	Decary heat equilibrium at 90F river temp				17.14													0.00418	0.004
								SDCHx											
Time	Step	Q(D)	P(pp)	P(lp)	Psdc	Total Q	dTrc	Tube				Shell							
hrs	hrs	mmBtu/hr					degF/hr	Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o				
2.00	0.1	54.966	18	1.5	-139.512	-65.05	-59.13	3000	315	350.00	248.46	1850	95	118.91	274.44				
2.10	0.10	54.107	18	1.5	-136.400	-62.79	-57.08	3000	315	344.09	245.04	1850	95	118.33	270.30				
2.20	0.10	53.300	18	1.5	-133.389	-60.59	-55.08	3000	315	338.38	241.73	1850	95	117.77	266.29				
2.30	0.10	52.540	18	1.5	-130.477	-58.44	-53.12	3000	315	332.87	238.53	1850	95	117.22	262.42				
2.40	0.10	51.822	18	1.5	-127.664	-56.34	-51.22	3000	315	327.56	235.43	1850	95	116.69	258.68				
2.50	0.10	51.143	18	1.5	-124.946	-54.30	-49.37	3000	315	322.44	232.45	1850	95	116.18	255.07				
2.60	0.10	50.500	18	1.5	-122.322	-52.32	-47.57	3000	315	317.50	229.56	1850	95	115.69	251.59				
2.70	0.10	49.888	18	1.5	-119.790	-50.40	-45.82	3000	315	312.74	226.78	1850	95	115.21	248.23				
2.80	0.10	49.305	18	1.5	-117.346	-48.54	-44.13	3000	315	308.16	224.09	1850	95	114.74	244.99				
2.90	0.10	48.749	18	1.5	-114.990	-46.74	-42.49	3000	315	303.75	221.50	1850	95	114.30	241.87				
3.00	0.05	48.218	18	1.5	-112.718	-45.00	-40.91	3000	315	299.50	219.00	1850	95	113.87	238.86				
3.05	0.05	47.961	18	1.5	-111.623	-44.16	-40.15	3000	315	297.45	217.79	1850	95	113.66	237.41				
3.10	0.05	47.710	18	1.5	-110.548	-43.34	-39.40	3000	315	295.45	216.61	1850	95	113.45	235.99				
3.15	0.05	47.464	18	1.5	-109.492	-42.53	-38.66	3000	315	293.48	215.45	1850	95	113.25	234.59				
3.20	0.05	47.223	18	1.5	-108.456	-41.73	-37.94	3000	315	291.54	214.31	1850	95	113.05	233.22				
3.25	0.05	46.987	18	1.5	-107.438	-40.95	-37.23	3000	315	289.65	213.19	1850	95	112.86	231.88				
3.30	0.05	46.756	18	1.5	-106.439	-40.18	-36.53	3000	315	287.78	212.09	1850	95	112.67	230.56				
3.35	0.05	46.529	18	1.5	-105.458	-39.43	-35.84	3000	315	285.96	211.01	1850	95	112.48	229.26				
3.40	0.05	46.307	18	1.5	-104.495	-38.69	-35.17	3000	315	284.17	209.95	1850	95	112.30	227.99				
3.45	0.05	46.089	18	1.5	-103.550	-37.96	-34.51	3000	315	282.41	208.91	1850	95	112.12	226.74				
3.50	0.05	45.876	18	1.5	-102.622	-37.25	-33.86	3000	315	280.68	207.89	1850	95	111.94	225.51				
3.55	0.05	45.666	18	1.5	-101.711	-36.54	-33.22	3000	315	278.99	206.88	1850	95	111.77	224.31				
3.60	0.05	45.460	18	1.5	-100.816	-35.86	-32.60	3000	315	277.33	205.90	1850	95	111.60	223.13				
3.65	0.05	45.258	18	1.5	-99.939	-35.18	-31.98	3000	315	275.70	204.93	1850	95	111.43	221.97				
3.70	0.05	45.059	18	1.5	-139.800	-75.24	-68.40	3000	315	274.10	174.89	4246	95	118.97	186.11				
3.75	0.05	44.864	18	1.5	-137.186	-72.82	-66.20	3000	315	270.68	173.45	4246	95	118.48	184.34				
3.80	0.05	44.673	18	1.5	-134.654	-70.48	-64.07	3000	315	267.37	172.06	4246	95	118.01	182.64				
3.85	0.05	44.485	18	1.5	-132.202	-68.22	-62.02	3000	315	264.16	170.71	4246	95	117.55	180.98				
3.90	0.05	44.300	18	1.5	-129.829	-66.03	-60.03	3000	315	261.06	169.39	4246	95	117.10	179.38				
3.95	0.05	44.118	18	1.5	-127.531	-63.91	-58.10	3000	315	258.06	168.11	4246	95	116.67	177.83				
4.00	0.05	43.939	18	1.5	-125.305	-61.87	-56.24	3000	315	255.16	166.88	4246	95	116.25	176.33				
4.05	0.10	43.763	18	1.5	-123.149	-59.89	-54.44	3000	315	252.35	165.68	4246	95	115.84	174.88				
4.15	0.20	43.419	18	1.5	-118.970	-56.05	-50.96	3000	315	246.90	163.34	4246	95	115.05	172.06				
4.35	0.40	42.764	18	1.5	-111.136	-48.87	-44.43	3000	315	236.71	158.95	4246	95	113.57	166.78				
4.75	0.50	41.566	18	1.5	-97.441	-36.38	-33.07	3000	315	218.94	151.19	4246	95	110.95	157.54				
5.25	0.50	40.243	18	1.5	-84.676	-24.93	-22.67	3000	315	202.40	143.86	4246	95	108.49	148.92				
5.75	0.50	39.078	0	1.5	-75.920	-35.34	-32.13	3000	315	191.07	138.77	4246	95	106.78	143.01				
6.25	0.50	38.039	0	1.5	-63.515	-23.98	-21.80	3000	315	175.01	131.47	4246	95	104.35	134.62				
6.75	0.50	37.105	0	1.5	-55.112	-16.51	-15.01	3000	315	164.11	126.46	4246	95	102.69	128.94				
7.25	0.50	36.258	0	1.5	-49.336	-11.58	-10.53	3000	315	156.61	122.97	4246	95	101.55	125.03				
7.75	0.50	35.485	0	1.5	-45.292	-8.31	-7.55	3000	315	151.34	120.51	4246	95	100.74	122.29				
8.25	0.50	34.776	0	1.5	-42.394	-6.12	-5.56	3000	315	147.57	118.74	4246	95	100.16	120.33				
8.75	0.50	34.121	0	1.5	-40.261	-4.64	-4.22	3000	315	144.79	117.43	4246	95	99.73	118.88				
9.25	0.55	33.514	0	1.5	-38.645	-3.63	-3.30	3000	315	142.68	116.43	4246	95	99.41	117.79				
9.80	0.70	32.894	0	1.5	-37.253	-2.86	-2.60	3000	315	140.86	115.57	4246	95	99.13	116.84				
10.50	0.91	32.169	0	1.5	-35.862	-2.19	-1.99	3000	315	139.04	114.71	4246	95	98.85	115.90				
11.41	1.21	31.315	0	1.5	-34.472	-1.66	-1.51	3000	315	137.22	113.84	4246	95	98.57	114.96				
12.62	1.58	30.314	0	1.5	-33.083	-1.27	-1.15	3000	315	135.40	112.98	4246	95	98.29	114.02				
14.20	1.98	29.183	0	1.5	-31.695	-1.01	-0.92	3000	315	133.59	112.11	4246	95	98.01	113.07				
16.17	2.00	27.980	0	1.5	-30.308	-0.83	-0.75	3000	315	131.77	111.24	4246	95	97.73	112.13				
18.17	2.00	26.945	0	1.5	-29.160	-0.71	-0.65	3000	315	130.26	110.52	4246	95	97.50	111.35				
20.17	2.00	26.052	0	1.5	-28.170	-0.62	-0.56	3000	315	128.96	109.90	4246	95	97.30	110.68				

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
2.00	299.23	55.59	1.0272	1.24E-04	0.396	5.609	136,709	1.1578	2281	196.68	60.19	1.0044	2.08E-04	0.389	1.591	99,298	1.9335	917	9.589	487.57
2.10	294.56	55.80	1.0256	1.26E-04	0.396	5.609	134,617	1.1779	2270	194.32	60.24	1.0041	2.11E-04	0.389	1.591	97,917	1.9640	913	9.570	485.61
2.20	290.05	56.00	1.0241	1.29E-04	0.396	5.609	132,573	1.1983	2259	192.03	60.30	1.0038	2.14E-04	0.389	1.591	96,584	1.9943	909	9.551	483.67
2.30	285.70	56.20	1.0228	1.31E-04	0.396	5.609	130,578	1.2188	2247	189.82	60.35	1.0035	2.18E-04	0.388	1.591	95,297	2.0245	905	9.532	481.75
2.40	281.50	56.38	1.0215	1.34E-04	0.396	5.609	128,635	1.2395	2236	187.69	60.40	1.0033	2.21E-04	0.388	1.591	94,057	2.0544	901	9.514	479.86
2.50	277.44	56.56	1.0203	1.36E-04	0.396	5.609	126,743	1.2604	2224	185.62	60.44	1.0030	2.24E-04	0.387	1.591	92,862	2.0840	898	9.496	478.00
2.60	273.53	56.72	1.0191	1.38E-04	0.396	5.609	124,905	1.2813	2213	183.64	60.49	1.0028	2.27E-04	0.387	1.591	91,711	2.1134	894	9.478	476.18
2.70	269.76	56.88	1.0181	1.41E-04	0.396	5.609	123,120	1.3023	2202	181.72	60.53	1.0026	2.29E-04	0.387	1.591	90,602	2.1424	891	9.461	474.39
2.80	266.13	57.03	1.0171	1.43E-04	0.396	5.609	121,389	1.3233	2190	179.87	60.57	1.0024	2.32E-04	0.386	1.591	89,535	2.1711	887	9.444	472.64
2.90	262.62	57.18	1.0162	1.46E-04	0.396	5.609	119,711	1.3443	2179	178.08	60.61	1.0022	2.35E-04	0.386	1.591	88,509	2.1994	884	9.428	470.93
3.00	259.25	57.31	1.0153	1.48E-04	0.396	5.609	118,086	1.3652	2169	176.36	60.65	1.0021	2.38E-04	0.386	1.591	87,521	2.2273	881	9.412	469.25
3.05	257.62	57.38	1.0149	1.49E-04	0.396	5.609	117,301	1.3756	2163	175.53	60.67	1.0020	2.39E-04	0.385	1.591	87,046	2.2409	879	9.404	468.44
3.10	256.03	57.44	1.0145	1.50E-04	0.396	5.609	116,528	1.3859	2158	174.72	60.69	1.0019	2.41E-04	0.385	1.591	86,580	2.2545	877	9.397	467.63
3.15	254.46	57.50	1.0142	1.51E-04	0.396	5.609	115,768	1.3963	2153	173.92	60.70	1.0018	2.42E-04	0.385	1.591	86,123	2.2680	876	9.390	466.84
3.20	252.93	57.57	1.0138	1.53E-04	0.396	5.609	115,021	1.4066	2148	173.14	60.72	1.0017	2.43E-04	0.385	1.591	85,675	2.2813	874	9.382	466.05
3.25	251.42	57.62	1.0134	1.54E-04	0.396	5.609	114,286	1.4168	2142	172.37	60.74	1.0017	2.45E-04	0.385	1.591	85,235	2.2945	873	9.375	465.28
3.30	249.94	57.68	1.0131	1.55E-04	0.396	5.609	113,563	1.4271	2137	171.61	60.75	1.0016	2.46E-04	0.384	1.591	84,804	2.3077	871	9.368	464.51
3.35	248.48	57.74	1.0128	1.56E-04	0.396	5.609	112,853	1.4373	2132	170.87	60.77	1.0015	2.47E-04	0.384	1.591	84,381	2.3207	870	9.361	463.76
3.40	247.06	57.80	1.0124	1.57E-04	0.395	5.609	112,155	1.4474	2127	170.14	60.78	1.0015	2.49E-04	0.384	1.591	83,966	2.3336	869	9.354	463.01
3.45	245.66	57.85	1.0121	1.58E-04	0.395	5.609	111,468	1.4576	2122	169.43	60.80	1.0014	2.50E-04	0.384	1.591	83,559	2.3464	867	9.348	462.27
3.50	244.28	57.90	1.0118	1.59E-04	0.395	5.609	110,794	1.4677	2117	168.73	60.81	1.0013	2.51E-04	0.384	1.591	83,161	2.3590	866	9.341	461.55
3.55	242.94	57.95	1.0115	1.60E-04	0.395	5.609	110,131	1.4777	2113	168.04	60.83	1.0013	2.52E-04	0.384	1.591	82,770	2.3716	865	9.335	460.83
3.60	241.61	58.00	1.0112	1.61E-04	0.395	5.609	109,479	1.4877	2108	167.36	60.84	1.0012	2.54E-04	0.384	1.591	82,386	2.3840	863	9.328	460.12
3.65	240.31	58.05	1.0110	1.63E-04	0.395	5.609	108,839	1.4977	2103	166.70	60.86	1.0011	2.55E-04	0.383	1.591	82,010	2.3963	862	9.322	459.43
3.70	224.49	58.10	1.0079	1.77E-04	0.394	5.609	100,071	1.6311	2027	152.54	61.14	1.0000	2.84E-04	0.380	3.652	169,990	2.6880	1391	9.231	568.07
3.75	222.06	58.20	1.0075	1.79E-04	0.393	5.609	98,900	1.6537	2018	151.41	61.16	0.9999	2.86E-04	0.379	3.652	168,559	2.7137	1387	9.220	566.40
3.80	219.71	58.30	1.0071	1.82E-04	0.393	5.609	97,763	1.6762	2009	150.32	61.18	0.9999	2.89E-04	0.379	3.652	167,175	2.7391	1383	9.210	564.76
3.85	217.44	58.40	1.0067	1.84E-04	0.393	5.609	96,660	1.6986	2000	149.26	61.20	0.9998	2.91E-04	0.379	3.652	165,836	2.7641	1379	9.200	563.16
3.90	215.23	58.49	1.0063	1.86E-04	0.393	5.609	95,590	1.7208	1991	148.24	61.22	0.9997	2.93E-04	0.379	3.652	164,543	2.7886	1376	9.190	561.59
3.95	213.09	58.57	1.0060	1.89E-04	0.392	5.609	94,552	1.7429	1983	147.25	61.24	0.9997	2.96E-04	0.378	3.652	163,292	2.8127	1372	9.181	560.06
4.00	211.02	58.66	1.0056	1.91E-04	0.392	5.609	93,545	1.7648	1974	146.29	61.26	0.9996	2.98E-04	0.378	3.652	162,082	2.8364	1369	9.172	558.56
4.05	209.01	58.74	1.0053	1.93E-04	0.392	5.609	92,569	1.7866	1966	145.36	61.28	0.9995	3.00E-04	0.378	3.652	160,911	2.8597	1365	9.163	557.10
4.15	205.12	58.89	1.0048	1.98E-04	0.391	5.609	90,675	1.8302	1950	143.56	61.31	0.9994	3.05E-04	0.377	3.652	158,648	2.9058	1359	9.146	554.23
4.35	197.83	59.17	1.0038	2.07E-04	0.390	5.609	87,117	1.9176	1918	140.17	61.37	0.9992	3.13E-04	0.376	3.652	154,421	2.9958	1346	9.114	548.71
4.75	185.06	59.64	1.0022	2.25E-04	0.388	5.609	80,889	2.0905	1861	134.24	61.48	0.9989	3.29E-04	0.374	3.652	147,089	3.1650	1324	9.058	538.63
5.25	173.13	60.05	1.0010	2.44E-04	0.385	5.609	75,087	2.2792	1803	128.70	61.57	0.9986	3.46E-04	0.373	3.652	140,322	3.3380	1303	9.006	528.71
5.75	164.92	60.32	1.0002	2.58E-04	0.383	5.609	71,117	2.4273	1762	124.90	61.63	0.9984	3.58E-04	0.371	3.652	135,719	3.4661	1288	8.966	521.54
6.25	153.24	60.68	0.9993	2.82E-04	0.380	5.609	65,516	2.6689	1700	119.49	61.72	0.9982	3.76E-04	0.369	3.652	129,256	3.6626	1266	8.910	510.91
6.75	145.28	60.91	0.9987	3.01E-04	0.378	5.609	61,741	2.8580	1657	115.82	61.78	0.9981	3.90E-04	0.368	3.652	124,918	3.8065	1251	8.873	503.38
7.25	139.79	61.06	0.9984	3.15E-04	0.377	5.609	59,158	3.0022	1626	113.29	61.81	0.9980	4.00E-04	0.367	3.652	121,956	3.9111	1241	8.848	498.03
7.75	135.93	61.16	0.9982	3.25E-04	0.375	5.609	57,356	3.1110	1604	111.52	61.84	0.9979	4.07E-04	0.366	3.652	119,892	3.9872	1234	8.830	494.20
8.25	133.15	61.24	0.9980	3.33E-04	0.374	5.609	56,068	3.1932	1588	110.24	61.86	0.9979	4.12E-04	0.366	3.652	118,418	4.0433	1228	8.818	491.42
8.75	131.11	61.29	0.9979	3.39E-04	0.374	5.609	55,122	3.2562	1576	109.31	61.87	0.9979	4.16E-04	0.366	3.652	117,336	4.0855	1224	8.809	489.34
9.25	129.55	61.33	0.9978	3.43E-04	0.373	5.609	54,406	3.3054	1566	108.60	61.88	0.9978	4.19E-04	0.365	3.652	116,518	4.1179	1221	8.802	487.75
9.80	128.22	61.36	0.9978	3.48E-04	0.373	5.609	53,791	3.3489	1559	107.99	61.89	0.9978	4.21E-04	0.365	3.652	115,814	4.1461	1219	8.796	486.38
10.50	126.87	61.39	0.9977	3.52E-04	0.372	5.609	53,176	3.3933	1551	107.38	61.90	0.9978	4.24E-04	0.365	3.652	115,112	4.1747	1216	8.791	484.99
11.41	125.53	61.43	0.9976	3.56E-04	0.372	5.609	52,563	3.4387	1542	106.76	61.91	0.9978	4.27E-04	0.365	3.652	114,411	4.2036	1214	8.785	483.60
12.62	124.19	61.46	0.9976	3.60E-04	0.371	5.609	51,951	3.4852	1534	106.15	61.91	0.9978	4.29E-04	0.364	3.652	113,712	4.2328	1211	8.780	482.19
14.20	122.85	61.49	0.9975	3.65E-04	0.371	5.609	51,340	3.5327	1526	105.54	61.92	0.9978	4.32E-04	0.364	3.652	113,014	4.2623	1208	8.774	480.78
16.17	121.50	61.52	0.9974	3.70E-04	0.371	5.609	50,730	3.5813	1518	104.93	61.93	0.9978	4.35E-04	0.364	3.652	112,318	4.2921	1206	8.768	479.36
18.17	120.39	61.55	0.9974	3.73E-04	0.370	5.609	50,226	3.6225	1511	104.43	61.94	0.9977	4.37E-04	0.364	3.652	111,742	4.3171	1204	8.764	478.18
20.17	119.43	61.57	0.9974	3.77E-04	0.370	5.609	49,792	3.6586	1505	103.99	61.94	0.9977	4.39E-04	0.363	3.652	111,247	4.3388	1202	8.760	477.15

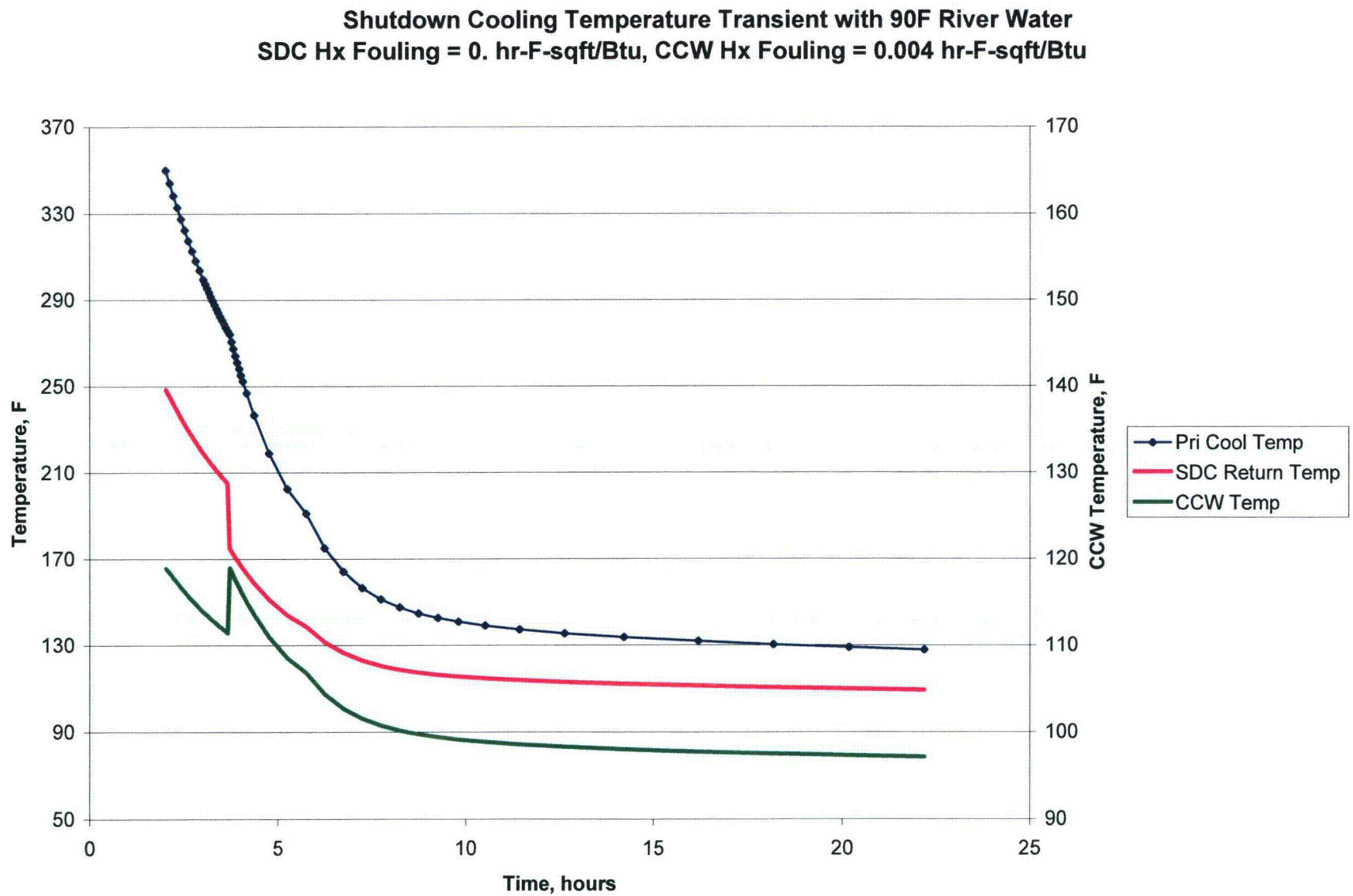
CCW HX Fouling 0.004

Time	SDC HX tube side							SDC HX shell side							SDC Duty	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX	CCW Temp
hrs	W	WCp	Cr	NTU	effectivenes	DT	Tt,o	W	WCp	Cr	NTU	effectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr	Ts,o
2.00	1,337,560	1,373,944	#N/A	#N/A	#N/A	101.54	248.46	893,084	897,012	0.653	2.729	0.673	155.53	274.44	139.51	248.46	274.44	7.358	146.87	8,100	3	48.96	118.91
2.10	1,342,692	1,377,087	#N/A	#N/A	#N/A	99.05	245.04	893,912	897,570	0.652	2.716	0.673	151.97	270.30	136.40	245.04	270.30	7.358	143.76	8,100	3	47.92	118.33
2.20	1,347,576	1,380,103	#N/A	#N/A	#N/A	96.65	241.73	894,705	898,109	0.651	2.703	0.673	148.52	266.29	133.39	241.73	266.29	7.358	140.75	8,100	3	46.92	117.77
2.30	1,352,225	1,382,998	#N/A	#N/A	#N/A	94.34	238.53	895,464	898,631	0.650	2.691	0.673	145.20	262.42	130.48	238.53	262.42	7.358	137.84	8,100	3	45.95	117.22
2.40	1,356,650	1,385,775	#N/A	#N/A	#N/A	92.12	235.43	896,192	899,134	0.649	2.679	0.673	141.99	258.68	127.66	235.43	258.68	7.358	135.02	8,100	3	45.01	116.69
2.50	1,360,863	1,388,441	#N/A	#N/A	#N/A	89.99	232.45	896,889	899,620	0.648	2.667	0.673	138.89	255.07	124.95	232.45	255.07	7.358	132.30	8,100	3	44.10	116.18
2.60	1,364,873	1,390,998	#N/A	#N/A	#N/A	87.94	229.56	897,555	900,088	0.647	2.656	0.673	135.90	251.59	122.32	229.56	251.59	7.358	129.68	8,100	3	43.23	115.69
2.70	1,368,691	1,393,452	#N/A	#N/A	#N/A	85.97	226.78	898,194	900,539	0.646	2.644	0.673	133.02	248.23	119.79	226.78	248.23	7.358	127.15	8,100	3	42.38	115.21
2.80	1,372,327	1,395,807	#N/A	#N/A	#N/A	84.07	224.09	898,804	900,974	0.645	2.633	0.673	130.24	244.99	117.35	224.09	244.99	7.358	124.70	8,100	3	41.57	114.74
2.90	1,375,789	1,398,066	#N/A	#N/A	#N/A	82.25	221.50	899,389	901,392	0.645	2.623	0.673	127.57	241.87	114.99	221.50	241.87	7.358	122.35	8,100	3	40.78	114.30
3.00	1,379,088	1,400,234	#N/A	#N/A	#N/A	80.50	219.00	899,947	901,795	0.644	2.612	0.673	124.99	238.86	112.72	219.00	238.86	7.358	120.08	8,100	3	40.03	113.87
3.05	1,380,663	1,401,275	#N/A	#N/A	#N/A	79.66	217.79	900,215	901,989	0.644	2.607	0.673	123.75	237.41	111.62	217.79	237.41	7.358	118.98	8,100	3	39.66	113.66
3.10	1,382,201	1,402,295	#N/A	#N/A	#N/A	78.83	216.61	900,477	902,179	0.643	2.602	0.673	122.53	235.99	110.55	216.61	235.99	7.358	117.91	8,100	3	39.30	113.45
3.15	1,383,703	1,403,294	#N/A	#N/A	#N/A	78.03	215.45	900,733	902,365	0.643	2.597	0.673	121.34	234.59	109.49	215.45	234.59	7.358	116.85	8,100	3	38.95	113.25
3.20	1,385,169	1,404,273	#N/A	#N/A	#N/A	77.23	214.31	900,984	902,548	0.643	2.592	0.673	120.17	233.22	108.46	214.31	233.22	7.358	115.81	8,100	3	38.60	113.05
3.25	1,386,601	1,405,233	#N/A	#N/A	#N/A	76.46	213.19	901,229	902,727	0.642	2.587	0.673	119.02	231.88	107.44	213.19	231.88	7.358	114.80	8,100	3	38.27	112.86
3.30	1,387,999	1,406,173	#N/A	#N/A	#N/A	75.69	212.09	901,469	902,903	0.642	2.583	0.673	117.89	230.56	106.44	212.09	230.56	7.358	113.80	8,100	3	37.93	112.67
3.35	1,389,365	1,407,094	#N/A	#N/A	#N/A	74.95	211.01	901,704	903,075	0.642	2.578	0.673	116.78	229.26	105.46	211.01	229.26	7.358	112.82	8,100	3	37.61	112.48
3.40	1,390,699	1,407,996	#N/A	#N/A	#N/A	74.22	209.95	901,933	903,244	0.642	2.573	0.673	115.69	227.99	104.50	209.95	227.99	7.358	111.85	8,100	3	37.28	112.30
3.45	1,392,002	1,408,881	#N/A	#N/A	#N/A	73.50	208.91	902,158	903,410	0.641	2.569	0.673	114.62	226.74	103.55	208.91	226.74	7.358	110.91	8,100	3	36.97	112.12
3.50	1,393,274	1,409,747	#N/A	#N/A	#N/A	72.79	207.89	902,377	903,572	0.641	2.564	0.673	113.57	225.51	102.62	207.89	225.51	7.358	109.98	8,100	3	36.66	111.94
3.55	1,394,517	1,410,596	#N/A	#N/A	#N/A	72.10	206.88	902,592	903,732	0.641	2.560	0.673	112.55	224.31	101.71	206.88	224.31	7.358	109.07	8,100	3	36.36	111.77
3.60	1,395,731	1,411,428	#N/A	#N/A	#N/A	71.43	205.90	902,803	903,888	0.640	2.555	0.673	111.54	223.13	100.82	205.90	223.13	7.358	108.17	8,100	3	36.06	111.60
3.65	1,396,918	1,412,244	#N/A	#N/A	#N/A	70.77	204.93	903,008	904,041	0.640	2.551	0.673	110.55	221.97	99.94	204.93	221.97	7.358	107.30	8,100	3	35.77	111.43
3.70	1,398,076	1,409,108	0.677	2.024	0.640	99.21	174.89	2,082,245	2,082,283	#N/A	#N/A	#N/A	67.14	186.11	139.80	174.89	186.11	7.358	147.16	8,100	3	49.05	118.97
3.75	1,400,539	1,410,988	0.677	2.015	0.639	97.23	173.45	2,082,987	2,082,859	#N/A	#N/A	#N/A	65.86	184.34	137.19	173.45	184.34	7.358	144.54	8,100	3	48.18	118.48
3.80	1,402,901	1,412,798	0.678	2.007	0.638	95.31	172.06	2,083,701	2,083,415	#N/A	#N/A	#N/A	64.63	182.64	134.65	172.06	182.64	7.358	142.01	8,100	3	47.34	118.01
3.85	1,405,166	1,414,542	0.679	1.999	0.637	93.46	170.71	2,084,389	2,083,951	#N/A	#N/A	#N/A	63.44	180.98	132.20	170.71	180.98	7.358	139.56	8,100	3	46.52	117.55
3.90	1,407,341	1,416,221	0.679	1.991	0.637	91.67	169.39	2,085,050	2,084,469	#N/A	#N/A	#N/A	62.28	179.38	129.83	169.39	179.38	7.358	137.19	8,100	3	45.73	117.10
3.95	1,409,428	1,417,839	0.680	1.983	0.636	89.95	168.11	2,085,688	2,084,969	#N/A	#N/A	#N/A	61.17	177.83	127.53	168.11	177.83	7.358	134.89	8,100	3	44.96	116.67
4.00	1,411,432	1,419,397	0.681	1.975	0.636	88.28	166.88	2,086,302	2,085,452	#N/A	#N/A	#N/A	60.09	176.33	125.31	166.88	176.33	7.358	132.66	8,100	3	44.22	116.25
4.05	1,413,356	1,420,899	0.681	1.968	0.635	86.67	165.68	2,086,893	2,085,918	#N/A	#N/A	#N/A	59.04	174.88	123.15	165.68	174.88	7.358	130.51	8,100	3	43.50	115.84
4.15	1,417,038	1,423,787	0.682	1.954	0.634	83.56	163.34	2,088,031	2,086,818	#N/A	#N/A	#N/A	57.01	172.06	118.97	163.34	172.06	7.358	126.33	8,100	3	42.11	115.05
4.35	1,423,776	1,429,123	0.684	1.927	0.631	77.76	158.95	2,090,133	2,088,491	#N/A	#N/A	#N/A	53.21	166.78	111.14	158.95	166.78	7.358	118.49	8,100	3	39.50	113.57
4.75	1,435,039	1,438,190	0.688	1.880	0.627	67.75	151.19	2,093,705	2,091,366	#N/A	#N/A	#N/A	46.59	157.54	97.44	151.19	157.54	7.358	104.80	8,100	3	34.93	110.95
5.25	1,444,947	1,446,322	0.691	1.835	0.623	58.55	143.86	2,096,914	2,093,986	#N/A	#N/A	#N/A	40.44	148.92	84.68	143.86	148.92	7.358	92.03	8,100	3	30.68	108.49
5.75	1,451,408	1,451,704	0.693	1.804	0.620	52.30	138.77	2,099,047	2,095,748	#N/A	#N/A	#N/A	36.23	143.01	75.92	138.77	143.01	7.358	83.28	8,100	3	27.76	106.78
6.25	1,460,084	1,459,026	0.695	1.758	0.616	43.53	131.47	2,101,967	2,098,194	#N/A	#N/A	#N/A	30.27	134.62	63.51	131.47	134.62	7.358	70.87	8,100	3	23.62	104.35
6.75	1,465,631	1,463,764	0.697	1.726	0.613	37.65	126.46	2,103,877	2,099,816	#N/A	#N/A	#N/A	26.25	128.94	55.11	126.46	128.94	7.358	62.47	8,100	3	20.82	102.69
7.25	1,469,284	1,466,907	0.698	1.704	0.611	33.63	122.97	2,105,156	2,100,915	#N/A	#N/A	#N/A	23.48	125.03	49.34	122.97	125.03	7.358	56.69	8,100	3	18.90	101.55
7.75	1,471,761	1,469,050	0.699	1.689	0.609	30.83	120.51	2,106,035	2,101,676	#N/A	#N/A	#N/A	21.55	122.29	45.29	120.51	122.29	7.358	52.65	8,100	3	17.55	100.74
8.25	1,473,494	1,470,555	0.700	1.678	0.608	28.83	118.74	2,106,657	2,102,218	#N/A	#N/A	#N/A	20.17	120.33	42.39	118.74	120.33	7.358	49.75	8,100	3	16.58	100.16
8.75	1,474,746	1,471,645	0.700	1.669	0.607	27.36	117.43	2,107,109	2,102,615	#N/A	#N/A	#N/A	19.15	118.88	40.26	117.43	118.88	7.358	47.62	8,100	3	15.87	99.73
9.25	1,475,682	1,472,462	0.700	1.663	0.607	26.25	116.43	2,107,450	2,102,914	#N/A	#N/A	#N/A	18.38	117.79	38.65	116.43	117.79	7.358	46.00	8,100	3	15.33	99.41
9.80	1,476,479	1,473,159	0.700	1.657	0.606	25.29	115.57	2,107,741	2,103,172	#N/A	#N/A	#N/A	17.71	116.84	37.25	115.57	116.84	7.358	44.61	8,100	3	14.87	99.13
10.50	1,477,267	1,473,848	0.701	1.652	0.605	24.33	114.71	2,108,031	2,103,428	#N/A	#N/A	#N/A	17.05	115.90	35.86	114.71	115.90	7.358	43.22	8,100	3	14.41	98.85
11.41	1,478,046	1,474,531	0.701	1.646	0.605	23.38	113.84	2,108,319	2,103,683	#N/A	#N/A	#N/A	16.39	114.96	34.47	113.84	114.96	7.358	41.83	8,100	3	13.94	98.57
12.62	1,478,815	1,475,207	0.701	1.641	0.604	22.43	112.98	2,108,604	2,103,938	#N/A	#N/A	#N/A	15.72	114.02	33.08	112.98	114.02	7.358	40.44	8,100	3	13.48	98.29
14.20	1,479,576	1,475,876	0.701	1.635	0.604	21.48	112.11	2,108,888	2,104,192	#N/A	#N/A	#N/A	15.06	113.07	31.70	112.11	113.07	7.358	39.05	8,100	3	13.02	98.01
16.17	1,480,326	1,476,538	0.702	1.630	0.603	20.53	111.24	2,109,170	2,104,444	#N/A	#N/A	#N/A	14.40	112.13	30.31	111.24	112.13	7.358	37.67	8,100	3	12.56	97.73
18.17	1,480,941	1,477,081	0.702	1.625	0.603	19.74	110.52	2,109,402	2,104,653	#N/A	#N/A	#N/A	13.86	111.35	29.16	110.52	111.35	7.358	36.52	8,100	3	12.17	97.50
20.17	1,481,466	1,477,545	0.702	1.621	0.602	19.07	109.90	2,109,601	2,104,833	#N/A	#N/A	#N/A	13.38	110.68	28.17	109.90	110.68	7.358	35.53	8,100	3	11.84	97.30

								SDCHx							
Time	Step	Q(D)	P(pp)	P(lp)	Psdc	Total Q	dTrc	Tube				Shell			
hrs	hrs	mmBtu/hr					degF/hr	Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
22.17	0.00	25.268	0	1.5	-27.314	-0.55	-0.50	3000	315	127.84	109.36	4246	95	97.13	110.10

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
22.17	118.60	61.59	0.9973	3.80E-04	0.369	5.609	49,417	3.6904	1500	103.61	61.95	0.9977	4.41E-04	0.363	3.652	110,819	4.3577	1200	8.757	476.26

Time	SDC HX tube side							SDC HX shell side							SDC Duty	Tt,o Iterate	Ts,o Iterate		Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	effectivenes	DT	Tt,o	W	WCp	Cr	NTU	effectivenes	DTs	Ts,o	Btu/hr				mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
22.17	1,481,916	1,477,944	0.702	1.618	0.602	18.48	109.36	2,109,773	2,104,988	#N/A	#N/A	#N/A	12.98	110.10	27.31	109.36	110.10		7.358	34.67	8,100	3	11.56		97.13


Shutdown Cooling Temperature Transient with 90F River Water
SDC Hx Fouling = 0. hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu
Temperature, F
CCW Temperature, F
Time, hours
370
330
290
250
210
170
130
90
50
170
160
150
140
130
120
110
100
90
0
5
10
15
20
25
Pri Cool Temp
SDC Return Temp
CCW Temp

Shutdown Cooling Temperature Transient with 90F River Water **SDC**

Hx Fouling = 0.00418 hr-F-sqft/Btu, CCW Hx Fouling = 0.0015 hr-F-sqft/Btu

	Initial RC Temperature, F				350											SDC HX	CCW HX
	Initial Time				2					2754		Shell Film Multiplier				0.09751	
	RCS Temperature after 8 hours				216.94							Shell Film Re power				0.61709	
	Time after trip to 130F Primary Coolant Temp				14.99			Initial CCW to SDCHx		1850		Shell Film Pr power				0.333	
	Time after SDC initiation to 130F PC Temp				13.0			CCW Flow Step Temp		275		Fouling (total = tube side)				0.00418	0.0015
	Decary heat equilibrium at 90F river temp				0.00			2 HX Temp		225						0.00418	0.004
										SDCHx (per exchanger)							
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell					
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o		
2.00	0.1	54.966	19.5	-107.42	-32.95	-29.95	1	3000	315	350.00	272.14	1850	95	105.291	224.05		
2.10	0.10	54.107	19.5	-106.17	-32.56	-29.60	1	3000	315	347.00	270.13	1850	95	105.13	222.48		
2.20	0.10	53.300	19.5	-104.93	-32.13	-29.21	1	3000	315	344.04	268.15	1850	95	104.98	220.93		
2.30	0.10	52.540	19.5	-103.71	-31.67	-28.79	1	3000	315	341.12	266.19	1850	95	104.82	219.41		
2.40	0.10	51.822	19.5	-102.51	-31.18	-28.35	1	3000	315	338.24	264.25	1850	95	104.67	217.90		
2.50	0.10	51.143	19.5	-101.32	-30.68	-27.89	1	3000	315	335.41	262.34	1850	95	104.52	216.42		
2.60	0.10	50.500	19.5	-100.15	-30.15	-27.41	1	3000	315	332.62	260.46	1850	95	104.38	214.96		
2.70	0.10	49.888	19.5	-99.01	-29.62	-26.93	1	3000	315	329.88	258.61	1850	95	104.23	213.53		
2.80	0.10	49.305	19.5	-97.88	-29.08	-26.43	1	3000	315	327.19	256.80	1850	95	104.09	212.12		
2.90	0.10	48.749	19.5	-96.78	-28.53	-25.93	1	3000	315	324.54	255.01	1850	95	103.95	210.74		
3.00	0.10	48.218	19.5	-95.69	-27.97	-25.43	1	3000	315	321.95	253.26	1850	95	103.81	209.39		
3.10	0.10	47.710	19.5	-94.63	-27.42	-24.92	1	3000	315	319.41	251.54	1850	95	103.67	208.06		
3.20	0.10	47.223	19.5	-93.58	-26.86	-24.42	1	3000	315	316.92	249.85	1850	95	103.54	206.76		
3.30	0.10	46.756	19.5	-92.56	-26.31	-23.91	1	3000	315	314.47	248.20	1850	95	103.41	205.48		
3.40	0.10	46.307	19.5	-91.56	-25.75	-23.41	1	3000	315	312.08	246.58	1850	95	103.28	204.23		
3.50	0.10	45.876	19.5	-90.58	-25.20	-22.91	1	3000	315	309.74	244.99	1850	95	103.16	203.01		
3.60	0.10	45.460	19.5	-89.62	-24.66	-22.42	1	3000	315	307.45	243.43	1850	95	103.04	201.81		
3.70	0.10	45.059	19.5	-88.68	-24.12	-21.93	1	3000	315	305.21	241.91	1850	95	102.92	200.64		
3.80	0.10	44.673	19.5	-87.76	-23.59	-21.45	1	3000	315	303.01	240.42	1850	95	102.80	199.50		
3.90	0.10	44.300	19.5	-86.86	-23.07	-20.97	1	3000	315	300.87	238.96	1850	95	102.68	198.38		
4.00	0.10	43.939	19.5	-85.99	-22.55	-20.50	1	3000	315	298.77	237.53	1850	95	102.57	197.29		
4.10	0.10	43.590	19.5	-85.13	-22.04	-20.03	1	3000	315	296.72	236.13	1850	95	102.46	196.22		
4.20	0.10	43.252	19.5	-84.29	-21.54	-19.58	1	3000	315	294.72	234.77	1850	95	102.35	195.17		
4.30	0.10	42.917	19.5	-83.45	-21.03	-19.12	1	3000	315	292.72	233.40	1850	95	102.25	194.13		
4.41	0.11	42.585	19.5	-82.61	-20.53	-18.66	1	3000	315	290.72	232.04	1850	95	102.14	193.09		
4.51	0.11	42.256	19.5	-81.77	-20.02	-18.20	1	3000	315	288.72	230.67	1850	95	102.03	192.04		
4.62	0.11	41.929	19.5	-80.94	-19.51	-17.73	1	3000	315	286.72	229.30	1850	95	101.92	191.00		
4.74	0.12	41.604	19.5	-80.10	-19.00	-17.27	1	3000	315	284.72	227.94	1850	95	101.81	189.96		
4.85	0.12	41.280	19.5	-79.26	-18.48	-16.80	1	3000	315	282.72	226.57	1850	95	101.71	188.92		
4.97	0.12	40.958	19.5	-78.42	-17.96	-16.33	1	3000	315	280.72	225.20	1850	95	101.60	187.87		
5.09	0.13	40.638	19.5	-77.59	-17.45	-15.86	1	3000	315	278.72	223.83	1850	95	101.49	186.83		
5.22	0.13	40.318	19.5	-76.75	-16.93	-15.39	1	3000	315	276.72	222.46	1850	95	101.38	185.79		
5.35	0.10	39.999	19.5	-93.68	-34.18	-31.08	1	3000	315	274.72	208.44	4246	95	103.55	148.26		
5.45	0.10	39.760	19.5	-92.07	-32.81	-29.83	1	3000	315	271.61	206.54	4246	95	103.35	147.29		
5.55	0.10	39.527	19.5	-90.53	-31.50	-28.64	1	3000	315	268.63	204.71	4246	95	103.15	146.35		
5.65	0.10	39.300	19.5	-89.05	-30.25	-27.50	1	3000	315	265.77	202.95	4246	95	102.96	145.45		
5.75	0.10	39.078	19.5	-87.63	-29.05	-26.41	1	3000	315	263.02	201.26	4246	95	102.78	144.58		
5.85	0.10	38.861	19.5	-86.26	-27.90	-25.37	1	3000	315	260.37	199.64	4246	95	102.61	143.75		
5.95	0.10	38.649	19.5	-84.95	-26.80	-24.37	1	3000	315	257.84	198.08	4246	95	102.44	142.95		
6.05	0.10	38.441	19.5	-83.69	-25.75	-23.41	1	3000	315	255.40	196.58	4246	95	102.28	142.19		
6.15	0.10	38.238	19.5	-82.48	-24.74	-22.49	1	3000	315	253.06	195.13	4246	95	102.12	141.45		
6.25	0.10	38.039	19.5	-81.32	-23.78	-21.62	1	3000	315	250.81	193.75	4246	95	101.97	140.74		
6.35	0.10	37.845	19.5	-80.20	-22.86	-20.78	1	3000	315	248.65	192.41	4246	95	101.83	140.06		
6.45	0.10	37.654	19.5	-79.13	-21.97	-19.98	1	3000	315	246.57	191.12	4246	95	101.69	139.41		
6.55	0.10	37.467	19.5	-78.09	-21.13	-19.21	1	3000	315	244.57	189.88	4246	95	101.56	138.78		
6.65	0.11	37.277	19.5	-77.06	-20.28	-18.44	1	3000	315	242.57	188.64	4246	95	101.42	138.15		
6.76	0.11	37.083	19.5	-76.03	-19.44	-17.68	1	3000	315	240.57	187.40	4246	95	101.29	137.52		
6.88	0.12	36.884	19.5	-74.99	-18.61	-16.92	1	3000	315	238.57	186.16	4246	95	101.15	136.89		
6.99	0.12	36.682	19.5	-73.96	-17.78	-16.16	1	3000	315	236.57	184.92	4246	95	101.02	136.26		
7.12	0.13	36.475	19.5	-72.93	-16.95	-15.41	1	3000	315	234.57	183.67	4246	95	100.89	135.63		
7.25	0.14	36.262	19.5	-71.90	-16.13	-14.67	1	3000	315	232.57	182.43	4246	95	100.75	135.01		
7.38	0.14	36.045	19.5	-70.86	-15.32	-13.93	1	3000	315	230.57	181.18	4246	95	100.62	134.38		

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
2.00	311.07	55.59	1.0315	1.18E-04	0.395	5.609	143,331	1.1107	2326	164.67	60.90	1.0010	2.59E-04	0.383	1.591	80,860	2.4347	858	9.533	158.75
2.10	308.57	55.70	1.0305	1.19E-04	0.395	5.609	142,208	1.1202	2321	163.81	60.92	1.0009	2.60E-04	0.383	1.591	80,374	2.4513	856	9.523	158.65
2.20	306.10	55.80	1.0296	1.21E-04	0.395	5.609	141,091	1.1298	2315	162.96	60.93	1.0008	2.62E-04	0.382	1.591	79,893	2.4679	854	9.513	158.55
2.30	303.65	55.91	1.0288	1.22E-04	0.396	5.609	139,981	1.1395	2309	162.12	60.95	1.0008	2.64E-04	0.382	1.591	79,420	2.4845	853	9.504	158.45
2.40	301.25	56.01	1.0279	1.23E-04	0.396	5.609	138,880	1.1493	2303	161.29	60.97	1.0007	2.65E-04	0.382	1.591	78,954	2.5011	851	9.494	158.34
2.50	298.88	56.11	1.0271	1.24E-04	0.396	5.609	137,790	1.1593	2297	160.47	60.98	1.0006	2.67E-04	0.382	1.591	78,495	2.5175	849	9.484	158.24
2.60	296.54	56.21	1.0263	1.25E-04	0.396	5.609	136,712	1.1692	2291	159.67	61.00	1.0006	2.68E-04	0.382	1.591	78,045	2.5339	848	9.475	158.14
2.70	294.25	56.30	1.0255	1.26E-04	0.396	5.609	135,646	1.1793	2285	158.88	61.02	1.0005	2.70E-04	0.381	1.591	77,602	2.5502	846	9.466	158.04
2.80	291.99	56.39	1.0248	1.28E-04	0.396	5.609	134,593	1.1894	2279	158.11	61.03	1.0004	2.72E-04	0.381	1.591	77,169	2.5664	845	9.457	157.94
2.90	289.78	56.48	1.0240	1.29E-04	0.396	5.609	133,555	1.1995	2273	157.35	61.05	1.0004	2.73E-04	0.381	1.591	76,743	2.5824	843	9.447	157.84
3.00	287.60	56.57	1.0234	1.30E-04	0.396	5.609	132,531	1.2097	2267	156.60	61.06	1.0003	2.75E-04	0.381	1.591	76,326	2.5983	842	9.439	157.74
3.10	285.47	56.66	1.0227	1.31E-04	0.396	5.609	131,523	1.2199	2261	155.87	61.08	1.0003	2.76E-04	0.381	1.591	75,918	2.6141	840	9.430	157.65
3.20	283.38	56.74	1.0220	1.32E-04	0.396	5.609	130,530	1.2301	2255	155.15	61.09	1.0002	2.78E-04	0.380	1.591	75,518	2.6297	839	9.421	157.55
3.30	281.34	56.82	1.0214	1.34E-04	0.396	5.609	129,554	1.2403	2249	154.45	61.10	1.0002	2.79E-04	0.380	1.591	75,126	2.6452	837	9.413	157.45
3.40	279.33	56.90	1.0208	1.35E-04	0.396	5.609	128,594	1.2506	2243	153.76	61.12	1.0001	2.81E-04	0.380	1.591	74,744	2.6605	836	9.404	157.36
3.50	277.36	56.98	1.0202	1.36E-04	0.396	5.609	127,651	1.2608	2237	153.08	61.13	1.0001	2.82E-04	0.380	1.591	74,369	2.6756	834	9.396	157.27
3.60	275.44	57.06	1.0197	1.37E-04	0.396	5.609	126,725	1.2710	2231	152.43	61.14	1.0000	2.84E-04	0.380	1.591	74,004	2.6905	833	9.388	157.17
3.70	273.56	57.13	1.0191	1.38E-04	0.396	5.609	125,815	1.2811	2226	151.78	61.16	1.0000	2.85E-04	0.380	1.591	73,646	2.7052	831	9.380	157.08
3.80	271.72	57.20	1.0186	1.40E-04	0.396	5.609	124,923	1.2913	2220	151.15	61.17	0.9999	2.87E-04	0.379	1.591	73,297	2.7198	830	9.372	156.99
3.90	269.91	57.27	1.0181	1.41E-04	0.396	5.609	124,048	1.3014	2214	150.53	61.18	0.9999	2.88E-04	0.379	1.591	72,955	2.7342	829	9.365	156.90
4.00	268.15	57.34	1.0177	1.42E-04	0.396	5.609	123,190	1.3115	2209	149.93	61.19	0.9998	2.89E-04	0.379	1.591	72,622	2.7483	828	9.357	156.82
4.10	266.43	57.40	1.0172	1.43E-04	0.396	5.609	122,348	1.3215	2203	149.34	61.20	0.9998	2.91E-04	0.379	1.591	72,296	2.7623	826	9.350	156.73
4.20	264.74	57.47	1.0167	1.44E-04	0.396	5.609	121,524	1.3315	2198	148.76	61.21	0.9998	2.92E-04	0.379	1.591	71,979	2.7761	825	9.343	156.65
4.30	263.06	57.53	1.0163	1.45E-04	0.396	5.609	120,699	1.3416	2192	148.19	61.22	0.9997	2.93E-04	0.379	1.591	71,662	2.7899	824	9.336	156.56
4.41	261.38	57.59	1.0159	1.46E-04	0.396	5.609	119,872	1.3519	2187	147.61	61.24	0.9997	2.95E-04	0.378	1.591	71,345	2.8039	823	9.328	156.47
4.51	259.70	57.65	1.0154	1.48E-04	0.396	5.609	119,043	1.3624	2181	147.04	61.25	0.9996	2.96E-04	0.378	1.591	71,029	2.8180	821	9.321	156.39
4.62	258.01	57.72	1.0150	1.49E-04	0.396	5.609	118,213	1.3731	2175	146.46	61.26	0.9996	2.98E-04	0.378	1.591	70,713	2.8322	820	9.314	156.30
4.74	256.33	57.78	1.0146	1.50E-04	0.396	5.609	117,380	1.3840	2169	145.89	61.27	0.9996	2.99E-04	0.378	1.591	70,398	2.8465	819	9.307	156.21
4.85	254.64	57.84	1.0142	1.51E-04	0.396	5.609	116,546	1.3951	2164	145.31	61.28	0.9995	3.00E-04	0.378	1.591	70,082	2.8610	818	9.300	156.12
4.97	252.96	57.90	1.0138	1.52E-04	0.396	5.609	115,710	1.4063	2158	144.74	61.29	0.9995	3.02E-04	0.378	1.591	69,768	2.8756	816	9.293	156.03
5.09	251.27	57.96	1.0134	1.54E-04	0.396	5.609	114,873	1.4178	2152	144.16	61.30	0.9995	3.03E-04	0.377	1.591	69,453	2.8903	815	9.286	155.94
5.22	249.59	58.02	1.0130	1.55E-04	0.396	5.609	114,034	1.4295	2146	143.59	61.31	0.9994	3.05E-04	0.377	1.591	69,139	2.9051	814	9.280	155.85
5.35	241.58	58.08	1.0112	1.61E-04	0.395	5.609	109,608	1.4880	2110	125.91	61.62	0.9985	3.55E-04	0.372	3.652	136,940	3.4313	1292	9.202	167.37
5.45	239.07	58.18	1.0107	1.64E-04	0.395	5.609	108,368	1.5073	2101	125.32	61.63	0.9984	3.57E-04	0.371	3.652	136,227	3.4515	1290	9.193	167.25
5.55	236.67	58.27	1.0102	1.66E-04	0.395	5.609	107,175	1.5264	2092	124.75	61.64	0.9984	3.58E-04	0.371	3.652	135,544	3.4712	1287	9.184	167.14
5.65	234.36	58.35	1.0098	1.68E-04	0.395	5.609	106,027	1.5452	2083	124.21	61.65	0.9984	3.60E-04	0.371	3.652	134,889	3.4902	1285	9.176	167.02
5.75	232.14	58.43	1.0093	1.70E-04	0.394	5.609	104,923	1.5637	2074	123.68	61.65	0.9984	3.62E-04	0.371	3.652	134,261	3.5087	1283	9.167	166.91
5.85	230.01	58.51	1.0089	1.72E-04	0.394	5.609	103,860	1.5819	2066	123.18	61.66	0.9984	3.64E-04	0.371	3.652	133,658	3.5266	1281	9.160	166.80
5.95	227.96	58.58	1.0085	1.74E-04	0.394	5.609	102,837	1.5998	2058	122.70	61.67	0.9983	3.65E-04	0.370	3.652	133,079	3.5439	1279	9.152	166.70
6.05	225.99	58.65	1.0082	1.75E-04	0.394	5.609	101,854	1.6174	2050	122.23	61.68	0.9983	3.67E-04	0.370	3.652	132,524	3.5607	1277	9.145	166.60
6.15	224.10	58.72	1.0078	1.77E-04	0.394	5.609	100,908	1.6347	2043	121.79	61.68	0.9983	3.68E-04	0.370	3.652	131,991	3.5769	1276	9.138	166.50
6.25	222.28	58.78	1.0075	1.79E-04	0.393	5.609	99,998	1.6517	2035	121.36	61.69	0.9983	3.70E-04	0.370	3.652	131,479	3.5927	1274	9.131	166.40
6.35	220.53	58.84	1.0072	1.81E-04	0.393	5.609	99,122	1.6683	2028	120.95	61.70	0.9983	3.71E-04	0.370	3.652	130,988	3.6079	1272	9.124	166.31
6.45	218.85	58.90	1.0069	1.83E-04	0.393	5.609	98,280	1.6846	2021	120.55	61.70	0.9982	3.73E-04	0.370	3.652	130,516	3.6226	1271	9.118	166.22
6.55	217.23	58.95	1.0066	1.84E-04	0.393	5.609	97,468	1.7006	2014	120.17	61.71	0.9982	3.74E-04	0.370	3.652	130,063	3.6369	1269	9.112	166.13
6.65	215.61	59.01	1.0064	1.86E-04	0.393	5.609	96,656	1.7169	2008	119.79	61.72	0.9982	3.75E-04	0.369	3.652	129,609	3.6513	1268	9.106	166.05
6.76	213.99	59.06	1.0061	1.88E-04	0.392	5.609	95,844	1.7336	2001	119.40	61.72	0.9982	3.77E-04	0.369	3.652	129,156	3.6657	1266	9.100	165.96
6.88	212.37	59.12	1.0059	1.90E-04	0.392	5.609	95,031	1.7505	1994	119.02	61.73	0.9982	3.78E-04	0.369	3.652	128,704	3.6803	1264	9.094	165.87
6.99	210.74	59.17	1.0056	1.91E-04	0.392	5.609	94,217	1.7678	1987	118.64	61.73	0.9982	3.79E-04	0.369	3.652	128,252	3.6950	1263	9.088	165.78
7.12	209.12	59.23	1.0054	1.93E-04	0.392	5.609	93,403	1.7854	1980	118.26	61.74	0.9982	3.81E-04	0.369	3.652	127,800	3.7097	1261	9.082	165.68
7.25	207.50	59.28	1.0051	1.95E-04	0.391	5.609	92,589	1.8033	1973	117.88	61.74	0.9981	3.82E-04	0.369	3.652	127,348	3.7246	1260	9.076	165.59
7.38	205.87	59.33	1.0049	1.97E-04	0.391	5.609	91,775	1.8216	1966	117.50	61.75	0.9981	3.84E-04	0.369	3.652	126,897	3.7395	1258	9.070	165.50

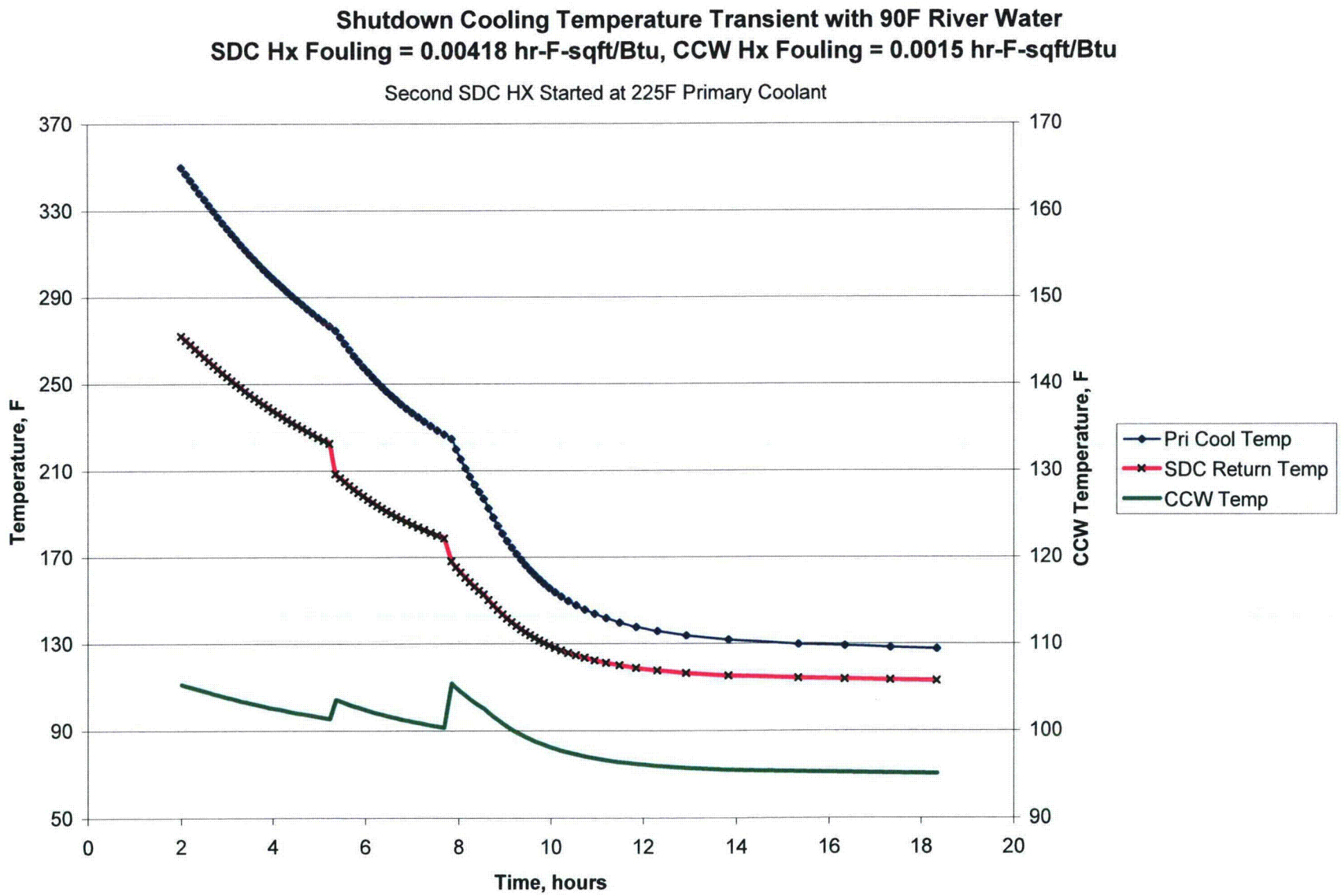
CCW HX Fouling 0.0015

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
2.00	1,337,560	1,379,666	#N/A	#N/A	#N/A	77.86	272.14	903,634	904,509	0.656	0.881	0.485	118.76	224.05	107.42	272.14	224.05	7.358	114.77	8,100	3	38.26	12	105.29
2.10	1,340,169	1,381,103	#N/A	#N/A	#N/A	76.87	270.13	903,898	904,707	0.655	0.880	0.485	117.35	222.48	106.17	270.13	222.48	7.358	113.52	8,100	3	37.84	13	105.13
2.20	1,342,728	1,382,522	#N/A	#N/A	#N/A	75.90	268.15	904,158	904,902	0.655	0.880	0.485	115.96	220.93	104.93	268.15	220.93	7.358	112.29	8,100	3	37.43	14	104.98
2.30	1,345,235	1,383,919	#N/A	#N/A	#N/A	74.94	266.19	904,413	905,094	0.654	0.879	0.485	114.58	219.41	103.71	266.19	219.41	7.358	111.07	8,100	3	37.02	15	104.82
2.40	1,347,690	1,385,295	#N/A	#N/A	#N/A	74.00	264.25	904,663	905,283	0.653	0.878	0.485	113.23	217.90	102.51	264.25	217.90	7.358	109.86	8,100	3	36.62	16	104.67
2.50	1,350,089	1,386,649	#N/A	#N/A	#N/A	73.07	262.34	904,908	905,469	0.653	0.877	0.485	111.90	216.42	101.32	262.34	216.42	7.358	108.68	8,100	3	36.23	17	104.52
2.60	1,352,434	1,387,978	#N/A	#N/A	#N/A	72.16	260.46	905,149	905,652	0.652	0.877	0.485	110.59	214.96	100.15	260.46	214.96	7.358	107.51	8,100	3	35.84	18	104.38
2.70	1,354,723	1,389,284	#N/A	#N/A	#N/A	71.27	258.61	905,384	905,831	0.652	0.876	0.484	109.30	213.53	99.01	258.61	213.53	7.358	106.37	8,100	3	35.46	19	104.23
2.80	1,356,957	1,390,565	#N/A	#N/A	#N/A	70.39	256.80	905,615	906,007	0.652	0.875	0.484	108.04	212.12	97.88	256.80	212.12	7.358	105.24	8,100	3	35.08	20	104.09
2.90	1,359,135	1,391,821	#N/A	#N/A	#N/A	69.53	255.01	905,840	906,179	0.651	0.874	0.484	106.80	210.74	96.78	255.01	210.74	7.358	104.13	8,100	3	34.71	21	103.95
3.00	1,361,259	1,393,052	#N/A	#N/A	#N/A	68.69	253.26	906,060	906,348	0.651	0.874	0.484	105.58	209.39	95.69	253.26	209.39	7.358	103.05	8,100	3	34.35	22	103.81
3.10	1,363,329	1,394,258	#N/A	#N/A	#N/A	67.87	251.54	906,275	906,513	0.650	0.873	0.484	104.39	208.06	94.63	251.54	208.06	7.358	101.98	8,100	3	33.99	23	103.67
3.20	1,365,344	1,395,439	#N/A	#N/A	#N/A	67.06	249.85	906,485	906,674	0.650	0.872	0.484	103.22	206.76	93.58	249.85	206.76	7.358	100.94	8,100	3	33.65	24	103.54
3.30	1,367,307	1,396,595	#N/A	#N/A	#N/A	66.28	248.20	906,690	906,832	0.649	0.872	0.484	102.07	205.48	92.56	248.20	205.48	7.358	99.92	8,100	3	33.31	25	103.41
3.40	1,369,218	1,397,726	#N/A	#N/A	#N/A	65.51	246.58	906,890	906,986	0.649	0.871	0.483	100.95	204.23	91.56	246.58	204.23	7.358	98.92	8,100	3	32.97	26	103.28
3.50	1,371,078	1,398,832	#N/A	#N/A	#N/A	64.75	244.99	907,085	907,137	0.648	0.870	0.483	99.85	203.01	90.58	244.99	203.01	7.358	97.94	8,100	3	32.65	27	103.16
3.60	1,372,887	1,399,914	#N/A	#N/A	#N/A	64.02	243.43	907,275	907,285	0.648	0.870	0.483	98.78	201.81	89.62	243.43	201.81	7.358	96.98	8,100	3	32.33	28	103.04
3.70	1,374,648	1,400,971	#N/A	#N/A	#N/A	63.30	241.91	907,460	907,428	0.648	0.869	0.483	97.73	200.64	88.68	241.91	200.64	7.358	96.04	8,100	3	32.01	29	102.92
3.80	1,376,361	1,402,005	#N/A	#N/A	#N/A	62.60	240.42	907,641	907,569	0.647	0.868	0.483	96.70	199.50	87.76	240.42	199.50	7.358	95.12	8,100	3	31.71	30	102.80
3.90	1,378,027	1,403,015	#N/A	#N/A	#N/A	61.91	238.96	907,817	907,706	0.647	0.868	0.483	95.70	198.38	86.86	238.96	198.38	7.358	94.22	8,100	3	31.41	31	102.68
4.00	1,379,647	1,404,002	#N/A	#N/A	#N/A	61.24	237.53	907,989	907,839	0.647	0.867	0.483	94.72	197.29	85.99	237.53	197.29	7.358	93.34	8,100	3	31.11	32	102.57
4.10	1,381,223	1,404,966	#N/A	#N/A	#N/A	60.59	236.13	908,156	907,970	0.646	0.867	0.483	93.76	196.22	85.13	236.13	196.22	7.358	92.49	8,100	3	30.83	33	102.46
4.20	1,382,755	1,405,908	#N/A	#N/A	#N/A	59.95	234.77	908,319	908,097	0.646	0.866	0.483	92.82	195.17	84.29	234.77	195.17	7.358	91.65	8,100	3	30.55	34	102.35
4.30	1,384,277	1,406,848	#N/A	#N/A	#N/A	59.32	233.40	908,481	908,224	0.646	0.865	0.482	91.88	194.13	83.45	233.40	194.13	7.358	90.81	8,100	3	30.27	35	102.25
4.41	1,385,791	1,407,786	#N/A	#N/A	#N/A	58.68	232.04	908,642	908,351	0.645	0.865	0.482	90.95	193.09	82.61	232.04	193.09	7.358	89.97	8,100	3	29.99	36	102.14
4.51	1,387,297	1,408,725	#N/A	#N/A	#N/A	58.05	230.67	908,803	908,477	0.645	0.864	0.482	90.01	192.04	81.77	230.67	192.04	7.358	89.13	8,100	3	29.71	37	102.03
4.62	1,388,796	1,409,663	#N/A	#N/A	#N/A	57.42	229.30	908,963	908,603	0.645	0.864	0.482	89.08	191.00	80.94	229.30	191.00	7.358	88.29	8,100	3	29.43	38	101.92
4.74	1,390,287	1,410,600	#N/A	#N/A	#N/A	56.78	227.94	909,123	908,729	0.644	0.863	0.482	88.14	189.96	80.10	227.94	189.96	7.358	87.46	8,100	3	29.15	39	101.81
4.85	1,391,770	1,411,536	#N/A	#N/A	#N/A	56.15	226.57	909,282	908,854	0.644	0.862	0.482	87.21	188.92	79.26	226.57	188.92	7.358	86.62	8,100	3	28.87	40	101.71
4.97	1,393,246	1,412,472	#N/A	#N/A	#N/A	55.52	225.20	909,441	908,980	0.644	0.862	0.482	86.28	187.87	78.42	225.20	187.87	7.358	85.78	8,100	3	28.59	41	101.60
5.09	1,394,714	1,413,407	#N/A	#N/A	#N/A	54.89	223.83	909,599	909,105	0.643	0.861	0.482	85.34	186.83	77.59	223.83	186.83	7.358	84.94	8,100	3	28.31	42	101.49
5.22	1,396,174	1,414,342	#N/A	#N/A	#N/A	54.26	222.46	909,756	909,229	0.643	0.860	0.481	84.41	185.79	76.75	222.46	185.79	7.358	84.11	8,100	3	28.04	43	101.38
5.35	1,397,627	1,413,335	0.675	0.594	0.387	66.28	208.44	########	2,095,283	#N/A	#N/A	#N/A	44.71	148.26	93.68	208.44	148.26	7.358	101.04	8,100	3	33.68	44	103.55
5.45	1,399,868	1,414,864	0.675	0.593	0.387	65.08	206.54	########	2,095,555	#N/A	#N/A	#N/A	43.94	147.29	92.07	206.54	147.29	7.358	99.43	8,100	3	33.14	45	103.35
5.55	1,402,003	1,416,328	0.676	0.592	0.386	63.92	204.71	########	2,095,815	#N/A	#N/A	#N/A	43.20	146.35	90.53	204.71	146.35	7.358	97.89	8,100	3	32.63	46	103.15
5.65	1,404,037	1,417,731	0.676	0.591	0.386	62.81	202.95	########	2,096,064	#N/A	#N/A	#N/A	42.48	145.45	89.05	202.95	145.45	7.358	96.41	8,100	3	32.14	47	102.96
5.75	1,405,975	1,419,075	0.677	0.590	0.385	61.75	201.26	########	2,096,303	#N/A	#N/A	#N/A	41.80	144.58	87.63	201.26	144.58	7.358	94.99	8,100	3	31.66	48	102.78
5.85	1,407,822	1,420,363	0.677	0.590	0.385	60.73	199.64	########	2,096,532	#N/A	#N/A	#N/A	41.15	143.75	86.26	199.64	143.75	7.358	93.62	8,100	3	31.21	49	102.61
5.95	1,409,584	1,421,598	0.678	0.589	0.385	59.76	198.08	########	2,096,751	#N/A	#N/A	#N/A	40.52	142.95	84.95	198.08	142.95	7.358	92.31	8,100	3	30.77	50	102.44
6.05	1,411,264	1,422,781	0.678	0.588	0.384	58.82	196.58	########	2,096,962	#N/A	#N/A	#N/A	39.91	142.19	83.69	196.58	142.19	7.358	91.05	8,100	3	30.35	51	102.28
6.15	1,412,868	1,423,916	0.679	0.587	0.384	57.93	195.13	########	2,097,163	#N/A	#N/A	#N/A	39.33	141.45	82.48	195.13	141.45	7.358	89.84	8,100	3	29.95	52	102.12
6.25	1,414,400	1,425,005	0.679	0.586	0.383	57.07	193.75	########	2,097,356	#N/A	#N/A	#N/A	38.77	140.74	81.32	193.75	140.74	7.358	88.68	8,100	3	29.56	53	101.97
6.35	1,415,862	1,426,049	0.680	0.585	0.383	56.24	192.41	########	2,097,542	#N/A	#N/A	#N/A	38.24	140.06	80.20	192.41	140.06	7.358	87.56	8,100	3	29.19	54	101.83
6.45	1,417,259	1,427,050	0.680	0.585	0.383	55.45	191.12	########	2,097,720	#N/A	#N/A	#N/A	37.72	139.41	79.13	191.12	139.41	7.358	86.49	8,100	3	28.83	55	101.69
6.55	1,418,596	1,428,012	0.681	0.584	0.382	54.69	189.88	########	2,097,890	#N/A	#N/A	#N/A	37.23	138.78	78.09	189.88	138.78	7.358	85.45	8,100	3	28.48	56	101.56
6.65	1,419,926	1,428,973	0.681	0.583	0.382	53.93	188.64	########	2,098,061	#N/A	#N/A	#N/A	36.73	138.15	77.06	188.64	138.15	7.358	84.42	8,100	3	28.14	57	101.42
6.76	1,421,247	1,429,931	0.681	0.583	0.382	53.17	187.40	########	2,098,231	#N/A	#N/A	#N/A	36.23	137.52	76.03	187.40	137.52	7.358	83.39	8,100	3	27.80	58	101.29
6.88	1,422,561	1,430,888	0.682	0.582	0.381	52.41	186.16	########	2,098,401	#N/A	#N/A	#N/A	35.74	136.89	74.99	186.16	136.89	7.358	82.35	8,100	3	27.45	59	101.15
6.99	1,423,867	1,431,842	0.682	0.581	0.381	51.65	184.92	########	2,098,571	#N/A	#N/A	#N/A	35.24	136.26	73.96	184.92	136.26	7.358	81.32	8,100	3	27.11	60	101.02
7.12	1,425,165	1,432,795	0.683	0.580	0.381	50.90	183.67	########	2,098,740	#N/A	#N/A	#N/A	34.75	135.63	72.93	183.67	135.63	7.358	80.29	8,100	3	26.76	61	100.89
7.25	1,426,455	1,433,745	0.683	0.580	0.380	50.15	182.43	########	2,098,909	#N/A	#N/A	#N/A	34.25	135.01	71.90	182.43	135.01	7.358	79.25	8,100	3	26.42	62	100.75
7.38	1,427,738	1,434,694	0.683	0.579	0.380	49.39	181.18	########	2,099,078	#N/A	#N/A	#N/A	33.76	134.38	70.86	181.18	134.38	7.358	78.22	8,100	3	26.07	63	100.62

								SDCHx (per exchanger)							
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell			
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
7.53	0.15	35.821	19.5	-69.83	-14.51	-13.19	1	3000	315	228.57	179.93	4246	95	100.48	133.75
7.68	0.16	35.591	19.5	-68.80	-13.71	-12.46	1	3000	315	226.57	178.68	4246	95	100.35	133.12
7.84	0.10	35.354	19.5	-54.19	-53.52	-48.66	2	2000	315	224.57	167.99	3254	95	105.41	139.13
7.94	0.10	35.209	19.5	-52.18	-49.66	-45.14	2	2000	315	219.71	165.31	3254	95	104.91	137.37
8.04	0.10	35.067	19.5	-50.32	-46.08	-41.89	2	2000	315	215.19	162.81	3254	95	104.44	135.74
8.14	0.10	34.928	19.5	-48.60	-42.77	-38.88	2	2000	315	211.00	160.49	3254	95	104.00	134.22
8.24	0.10	34.790	19.5	-47.00	-39.71	-36.10	2	2000	315	207.11	158.32	3254	95	103.59	132.82
8.34	0.10	34.655	19.5	-45.51	-36.87	-33.52	2	2000	315	203.50	156.31	3254	95	103.22	131.51
8.44	0.10	34.522	19.5	-44.14	-34.25	-31.14	2	2000	315	200.15	154.44	3254	95	102.86	130.29
8.54	0.10	34.390	1.5	-42.86	-49.82	-45.29	2	2000	315	197.04	152.69	3254	95	102.54	129.17
8.64	0.10	34.261	1.5	-41.00	-46.23	-42.03	2	2000	315	192.51	150.15	3254	95	102.06	127.53
8.74	0.10	34.134	1.5	-39.27	-42.91	-39.00	2	2000	315	188.31	147.78	3254	95	101.61	126.01
8.84	0.10	34.009	1.5	-37.67	-39.83	-36.21	2	2000	315	184.41	145.58	3254	95	101.20	124.59
8.94	0.10	33.886	1.5	-36.19	-36.98	-33.62	2	2000	315	180.78	143.53	3254	95	100.81	123.28
9.04	0.10	33.764	1.5	-34.81	-34.35	-31.23	2	2000	315	177.42	141.62	3254	95	100.45	122.06
9.14	0.10	33.644	1.5	-33.53	-31.91	-29.01	2	2000	315	174.30	139.85	3254	95	100.12	120.93
9.24	0.10	33.526	1.5	-32.34	-29.66	-26.96	2	2000	315	171.40	138.19	3254	95	99.81	119.88
9.34	0.10	33.410	1.5	-31.24	-27.57	-25.06	2	2000	315	168.70	136.65	3254	95	99.52	118.91
9.44	0.10	33.295	1.5	-30.22	-25.64	-23.31	2	2000	315	166.20	135.22	3254	95	99.25	118.00
9.54	0.10	33.182	1.5	-29.26	-23.85	-21.68	2	2000	315	163.87	133.89	3254	95	99.00	117.16
9.64	0.10	33.070	1.5	-28.38	-22.19	-20.17	2	2000	315	161.70	132.64	3254	95	98.77	116.37
9.74	0.11	32.960	1.5	-27.56	-20.65	-18.78	2	2000	315	159.68	131.48	3254	95	98.55	115.64
9.85	0.11	32.845	1.5	-26.74	-19.14	-17.40	2	2000	315	157.68	130.33	3254	95	98.33	114.92
9.96	0.12	32.722	1.5	-25.93	-17.63	-16.03	2	2000	315	155.68	129.18	3254	95	98.12	114.20
10.09	0.14	32.590	1.5	-25.11	-16.14	-14.67	2	2000	315	153.68	128.03	3254	95	97.90	113.48
10.22	0.15	32.449	1.5	-24.30	-14.65	-13.32	2	2000	315	151.68	126.87	3254	95	97.68	112.75
10.37	0.17	32.297	1.5	-23.49	-13.18	-11.98	2	2000	315	149.68	125.71	3254	95	97.47	112.03
10.54	0.19	32.131	1.5	-22.67	-11.72	-10.65	2	2000	315	147.68	124.55	3254	95	97.25	111.31
10.73	0.21	31.948	1.5	-21.86	-10.28	-9.34	2	2000	315	145.68	123.39	3254	95	97.03	110.59
10.94	0.25	31.745	1.5	-21.05	-8.86	-8.05	2	2000	315	143.68	122.23	3254	95	96.82	109.87
11.19	0.29	31.515	1.5	-20.24	-7.47	-6.79	2	2000	315	141.68	121.07	3254	95	96.60	109.14
11.48	0.36	31.252	1.5	-19.43	-6.11	-5.56	2	2000	315	139.68	119.90	3254	95	96.38	108.42
11.84	0.46	30.942	1.5	-18.62	-4.80	-4.37	2	2000	315	137.68	118.74	3254	95	96.16	107.70
12.30	0.62	30.565	1.5	-17.81	-3.56	-3.24	2	2000	315	135.68	117.57	3254	95	95.94	106.98
12.92	0.91	30.085	1.5	-17.01	-2.43	-2.21	2	2000	315	133.68	116.40	3254	95	95.73	106.26
13.83	1.50	29.433	1.5	-16.20	-1.46	-1.33	2	2000	315	131.68	115.23	3254	95	95.51	105.54
15.33	1.00	28.468	1.5	-15.39	-0.82	-0.74	2	2000	315	129.68	114.05	3254	95	95.29	104.82
16.33	1.00	27.893	1.5	-15.09	-0.79	-0.72	2	2000	315	128.94	113.62	3254	95	95.21	104.56
17.33	1.00	27.362	1.5	-14.80	-0.74	-0.68	2	2000	315	128.22	113.19	3254	95	95.13	104.30
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06
18.33	0.00	26.871	1.5	-14.53	-0.69	-0.63	2	2000	315	127.54	112.80	3254	95	95.05	104.06

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
7.53	204.25	59.39	1.0046	1.99E-04	0.391	5.609	90,960	1.8402	1958	117.12	61.76	0.9981	3.85E-04	0.368	3.652	126,447	3.7546	1257	9.064	165.40
7.68	202.63	59.44	1.0044	2.01E-04	0.391	5.609	90,146	1.8592	1951	116.73	61.76	0.9981	3.86E-04	0.368	3.652	125,997	3.7697	1255	9.058	165.31
7.84	196.28	59.49	1.0036	2.09E-04	0.390	3.739	57,832	1.9371	1387	122.27	61.68	0.9983	3.67E-04	0.370	2.799	101,598	3.5593	1084	9.056	155.88
7.94	192.51	59.62	1.0031	2.14E-04	0.389	3.739	56,584	1.9864	1374	121.14	61.69	0.9983	3.71E-04	0.370	2.799	100,562	3.6007	1080	9.041	155.60
8.04	189.00	59.73	1.0027	2.19E-04	0.388	3.739	55,426	2.0342	1363	120.09	61.71	0.9982	3.74E-04	0.370	2.799	99,603	3.6399	1077	9.027	155.33
8.14	185.74	59.84	1.0023	2.24E-04	0.388	3.739	54,352	2.0806	1351	119.11	61.73	0.9982	3.78E-04	0.369	2.799	98,715	3.6769	1073	9.015	155.08
8.24	182.72	59.93	1.0019	2.28E-04	0.387	3.739	53,355	2.1253	1341	118.21	61.74	0.9982	3.81E-04	0.369	2.799	97,892	3.7119	1070	9.003	154.84
8.34	179.91	60.02	1.0016	2.33E-04	0.387	3.739	52,431	2.1685	1331	117.36	61.75	0.9981	3.84E-04	0.369	2.799	97,129	3.7448	1067	8.991	154.61
8.44	177.29	60.10	1.0014	2.37E-04	0.386	3.739	51,573	2.2101	1322	116.58	61.76	0.9981	3.87E-04	0.368	2.799	96,421	3.7759	1065	8.980	154.39
8.54	174.87	60.18	1.0011	2.41E-04	0.386	3.739	50,777	2.2500	1313	115.85	61.78	0.9981	3.90E-04	0.368	2.799	95,765	3.8051	1062	8.969	154.19
8.64	171.33	60.28	1.0008	2.47E-04	0.385	3.739	49,620	2.3104	1300	114.79	61.79	0.9980	3.94E-04	0.368	2.799	94,812	3.8483	1058	8.954	153.89
8.74	168.04	60.38	1.0005	2.53E-04	0.384	3.739	48,549	2.3691	1288	113.81	61.81	0.9980	3.98E-04	0.367	2.799	93,929	3.8892	1055	8.940	153.60
8.84	164.99	60.47	1.0002	2.58E-04	0.383	3.739	47,556	2.4260	1277	112.90	61.82	0.9980	4.01E-04	0.367	2.799	93,112	3.9278	1052	8.927	153.32
8.94	162.16	60.55	1.0000	2.64E-04	0.383	3.739	46,637	2.4810	1266	112.05	61.83	0.9979	4.04E-04	0.367	2.799	92,355	3.9642	1049	8.915	153.07
9.04	159.52	60.63	0.9998	2.69E-04	0.382	3.739	45,784	2.5341	1256	111.26	61.84	0.9979	4.08E-04	0.366	2.799	91,653	3.9985	1046	8.904	152.82
9.14	157.07	60.69	0.9996	2.74E-04	0.381	3.739	44,995	2.5853	1246	110.53	61.85	0.9979	4.11E-04	0.366	2.799	91,002	4.0308	1043	8.894	152.59
9.24	154.80	60.76	0.9994	2.79E-04	0.381	3.739	44,262	2.6344	1237	109.85	61.86	0.9979	4.13E-04	0.366	2.799	90,399	4.0612	1041	8.884	152.37
9.34	152.68	60.81	0.9992	2.83E-04	0.380	3.739	43,583	2.6816	1229	109.21	61.87	0.9979	4.16E-04	0.365	2.799	89,839	4.0897	1039	8.875	152.17
9.44	150.71	60.87	0.9991	2.88E-04	0.380	3.739	42,953	2.7267	1221	108.63	61.88	0.9978	4.19E-04	0.365	2.799	89,320	4.1166	1037	8.867	151.97
9.54	148.88	60.91	0.9990	2.92E-04	0.379	3.739	42,369	2.7699	1214	108.08	61.89	0.9978	4.21E-04	0.365	2.799	88,837	4.1419	1035	8.860	151.79
9.64	147.17	60.96	0.9989	2.96E-04	0.379	3.739	41,826	2.8112	1207	107.57	61.90	0.9978	4.23E-04	0.365	2.799	88,389	4.1656	1033	8.853	151.62
9.74	145.58	61.00	0.9987	3.00E-04	0.378	3.739	41,322	2.8505	1201	107.10	61.90	0.9978	4.25E-04	0.365	2.799	87,973	4.1878	1031	8.846	151.45
9.85	144.01	61.04	0.9986	3.04E-04	0.378	3.739	40,823	2.8905	1194	106.63	61.91	0.9978	4.27E-04	0.364	2.799	87,560	4.2101	1029	8.840	151.29
9.96	142.43	61.08	0.9985	3.08E-04	0.377	3.739	40,325	2.9314	1188	106.16	61.91	0.9978	4.29E-04	0.364	2.799	87,149	4.2326	1028	8.834	151.13
10.09	140.85	61.12	0.9984	3.12E-04	0.377	3.739	39,828	2.9733	1181	105.69	61.92	0.9978	4.31E-04	0.364	2.799	86,738	4.2552	1026	8.827	150.96
10.22	139.28	61.16	0.9984	3.16E-04	0.376	3.739	39,332	3.0163	1175	105.22	61.93	0.9978	4.33E-04	0.364	2.799	86,327	4.2781	1024	8.821	150.79
10.37	137.70	61.20	0.9983	3.20E-04	0.376	3.739	38,837	3.0603	1168	104.75	61.93	0.9978	4.36E-04	0.364	2.799	85,917	4.3011	1023	8.815	150.62
10.54	136.12	61.23	0.9982	3.24E-04	0.375	3.739	38,343	3.1055	1161	104.28	61.94	0.9977	4.38E-04	0.364	2.799	85,508	4.3244	1021	8.809	150.45
10.73	134.54	61.27	0.9981	3.29E-04	0.375	3.739	37,850	3.1517	1155	103.81	61.95	0.9977	4.40E-04	0.363	2.799	85,099	4.3478	1019	8.803	150.27
10.94	132.96	61.31	0.9980	3.33E-04	0.374	3.739	37,359	3.1992	1148	103.34	61.95	0.9977	4.42E-04	0.363	2.799	84,691	4.3715	1017	8.797	150.10
11.19	131.37	61.35	0.9979	3.38E-04	0.374	3.739	36,868	3.2479	1141	102.87	61.96	0.9977	4.44E-04	0.363	2.799	84,283	4.3954	1016	8.791	149.92
11.48	129.79	61.38	0.9978	3.43E-04	0.373	3.739	36,379	3.2978	1134	102.40	61.97	0.9977	4.46E-04	0.363	2.799	83,877	4.4194	1014	8.785	149.74
11.84	128.21	61.42	0.9978	3.48E-04	0.373	3.739	35,891	3.3491	1128	101.93	61.97	0.9977	4.49E-04	0.363	2.799	83,470	4.4437	1012	8.779	149.55
12.30	126.62	61.45	0.9977	3.53E-04	0.372	3.739	35,405	3.4017	1121	101.46	61.98	0.9977	4.51E-04	0.362	2.799	83,065	4.4682	1010	8.773	149.37
12.92	125.04	61.49	0.9976	3.58E-04	0.372	3.739	34,920	3.4557	1114	100.99	61.98	0.9977	4.53E-04	0.362	2.799	82,660	4.4929	1009	8.767	149.18
13.83	123.45	61.52	0.9975	3.63E-04	0.371	3.739	34,436	3.5112	1107	100.53	61.99	0.9977	4.55E-04	0.362	2.799	82,256	4.5178	1007	8.762	148.99
15.33	121.87	61.56	0.9975	3.68E-04	0.371	3.739	33,953	3.5682	1100	100.06	62.00	0.9977	4.58E-04	0.362	2.799	81,853	4.5430	1005	8.756	148.80
16.33	121.28	61.57	0.9974	3.70E-04	0.370	3.739	33,775	3.5897	1097	99.88	62.00	0.9977	4.58E-04	0.362	2.799	81,703	4.5524	1005	8.754	148.73
17.33	120.70	61.58	0.9974	3.72E-04	0.370	3.739	33,601	3.6108	1095	99.71	62.00	0.9977	4.59E-04	0.362	2.799	81,558	4.5615	1004	8.752	148.66
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59
18.33	120.17	61.59	0.9974	3.74E-04	0.370	3.739	33,439	3.6308	1092	99.55	62.00	0.9977	4.60E-04	0.362	2.799	81,422	4.5701	1003	8.750	148.59

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate			Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp	
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr					mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o	
7.53	1,429,012	1,435,640	0.684	0.578	0.380	48.64	179.93	########	2,099,246	#N/A	#N/A	#N/A	33.26	133.75	69.83	179.93	133.75			7.358	77.19	8,100	3	25.73	64	100.48	
7.68	1,430,279	1,436,584	0.684	0.578	0.379	47.89	178.68	########	2,099,414	#N/A	#N/A	#N/A	32.77	133.12	68.80	178.68	133.12			7.358	76.16	8,100	3	25.39	65	100.35	
7.84	954,358	957,749	0.596	0.817	0.475	56.58	167.99	########	1,607,032	#N/A	#N/A	#N/A	33.72	139.13	54.19	167.99	139.13			7.358	115.73	8,100	3	38.58	66	105.41	
7.94	956,378	959,318	0.597	0.814	0.474	54.40	165.31	########	1,607,423	#N/A	#N/A	#N/A	32.46	137.37	52.18	165.31	137.37			7.358	111.73	8,100	3	37.24	67	104.91	
8.04	958,223	960,762	0.598	0.812	0.473	52.38	162.81	########	1,607,784	#N/A	#N/A	#N/A	31.30	135.74	50.32	162.81	135.74			7.358	108.01	8,100	3	36.00	68	104.44	
8.14	959,910	962,092	0.598	0.809	0.472	50.51	160.49	########	1,608,118	#N/A	#N/A	#N/A	30.22	134.22	48.60	160.49	134.22			7.358	104.56	8,100	3	34.85	69	104.00	
8.24	961,455	963,316	0.599	0.807	0.471	48.79	158.32	########	1,608,427	#N/A	#N/A	#N/A	29.22	132.82	47.00	158.32	132.82			7.358	101.36	8,100	3	33.79	70	103.59	
8.34	962,870	964,444	0.600	0.805	0.471	47.19	156.31	########	1,608,712	#N/A	#N/A	#N/A	28.29	131.51	45.51	156.31	131.51			7.358	98.39	8,100	3	32.80	71	103.22	
8.44	964,169	965,483	0.600	0.803	0.470	45.71	154.44	########	1,608,976	#N/A	#N/A	#N/A	27.43	130.29	44.14	154.44	130.29			7.358	95.63	8,100	3	31.88	72	102.86	
8.54	965,360	966,442	0.601	0.801	0.469	44.34	152.69	########	1,609,221	#N/A	#N/A	#N/A	26.63	129.17	42.86	152.69	129.17			7.358	93.07	8,100	3	31.02	73	102.54	
8.64	967,069	967,824	0.601	0.798	0.468	42.36	150.15	########	1,609,575	#N/A	#N/A	#N/A	25.47	127.53	41.00	150.15	127.53			7.358	89.35	8,100	3	29.78	74	102.06	
8.74	968,628	969,092	0.602	0.796	0.467	40.52	147.78	########	1,609,902	#N/A	#N/A	#N/A	24.39	126.01	39.27	147.78	126.01			7.358	85.90	8,100	3	28.63	75	101.61	
8.84	970,052	970,256	0.603	0.793	0.467	38.82	145.58	########	1,610,204	#N/A	#N/A	#N/A	23.39	124.59	37.67	145.58	124.59			7.358	82.70	8,100	3	27.57	76	101.20	
8.94	971,353	971,325	0.603	0.791	0.466	37.25	143.53	########	1,610,484	#N/A	#N/A	#N/A	22.47	123.28	36.19	143.53	123.28			7.358	79.73	8,100	3	26.58	77	100.81	
9.04	972,544	972,307	0.604	0.789	0.465	35.80	141.62	########	1,610,742	#N/A	#N/A	#N/A	21.61	122.06	34.81	141.62	122.06			7.358	76.97	8,100	3	25.66	78	100.45	
9.14	973,635	973,210	0.604	0.787	0.464	34.45	139.85	########	1,610,981	#N/A	#N/A	#N/A	20.81	120.93	33.53	139.85	120.93			7.358	74.42	8,100	3	24.81	79	100.12	
9.24	974,634	974,041	0.605	0.785	0.464	33.20	138.19	########	1,611,203	#N/A	#N/A	#N/A	20.07	119.88	32.34	138.19	119.88			7.358	72.04	8,100	3	24.01	80	99.81	
9.34	975,552	974,805	0.605	0.784	0.463	32.05	136.65	########	1,611,408	#N/A	#N/A	#N/A	19.39	118.91	31.24	136.65	118.91			7.358	69.84	8,100	3	23.28	81	99.52	
9.44	976,394	975,509	0.605	0.782	0.463	30.97	135.22	########	1,611,598	#N/A	#N/A	#N/A	18.75	118.00	30.22	135.22	118.00			7.358	67.79	8,100	3	22.60	82	99.25	
9.54	977,168	976,158	0.606	0.781	0.462	29.98	133.89	########	1,611,774	#N/A	#N/A	#N/A	18.16	117.16	29.26	133.89	117.16			7.358	65.89	8,100	3	21.96	83	99.00	
9.64	977,880	976,756	0.606	0.779	0.462	29.06	132.64	########	1,611,938	#N/A	#N/A	#N/A	17.61	116.37	28.38	132.64	116.37			7.358	64.12	8,100	3	21.37	84	98.77	
9.74	978,536	977,308	0.606	0.778	0.461	28.20	131.48	########	1,612,090	#N/A	#N/A	#N/A	17.09	115.64	27.56	131.48	115.64			7.358	62.47	8,100	3	20.82	85	98.55	
9.85	979,179	977,851	0.607	0.777	0.461	27.35	130.33	########	1,612,240	#N/A	#N/A	#N/A	16.59	114.92	26.74	130.33	114.92			7.358	60.84	8,100	3	20.28	86	98.33	
9.96	979,816	978,390	0.607	0.775	0.460	26.50	129.18	########	1,612,390	#N/A	#N/A	#N/A	16.08	114.20	25.93	129.18	114.20			7.358	59.21	8,100	3	19.74	87	98.12	
10.09	980,446	978,924	0.607	0.774	0.460	25.65	128.03	########	1,612,539	#N/A	#N/A	#N/A	15.57	113.48	25.11	128.03	113.48			7.358	57.58	8,100	3	19.19	88	97.90	
10.22	981,069	979,453	0.607	0.773	0.459	24.81	126.87	########	1,612,689	#N/A	#N/A	#N/A	15.07	112.75	24.30	126.87	112.75			7.358	55.96	8,100	3	18.65	89	97.68	
10.37	981,686	979,977	0.608	0.772	0.459	23.97	125.71	########	1,612,837	#N/A	#N/A	#N/A	14.56	112.03	23.49	125.71	112.03			7.358	54.33	8,100	3	18.11	90	97.47	
10.54	982,295	980,496	0.608	0.770	0.459	23.13	124.55	########	1,612,986	#N/A	#N/A	#N/A	14.06	111.31	22.67	124.55	111.31			7.358	52.71	8,100	3	17.57	91	97.25	
10.73	982,897	981,011	0.608	0.769	0.458	22.29	123.39	########	1,613,134	#N/A	#N/A	#N/A	13.55	110.59	21.86	123.39	110.59			7.358	51.08	8,100	3	17.03	92	97.03	
10.94	983,492	981,520	0.608	0.768	0.458	21.45	122.23	########	1,613,282	#N/A	#N/A	#N/A	13.05	109.87	21.05	122.23	109.87			7.358	49.46	8,100	3	16.49	93	96.82	
11.19	984,080	982,025	0.609	0.766	0.457	20.61	121.07	########	1,613,429	#N/A	#N/A	#N/A	12.55	109.14	20.24	121.07	109.14			7.358	47.84	8,100	3	15.95	94	96.60	
11.48	984,661	982,524	0.609	0.765	0.457	19.78	119.90	########	1,613,576	#N/A	#N/A	#N/A	12.04	108.42	19.43	119.90	108.42			7.358	46.22	8,100	3	15.41	95	96.38	
11.84	985,234	983,018	0.609	0.764	0.456	18.94	118.74	########	1,613,723	#N/A	#N/A	#N/A	11.54	107.70	18.62	118.74	107.70			7.358	44.60	8,100	3	14.87	96	96.16	
12.30	985,800	983,506	0.609	0.762	0.456	18.11	117.57	########	1,613,869	#N/A	#N/A	#N/A	11.04	106.98	17.81	117.57	106.98			7.358	42.98	8,100	3	14.33	97	95.94	
12.92	986,358	983,990	0.610	0.761	0.455	17.28	116.40	########	1,614,015	#N/A	#N/A	#N/A	10.54	106.26	17.01	116.40	106.26			7.358	41.37	8,100	3	13.79	98	95.73	
13.83	986,908	984,467	0.610	0.760	0.455	16.45	115.23	########	1,614,161	#N/A	#N/A	#N/A	10.04	105.54	16.20	115.23	105.54			7.358	39.76	8,100	3	13.25	99	95.51	
15.33	987,451	984,939	0.610	0.758	0.454	15.63	114.05	########	1,614,306	#N/A	#N/A	#N/A	9.53	104.82	15.39	114.05	104.82			7.358	38.14	8,100	3	12.71	99	95.29	
16.33	987,650	985,113	0.610	0.758	0.454	15.32	113.62	########	1,614,360	#N/A	#N/A	#N/A	9.35	104.56	15.09	113.62	104.56			7.358	37.54	8,100	3	12.51	99	95.21	
17.33	987,843	985,282	0.610	0.757	0.454	15.02	113.19	########	1,614,413	#N/A	#N/A	#N/A	9.17	104.30	14.80	113.19	104.30			7.358	36.96	8,100	3	12.32	99	95.13	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	
18.33	988,023	985,438	0.610	0.757	0.454	14.75	112.80	########	1,614,462	#N/A	#N/A	#N/A	9.00	104.06	14.53	112.80	104.06			7.358	36.42	8,100	3	12.14	99	95.05	


Shutdown Cooling Temperature Transient with 90F River Water
SDC Hx Fouling = 0.00418 hr-F-sqft/Btu, CCW Hx Fouling = 0.0015 hr-F-sqft/Btu
Second SDC HX Started at 225F Primary Coolant
Temperature, F
CCW Temperature, F
Time, hours
370
330
290
250
210
170
130
90
50
170
160
150
140
130
120
110
100
90
0
2
4
6
8
10
12
14
16
18
20
Pri Cool Temp
SDC Return Temp
CCW Temp

Shutdown Cooling Temperature Transient with 90F River Water **SDC**

Hx Fouling = 0.00418 hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu

	Initial RC Temperature, F				350											SDC HX	CCW HX
	Initial Time				2				2754		Shell Film Multiplier					0.09751	
	RCS Temperature after 8 hours				229.36						Shell Film Re power					0.61709	
	Time after trip to 130F Primary Coolant Temp				18.30		Initial CCW to SDCHx		1850		Shell Film Pr power					0.333	
	Time after SDC initiation to 130F PC Temp				16.3		CCW Flow Step Temp		275		Fouling (total = tube side)					0.00418	0.004
	Decary heat equilibrium at 90F river temp				0.00		2 HX Temp		225							0.00418	0.004
								SDCHx (per exchanger)									
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell					
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o		
2.00	0.1	54.966	19.5	-104.43	-29.97	-27.24	1	3000	315	350.00	274.34	1850	95	112.29	227.91		
2.10	0.10	54.107	19.5	-103.32	-29.72	-27.02	1	3000	315	347.28	272.48	1850	95	112.08	226.44		
2.20	0.10	53.300	19.5	-102.23	-29.43	-26.75	1	3000	315	344.57	270.65	1850	95	111.87	224.99		
2.30	0.10	52.540	19.5	-101.14	-29.10	-26.45	1	3000	315	341.90	268.83	1850	95	111.66	223.55		
2.40	0.10	51.822	19.5	-100.06	-28.74	-26.13	1	3000	315	339.25	267.02	1850	95	111.45	222.13		
2.50	0.10	51.143	19.5	-99.00	-28.35	-25.78	1	3000	315	336.64	265.24	1850	95	111.25	220.73		
2.60	0.10	50.500	19.5	-97.95	-27.95	-25.41	1	3000	315	334.06	263.48	1850	95	111.04	219.35		
2.70	0.10	49.888	19.5	-96.91	-27.52	-25.02	1	3000	315	331.52	261.75	1850	95	110.85	217.98		
2.80	0.10	49.305	19.5	-95.89	-27.09	-24.63	1	3000	315	329.02	260.04	1850	95	110.65	216.64		
2.90	0.10	48.749	19.5	-94.89	-26.64	-24.22	1	3000	315	326.56	258.36	1850	95	110.46	215.32		
3.00	0.10	48.218	19.5	-93.90	-26.18	-23.80	1	3000	315	324.14	256.70	1850	95	110.27	214.02		
3.10	0.10	47.710	19.5	-92.93	-25.72	-23.38	1	3000	315	321.76	255.07	1850	95	110.08	212.74		
3.20	0.10	47.223	19.5	-91.98	-25.26	-22.96	1	3000	315	319.42	253.47	1850	95	109.90	211.48		
3.30	0.10	46.756	19.5	-91.04	-24.79	-22.53	1	3000	315	317.12	251.89	1850	95	109.72	210.25		
3.40	0.10	46.307	19.5	-90.12	-24.32	-22.11	1	3000	315	314.87	250.35	1850	95	109.54	209.04		
3.50	0.10	45.876	19.5	-89.22	-23.85	-21.68	1	3000	315	312.66	248.83	1850	95	109.37	207.86		
3.60	0.10	45.460	19.5	-88.34	-23.38	-21.25	1	3000	315	310.49	247.34	1850	95	109.19	206.69		
3.70	0.10	45.059	19.5	-87.47	-22.91	-20.83	1	3000	315	308.36	245.88	1850	95	109.03	205.55		
3.80	0.10	44.673	19.5	-86.62	-22.45	-20.41	1	3000	315	306.28	244.44	1850	95	108.86	204.44		
3.90	0.10	44.300	19.5	-85.79	-21.99	-19.99	1	3000	315	304.24	243.04	1850	95	108.70	203.34		
4.00	0.10	43.939	19.5	-84.97	-21.54	-19.58	1	3000	315	302.24	241.66	1850	95	108.54	202.27		
4.10	0.10	43.582	19.5	-84.16	-21.08	-19.16	1	3000	315	300.24	240.28	1850	95	108.39	201.20		
4.21	0.11	43.230	19.5	-83.34	-20.61	-18.74	1	3000	315	298.24	238.90	1850	95	108.23	200.13		
4.31	0.11	42.881	19.5	-82.53	-20.15	-18.31	1	3000	315	296.24	237.52	1850	95	108.07	199.05		
4.42	0.11	42.536	19.5	-81.71	-19.67	-17.89	1	3000	315	294.24	236.14	1850	95	107.91	197.98		
4.53	0.11	42.194	19.5	-80.89	-19.20	-17.45	1	3000	315	292.24	234.76	1850	95	107.75	196.91		
4.65	0.12	41.856	19.5	-80.08	-18.72	-17.02	1	3000	315	290.24	233.38	1850	95	107.59	195.84		
4.77	0.12	41.519	19.5	-79.26	-18.24	-16.58	1	3000	315	288.24	232.00	1850	95	107.43	194.77		
4.89	0.12	41.186	19.5	-78.45	-17.76	-16.15	1	3000	315	286.24	230.61	1850	95	107.28	193.70		
5.01	0.13	40.854	19.5	-77.63	-17.28	-15.71	1	3000	315	284.24	229.23	1850	95	107.12	192.63		
5.14	0.13	40.524	19.5	-76.81	-16.79	-15.26	1	3000	315	282.24	227.84	1850	95	106.96	191.56		
5.27	0.13	40.196	19.5	-76.00	-16.30	-14.82	1	3000	315	280.24	226.45	1850	95	106.80	190.48		
5.40	0.14	39.869	19.5	-75.18	-15.81	-14.38	1	3000	315	278.24	225.07	1850	95	106.64	189.41		
5.54	0.14	39.543	19.5	-74.37	-15.32	-13.93	1	3000	315	276.24	223.68	1850	95	106.48	188.34		
5.69	0.10	39.217	19.5	-90.26	-31.54	-28.67	1	3000	315	274.24	210.41	4246	95	109.56	152.69		
5.79	0.10	38.997	19.5	-88.82	-30.32	-27.57	1	3000	315	271.37	208.62	4246	95	109.29	151.72		
5.89	0.10	38.782	19.5	-87.44	-29.16	-26.51	1	3000	315	268.62	206.89	4246	95	109.02	150.79		
5.99	0.10	38.571	19.5	-86.11	-28.04	-25.49	1	3000	315	265.97	205.24	4246	95	108.76	149.89		
6.09	0.10	38.365	19.5	-84.83	-26.97	-24.52	1	3000	315	263.42	203.64	4246	95	108.52	149.03		
6.19	0.10	38.164	19.5	-83.60	-25.94	-23.58	1	3000	315	260.97	202.10	4246	95	108.28	148.20		
6.29	0.10	37.967	19.5	-82.42	-24.96	-22.69	1	3000	315	258.61	200.62	4246	95	108.05	147.40		
6.39	0.10	37.774	19.5	-81.29	-24.01	-21.83	1	3000	315	256.34	199.20	4246	95	107.83	146.63		
6.49	0.10	37.585	19.5	-80.19	-23.11	-21.01	1	3000	315	254.16	197.83	4246	95	107.62	145.90		
6.59	0.10	37.399	19.5	-79.14	-22.24	-20.22	1	3000	315	252.05	196.50	4246	95	107.41	145.19		
6.69	0.10	37.218	19.5	-78.13	-21.41	-19.46	1	3000	315	250.03	195.23	4246	95	107.21	144.50		
6.79	0.11	37.035	19.5	-77.13	-20.59	-18.72	1	3000	315	248.03	193.97	4246	95	107.02	143.82		
6.90	0.11	36.849	19.5	-76.13	-19.78	-17.98	1	3000	315	246.03	192.71	4246	95	106.82	143.15		
7.01	0.12	36.659	19.5	-75.12	-18.97	-17.24	1	3000	315	244.03	191.44	4246	95	106.63	142.47		
7.12	0.12	36.465	19.5	-74.12	-18.16	-16.51	1	3000	315	242.03	190.18	4246	95	106.43	141.80		
7.24	0.13	36.267	19.5	-73.12	-17.36	-15.78	1	3000	315	240.03	188.91	4246	95	106.24	141.12		
7.37	0.13	36.064	19.5	-72.12	-16.56	-15.05	1	3000	315	238.03	187.65	4246	95	106.04	140.44		
7.50	0.14	35.856	19.5	-71.12	-15.76	-14.33	1	3000	315	236.03	186.38	4246	95	105.85	139.77		

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
2.00	312.17	55.59	1.0319	1.18E-04	0.395	5.609	143,945	1.1066	2331	170.10	60.78	1.0014	2.49E-04	0.384	1.591	83,939	2.3344	869	9.551	159.16
2.10	309.88	55.69	1.0310	1.19E-04	0.395	5.609	142,918	1.1152	2325	169.26	60.80	1.0014	2.50E-04	0.384	1.591	83,463	2.3494	867	9.542	159.06
2.20	307.61	55.78	1.0302	1.20E-04	0.395	5.609	141,893	1.1239	2320	168.43	60.82	1.0013	2.52E-04	0.384	1.591	82,991	2.3645	865	9.533	158.97
2.30	305.36	55.88	1.0294	1.21E-04	0.395	5.609	140,872	1.1327	2315	167.61	60.84	1.0012	2.53E-04	0.384	1.591	82,524	2.3795	864	9.525	158.87
2.40	303.14	55.97	1.0286	1.22E-04	0.396	5.609	139,857	1.1416	2309	166.79	60.85	1.0012	2.55E-04	0.383	1.591	82,062	2.3946	862	9.516	158.78
2.50	300.94	56.06	1.0278	1.23E-04	0.396	5.609	138,849	1.1506	2304	165.99	60.87	1.0011	2.56E-04	0.383	1.591	81,607	2.4096	860	9.507	158.69
2.60	298.77	56.15	1.0270	1.24E-04	0.396	5.609	137,849	1.1597	2298	165.20	60.89	1.0010	2.58E-04	0.383	1.591	81,158	2.4246	859	9.498	158.59
2.70	296.64	56.24	1.0263	1.25E-04	0.396	5.609	136,858	1.1688	2293	164.41	60.90	1.0009	2.59E-04	0.383	1.591	80,717	2.4396	857	9.490	158.50
2.80	294.53	56.33	1.0256	1.26E-04	0.396	5.609	135,877	1.1780	2287	163.65	60.92	1.0009	2.61E-04	0.383	1.591	80,282	2.4545	856	9.481	158.40
2.90	292.46	56.41	1.0249	1.27E-04	0.396	5.609	134,908	1.1873	2282	162.89	60.93	1.0008	2.62E-04	0.382	1.591	79,855	2.4693	854	9.472	158.31
3.00	290.42	56.50	1.0243	1.29E-04	0.396	5.609	133,950	1.1966	2276	162.14	60.95	1.0008	2.64E-04	0.382	1.591	79,435	2.4840	853	9.464	158.22
3.10	288.41	56.58	1.0236	1.30E-04	0.396	5.609	133,004	1.2059	2270	161.41	60.96	1.0007	2.65E-04	0.382	1.591	79,023	2.4986	851	9.456	158.13
3.20	286.44	56.66	1.0230	1.31E-04	0.396	5.609	132,072	1.2152	2265	160.69	60.98	1.0006	2.66E-04	0.382	1.591	78,618	2.5131	850	9.448	158.04
3.30	284.51	56.73	1.0224	1.32E-04	0.396	5.609	131,152	1.2246	2259	159.98	60.99	1.0006	2.68E-04	0.382	1.591	78,222	2.5274	848	9.439	157.94
3.40	282.61	56.81	1.0218	1.33E-04	0.396	5.609	130,246	1.2340	2254	159.29	61.01	1.0005	2.69E-04	0.382	1.591	77,833	2.5417	847	9.431	157.86
3.50	280.74	56.88	1.0212	1.34E-04	0.396	5.609	129,355	1.2433	2248	158.61	61.02	1.0005	2.71E-04	0.381	1.591	77,452	2.5558	846	9.424	157.77
3.60	278.91	56.96	1.0207	1.35E-04	0.396	5.609	128,477	1.2527	2243	157.94	61.03	1.0004	2.72E-04	0.381	1.591	77,078	2.5698	844	9.416	157.68
3.70	277.12	57.03	1.0202	1.36E-04	0.396	5.609	127,614	1.2620	2238	157.29	61.05	1.0004	2.73E-04	0.381	1.591	76,712	2.5836	843	9.408	157.59
3.80	275.36	57.09	1.0197	1.37E-04	0.396	5.609	126,765	1.2714	2232	156.65	61.06	1.0003	2.75E-04	0.381	1.591	76,354	2.5972	842	9.401	157.51
3.90	273.64	57.16	1.0192	1.38E-04	0.396	5.609	125,931	1.2807	2227	156.02	61.07	1.0003	2.76E-04	0.381	1.591	76,004	2.6107	840	9.393	157.42
4.00	271.95	57.22	1.0187	1.39E-04	0.396	5.609	125,112	1.2900	2222	155.41	61.08	1.0002	2.77E-04	0.381	1.591	75,661	2.6241	839	9.386	157.34
4.10	270.26	57.29	1.0182	1.40E-04	0.396	5.609	124,290	1.2994	2216	154.79	61.10	1.0002	2.79E-04	0.380	1.591	75,318	2.6376	838	9.379	157.25
4.21	268.57	57.35	1.0178	1.42E-04	0.396	5.609	123,466	1.3090	2211	154.18	61.11	1.0001	2.80E-04	0.380	1.591	74,976	2.6512	836	9.372	157.17
4.31	266.88	57.42	1.0173	1.43E-04	0.396	5.609	122,640	1.3188	2206	153.56	61.12	1.0001	2.81E-04	0.380	1.591	74,634	2.6649	835	9.365	157.08
4.42	265.19	57.48	1.0169	1.44E-04	0.396	5.609	121,811	1.3288	2200	152.95	61.13	1.0000	2.83E-04	0.380	1.591	74,292	2.6787	834	9.357	156.99
4.53	263.50	57.54	1.0164	1.45E-04	0.396	5.609	120,981	1.3389	2195	152.33	61.14	1.0000	2.84E-04	0.380	1.591	73,951	2.6926	833	9.350	156.91
4.65	261.81	57.61	1.0160	1.46E-04	0.396	5.609	120,149	1.3493	2189	151.72	61.16	1.0000	2.85E-04	0.380	1.591	73,610	2.7067	831	9.343	156.82
4.77	260.12	57.67	1.0156	1.47E-04	0.396	5.609	119,315	1.3598	2183	151.10	61.17	0.9999	2.87E-04	0.379	1.591	73,270	2.7209	830	9.336	156.73
4.89	258.43	57.73	1.0151	1.48E-04	0.396	5.609	118,479	1.3705	2178	150.49	61.18	0.9999	2.88E-04	0.379	1.591	72,930	2.7352	829	9.328	156.64
5.01	256.73	57.79	1.0147	1.50E-04	0.396	5.609	117,641	1.3813	2172	149.87	61.19	0.9998	2.90E-04	0.379	1.591	72,590	2.7497	827	9.321	156.55
5.14	255.04	57.85	1.0143	1.51E-04	0.396	5.609	116,801	1.3924	2166	149.26	61.20	0.9998	2.91E-04	0.379	1.591	72,251	2.7643	826	9.314	156.46
5.27	253.35	57.92	1.0139	1.52E-04	0.396	5.609	115,960	1.4037	2160	148.64	61.22	0.9997	2.92E-04	0.379	1.591	71,912	2.7790	825	9.306	156.37
5.40	251.65	57.98	1.0135	1.53E-04	0.396	5.609	115,118	1.4152	2154	148.03	61.23	0.9997	2.94E-04	0.379	1.591	71,574	2.7938	823	9.299	156.27
5.54	249.96	58.04	1.0131	1.55E-04	0.396	5.609	114,273	1.4269	2148	147.41	61.24	0.9997	2.95E-04	0.378	1.591	71,235	2.8088	822	9.292	156.18
5.69	242.32	58.10	1.0114	1.61E-04	0.395	5.609	110,057	1.4823	2114	131.13	61.53	0.9987	3.39E-04	0.373	3.652	143,272	3.2604	1312	9.220	167.76
5.79	239.99	58.18	1.0109	1.63E-04	0.395	5.609	108,902	1.5002	2105	130.50	61.54	0.9987	3.40E-04	0.373	3.652	142,511	3.2801	1310	9.211	167.65
5.89	237.76	58.27	1.0104	1.65E-04	0.395	5.609	107,789	1.5177	2097	129.90	61.55	0.9987	3.42E-04	0.373	3.652	141,781	3.2992	1308	9.203	167.54
5.99	235.60	58.34	1.0100	1.67E-04	0.395	5.609	106,717	1.5350	2089	129.33	61.56	0.9986	3.44E-04	0.373	3.652	141,079	3.3178	1305	9.195	167.43
6.09	233.53	58.42	1.0096	1.68E-04	0.394	5.609	105,684	1.5521	2081	128.77	61.57	0.9986	3.46E-04	0.373	3.652	140,405	3.3358	1303	9.187	167.32
6.19	231.53	58.49	1.0092	1.70E-04	0.394	5.609	104,688	1.5688	2073	128.24	61.58	0.9986	3.47E-04	0.372	3.652	139,757	3.3532	1301	9.179	167.22
6.29	229.62	58.56	1.0088	1.72E-04	0.394	5.609	103,730	1.5853	2066	127.73	61.59	0.9986	3.49E-04	0.372	3.652	139,134	3.3702	1299	9.172	167.12
6.39	227.77	58.62	1.0085	1.74E-04	0.394	5.609	102,806	1.6015	2058	127.23	61.60	0.9985	3.51E-04	0.372	3.652	138,536	3.3866	1297	9.165	167.02
6.49	225.99	58.69	1.0082	1.75E-04	0.394	5.609	101,916	1.6174	2051	126.76	61.60	0.9985	3.52E-04	0.372	3.652	137,961	3.4026	1295	9.158	166.93
6.59	224.28	58.75	1.0079	1.77E-04	0.394	5.609	101,059	1.6330	2044	126.30	61.61	0.9985	3.53E-04	0.372	3.652	137,408	3.4180	1294	9.152	166.84
6.69	222.63	58.80	1.0076	1.79E-04	0.393	5.609	100,233	1.6484	2038	125.86	61.62	0.9985	3.55E-04	0.372	3.652	136,877	3.4330	1292	9.145	166.75
6.79	221.00	58.86	1.0073	1.80E-04	0.393	5.609	99,415	1.6638	2031	125.42	61.63	0.9985	3.56E-04	0.371	3.652	136,352	3.4480	1290	9.139	166.66
6.90	219.37	58.91	1.0070	1.82E-04	0.393	5.609	98,597	1.6795	2024	124.99	61.63	0.9984	3.58E-04	0.371	3.652	135,827	3.4630	1288	9.133	166.57
7.01	217.74	58.97	1.0067	1.84E-04	0.393	5.609	97,778	1.6956	2017	124.55	61.64	0.9984	3.59E-04	0.371	3.652	135,302	3.4782	1287	9.127	166.48
7.12	216.11	59.02	1.0065	1.86E-04	0.393	5.609	96,958	1.7119	2011	124.11	61.65	0.9984	3.61E-04	0.371	3.652	134,779	3.4935	1285	9.121	166.38
7.24	214.47	59.08	1.0062	1.87E-04	0.392	5.609	96,138	1.7285	2004	123.68	61.65	0.9984	3.62E-04	0.371	3.652	134,255	3.5089	1283	9.114	166.29
7.37	212.84	59.13	1.0059	1.89E-04	0.392	5.609	95,317	1.7455	1997	123.24	61.66	0.9984	3.63E-04	0.371	3.652	133,732	3.5244	1281	9.108	166.20
7.50	211.21	59.19	1.0057	1.91E-04	0.392	5.609	94,496	1.7628	1990	122.81	61.67	0.9983	3.65E-04	0.371	3.652	133,210	3.5400	1280	9.102	166.10

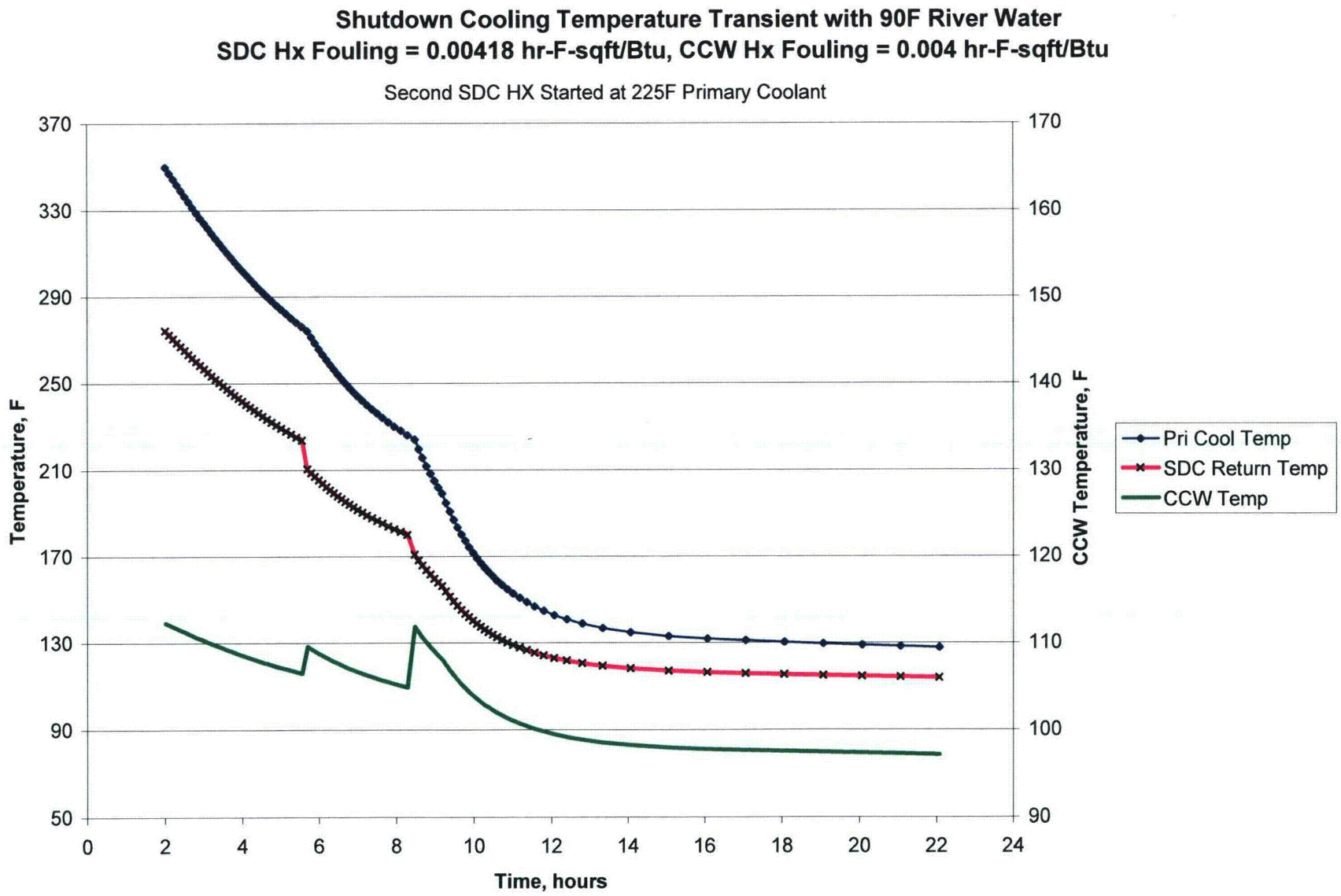
CCW HX Fouling 0.004

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
2.00	1,337,560	1,380,222	#N/A	#N/A	#N/A	75.66	274.34	901,948	903,255	0.654	0.885	0.486	115.62	227.91	104.43	274.34	227.91	7.358	111.79	8,100	3	37.26	12	112.29
2.10	1,339,934	1,381,514	#N/A	#N/A	#N/A	74.79	272.48	902,211	903,449	0.654	0.884	0.486	114.37	226.44	103.32	272.48	226.44	7.358	110.68	8,100	3	36.89	13	112.08
2.20	1,342,272	1,382,795	#N/A	#N/A	#N/A	73.93	270.65	902,471	903,642	0.653	0.883	0.486	113.13	224.99	102.23	270.65	224.99	7.358	109.58	8,100	3	36.53	14	111.87
2.30	1,344,572	1,384,062	#N/A	#N/A	#N/A	73.07	268.83	902,727	903,832	0.653	0.882	0.486	111.90	223.55	101.14	268.83	223.55	7.358	108.50	8,100	3	36.17	15	111.66
2.40	1,346,831	1,385,314	#N/A	#N/A	#N/A	72.23	267.02	902,980	904,020	0.653	0.882	0.486	110.68	222.13	100.06	267.02	222.13	7.358	107.42	8,100	3	35.81	16	111.45
2.50	1,349,049	1,386,549	#N/A	#N/A	#N/A	71.40	265.24	903,228	904,205	0.652	0.881	0.486	109.48	220.73	99.00	265.24	220.73	7.358	106.35	8,100	3	35.45	17	111.25
2.60	1,351,223	1,387,766	#N/A	#N/A	#N/A	70.58	263.48	903,472	904,388	0.652	0.880	0.486	108.30	219.35	97.95	263.48	219.35	7.358	105.31	8,100	3	35.10	18	111.04
2.70	1,353,353	1,388,965	#N/A	#N/A	#N/A	69.77	261.75	903,712	904,567	0.651	0.880	0.485	107.14	217.98	96.91	261.75	217.98	7.358	104.27	8,100	3	34.76	19	110.85
2.80	1,355,437	1,390,144	#N/A	#N/A	#N/A	68.98	260.04	903,948	904,744	0.651	0.879	0.485	105.99	216.64	95.89	260.04	216.64	7.358	103.25	8,100	3	34.42	20	110.65
2.90	1,357,477	1,391,304	#N/A	#N/A	#N/A	68.20	258.36	904,178	904,918	0.650	0.878	0.485	104.86	215.32	94.89	258.36	215.32	7.358	102.25	8,100	3	34.08	21	110.46
3.00	1,359,470	1,392,444	#N/A	#N/A	#N/A	67.44	256.70	904,404	905,088	0.650	0.878	0.485	103.75	214.02	93.90	256.70	214.02	7.358	101.26	8,100	3	33.75	22	110.27
3.10	1,361,418	1,393,563	#N/A	#N/A	#N/A	66.69	255.07	904,626	905,255	0.650	0.877	0.485	102.66	212.74	92.93	255.07	212.74	7.358	100.29	8,100	3	33.43	23	110.08
3.20	1,363,320	1,394,662	#N/A	#N/A	#N/A	65.95	253.47	904,843	905,420	0.649	0.876	0.485	101.59	211.48	91.98	253.47	211.48	7.358	99.34	8,100	3	33.11	24	109.90
3.30	1,365,178	1,395,740	#N/A	#N/A	#N/A	65.23	251.89	905,055	905,580	0.649	0.876	0.485	100.54	210.25	91.04	251.89	210.25	7.358	98.40	8,100	3	32.80	25	109.72
3.40	1,366,991	1,396,798	#N/A	#N/A	#N/A	64.52	250.35	905,262	905,738	0.648	0.875	0.485	99.50	209.04	90.12	250.35	209.04	7.358	97.48	8,100	3	32.49	26	109.54
3.50	1,368,759	1,397,834	#N/A	#N/A	#N/A	63.83	248.83	905,465	905,893	0.648	0.874	0.484	98.49	207.86	89.22	248.83	207.86	7.358	96.58	8,100	3	32.19	27	109.37
3.60	1,370,484	1,398,850	#N/A	#N/A	#N/A	63.15	247.34	905,663	906,044	0.648	0.874	0.484	97.50	206.69	88.34	247.34	206.69	7.358	95.70	8,100	3	31.90	28	109.19
3.70	1,372,166	1,399,845	#N/A	#N/A	#N/A	62.49	245.88	905,856	906,192	0.647	0.873	0.484	96.53	205.55	87.47	245.88	205.55	7.358	94.83	8,100	3	31.61	29	109.03
3.80	1,373,806	1,400,820	#N/A	#N/A	#N/A	61.84	244.44	906,045	906,336	0.647	0.872	0.484	95.57	204.44	86.62	244.44	204.44	7.358	93.98	8,100	3	31.33	30	108.86
3.90	1,375,405	1,401,774	#N/A	#N/A	#N/A	61.20	243.04	906,230	906,478	0.647	0.872	0.484	94.64	203.34	85.79	243.04	203.34	7.358	93.15	8,100	3	31.05	31	108.70
4.00	1,376,964	1,402,709	#N/A	#N/A	#N/A	60.58	241.66	906,410	906,617	0.646	0.871	0.484	93.73	202.27	84.97	241.66	202.27	7.358	92.33	8,100	3	30.78	32	108.54
4.10	1,378,515	1,403,643	#N/A	#N/A	#N/A	59.96	240.28	906,590	906,755	0.646	0.871	0.484	92.81	201.20	84.16	240.28	201.20	7.358	91.52	8,100	3	30.51	33	108.39
4.21	1,380,058	1,404,577	#N/A	#N/A	#N/A	59.34	238.90	906,769	906,893	0.646	0.870	0.484	91.90	200.13	83.34	238.90	200.13	7.358	90.70	8,100	3	30.23	34	108.23
4.31	1,381,593	1,405,510	#N/A	#N/A	#N/A	58.72	237.52	906,947	907,031	0.645	0.869	0.484	90.99	199.05	82.53	237.52	199.05	7.358	89.88	8,100	3	29.96	35	108.07
4.42	1,383,121	1,406,443	#N/A	#N/A	#N/A	58.10	236.14	907,125	907,168	0.645	0.869	0.483	90.07	197.98	81.71	236.14	197.98	7.358	89.07	8,100	3	29.69	36	107.91
4.53	1,384,641	1,407,375	#N/A	#N/A	#N/A	57.48	234.76	907,302	907,306	0.645	0.868	0.483	89.16	196.91	80.89	234.76	196.91	7.358	88.25	8,100	3	29.42	37	107.75
4.65	1,386,153	1,408,307	#N/A	#N/A	#N/A	56.86	233.38	907,479	907,443	0.644	0.868	0.483	88.25	195.84	80.08	233.38	195.84	7.358	87.44	8,100	3	29.15	38	107.59
4.77	1,387,658	1,409,238	#N/A	#N/A	#N/A	56.24	232.00	907,655	907,579	0.644	0.867	0.483	87.33	194.77	79.26	232.00	194.77	7.358	86.62	8,100	3	28.87	39	107.43
4.89	1,389,154	1,410,169	#N/A	#N/A	#N/A	55.63	230.61	907,830	907,716	0.644	0.866	0.483	86.42	193.70	78.45	230.61	193.70	7.358	85.80	8,100	3	28.60	40	107.28
5.01	1,390,643	1,411,099	#N/A	#N/A	#N/A	55.01	229.23	908,005	907,852	0.643	0.866	0.483	85.51	192.63	77.63	229.23	192.63	7.358	84.99	8,100	3	28.33	41	107.12
5.14	1,392,125	1,412,029	#N/A	#N/A	#N/A	54.40	227.84	908,179	907,988	0.643	0.865	0.483	84.60	191.56	76.81	227.84	191.56	7.358	84.17	8,100	3	28.06	42	106.96
5.27	1,393,599	1,412,958	#N/A	#N/A	#N/A	53.79	226.45	908,353	908,124	0.643	0.864	0.483	83.69	190.48	76.00	226.45	190.48	7.358	83.36	8,100	3	27.79	43	106.80
5.40	1,395,065	1,413,887	#N/A	#N/A	#N/A	53.17	225.07	908,526	908,259	0.642	0.864	0.482	82.78	189.41	75.18	225.07	189.41	7.358	82.54	8,100	3	27.51	44	106.64
5.54	1,396,523	1,414,815	#N/A	#N/A	#N/A	52.56	223.68	908,698	908,394	0.642	0.863	0.482	81.86	188.34	74.37	223.68	188.34	7.358	81.72	8,100	3	27.24	45	106.48
5.69	1,397,974	1,413,909	0.676	0.596	0.388	63.83	210.41	########	2,092,848	#N/A	#N/A	#N/A	43.13	152.69	90.26	210.41	152.69	7.358	97.61	8,100	3	32.54	46	109.56
5.79	1,400,041	1,415,307	0.676	0.595	0.387	62.76	208.62	########	2,093,142	#N/A	#N/A	#N/A	42.43	151.72	88.82	208.62	151.72	7.358	96.18	8,100	3	32.06	47	109.29
5.89	1,402,013	1,416,648	0.677	0.594	0.387	61.72	206.89	########	2,093,425	#N/A	#N/A	#N/A	41.77	150.79	87.44	206.89	150.79	7.358	94.80	8,100	3	31.60	48	109.02
5.99	1,403,895	1,417,936	0.677	0.593	0.386	60.73	205.24	########	2,093,695	#N/A	#N/A	#N/A	41.13	149.89	86.11	205.24	149.89	7.358	93.47	8,100	3	31.16	49	108.76
6.09	1,405,693	1,419,172	0.678	0.592	0.386	59.78	203.64	########	2,093,955	#N/A	#N/A	#N/A	40.51	149.03	84.83	203.64	149.03	7.358	92.19	8,100	3	30.73	50	108.52
6.19	1,407,410	1,420,359	0.678	0.591	0.386	58.86	202.10	########	2,094,204	#N/A	#N/A	#N/A	39.92	148.20	83.60	202.10	148.20	7.358	90.96	8,100	3	30.32	51	108.28
6.29	1,409,051	1,421,498	0.679	0.590	0.385	57.98	200.62	########	2,094,443	#N/A	#N/A	#N/A	39.35	147.40	82.42	200.62	147.40	7.358	89.78	8,100	3	29.93	52	108.05
6.39	1,410,619	1,422,592	0.679	0.589	0.385	57.14	199.20	########	2,094,672	#N/A	#N/A	#N/A	38.81	146.63	81.29	199.20	146.63	7.358	88.64	8,100	3	29.55	53	107.83
6.49	1,412,119	1,423,644	0.680	0.589	0.384	56.33	197.83	########	2,094,892	#N/A	#N/A	#N/A	38.28	145.90	80.19	197.83	145.90	7.358	87.55	8,100	3	29.18	54	107.62
6.59	1,413,554	1,424,654	0.680	0.588	0.384	55.55	196.50	########	2,095,104	#N/A	#N/A	#N/A	37.77	145.19	79.14	196.50	145.19	7.358	86.50	8,100	3	28.83	55	107.41
6.69	1,414,927	1,425,624	0.680	0.587	0.384	54.80	195.23	########	2,095,307	#N/A	#N/A	#N/A	37.29	144.50	78.13	195.23	144.50	7.358	85.49	8,100	3	28.50	56	107.21
6.79	1,416,278	1,426,582	0.681	0.586	0.383	54.06	193.97	########	2,095,507	#N/A	#N/A	#N/A	36.81	143.82	77.13	193.97	143.82	7.358	84.48	8,100	3	28.16	57	107.02
6.90	1,417,620	1,427,539	0.681	0.586	0.383	53.33	192.71	########	2,095,707	#N/A	#N/A	#N/A	36.32	143.15	76.13	192.71	143.15	7.358	83.48	8,100	3	27.83	58	106.82
7.01	1,418,955	1,428,494	0.682	0.585	0.383	52.59	191.44	########	2,095,907	#N/A	#N/A	#N/A	35.84	142.47	75.12	191.44	142.47	7.358	82.48	8,100	3	27.49	59	106.63
7.12	1,420,282	1,429,447	0.682	0.584	0.382	51.85	190.18	########	2,096,106	#N/A	#N/A	#N/A	35.36	141.80	74.12	190.18	141.80	7.358	81.48	8,100	3	27.16	60	106.43
7.24	1,421,602	1,430,398	0.682	0.584	0.382	51.12	188.91	########	2,096,305	#N/A	#N/A	#N/A	34.88	141.12	73.12	188.91	141.12	7.358	80.48	8,100	3	26.83	61	106.24
7.37	1,422,913	1,431,348	0.683	0.583	0.382	50.39	187.65	########	2,096,504	#N/A	#N/A	#N/A	34.40	140.44	72.12	187.65	140.44	7.358	79.48	8,100	3	26.49	62	106.04
7.50	1,424,217	1,432,296	0.683	0.582	0.381	49.65	186.38	########	2,096,702	#N/A	#N/A	#N/A	33.92	139.77	71.12	186.38	139.77	7.358	78.48	8,100	3	26.16	63	105.85

								SDCHx (per exchanger)							
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell			
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
7.64	0.15	35.644	19.5	-70.12	-14.98	-13.61	1	3000	315	234.03	185.11	4246	95	105.65	139.09
7.79	0.15	35.425	19.5	-69.12	-14.19	-12.90	1	3000	315	232.03	183.84	4246	95	105.45	138.41
7.95	0.16	35.200	19.5	-68.12	-13.42	-12.20	1	3000	315	230.03	182.57	4246	95	105.26	137.74
8.11	0.17	34.969	19.5	-67.12	-12.65	-11.50	1	3000	315	228.03	181.29	4246	95	105.06	137.06
8.28	0.19	34.730	19.5	-66.12	-11.89	-10.81	1	3000	315	226.03	180.02	4246	95	104.87	136.39
8.47	0.10	34.483	19.5	-51.09	-48.19	-43.81	2	2000	315	224.03	170.71	3254	95	111.86	143.68
8.57	0.10	34.352	19.5	-49.37	-44.89	-40.81	2	2000	315	219.65	168.19	3254	95	111.20	141.95
8.67	0.10	34.224	19.5	-47.78	-41.83	-38.03	2	2000	315	215.57	165.84	3254	95	110.58	140.33
8.77	0.10	34.097	19.5	-46.29	-38.98	-35.44	2	2000	315	211.77	163.65	3254	95	110.01	138.83
8.87	0.10	33.973	19.5	-44.90	-36.33	-33.03	2	2000	315	208.22	161.60	3254	95	109.48	137.43
8.97	0.10	33.850	19.5	-43.61	-33.87	-30.79	2	2000	315	204.92	159.69	3254	95	108.98	136.12
9.07	0.10	33.729	19.5	-42.41	-31.59	-28.72	2	2000	315	201.84	157.90	3254	95	108.51	134.90
9.17	0.10	33.610	1.5	-41.29	-47.46	-43.15	2	2000	315	198.97	156.23	3254	95	108.08	133.76
9.27	0.10	33.492	1.5	-39.60	-44.21	-40.19	2	2000	315	194.66	153.71	3254	95	107.42	132.05
9.37	0.10	33.376	1.5	-38.03	-41.19	-37.44	2	2000	315	190.64	151.37	3254	95	106.81	130.46
9.47	0.10	33.262	1.5	-36.57	-38.38	-34.89	2	2000	315	186.89	149.17	3254	95	106.24	128.98
9.57	0.10	33.149	1.5	-35.21	-35.78	-32.52	2	2000	315	183.40	147.12	3254	95	105.71	127.59
9.67	0.10	33.038	1.5	-33.95	-33.35	-30.32	2	2000	315	180.15	145.21	3254	95	105.21	126.31
9.77	0.10	32.928	1.5	-32.77	-31.10	-28.28	2	2000	315	177.12	143.42	3254	95	104.75	125.11
9.87	0.10	32.820	1.5	-31.67	-29.01	-26.37	2	2000	315	174.29	141.76	3254	95	104.32	123.99
9.97	0.10	32.713	1.5	-30.64	-27.07	-24.61	2	2000	315	171.65	140.20	3254	95	103.91	122.94
10.07	0.10	32.608	1.5	-29.68	-25.26	-22.96	2	2000	315	169.19	138.74	3254	95	103.54	121.97
10.17	0.10	32.504	1.5	-28.79	-23.58	-21.44	2	2000	315	166.90	137.38	3254	95	103.18	121.06
10.27	0.10	32.402	1.5	-27.96	-22.02	-20.02	2	2000	315	164.75	136.10	3254	95	102.85	120.21
10.37	0.11	32.300	1.5	-27.19	-20.57	-18.70	2	2000	315	162.75	134.91	3254	95	102.55	119.42
10.48	0.12	32.193	1.5	-26.41	-19.13	-17.39	2	2000	315	160.75	133.72	3254	95	102.24	118.63
10.59	0.12	32.080	1.5	-25.64	-17.69	-16.08	2	2000	315	158.75	132.53	3254	95	101.93	117.84
10.72	0.14	31.959	1.5	-24.86	-16.26	-14.78	2	2000	315	156.75	131.33	3254	95	101.62	117.05
10.85	0.15	31.830	1.5	-24.09	-14.85	-13.50	2	2000	315	154.75	130.14	3254	95	101.32	116.26
11.00	0.16	31.691	1.5	-23.31	-13.44	-12.22	2	2000	315	152.75	128.94	3254	95	101.01	115.47
11.16	0.18	31.540	1.5	-22.54	-12.04	-10.95	2	2000	315	150.75	127.74	3254	95	100.70	114.68
11.35	0.21	31.375	1.5	-21.77	-10.66	-9.70	2	2000	315	148.75	126.54	3254	95	100.39	113.89
11.55	0.24	31.193	1.5	-21.00	-9.30	-8.46	2	2000	315	146.75	125.34	3254	95	100.08	113.11
11.79	0.28	30.989	1.5	-20.23	-7.97	-7.24	2	2000	315	144.75	124.14	3254	95	99.77	112.32
12.06	0.33	30.758	1.5	-19.46	-6.66	-6.05	2	2000	315	142.75	122.93	3254	95	99.46	111.53
12.39	0.41	30.491	1.5	-18.69	-5.38	-4.89	2	2000	315	140.75	121.73	3254	95	99.16	110.74
12.80	0.53	30.173	1.5	-17.92	-4.16	-3.79	2	2000	315	138.75	120.52	3254	95	98.85	109.95
13.33	0.73	29.781	1.5	-17.15	-3.02	-2.74	2	2000	315	136.75	119.31	3254	95	98.54	109.17
14.06	1.00	29.274	1.5	-16.38	-1.99	-1.81	2	2000	315	134.75	118.10	3254	95	98.23	108.38
15.06	1.00	28.631	1.5	-15.69	-1.25	-1.13	2	2000	315	132.94	117.00	3254	95	97.95	107.67
16.06	1.00	28.042	1.5	-15.25	-0.97	-0.88	2	2000	315	131.81	116.31	3254	95	97.77	107.23
17.06	1.00	27.501	1.5	-14.92	-0.84	-0.76	2	2000	315	130.93	115.78	3254	95	97.64	106.88
18.06	1.00	26.999	1.5	-14.63	-0.76	-0.69	2	2000	315	130.17	115.32	3254	95	97.52	106.58
19.06	1.00	26.533	1.5	-14.36	-0.70	-0.63	2	2000	315	129.48	114.90	3254	95	97.41	106.31
20.06	1.00	26.098	1.5	-14.12	-0.65	-0.59	2	2000	315	128.85	114.52	3254	95	97.31	106.07
21.06	1.00	25.691	1.5	-13.90	-0.60	-0.55	2	2000	315	128.27	114.16	3254	95	97.22	105.83
22.06	0.00	25.309	1.5	-13.69	-0.57	-0.51	2	2000	315	127.72	113.83	3254	95	97.14	105.62
22.06	0.00	25.309	1.5	-13.69	-0.57	-0.51	2	2000	315	127.72	113.83	3254	95	97.14	105.62
22.06	0.00	25.309	1.5	-13.69	-0.57	-0.51	2	2000	315	127.72	113.83	3254	95	97.14	105.62
22.06	0.00	25.309	1.5	-13.69	-0.57	-0.51	2	2000	315	127.72	113.83	3254	95	97.14	105.62

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
7.64	209.57	59.24	1.0054	1.93E-04	0.392	5.609	93,675	1.7804	1983	122.37	61.67	0.9983	3.66E-04	0.370	3.652	132,688	3.5557	1278	9.096	166.01
7.79	207.94	59.30	1.0052	1.95E-04	0.392	5.609	92,854	1.7984	1975	121.93	61.68	0.9983	3.68E-04	0.370	3.652	132,167	3.5715	1276	9.090	165.91
7.95	206.30	59.35	1.0049	1.97E-04	0.391	5.609	92,032	1.8168	1968	121.50	61.69	0.9983	3.69E-04	0.370	3.652	131,647	3.5875	1274	9.083	165.81
8.11	204.66	59.40	1.0047	1.98E-04	0.391	5.609	91,210	1.8355	1961	121.06	61.70	0.9983	3.71E-04	0.370	3.652	131,127	3.6036	1273	9.077	165.72
8.28	203.03	59.45	1.0045	2.00E-04	0.391	5.609	90,388	1.8545	1954	120.63	61.70	0.9982	3.72E-04	0.370	3.652	130,607	3.6198	1271	9.071	165.62
8.47	197.37	59.51	1.0037	2.08E-04	0.390	3.739	58,242	1.9233	1391	127.77	61.59	0.9986	3.49E-04	0.372	2.799	106,670	3.3687	1103	9.075	156.35
8.57	193.92	59.62	1.0033	2.12E-04	0.389	3.739	57,098	1.9676	1380	126.57	61.61	0.9985	3.53E-04	0.372	2.799	105,561	3.4087	1099	9.061	156.09
8.67	190.71	59.72	1.0029	2.17E-04	0.389	3.739	56,033	2.0107	1369	125.46	61.63	0.9985	3.56E-04	0.371	2.799	104,531	3.4467	1095	9.049	155.83
8.77	187.71	59.82	1.0025	2.21E-04	0.388	3.739	55,040	2.0524	1359	124.42	61.64	0.9984	3.60E-04	0.371	2.799	103,572	3.4827	1091	9.036	155.59
8.87	184.91	59.91	1.0022	2.25E-04	0.388	3.739	54,116	2.0927	1349	123.45	61.66	0.9984	3.63E-04	0.371	2.799	102,681	3.5169	1088	9.025	155.37
8.97	182.30	59.99	1.0019	2.29E-04	0.387	3.739	53,255	2.1316	1340	122.55	61.67	0.9983	3.66E-04	0.370	2.799	101,852	3.5493	1085	9.015	155.15
9.07	179.87	60.06	1.0016	2.33E-04	0.387	3.739	52,453	2.1691	1332	121.71	61.69	0.9983	3.69E-04	0.370	2.799	101,080	3.5799	1082	9.005	154.95
9.17	177.60	60.13	1.0014	2.36E-04	0.386	3.739	51,705	2.2051	1324	120.92	61.70	0.9983	3.71E-04	0.370	2.799	100,361	3.6089	1080	8.995	154.75
9.27	174.19	60.23	1.0011	2.42E-04	0.386	3.739	50,584	2.2614	1311	119.74	61.72	0.9982	3.76E-04	0.369	2.799	99,284	3.6531	1075	8.980	154.45
9.37	171.00	60.33	1.0007	2.47E-04	0.385	3.739	49,540	2.3161	1300	118.64	61.73	0.9982	3.79E-04	0.369	2.799	98,283	3.6952	1072	8.966	154.17
9.47	168.03	60.41	1.0005	2.53E-04	0.384	3.739	48,570	2.3693	1289	117.61	61.75	0.9981	3.83E-04	0.369	2.799	97,352	3.7351	1068	8.952	153.90
9.57	165.26	60.49	1.0002	2.58E-04	0.383	3.739	47,668	2.4209	1278	116.65	61.76	0.9981	3.87E-04	0.368	2.799	96,487	3.7730	1065	8.940	153.64
9.67	162.68	60.57	1.0000	2.63E-04	0.383	3.739	46,828	2.4707	1268	115.76	61.78	0.9981	3.90E-04	0.368	2.799	95,682	3.8088	1062	8.929	153.40
9.77	160.27	60.63	0.9998	2.68E-04	0.382	3.739	46,047	2.5188	1259	114.93	61.79	0.9980	3.93E-04	0.368	2.799	94,934	3.8428	1059	8.918	153.17
9.87	158.02	60.69	0.9996	2.72E-04	0.382	3.739	45,320	2.5652	1250	114.15	61.80	0.9980	3.96E-04	0.367	2.799	94,237	3.8749	1056	8.908	152.95
9.97	155.92	60.75	0.9995	2.76E-04	0.381	3.739	44,644	2.6099	1242	113.43	61.81	0.9980	3.99E-04	0.367	2.799	93,589	3.9052	1054	8.899	152.74
10.07	153.97	60.80	0.9993	2.81E-04	0.381	3.739	44,013	2.6528	1235	112.75	61.82	0.9980	4.02E-04	0.367	2.799	92,985	3.9339	1051	8.891	152.55
10.17	152.14	60.85	0.9992	2.85E-04	0.380	3.739	43,426	2.6939	1227	112.12	61.83	0.9979	4.04E-04	0.367	2.799	92,422	3.9609	1049	8.883	152.36
10.27	150.43	60.90	0.9991	2.89E-04	0.380	3.739	42,879	2.7333	1220	111.53	61.84	0.9979	4.07E-04	0.366	2.799	91,898	3.9864	1047	8.875	152.19
10.37	148.83	60.94	0.9990	2.92E-04	0.379	3.739	42,369	2.7710	1214	110.98	61.85	0.9979	4.09E-04	0.366	2.799	91,409	4.0105	1045	8.869	152.02
10.48	147.24	60.98	0.9989	2.96E-04	0.379	3.739	41,861	2.8096	1208	110.44	61.86	0.9979	4.11E-04	0.366	2.799	90,921	4.0348	1043	8.862	151.86
10.59	145.64	61.02	0.9987	3.00E-04	0.378	3.739	41,353	2.8491	1201	109.89	61.86	0.9979	4.13E-04	0.366	2.799	90,435	4.0593	1041	8.855	151.69
10.72	144.04	61.06	0.9986	3.04E-04	0.378	3.739	40,847	2.8896	1195	109.34	61.87	0.9979	4.16E-04	0.366	2.799	89,949	4.0841	1039	8.848	151.52
10.85	142.44	61.10	0.9985	3.08E-04	0.377	3.739	40,341	2.9310	1188	108.79	61.88	0.9979	4.18E-04	0.365	2.799	89,464	4.1091	1037	8.842	151.35
11.00	140.85	61.14	0.9984	3.12E-04	0.377	3.739	39,837	2.9735	1181	108.24	61.89	0.9978	4.20E-04	0.365	2.799	88,979	4.1344	1035	8.835	151.17
11.16	139.25	61.18	0.9984	3.16E-04	0.376	3.739	39,334	3.0171	1175	107.69	61.89	0.9978	4.23E-04	0.365	2.799	88,496	4.1599	1033	8.829	150.99
11.35	137.65	61.21	0.9983	3.20E-04	0.376	3.739	38,831	3.0618	1168	107.14	61.90	0.9978	4.25E-04	0.365	2.799	88,013	4.1857	1031	8.822	150.82
11.55	136.05	61.25	0.9982	3.25E-04	0.375	3.739	38,330	3.1076	1161	106.59	61.91	0.9978	4.27E-04	0.364	2.799	87,531	4.2117	1029	8.816	150.64
11.79	134.44	61.29	0.9981	3.29E-04	0.375	3.739	37,831	3.1545	1155	106.05	61.92	0.9978	4.30E-04	0.364	2.799	87,050	4.2380	1027	8.809	150.45
12.06	132.84	61.33	0.9980	3.34E-04	0.374	3.739	37,332	3.2027	1148	105.50	61.92	0.9978	4.32E-04	0.364	2.799	86,570	4.2645	1025	8.803	150.27
12.39	131.24	61.36	0.9979	3.38E-04	0.374	3.739	36,835	3.2521	1141	104.95	61.93	0.9978	4.35E-04	0.364	2.799	86,091	4.2913	1023	8.796	150.08
12.80	129.63	61.40	0.9978	3.43E-04	0.373	3.739	36,338	3.3029	1134	104.40	61.94	0.9977	4.37E-04	0.364	2.799	85,613	4.3184	1021	8.790	149.89
13.33	128.03	61.43	0.9977	3.48E-04	0.373	3.739	35,844	3.3550	1127	103.85	61.95	0.9977	4.40E-04	0.363	2.799	85,136	4.3457	1019	8.784	149.70
14.06	126.42	61.47	0.9977	3.53E-04	0.372	3.739	35,350	3.4084	1120	103.30	61.95	0.9977	4.42E-04	0.363	2.799	84,659	4.3734	1017	8.778	149.51
15.06	124.97	61.50	0.9976	3.58E-04	0.372	3.739	34,905	3.4581	1114	102.81	61.96	0.9977	4.44E-04	0.363	2.799	84,229	4.3986	1015	8.772	149.33
16.06	124.06	61.52	0.9976	3.61E-04	0.371	3.739	34,627	3.4897	1110	102.50	61.96	0.9977	4.46E-04	0.363	2.799	83,960	4.4145	1014	8.769	149.22
17.06	123.36	61.53	0.9975	3.63E-04	0.371	3.739	34,412	3.5146	1107	102.26	61.97	0.9977	4.47E-04	0.363	2.799	83,752	4.4269	1013	8.766	149.13
18.06	122.75	61.55	0.9975	3.65E-04	0.371	3.739	34,226	3.5364	1104	102.05	61.97	0.9977	4.48E-04	0.363	2.799	83,572	4.4376	1013	8.764	149.05
19.06	122.19	61.56	0.9975	3.67E-04	0.371	3.739	34,058	3.5563	1101	101.86	61.97	0.9977	4.49E-04	0.363	2.799	83,410	4.4474	1012	8.762	148.99
20.06	121.69	61.57	0.9974	3.69E-04	0.371	3.739	33,904	3.5747	1099	101.69	61.97	0.9977	4.50E-04	0.362	2.799	83,260	4.4564	1011	8.760	148.92
21.06	121.21	61.58	0.9974	3.71E-04	0.370	3.739	33,761	3.5921	1097	101.53	61.98	0.9977	4.50E-04	0.362	2.799	83,121	4.4648	1011	8.758	148.86
22.06	120.77	61.59	0.9974	3.72E-04	0.370	3.739	33,627	3.6084	1095	101.38	61.98	0.9977	4.51E-04	0.362	2.799	82,992	4.4727	1010	8.757	148.81
22.06	120.77	61.59	0.9974	3.72E-04	0.370	3.739	33,627	3.6084	1095	101.38	61.98	0.9977	4.51E-04	0.362	2.799	82,992	4.4727	1010	8.757	148.81
22.06	120.77	61.59	0.9974	3.72E-04	0.370	3.739	33,627	3.6084	1095	101.38	61.98	0.9977	4.51E-04	0.362	2.799	82,992	4.4727	1010	8.757	148.81
22.06	120.77	61.59	0.9974	3.72E-04	0.370	3.739	33,627	3.6084	1095	101.38	61.98	0.9977	4.51E-04	0.362	2.799	82,992	4.4727	1010	8.757	148.81

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate			Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr					mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
7.64	1,425,513	1,433,242	0.684	0.581	0.381	48.92	185.11	########	2,096,899	#N/A	#N/A	#N/A	33.44	139.09	70.12	185.11	139.09			7.358	77.48	8,100	3	25.83	64	105.65
7.79	1,426,801	1,434,186	0.684	0.581	0.381	48.19	183.84	########	2,097,096	#N/A	#N/A	#N/A	32.96	138.41	69.12	183.84	138.41			7.358	76.48	8,100	3	25.49	65	105.45
7.95	1,428,082	1,435,128	0.684	0.580	0.380	47.47	182.57	########	2,097,293	#N/A	#N/A	#N/A	32.48	137.74	68.12	182.57	137.74			7.358	75.48	8,100	3	25.16	66	105.26
8.11	1,429,354	1,436,068	0.685	0.579	0.380	46.74	181.29	########	2,097,489	#N/A	#N/A	#N/A	32.00	137.06	67.12	181.29	137.06			7.358	74.48	8,100	3	24.83	67	105.06
8.28	1,430,618	1,437,005	0.685	0.579	0.380	46.01	180.02	########	2,097,685	#N/A	#N/A	#N/A	31.52	136.39	66.12	180.02	136.39			7.358	73.48	8,100	3	24.49	68	104.87
8.47	954,583	958,111	0.597	0.819	0.475	53.32	170.71	########	1,605,098	#N/A	#N/A	#N/A	31.83	143.68	51.09	170.71	143.68			7.358	109.54	8,100	3	36.51	69	111.86
8.57	956,400	959,509	0.598	0.817	0.474	51.46	168.19	########	1,605,523	#N/A	#N/A	#N/A	30.75	141.95	49.37	168.19	141.95			7.358	106.10	8,100	3	35.37	70	111.20
8.67	958,069	960,804	0.598	0.814	0.474	49.73	165.84	########	1,605,917	#N/A	#N/A	#N/A	29.75	140.33	47.78	165.84	140.33			7.358	102.91	8,100	3	34.30	71	110.58
8.77	959,604	962,001	0.599	0.812	0.473	48.12	163.65	########	1,606,282	#N/A	#N/A	#N/A	28.82	138.83	46.29	163.65	138.83			7.358	99.93	8,100	3	33.31	72	110.01
8.87	961,016	963,110	0.599	0.810	0.472	46.62	161.60	########	1,606,621	#N/A	#N/A	#N/A	27.95	137.43	44.90	161.60	137.43			7.358	97.16	8,100	3	32.39	73	109.48
8.97	962,317	964,136	0.600	0.808	0.471	45.23	159.69	########	1,606,935	#N/A	#N/A	#N/A	27.14	136.12	43.61	159.69	136.12			7.358	94.58	8,100	3	31.53	74	108.98
9.07	963,516	965,087	0.600	0.806	0.471	43.94	157.90	########	1,607,227	#N/A	#N/A	#N/A	26.39	134.90	42.41	157.90	134.90			7.358	92.17	8,100	3	30.72	75	108.51
9.17	964,622	965,968	0.601	0.804	0.470	42.74	156.23	########	1,607,499	#N/A	#N/A	#N/A	25.68	133.76	41.29	156.23	133.76			7.358	89.93	8,100	3	29.98	76	108.08
9.27	966,263	967,281	0.602	0.802	0.469	40.94	153.71	########	1,607,904	#N/A	#N/A	#N/A	24.63	132.05	39.60	153.71	132.05			7.358	86.56	8,100	3	28.85	77	107.42
9.37	967,767	968,492	0.602	0.799	0.468	39.27	151.37	########	1,608,280	#N/A	#N/A	#N/A	23.65	130.46	38.03	151.37	130.46			7.358	83.42	8,100	3	27.81	78	106.81
9.47	969,147	969,610	0.603	0.797	0.468	37.72	149.17	########	1,608,629	#N/A	#N/A	#N/A	22.74	128.98	36.57	149.17	128.98			7.358	80.50	8,100	3	26.83	79	106.24
9.57	970,414	970,641	0.603	0.795	0.467	36.28	147.12	########	1,608,952	#N/A	#N/A	#N/A	21.89	127.59	35.21	147.12	127.59			7.358	77.78	8,100	3	25.93	80	105.71
9.67	971,579	971,593	0.604	0.793	0.466	34.94	145.21	########	1,609,251	#N/A	#N/A	#N/A	21.09	126.31	33.95	145.21	126.31			7.358	75.25	8,100	3	25.08	81	105.21
9.77	972,651	972,472	0.604	0.791	0.466	33.69	143.42	########	1,609,530	#N/A	#N/A	#N/A	20.36	125.11	32.77	143.42	125.11			7.358	72.89	8,100	3	24.30	82	104.75
9.87	973,638	973,285	0.605	0.789	0.465	32.53	141.76	########	1,609,788	#N/A	#N/A	#N/A	19.67	123.99	31.67	141.76	123.99			7.358	70.69	8,100	3	23.56	83	104.32
9.97	974,547	974,036	0.605	0.787	0.464	31.46	140.20	########	1,610,028	#N/A	#N/A	#N/A	19.03	122.94	30.64	140.20	122.94			7.358	68.64	8,100	3	22.88	84	103.91
10.07	975,386	974,731	0.605	0.786	0.464	30.45	138.74	########	1,610,251	#N/A	#N/A	#N/A	18.43	121.97	29.68	138.74	121.97			7.358	66.73	8,100	3	22.24	85	103.54
10.17	976,160	975,374	0.606	0.784	0.463	29.52	137.38	########	1,610,459	#N/A	#N/A	#N/A	17.88	121.06	28.79	137.38	121.06			7.358	64.94	8,100	3	21.65	86	103.18
10.27	976,875	975,970	0.606	0.783	0.463	28.65	136.10	########	1,610,652	#N/A	#N/A	#N/A	17.36	120.21	27.96	136.10	120.21			7.358	63.28	8,100	3	21.09	87	102.85
10.37	977,535	976,522	0.606	0.782	0.462	27.84	134.91	########	1,610,832	#N/A	#N/A	#N/A	16.88	119.42	27.19	134.91	119.42			7.358	61.73	8,100	3	20.58	88	102.55
10.48	978,189	977,069	0.606	0.780	0.462	27.03	133.72	########	1,611,011	#N/A	#N/A	#N/A	16.39	118.63	26.41	133.72	118.63			7.358	60.18	8,100	3	20.06	89	102.24
10.59	978,836	977,612	0.607	0.779	0.462	26.22	132.53	########	1,611,190	#N/A	#N/A	#N/A	15.91	117.84	25.64	132.53	117.84			7.358	58.63	8,100	3	19.54	90	101.93
10.72	979,476	978,150	0.607	0.778	0.461	25.42	131.33	########	1,611,368	#N/A	#N/A	#N/A	15.43	117.05	24.86	131.33	117.05			7.358	57.08	8,100	3	19.03	91	101.62
10.85	980,110	978,684	0.607	0.776	0.461	24.61	130.14	########	1,611,545	#N/A	#N/A	#N/A	14.95	116.26	24.09	130.14	116.26			7.358	55.53	8,100	3	18.51	92	101.32
11.00	980,737	979,213	0.608	0.775	0.460	23.81	128.94	########	1,611,723	#N/A	#N/A	#N/A	14.47	115.47	23.31	128.94	115.47			7.358	53.99	8,100	3	18.00	93	101.01
11.16	981,357	979,738	0.608	0.774	0.460	23.01	127.74	########	1,611,899	#N/A	#N/A	#N/A	13.98	114.68	22.54	127.74	114.68			7.358	52.44	8,100	3	17.48	94	100.70
11.35	981,970	980,258	0.608	0.772	0.459	22.21	126.54	########	1,612,075	#N/A	#N/A	#N/A	13.50	113.89	21.77	126.54	113.89			7.358	50.90	8,100	3	16.97	95	100.39
11.55	982,576	980,773	0.608	0.771	0.459	21.41	125.34	########	1,612,251	#N/A	#N/A	#N/A	13.02	113.11	21.00	125.34	113.11			7.358	49.35	8,100	3	16.45	96	100.08
11.79	983,175	981,283	0.609	0.770	0.458	20.61	124.14	########	1,612,426	#N/A	#N/A	#N/A	12.54	112.32	20.23	124.14	112.32			7.358	47.81	8,100	3	15.94	97	99.77
12.06	983,767	981,788	0.609	0.768	0.458	19.82	122.93	########	1,612,600	#N/A	#N/A	#N/A	12.07	111.53	19.46	122.93	111.53			7.358	46.27	8,100	3	15.42	98	99.46
12.39	984,351	982,288	0.609	0.767	0.457	19.02	121.73	########	1,612,774	#N/A	#N/A	#N/A	11.59	110.74	18.69	121.73	110.74			7.358	44.73	8,100	3	14.91	99	99.16
12.80	984,928	982,783	0.609	0.766	0.457	18.23	120.52	########	1,612,948	#N/A	#N/A	#N/A	11.11	109.95	17.92	120.52	109.95			7.358	43.19	8,100	3	14.40	99	98.85
13.33	985,498	983,273	0.610	0.764	0.456	17.44	119.31	########	1,613,121	#N/A	#N/A	#N/A	10.63	109.17	17.15	119.31	109.17			7.358	41.66	8,100	3	13.89	99	98.54
14.06	986,060	983,757	0.610	0.763	0.456	16.65	118.10	########	1,613,293	#N/A	#N/A	#N/A	10.15	108.38	16.38	118.10	108.38			7.358	40.12	8,100	3	13.37	99	98.23
15.06	986,562	984,190	0.610	0.762	0.456	15.94	117.00	########	1,613,449	#N/A	#N/A	#N/A	9.72	107.67	15.69	117.00	107.67			7.358	38.73	8,100	3	12.91	99	97.95
16.06	986,873	984,459	0.610	0.761	0.455	15.49	116.31	########	1,613,546	#N/A	#N/A	#N/A	9.45	107.23	15.25	116.31	107.23			7.358	37.87	8,100	3	12.62	99	97.77
17.06	987,113	984,667	0.610	0.760	0.455	15.15	115.78	########	1,613,621	#N/A	#N/A	#N/A	9.24	106.88	14.92	115.78	106.88			7.358	37.19	8,100	3	12.40	99	97.64
18.06	987,318	984,845	0.610	0.760	0.455	14.85	115.32	########	1,613,686	#N/A	#N/A	#N/A	9.06	106.58	14.63	115.32	106.58			7.358	36.61	8,100	3	12.20	99	97.52
19.06	987,504	985,006	0.610	0.759	0.455	14.58	114.90	########	1,613,745	#N/A	#N/A	#N/A	8.90	106.31	14.36	114.90	106.31			7.358	36.09	8,100	3	12.03	99	97.41
20.06	987,673	985,153	0.610	0.759	0.455	14.34	114.52	########	1,613,799	#N/A	#N/A	#N/A	8.75	106.07	14.12	114.52	106.07			7.358	35.60	8,100	3	11.87	99	97.31
21.06	987,830	985,290	0.611	0.758	0.454	14.11	114.16	########	1,613,849	#N/A	#N/A	#N/A	8.61	105.83	13.90	114.16	105.83			7.358	35.15	8,100	3	11.72	99	97.22
22.06	987,976	985,417	0.611	0.758	0.454	13.89	113.83	########	1,613,896	#N/A	#N/A	#N/A	8.48	105.62	13.69	113.83	105.62			7.358	34.73	8,100	3	11.58	99	97.14
22.06	987,976	985,417	0.611	0.758	0.454	13.89	113.83	########	1,613,896	#N/A	#N/A	#N/A	8.48	105.62	13.69	113.83	105.62			7.358	34.73	8,100	3	11.58	99	97.14
22.06	987,976	985,417	0.611	0.758	0.454	13.89	113.83	########	1,613,896	#N/A	#N/A	#N/A	8.48	105.62	13.69	113.83	105.62			7.358	34.73	8,100	3	11.58	99	97.14
22.06	987,976	985,417	0.611	0.758	0.454	13.89	113.83	########	1,613,896	#N/A	#N/A	#N/A	8.48	105.62	13.69	113.83	105.62			7.358	34.73	8,100	3	11.58	99	97.14


Shutdown Cooling Temperature Transient with 90F River Water
SDC Hx Fouling = 0.00418 hr-F-sqft/Btu, CCW Hx Fouling = 0.004 hr-F-sqft/Btu
Second SDC HX Started at 225F Primary Coolant
Temperature, F
CCW Temperature, F
Time, hours
370
330
290
250
210
170
130
90
50
170
160
150
140
130
120
110
100
90
0
2
4
6
8
10
12
14
16
18
20
22
24
Pri Cool Temp
SDC Return Temp
CCW Temp

Shutdown Cooling Heat Exchanger

Heat transfer rate, clean	487		Btu/hr-F-sqft
Heat transfer rate, dirty	320		Btu/hr-F-sqft
Heat Transfer Area (ft2)	5020		
Number of U-tubes	514		
tube od, inch	0.75		
tube gage (BWG, inch)	18	0.049	
tube id, inch	0.652		
Tube flow area, ft^2	1.19175		(from tube number and id)
Shell Flow Area, ft^2	2.5904		(adjusted to give bet fit to data sheet velocities)
Shell film correction factor	0.09751		

Hx Design Point (Mode B)

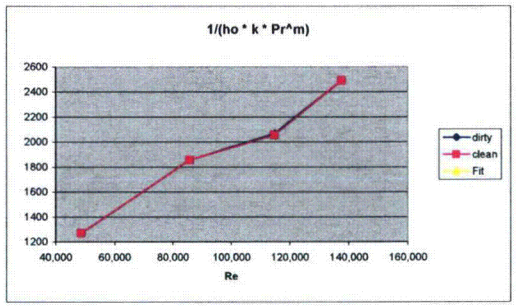
	Q, gpm	W	Pt,i	Tt,i	Tt,o	Tt,ave	rho lb/ft^3	Cp Btu/lb-F	mu lb/ft-sec	k Btu/hr-ft-F	Vel	Re	Pr	h (Btu/hr-ft2-F)	Fouling, hr-ft^2-F/Btu	Udirty	Uclean	WCp	Cr	NTU	effectiveness	DT	to	Duty mmBtu/hr
																	0							
tube	3000	1,476,852	3.88918	140	114.93	127.47	61.38	0.9989	3.50E-04	0.372	5.609	53,484	3.3809	1554	0.0005			1,475,215	0.66	1.089	0.53330358	25.07	114.93	
metal						114.38			3.95E-04	8.775				2005		320.002	487.85							36.98
shell	4500	2,237,087	100	93	109.57	101.28	61.98	0.9977	4.52E-04	0.362	3.870	114,657	4.4774	1233	0.0005			2,231,873	1.5129	1.089	#N/A	16.57	109.57	
																320	487							37.1
																0.000810743	0.000814		0.0010716					
												-1.53E-08	-3.6E-06			2,066.65	2,057.66							
Mode A																								
tube	1500	741,518	2.9424	125	100.16	112.58	61.63	0.9983	4.02E-04	0.367	2.804	23,342	3.9442	839	0			740,278	0.66	1.067	0.52842361	24.84	100.16	
metal						99.40			4.61E-04	8.698				1988		157.281	313.22							18.39
shell	2250	1,121,755	95	78	94.43	86.21	62.16	0.9976	5.35E-04	0.356	1.935	48,566	5.3992	759	0.00316542			1,119,112	1.5117	1.067	#N/A	16.43	94.43	
																158.7	318.9							18.526
																0.001261548	0.001262		0.003165					
												5.7E-05	5.7E-05			1,271.15	1,271.15							
Mode C																								
tube	2250	1,079,449	15.696	212	158.65	185.33	59.81	1.0033	2.24E-04	0.387	4.206	61,051	2.0890	1483	0			1,083,007	0.75	0.815	0.45595948	53.35	158.65	
metal						150.11			2.89E-04	9.001				2057		175.878	440.88							57.78
shell	2937	1,455,601	95	95	134.77	114.88	61.79	0.9980	3.93E-04	0.368	2.526	85,650	3.8445	994	0.00341756			1,452,745	1.3414	0.815	#N/A	39.77	134.77	
																178.1	455.2							58.931
																0.000935297	0.000935		0.003418					
												7.1E-05	7.1E-05			1,857.22	1,858.06							
Mode D																								
tube	3400	1,599,745	33.5275	255	198.02	226.51	58.66	1.0093	1.75E-04	0.393	6.356	116,024	1.6139	2270	0			1,614,677	0.69	0.526	0.35611814	56.98	198.02	
metal						170.59			2.48E-04	9.124				2085		169.130	575.70							92.00
shell	4728	2,343,356	95	95	134.34	114.67	61.79	0.9980	3.94E-04	0.368	4.067	137,599	3.8534	1332	0.0041756			2,338,741	1.4484	0.526	#N/A	39.34	134.34	
																170.7	594.3							94.391
																0.000696222	0.000696		0.004176					
												5.4E-05	5.4E-05			2,493.60	2,493.52							

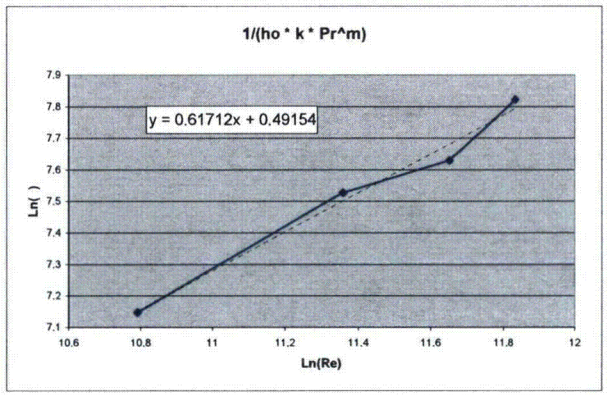
Re	dirty	clean	Ln(Re)	Ln(clean)
48,566	1,271	1,271	10.79068	7.14767613
85,650	1,857	1,858	11.35803	7.52729078
114,657	2,067	2,058	11.6497	7.62932323
137,599	2,494	2,494	11.8321	7.82145074

0.61709 0.49192

1.63545328

0.333





Effectiveness-Capacity Ratio-NTU for mix flow Hx

Capacity Ratio - WCp(tube) < WCp(shell)

NTU	0	0.2	0.4	0.6	0.8	1
0	0	0	0	0	0	0
0.5	0.393	0.378	0.364	0.350	0.337	0.324
1	0.632	0.593	0.557	0.523	0.492	0.462
1.5	0.777	0.718	0.664	0.613	0.567	0.524
2	0.865	0.792	0.723	0.661	0.603	0.552
2.5	0.918	0.835	0.757	0.685	0.620	0.562
3	0.950	0.861	0.775	0.697	0.626	0.564
3.5	0.970	0.876	0.785	0.701	0.627	0.561
4	0.982	0.884	0.789	0.702	0.624	0.556
4.5	0.989	0.889	0.791	0.700	0.620	0.551
5	0.993	0.892	0.790	0.697	0.615	0.544
5.5	0.996	0.893	0.789	0.693	0.609	0.538
6	0.998	0.893	0.787	0.689	0.604	0.532
6.5	0.999	0.893	0.785	0.685	0.599	0.526
7	0.999	0.892	0.782	0.680	0.593	0.520
7.5	0.999	0.892	0.780	0.676	0.588	0.515
8	1.000	0.891	0.777	0.672	0.583	0.510
8.5	1.000	0.890	0.774	0.668	0.578	0.505
9	1.000	0.889	0.771	0.664	0.573	0.500
9.5	1.000	0.888	0.769	0.660	0.569	0.496
10	1.000	0.887	0.766	0.656	0.564	0.492

Capacity Ratio - WCp(shell) < WCp(tube)

	0	0.2	0.4	0.6	0.8	1
0	0	0	0	0	0	0
0.5	0.393	0.378	0.364	0.350	0.337	0.324
1	0.632	0.593	0.557	0.523	0.492	0.462
1.5	0.777	0.718	0.664	0.613	0.567	0.524
2	0.865	0.791	0.723	0.661	0.603	0.552
2.5	0.918	0.833	0.757	0.685	0.620	0.562
3	0.950	0.857	0.775	0.697	0.626	0.564
3.5	0.970	0.870	0.785	0.701	0.627	0.561
4	0.982	0.876	0.789	0.702	0.624	0.556
4.5	0.989	0.878	0.791	0.700	0.620	0.551

18/8 Cr/Ni Steel (e.g. A249 TP304)

°F	Thermal Conductivity, Btu/hr/sqft/F
32	8.4
70	8.6
100	8.7
150	9
200	9.3
250	9.6
300	9.8
350	10.1
400	10.4
450	10.6
500	10.9
550	11.1
600	11.3
650	11.6
700	11.8
750	12
800	12.2
850	12.5
900	12.7
950	12.9
1000	13.2
1050	13.4
1100	13.6
1150	13.8
1200	14
1250	14.3
1300	14.5
1350	14.7
1400	14.9
1450	15.1
1500	15.3

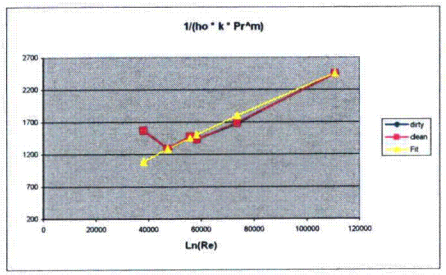
Component Cooling Water Heat Exchanger

Heat Transfer Area (ft2)	12400	effective
Number of tubes	2280	
No. of Passes	3	
tube od	0.75	
tube gage (BWG)	18	0.049
tube id	0.652	
Tube flow area, ft^2	1.76212	
Shell Flow Area, ft^2	1.74197	
Shell film correction factor	1.02130	

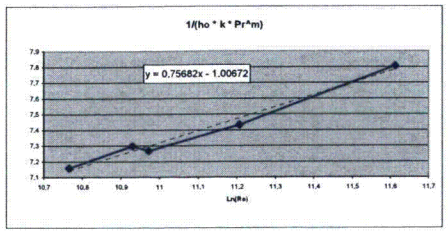
Tubes: 3/4", 18 BWG w. min wall, ST/STL - SA-249-TP-304 (OPPD Drawing File No. 18674,
Whitlock Mfg Co. N o. L-26132-1
Flow arrangement, pure counterflow per draining Cramer and Lindell drawing FC-AC1B1, dated 7/26/99

tube	0.333333
shell	0.333333

	Q, gpm	W	Pt,i	Tt,i	Tt,o	Tt,ave	rho lb/ft^3	Cp Btu/lb-F	mu lb/ft-sec	k Btu/hr-ft-F	Vel	Re	Pr	h (Btu/hr-ft2-F)	Fouling, hr-ft^2-F/Btu	Udirty	Uclean	WCp	Cr	NTU	effectivenes	DT	to	Duty mmBtu/hr
Hx Design Point (Mode E)																								
tube	2673	1,332,918	100	85	185.12	135.06	62.17	0.9989	3.27E-04	0.375	3.380	34,892	3.1407	1000	0			1,331,462	1.20	2.721		-100.12	185.12	
metal						157.46				9.045				2067		244.003	408.45							-133.30
shell	2283	1,109,178	100	239.8	119.91	179.85	60.57	1.0024	2.32E-04	0.386	2.920	110,479	2.1712	1228	0.00165			1,111,834	0.8350	2.721	0.775	-119.89	119.91	
																244	408							134.00
													-5.1E-08	-2.7E-06		0.0008146	0.0008172		0.00165					
																2,454.50	2,446.64							
Mode A																								
tube	1575	785,390	100	85	99.96	92.48	62.17	0.9976	4.97E-04	0.359	1.991	13,526	4.9820	523	0			783,494	1.02	2.820		-14.96	99.96	
metal						95.18				8.683				1984		174.975	237.24							-11.72
shell	1550	771,090	75	105.5	90.27	97.88	62.02	0.9977	4.68E-04	0.361	1.982	38,103	4.6634	661	0.0015			769,338	0.9819	2.820	0.743	-15.23	90.27	
																190.1	266							12.00
													4.5E-04	4.6E-04		0.0010573	0.0010563		0.00150					
																1,569.01	1,570.48							
Mode B																								
tube	3270	1,634,163	100	70	99.75	84.88	62.31	0.9976	5.43E-04	0.355	4.135	25,765	5.4951	896	0			1,630,306	1.14	2.056		-29.75	99.75	
metal						93.16			4.94E-04	8.677				1983		237.218	368.25							-48.50
shell	2885	1,434,171	95	118.4	84.50	101.45	61.98	0.9977	4.51E-04	0.362	3.690	73,636	4.4689	1078	0.0015			1,430,862	0.8777	2.056	0.700	-33.90	84.50	
																233.6	359.6							48.18
													-6.5E-05	-6.5E-05		0.000993	0.0009931		0.00150					
																1,687.22	1,687.14							
Mode C																								
tube	2518	1,258,356	100	70	86.02	78.01	62.31	0.9978	5.91E-04	0.352	3.184	18,239	6.0345	695	0			1,255,608	1.15	2.313		-16.02	86.02	
metal						82.01			5.62E-04	8.641				1975		204.083	294.12							-20.11
shell	2200	1,096,865	95	95.2	76.82	86.01	62.16	0.9976	5.36E-04	0.356	2.814	47,375	5.4136	808	0.0015			1,094,283	0.8715	2.313	0.729	-18.38	76.82	
																203.7	293.3							18.92
													-9.2E-06	-9.5E-06		0.0012474	0.0012477		0.00150					
																1,284.09	1,283.78							
Mode D																								
tube	2518	1,255,626	100	85	101.28	93.14	62.17	0.9976	4.94E-04	0.359	3.184	21,786	4.9410	764	0			1,252,598	1.15	2.443		-16.28	101.28	
metal						97.00			4.73E-04	8.690				1986		215.018	317.38							-20.40
shell	2200	1,093,785	95	110.2	91.51	100.85	61.99	0.9977	4.54E-04	0.362	2.814	55,804	4.5003	875	0.0015			1,091,251	0.8712	2.443	0.742	-18.69	91.51	
																215.5	318.4							18.92
													1.0E-05	1.0E-05		0.001132	0.0011323		0.00150					
																1,477.71	1,477.28							
Mode F																								
tube	3333	1,662,034	100	85	109.93	97.47	62.17	0.9976	4.71E-04	0.361	4.214	30,250	4.6857	982	0			1,658,073	1.65	2.867		-24.93	109.93	
metal						105.42			4.33E-04	8.727				1994		231.626	354.95							-41.34
shell	2025	1,003,970	95	134	92.74	113.37	61.81	0.9980	3.99E-04	0.367	2.590	58,209	3.9076	874	0.0015			1,001,950	0.6043	2.867	0.842	-41.26	92.74	
																228.3	347.2							39.488
													-6.3E-05	-6.3E-05		0.001207	0.001207		0.00150					
																1,432.97	1,432.99							



Re	dirty	clean		
38,103	1,569.01	1,570.48		
47,375	1,284.09	1,283.78	10.7658	7.157805
55,804	1,477.71	1,477.28	10.9296	7.298251
58,209	1,432.97	1,432.99	10.9718	7.267505
73,636	1,687.22	1,687.14	11.2069	7.430839
110,479	2,454.50	2,446.64	11.6126	7.80568
			0.75645	-0.99266
				0.37059

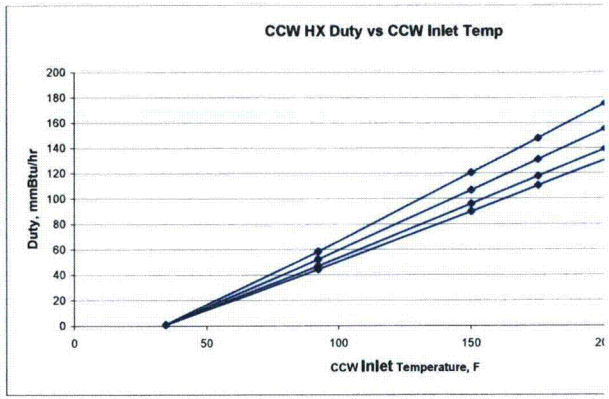


CCW Heat Exchanger Performance at Various Fouling Coefficients and CCW Inlet Temperatures with 90F River Water

River Water Temp	33	RW Flow, Total, gpm	8400	Shell Film Multiplier	1.0213
No CCW Hx	3	CCW Flow, total, gpm	8100	Shell Film Re power	0.75645
				Shell Film Pr power	0.333333333
				Fouling (total = tube side)	0.004

CCW - Based on Average Raw Water Flow

Case	Tube (River)				Shell (CCW)				Tube	Shell		Fouling (Total = Tube Side)		CCW HX tube side							CCW HX shell side					
	Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o	h (Btu/hr-ft2-F)	h (Btu/hr-ft2-F)	kmetal		Udirty	W	WCp	Cr	NTU	effectivenes	DT	Tt,o	W	WCp	Cr	NTU	effectivenes	DTs
1A	2800.0	30	33	33.66	2700	90	34.00	33.31	524	644	8.411	0.0000	234.31	1,401,776	1,410,819	1.04	2.137	0.672	0.66	33.66	1,351,748	1,359,578	0.9637	2.137	0.690	0.69
1B	2800.0	30	33	74.65	2700	90	92.00	48.64	632	857	8.570	0.0000	285.80	1,401,776	1,402,478	1.04	2.631	0.714	41.65	74.65	1,349,257	1,346,906	0.9604	2.631	0.735	43.36
1C	2800.0	30	33	118.89	2700	90	150.00	60.19	747	1044	8.668	0.0000	333.01	1,401,776	1,399,313	1.05	3.086	0.742	85.89	118.89	1,341,158	1,338,185	0.9563	3.086	0.768	89.81
1D	2800.0	30	33	138.56	2700	90	175.00	64.32	797	1118	8.713	0.0000	352.19	1,401,776	1,398,895	1.05	3.273	0.752	105.56	138.56	1,336,568	1,334,203	0.9538	3.273	0.779	110.68
1E	2800.0	30	33	158.48	2700	90	200.00	68.02	848	1188	8.778	0.0000	370.81	1,401,776	1,398,833	1.05	3.457	0.760	125.48	158.48	1,331,459	1,329,980	0.9508	3.457	0.790	131.98
2A	2800.0	30	33	33.60	2700	90	34.00	33.38	524	645	8.411	0.0015	173.37	1,401,776	1,410,840	1.04	1.581	0.606	0.60	33.60	1,351,749	1,359,560	0.9637	1.581	0.619	0.62
2B	2800.0	30	33	70.13	2700	90	92.00	53.30	620	870	8.570	0.0015	199.35	1,401,776	1,403,064	1.04	1.836	0.639	37.13	70.13	1,348,859	1,346,315	0.9596	1.836	0.656	38.70
2C	2800.0	30	33	109.19	2700	90	150.00	70.22	722	1070	8.668	0.0015	220.59	1,401,776	1,399,695	1.05	2.046	0.661	76.19	109.19	1,339,648	1,336,847	0.9551	2.046	0.682	79.78
2D	2800.0	30	33	126.49	2700	90	175.00	76.83	766	1149	8.714	0.0015	228.65	1,401,776	1,399,101	1.05	2.128	0.669	93.49	126.49	1,334,409	1,332,398	0.9523	2.128	0.691	98.17
2E	2800.0	30	33	143.97	2700	90	200.00	83.08	811	1224	8.779	0.0015	236.20	1,401,776	1,398,847	1.05	2.206	0.675	110.97	143.97	1,328,563	1,327,652	0.9491	2.206	0.700	116.92
3A	2800.0	30	33	33.54	2700	90	34.00	33.44	524	645	8.411	0.0030	137.58	1,401,776	1,410,857	1.04	1.255	0.551	0.54	33.54	1,351,751	1,359,545	0.9636	1.255	0.562	0.56
3B	2800.0	30	33	66.50	2700	90	92.00	57.06	610	880	8.570	0.0030	153.11	1,401,776	1,403,582	1.04	1.411	0.578	33.50	66.50	1,348,523	1,345,845	0.9589	1.411	0.592	34.94
3C	2800.0	30	33	101.47	2700	90	150.00	78.23	702	1090	8.668	0.0030	164.98	1,401,776	1,400,104	1.05	1.532	0.596	68.47	101.47	1,338,389	1,335,755	0.9540	1.532	0.613	71.77
3D	2800.0	30	33	116.90	2700	90	175.00	86.78	742	1173	8.714	0.0030	169.34	1,401,776	1,399,381	1.05	1.578	0.602	83.90	116.90	1,332,616	1,330,922	0.9511	1.578	0.621	88.22
3E	2800.0	30	33	132.47	2700	90	200.00	95.03	782	1252	8.779	0.0030	173.35	1,401,776	1,398,980	1.06	1.621	0.608	99.47	132.47	1,326,165	1,325,756	0.9477	1.621	0.629	104.97
4A	2800.0	30	33	33.51	2700	90	34.00	33.47	524	645	8.411	0.0040	120.94	1,401,776	1,410,867	1.04	1.103	0.519	0.51	33.51	1,351,752	1,359,537	0.9636	1.103	0.530	0.53
4B	2800.0	30	33	64.46	2700	90	92.00	59.18	605	886	8.570	0.0040	132.61	1,401,776	1,403,895	1.04	1.222	0.543	31.46	64.46	1,348,326	1,345,581	0.9585	1.222	0.556	32.82
4C	2800.0	30	33	97.14	2700	90	150.00	82.72	690	1102	8.669	0.0040	141.27	1,401,776	1,400,379	1.05	1.312	0.560	64.14	97.14	1,337,662	1,335,132	0.9534	1.312	0.575	67.28
4D	2800.0	30	33	111.54	2700	90	175.00	92.36	728	1187	8.714	0.0040	144.40	1,401,776	1,399,590	1.05	1.346	0.565	78.54	111.54	1,331,583	1,330,081	0.9503	1.346	0.582	82.64
4E	2800.0	30	33	128.97	2700	90	205.00	103.56	773	1283	8.794	0.0040	147.80	1,401,776	1,399,046	1.06	1.385	0.571	95.97	128.97	1,323,349	1,323,564	0.9460	1.385	0.590	101.44



RW Flow, Total, gpm	8400
CCW Flow, total, gpm	8100

Case	Ts,o	Duty, per Hx	Tshell,in	Tshell,out	TD
1A	33.31	0.94	34.00	33.31	0.31
1B	48.64	58.41	92.00	48.64	15.64
1C	60.19	120.19	150.00	60.19	27.19
1D	64.32	147.67	175.00	64.32	31.32
1E	68.02	175.53	200.00	68.02	35.02
2A	33.38	0.84	34.00	33.38	0.38
2B	53.30	52.10	92.00	53.30	20.30
2C	70.22	106.65	150.00	70.22	37.22
2D	76.83	130.80	175.00	76.83	43.83
2E	83.08	155.23	200.00	83.08	50.08
3A	33.44	0.76	34.00	33.44	0.44
3B	57.06	47.03	92.00	57.06	24.06
3C	78.23	95.87	150.00	78.23	45.23
3D	86.78	117.41	175.00	86.78	53.78
3E	95.03	139.16	200.00	95.03	62.03
4A	33.47	0.72	34.00	33.47	0.47
4B	59.18	44.16	92.00	59.18	26.18
4C	82.72	89.82	150.00	82.72	49.72
4D	92.36	109.92	175.00	92.36	59.36
4E	103.56	134.27	205.00	103.56	70.56

CCW HX Ts,o

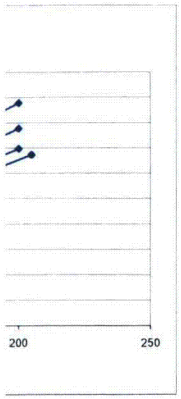
fouling	Duty, mmBtu/hr 1	34.25	67.5	100.75	134
0.0000	34.07	68.22	100.76	132.09	162.61
0.0015	34.19	72.28	108.68	143.85	178.29
0.0030	34.31	76.35	116.61	155.69	194.09
0.0040	34.39	79.06	121.92	163.63	204.67

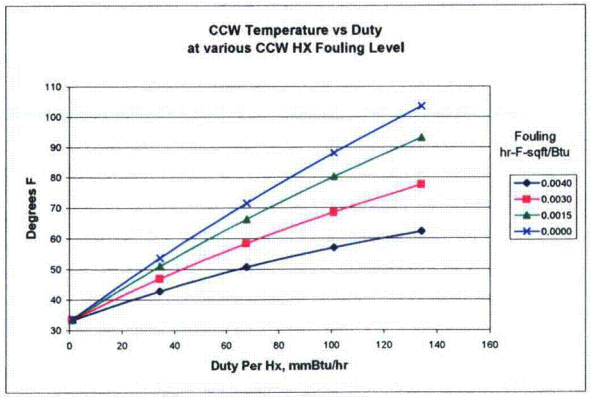
CCW HX shell outlet temperature

fouling	Duty, mmBtu/hr 1	34.25	67.50	100.75	134.00
0.0000	33.33	42.85	50.60	56.96	62.33
0.0015	33.45	46.90	58.44	68.55	77.67
0.0030	33.57	50.95	66.31	80.21	93.11
0.0040	33.65	53.65	71.56	88.01	103.44

Average CCW

33.70	55.54	75.68	94.53	112.47
33.82	59.59	83.56	106.20	127.98
33.94	63.65	91.46	117.95	143.60
34.02	66.36	96.74	125.82	154.06





Shutdown Cooling Temperature Transient with 33F River Water **SDC**

Hx Fouling = 0. hr-F-sqft/Btu, CCW Hx Fouling = 0. hr-F-sqft/Btu

Initial RC Temperature, F	350					SDC HX	CCW HX
Initial Time	2		2754		Shell Film Multiplier	0.09751	
RCS Temperature after 8 hours	<130				Shell Film Re power	0.61709	
Time after trip to 130F Primary Coolant Temp	4.68	Initial CCW to SDCHx	4246		Shell Film Pr power	0.333	
Time after SDC initiation to 130F PC Temp	2.7	CCW Flow Step Temp	300		Fouling (total = tube side)	0	0
Decary heat equilibrium at 90F river temp	0.00	2 HX Temp	110			0.00418	0.004

Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	SDCHx (per exchanger) Tube				Shell			
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
2.00	0.1	54.966	19.5	-259.89	-185.42	-168.56	1	3000	315	350.00	158.40	4246	95	54.86	178.65
2.10	0.10	54.107	19.5	-246.32	-172.71	-157.01	1	3000	315	333.14	153.04	4246	95	54.01	171.24
2.20	0.10	53.300	19.5	-233.58	-160.78	-146.16	1	3000	315	317.44	147.91	4246	95	53.19	164.27
2.30	0.10	52.540	19.5	-221.62	-149.58	-135.98	1	3000	315	302.83	143.04	4246	95	52.41	157.72
2.40	0.10	51.822	19.5	-210.41	-139.09	-126.44	1	3000	315	289.23	138.44	4246	95	51.65	151.57
2.50	0.10	51.143	19.5	-199.93	-129.28	-117.53	1	3000	315	276.58	134.08	4246	95	50.93	145.82
2.60	0.10	50.500	19.5	-190.13	-120.13	-109.21	1	3000	315	264.83	129.97	4246	95	50.25	140.43
2.70	0.10	49.888	19.5	-181.00	-111.61	-101.46	1	3000	315	253.91	126.10	4246	95	49.60	135.40
2.80	0.10	49.305	19.5	-172.49	-103.68	-94.26	1	3000	315	243.76	122.46	4246	95	48.98	130.71
2.90	0.10	48.749	19.5	-164.56	-96.31	-87.56	1	3000	315	234.34	119.03	4246	95	48.39	126.33
3.00	0.10	48.218	19.5	-157.18	-89.47	-81.33	1	3000	315	225.58	115.81	4246	95	47.84	122.25
3.10	0.10	47.710	19.5	-150.32	-83.11	-75.56	1	3000	315	217.45	112.79	4246	95	47.32	118.45
3.20	0.10	47.223	19.5	-143.94	-77.22	-70.20	1	3000	315	209.89	109.95	4246	95	46.82	114.91
3.30	0.10	46.756	19.5	-138.01	-71.76	-65.23	1	3000	315	202.87	107.28	4246	95	46.36	111.62
3.40	0.10	46.307	1.5	-132.50	-84.69	-76.99	1	3000	315	196.35	104.79	4246	95	45.92	108.56
3.50	0.10	45.876	1.5	-125.99	-78.62	-71.47	1	3000	315	188.65	101.81	4246	95	45.40	104.94
3.60	0.10	45.460	1.5	-119.96	-73.00	-66.36	1	3000	315	181.50	99.02	4246	95	44.91	101.58
3.70	0.10	45.059	1.5	-114.35	-67.80	-61.63	1	3000	315	174.87	96.40	4246	95	44.45	98.45
3.80	0.10	44.673	1.5	-109.16	-62.98	-57.26	1	3000	315	168.70	93.95	4246	95	44.02	95.55
3.90	0.10	44.300	1.5	-104.33	-58.53	-53.21	1	3000	315	162.98	91.66	4246	95	43.61	92.85
4.00	0.10	43.939	1.5	-99.86	-54.42	-49.47	1	3000	315	157.66	89.50	4246	95	43.24	90.35
4.10	0.10	43.590	1.5	-95.70	-50.61	-46.01	1	3000	315	152.71	87.49	4246	95	42.88	88.02
4.20	0.10	43.252	1.5	-91.84	-47.09	-42.80	1	3000	315	148.11	85.60	4246	95	42.55	85.85
4.30	0.10	42.924	1.5	-88.25	-43.83	-39.84	1	3000	315	143.83	83.83	4246	95	42.24	83.84
4.40	0.10	42.606	1.5	-84.93	-40.82	-37.11	1	3000	315	139.84	82.17	4246	95	41.94	81.98
4.50	0.10	42.298	1.5	-81.84	-38.04	-34.58	1	3000	315	136.13	80.61	4246	95	41.67	80.24
4.60	0.10	41.999	1.5	-78.96	-35.46	-32.24	1	3000	315	132.68	79.16	4246	95	41.42	78.62
4.70	0.10	41.708	1.5	-76.28	-33.07	-30.07	1	3000	315	129.45	77.79	4246	95	41.18	77.11
4.80	0.10	41.425	1.5	-73.79	-30.86	-28.06	1	3000	315	126.44	76.51	4246	95	40.95	75.71
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
2.00	254.20	55.59	1.0141	1.52E-04	0.396	5.609	111,764	1.3980	2094	116.76	61.76	0.9981	3.86E-04	0.368	3.652	126,025	3.7688	1255	9.213	549.16
2.10	243.09	56.19	1.0116	1.60E-04	0.395	5.609	106,857	1.4766	2062	112.63	61.82	0.9980	4.02E-04	0.367	3.652	121,183	3.9393	1238	9.167	542.62
2.20	232.68	56.72	1.0094	1.69E-04	0.394	5.609	102,152	1.5592	2028	108.73	61.88	0.9979	4.18E-04	0.365	3.652	116,671	4.1118	1222	9.124	536.17
2.30	222.94	57.21	1.0076	1.78E-04	0.393	5.609	97,677	1.6455	1995	105.06	61.93	0.9978	4.34E-04	0.364	3.652	112,467	4.2857	1206	9.084	529.84
2.40	213.83	57.64	1.0061	1.88E-04	0.392	5.609	93,445	1.7352	1961	101.61	61.98	0.9977	4.50E-04	0.362	3.652	108,556	4.4604	1191	9.046	523.67
2.50	205.33	58.03	1.0048	1.98E-04	0.391	5.609	89,460	1.8278	1928	98.38	62.02	0.9976	4.66E-04	0.361	3.652	104,926	4.6350	1177	9.011	517.69
2.60	197.40	58.38	1.0037	2.08E-04	0.390	5.609	85,722	1.9229	1896	95.34	62.05	0.9976	4.82E-04	0.360	3.652	101,558	4.8088	1164	8.976	511.87
2.70	190.01	58.69	1.0028	2.18E-04	0.389	5.609	82,225	2.0203	1864	92.50	62.09	0.9976	4.97E-04	0.359	3.652	98,437	4.9811	1151	8.942	506.26
2.80	183.11	58.98	1.0020	2.28E-04	0.387	5.609	78,961	2.1194	1833	89.84	62.12	0.9976	5.13E-04	0.357	3.652	95,548	5.1514	1139	8.911	500.88
2.90	176.69	59.23	1.0013	2.38E-04	0.386	5.609	75,920	2.2200	1804	87.36	62.15	0.9976	5.28E-04	0.356	3.652	92,875	5.3189	1128	8.882	495.73
3.00	170.70	59.47	1.0007	2.48E-04	0.385	5.609	73,091	2.3215	1775	85.04	62.17	0.9977	5.42E-04	0.355	3.652	90,403	5.4832	1117	8.856	490.82
3.10	165.12	59.68	1.0002	2.58E-04	0.383	5.609	70,461	2.4236	1748	82.88	62.19	0.9977	5.56E-04	0.354	3.652	88,117	5.6438	1107	8.832	486.14
3.20	159.92	59.87	0.9998	2.68E-04	0.382	5.609	68,019	2.5260	1722	80.87	62.21	0.9977	5.70E-04	0.353	3.652	86,004	5.8004	1097	8.810	481.70
3.30	155.08	60.04	0.9994	2.78E-04	0.381	5.609	65,752	2.6282	1697	78.99	62.23	0.9978	5.84E-04	0.352	3.652	84,050	5.9526	1089	8.790	477.48
3.40	150.57	60.19	0.9991	2.88E-04	0.380	5.609	63,649	2.7300	1673	77.24	62.25	0.9979	5.97E-04	0.351	3.652	82,244	6.1002	1080	8.772	473.48
3.50	145.23	60.37	0.9987	3.01E-04	0.378	5.609	61,173	2.8593	1645	75.17	62.26	0.9980	6.13E-04	0.350	3.652	80,125	6.2824	1070	8.752	468.66
3.60	140.26	60.54	0.9984	3.13E-04	0.377	5.609	58,882	2.9893	1618	73.24	62.28	0.9981	6.28E-04	0.349	3.652	78,170	6.4598	1061	8.734	464.09
3.70	135.64	60.68	0.9981	3.26E-04	0.375	5.609	56,762	3.1194	1592	71.45	62.29	0.9982	6.43E-04	0.348	3.652	76,366	6.6320	1052	8.717	459.76
3.80	131.33	60.81	0.9979	3.38E-04	0.374	5.609	54,802	3.2493	1567	69.78	62.31	0.9983	6.58E-04	0.348	3.652	74,702	6.7988	1044	8.703	455.65
3.90	127.32	60.93	0.9977	3.50E-04	0.373	5.609	52,988	3.3785	1544	68.23	62.32	0.9984	6.71E-04	0.347	3.652	73,167	6.9598	1036	8.692	451.80
4.00	123.58	61.04	0.9975	3.63E-04	0.371	5.609	51,310	3.5067	1522	66.79	62.33	0.9985	6.85E-04	0.346	3.652	71,749	7.1150	1029	8.683	448.16
4.10	120.10	61.14	0.9974	3.74E-04	0.370	5.609	49,757	3.6334	1501	65.45	62.34	0.9986	6.98E-04	0.345	3.652	70,439	7.2643	1022	8.675	444.72
4.20	116.86	61.23	0.9973	3.86E-04	0.369	5.609	48,320	3.7584	1482	64.20	62.35	0.9987	7.10E-04	0.345	3.652	69,227	7.4077	1016	8.668	441.47
4.30	113.83	61.31	0.9971	3.98E-04	0.368	5.609	46,988	3.8814	1463	63.04	62.35	0.9988	7.22E-04	0.344	3.652	68,108	7.5451	1010	8.661	438.39
4.40	111.01	61.38	0.9970	4.09E-04	0.367	5.609	45,754	4.0022	1446	61.96	62.36	0.9990	7.33E-04	0.343	3.652	67,075	7.6763	1005	8.655	435.48
4.50	108.37	61.44	0.9970	4.20E-04	0.366	5.609	44,609	4.1204	1430	60.96	62.37	0.9991	7.44E-04	0.343	3.652	66,117	7.8017	1000	8.649	432.74
4.60	105.92	61.50	0.9969	4.30E-04	0.365	5.609	43,548	4.2360	1414	60.02	62.37	0.9992	7.54E-04	0.342	3.652	65,229	7.9215	995	8.644	430.15
4.70	103.62	61.56	0.9968	4.41E-04	0.364	5.609	42,563	4.3487	1400	59.15	62.38	0.9993	7.63E-04	0.342	3.652	64,405	8.0358	991	8.638	427.70
4.80	101.48	61.61	0.9968	4.51E-04	0.363	5.609	41,649	4.4583	1386	58.33	62.38	0.9994	7.73E-04	0.341	3.652	63,641	8.1448	986	8.634	425.39
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21

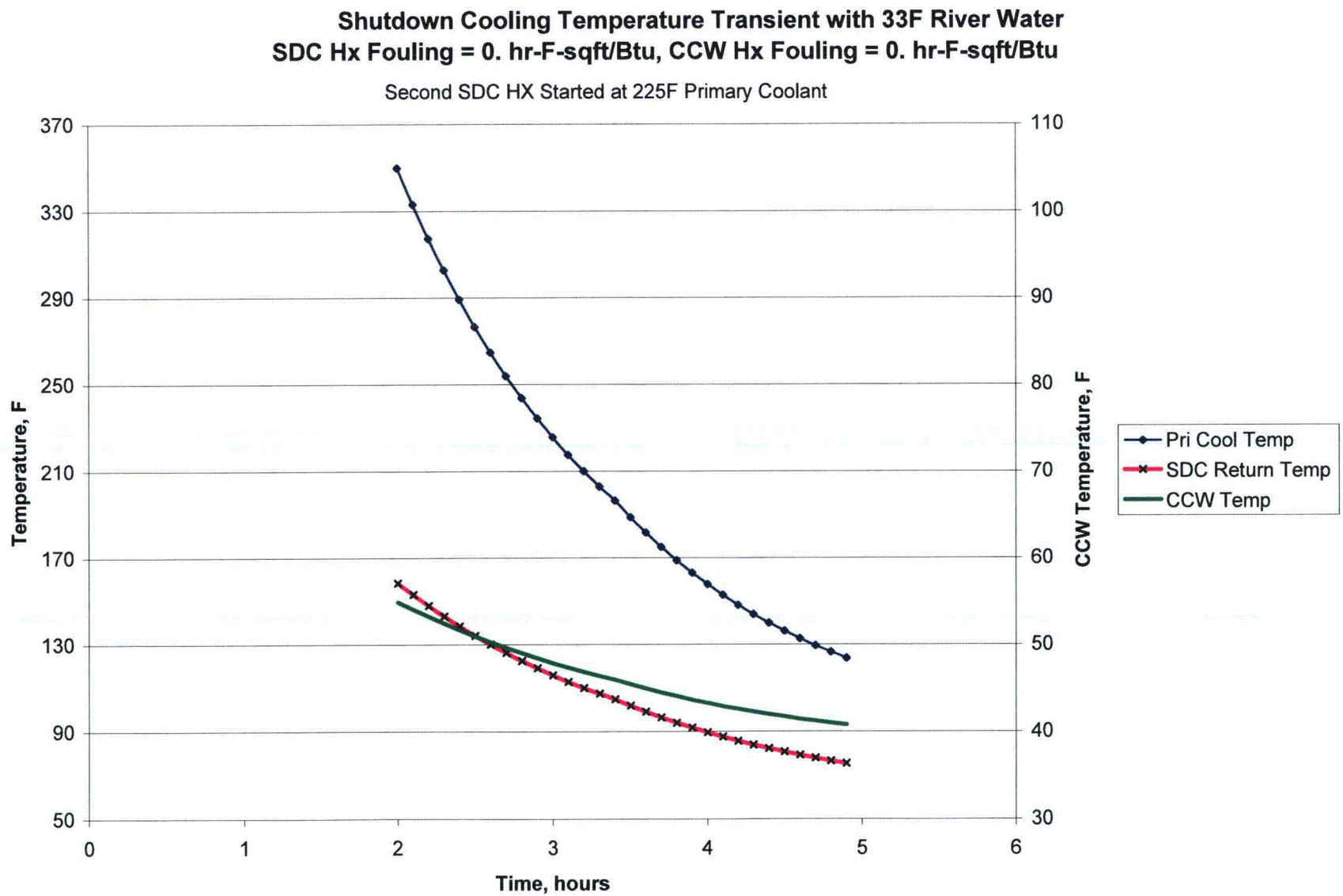
CCW HX Fouling 0

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX	CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr	Ts,o
2.00	1,337,560	1,356,414	0.646	2.032	0.649	191.60	158.40	########	2,099,403	#N/A	#N/A	#N/A	123.79	178.65	259.89	158.40	178.65	7.358	267.25	8,100	3	89.08	54.86
2.10	1,351,996	1,367,630	0.651	1.992	0.645	180.11	153.04	########	2,101,200	#N/A	#N/A	#N/A	117.23	171.24	246.32	153.04	171.24	7.358	253.68	8,100	3	84.56	54.01
2.20	1,364,919	1,377,779	0.655	1.954	0.642	169.53	147.91	########	2,102,858	#N/A	#N/A	#N/A	111.08	164.27	233.58	147.91	164.27	7.358	240.94	8,100	3	80.31	53.19
2.30	1,376,508	1,386,988	0.659	1.918	0.638	159.78	143.04	########	2,104,390	#N/A	#N/A	#N/A	105.31	157.72	221.62	143.04	157.72	7.358	228.97	8,100	3	76.32	52.41
2.40	1,386,915	1,395,355	0.663	1.884	0.635	150.79	138.44	########	2,105,806	#N/A	#N/A	#N/A	99.92	151.57	210.41	138.44	151.57	7.358	217.77	8,100	3	72.59	51.65
2.50	1,396,273	1,402,966	0.666	1.852	0.632	142.50	134.08	########	2,107,113	#N/A	#N/A	#N/A	94.88	145.82	199.93	134.08	145.82	7.358	207.28	8,100	3	69.09	50.93
2.60	1,404,697	1,409,893	0.669	1.823	0.628	134.86	129.97	########	2,108,323	#N/A	#N/A	#N/A	90.18	140.43	190.13	129.97	140.43	7.358	197.49	8,100	3	65.83	50.25
2.70	1,412,287	1,416,199	0.671	1.795	0.626	127.81	126.10	########	2,109,443	#N/A	#N/A	#N/A	85.80	135.40	181.00	126.10	135.40	7.358	188.36	8,100	3	62.79	49.60
2.80	1,419,134	1,421,942	0.674	1.768	0.623	121.30	122.46	########	2,110,481	#N/A	#N/A	#N/A	81.73	130.71	172.49	122.46	130.71	7.358	179.84	8,100	3	59.95	48.98
2.90	1,425,316	1,427,171	0.676	1.744	0.620	115.31	119.03	########	2,111,445	#N/A	#N/A	#N/A	77.94	126.33	164.56	119.03	126.33	7.358	171.92	8,100	3	57.31	48.39
3.00	1,430,902	1,431,934	0.678	1.721	0.618	109.77	115.81	########	2,112,340	#N/A	#N/A	#N/A	74.41	122.25	157.18	115.81	122.25	7.358	164.54	8,100	3	54.85	47.84
3.10	1,435,955	1,436,272	0.680	1.699	0.615	104.66	112.79	########	2,113,174	#N/A	#N/A	#N/A	71.14	118.45	150.32	112.79	118.45	7.358	157.68	8,100	3	52.56	47.32
3.20	1,440,529	1,440,223	0.681	1.679	0.613	99.95	109.95	########	2,113,951	#N/A	#N/A	#N/A	68.09	114.91	143.94	109.95	114.91	7.358	151.30	8,100	3	50.43	46.82
3.30	1,444,674	1,443,824	0.683	1.660	0.611	95.59	107.28	########	2,114,677	#N/A	#N/A	#N/A	65.26	111.62	138.01	107.28	111.62	7.358	145.37	8,100	3	48.46	46.36
3.40	1,448,433	1,447,106	0.684	1.643	0.609	91.56	104.79	########	2,115,355	#N/A	#N/A	#N/A	62.64	108.56	132.50	104.79	108.56	7.358	139.86	8,100	3	46.62	45.92
3.50	1,452,752	1,450,896	0.686	1.622	0.606	86.84	101.81	########	2,116,161	#N/A	#N/A	#N/A	59.54	104.94	125.99	101.81	104.94	7.358	133.35	8,100	3	44.45	45.40
3.60	1,456,645	1,454,331	0.687	1.602	0.604	82.48	99.02	########	2,116,917	#N/A	#N/A	#N/A	56.67	101.58	119.96	99.02	101.58	7.358	127.32	8,100	3	42.44	44.91
3.70	1,460,157	1,457,444	0.688	1.584	0.602	78.46	96.40	########	2,117,627	#N/A	#N/A	#N/A	54.00	98.45	114.35	96.40	98.45	7.358	121.71	8,100	3	40.57	44.45
3.80	1,463,327	1,460,267	0.689	1.566	0.600	74.75	93.95	########	2,118,294	#N/A	#N/A	#N/A	51.53	95.55	109.16	93.95	95.55	7.358	116.51	8,100	3	38.84	44.02
3.90	1,466,190	1,462,829	0.690	1.550	0.598	71.32	91.66	########	2,118,921	#N/A	#N/A	#N/A	49.24	92.85	104.33	91.66	92.85	7.358	111.69	8,100	3	37.23	43.61
4.00	1,468,780	1,465,156	0.691	1.536	0.596	68.15	89.50	########	2,119,512	#N/A	#N/A	#N/A	47.11	90.35	99.86	89.50	90.35	7.358	107.21	8,100	3	35.74	43.24
4.10	1,471,124	1,467,271	0.692	1.522	0.594	65.22	87.49	########	2,120,068	#N/A	#N/A	#N/A	45.14	88.02	95.70	87.49	88.02	7.358	103.06	8,100	3	34.35	42.88
4.20	1,473,247	1,469,197	0.693	1.508	0.592	62.51	85.60	########	2,120,592	#N/A	#N/A	#N/A	43.31	85.85	91.84	85.60	85.85	7.358	99.19	8,100	3	33.06	42.55
4.30	1,475,172	1,470,951	0.693	1.496	0.591	60.00	83.83	########	2,121,086	#N/A	#N/A	#N/A	41.61	83.84	88.25	83.83	83.84	7.358	95.61	8,100	3	31.87	42.24
4.40	1,476,920	1,472,552	0.694	1.485	0.589	57.68	82.17	########	2,121,551	#N/A	#N/A	#N/A	40.03	81.98	84.93	82.17	81.98	7.358	92.29	8,100	3	30.76	41.94
4.50	1,478,508	1,474,014	0.695	1.474	0.588	55.52	80.61	########	2,121,990	#N/A	#N/A	#N/A	38.57	80.24	81.84	80.61	80.24	7.358	89.20	8,100	3	29.73	41.67
4.60	1,479,953	1,475,352	0.695	1.464	0.586	53.52	79.16	########	2,122,404	#N/A	#N/A	#N/A	37.20	78.62	78.96	79.16	78.62	7.358	86.32	8,100	3	28.77	41.42
4.70	1,481,269	1,476,578	0.696	1.454	0.585	51.66	77.79	########	2,122,795	#N/A	#N/A	#N/A	35.93	77.11	76.28	77.79	77.11	7.358	83.64	8,100	3	27.88	41.18
4.80	1,482,469	1,477,702	0.696	1.445	0.584	49.93	76.51	########	2,123,164	#N/A	#N/A	#N/A	34.75	75.71	73.79	76.51	75.71	7.358	81.14	8,100	3	27.05	40.95
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	#N/A	#N/A	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	1.436	1.437	#N/A	33.65	74.40	71.46	75.31	74.40	7.358	78.82	8,100	3	26.27	40.75

								SDCHx (per exchanger)							
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell			
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
4.90	0.00	41.150	1.5	-71.46	-28.81	-26.19	1	3000	315	123.64	75.31	4246	95	40.75	74.40

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
4.90	99.48	61.65	0.9967	4.60E-04	0.362	5.609	40,800	4.5648	1373	57.57	62.38	0.9995	7.81E-04	0.341	3.652	62,930	8.2485	982	8.629	423.21

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate			Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr					mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
4.90	1,483,564	1,478,736	0.696	1.437	0.583	48.33	75.31	########	2,123,513	1.436	1.437	#N/A	33.65	74.40	71.46	75.31	74.40			7.358	78.82	8,100	3	26.27		40.75


Shutdown Cooling Temperature Transient with 33F River Water
SDC Hx Fouling = 0. hr-F-sqft/Btu, CCW Hx Fouling = 0. hr-F-sqft/Btu
Second SDC HX Started at 225F Primary Coolant
Temperature, F
CCW Temperature, F
Time, hours
370
330
290
250
210
170
130
90
50
110
100
90
80
70
60
50
40
30
0
1
2
3
4
5
6
Pri Cool Temp
SDC Return Temp
CCW Temp

Shutdown Cooling Temperature Transient with 33F River Water **SDC**

Hx Fouling = 0. hr-F-sqft/Btu, CCW Hx Fouling = 0. hr-F-sqft/Btu

Initial RC Temperature, F		350										SDC HX	CCW HX
Initial Time		2					2754		Shell Film Multiplier			0.09751	
RCS Temperature after 8 hours		<130							Shell Film Re power			0.61709	
Time after trip to 130F Primary Coolant Temp		5.07		Initial CCW to SDCHx			1850		Shell Film Pr power			0.333	
Time after SDC initiation to 130F PC Temp		3.1		CCW Flow Step Temp			275		Fouling (total = tube side)			0	0
Decary heat equilibrium at 90F river temp		0.00		2 HX Temp			110					0.00418	0.004

								SDCHx (per exchanger)							
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell			
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
2.00	0.1	54.966	19.5	-181.11	-106.64	-96.95	1	3000	315	350.00	217.53	1850	95	49.60	249.07
2.10	0.10	54.107	19.5	-175.66	-102.06	-92.78	1	3000	315	340.31	212.34	1850	95	49.21	242.52
2.20	0.10	53.300	19.5	-170.44	-97.64	-88.77	1	3000	315	331.03	207.34	1850	95	48.83	236.24
2.30	0.10	52.540	19.5	-165.43	-93.39	-84.90	1	3000	315	322.15	202.54	1850	95	48.46	230.22
2.40	0.10	51.822	19.5	-160.62	-89.30	-81.18	1	3000	315	313.66	197.92	1850	95	48.10	224.45
2.50	0.10	51.143	19.5	-156.00	-85.36	-77.60	1	3000	315	305.54	193.49	1850	95	47.75	218.91
2.60	0.10	50.500	19.5	-151.58	-81.58	-74.16	1	3000	315	297.78	189.24	1850	95	47.41	213.61
2.70	0.10	49.888	19.5	-147.33	-77.95	-70.86	1	3000	315	290.37	185.17	1850	95	47.09	208.54
2.80	0.10	49.305	19.5	-143.27	-74.47	-67.70	1	3000	315	283.28	181.26	1850	95	46.77	203.68
2.90	0.10	48.749	19.5	-139.38	-71.13	-64.67	1	3000	315	276.51	177.52	1850	95	46.47	199.04
3.00	0.10	48.218	19.5	-194.48	-126.76	-115.24	1	3000	315	270.04	131.80	4246	95	50.55	142.82
3.10	0.10	47.710	19.5	-184.86	-117.65	-106.95	1	3000	315	258.52	127.74	4246	95	49.87	137.53
3.20	0.10	47.223	19.5	-175.90	-109.17	-99.25	1	3000	315	247.83	123.92	4246	95	49.23	132.59
3.30	0.10	46.756	19.5	-167.56	-101.30	-92.09	1	3000	315	237.90	120.33	4246	95	48.61	127.98
3.40	0.10	46.307	19.5	-159.80	-94.00	-85.45	1	3000	315	228.69	116.96	4246	95	48.04	123.70
3.50	0.10	45.876	19.5	-152.60	-87.22	-79.29	1	3000	315	220.15	113.79	4246	95	47.49	119.71
3.60	0.10	45.460	19.5	-145.91	-80.95	-73.59	1	3000	315	212.22	110.82	4246	95	46.97	116.00
3.70	0.10	45.059	19.5	-139.69	-75.13	-68.30	1	3000	315	204.86	108.04	4246	95	46.49	112.55
3.80	0.10	44.673	1.5	-133.92	-87.75	-79.77	1	3000	315	198.03	105.43	4246	95	46.04	109.35
3.90	0.10	44.300	1.5	-127.18	-81.38	-73.98	1	3000	315	190.05	102.35	4246	95	45.50	105.60
4.00	0.10	43.939	1.5	-120.93	-75.49	-68.63	1	3000	315	182.65	99.47	4246	95	44.99	102.12
4.10	0.10	43.590	1.5	-115.13	-70.04	-63.68	1	3000	315	175.79	96.77	4246	95	44.52	98.89
4.20	0.10	43.252	1.5	-109.76	-65.01	-59.10	1	3000	315	169.42	94.24	4246	95	44.07	95.89
4.30	0.10	42.924	1.5	-104.78	-60.36	-54.87	1	3000	315	163.51	91.87	4246	95	43.65	93.10
4.40	0.10	42.606	1.5	-100.16	-56.06	-50.96	1	3000	315	158.03	89.65	4246	95	43.26	90.52
4.50	0.10	42.298	1.5	-95.88	-52.08	-47.35	1	3000	315	152.93	87.58	4246	95	42.90	88.12
4.60	0.10	41.999	1.5	-91.91	-48.41	-44.01	1	3000	315	148.19	85.64	4246	95	42.55	85.89
4.70	0.10	41.708	1.5	-88.22	-45.02	-40.92	1	3000	315	143.79	83.82	4246	95	42.23	83.83
4.80	0.10	41.425	1.5	-84.81	-41.88	-38.08	1	3000	315	139.70	82.11	4246	95	41.93	81.91
4.90	0.10	41.150	1.5	-81.64	-38.99	-35.44	1	3000	315	135.89	80.51	4246	95	41.65	80.13
5.00	0.10	40.883	1.5	-78.69	-36.31	-33.01	1	3000	315	132.35	79.02	4246	95	41.39	78.47
5.10	0.10	40.622	1.5	-75.95	-33.83	-30.75	1	3000	315	129.05	77.62	4246	95	41.15	76.92
5.20	0.10	40.368	1.5	-73.40	-31.53	-28.66	1	3000	315	125.97	76.31	4246	95	40.92	75.49
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
2.00	283.77	55.59	1.0222	1.32E-04	0.396	5.609	128,088	1.2282	2220	149.34	61.20	0.9998	2.91E-04	0.379	1.591	72,294	2.7624	826	9.404	455.84
2.10	276.32	55.93	1.0199	1.37E-04	0.396	5.609	124,730	1.2663	2200	145.86	61.27	0.9996	2.99E-04	0.378	1.591	70,385	2.8471	819	9.370	452.26
2.20	269.18	56.26	1.0179	1.41E-04	0.396	5.609	121,456	1.3055	2180	142.53	61.33	0.9994	3.07E-04	0.377	1.591	68,566	2.9325	812	9.337	448.73
2.30	262.34	56.57	1.0161	1.46E-04	0.396	5.609	118,276	1.3460	2160	139.34	61.39	0.9992	3.16E-04	0.376	1.591	66,830	3.0187	805	9.305	445.25
2.40	255.79	56.85	1.0145	1.50E-04	0.396	5.609	115,194	1.3875	2139	136.27	61.44	0.9990	3.24E-04	0.375	1.591	65,176	3.1054	798	9.276	441.85
2.50	249.52	57.12	1.0130	1.55E-04	0.396	5.609	112,214	1.4300	2119	133.33	61.49	0.9988	3.32E-04	0.374	1.591	63,599	3.1925	791	9.249	438.52
2.60	243.51	57.37	1.0117	1.60E-04	0.395	5.609	109,339	1.4734	2098	130.51	61.54	0.9987	3.40E-04	0.373	1.591	62,098	3.2798	784	9.222	435.26
2.70	237.77	57.60	1.0104	1.65E-04	0.395	5.609	106,569	1.5176	2078	127.81	61.59	0.9986	3.49E-04	0.372	1.591	60,668	3.3673	778	9.197	432.08
2.80	232.27	57.82	1.0093	1.70E-04	0.394	5.609	103,904	1.5626	2058	125.23	61.63	0.9984	3.57E-04	0.371	1.591	59,307	3.4547	772	9.172	428.97
2.90	227.01	58.03	1.0083	1.74E-04	0.394	5.609	101,345	1.6082	2038	122.75	61.67	0.9983	3.65E-04	0.371	1.591	58,012	3.5419	766	9.149	425.93
3.00	200.92	58.22	1.0042	2.03E-04	0.391	5.609	87,384	1.8796	1910	96.69	62.04	0.9976	4.75E-04	0.360	3.652	103,051	4.7302	1170	8.992	514.49
3.10	193.13	58.56	1.0032	2.13E-04	0.389	5.609	83,704	1.9781	1877	93.70	62.07	0.9976	4.91E-04	0.359	3.652	99,753	4.9071	1156	8.956	508.65
3.20	185.87	58.86	1.0023	2.23E-04	0.388	5.609	80,269	2.0787	1846	90.91	62.11	0.9976	5.06E-04	0.358	3.652	96,703	5.0820	1144	8.923	503.05
3.30	179.12	59.14	1.0016	2.34E-04	0.387	5.609	77,070	2.1809	1815	88.30	62.14	0.9976	5.22E-04	0.357	3.652	93,884	5.2545	1132	8.893	497.69
3.40	172.83	59.38	1.0009	2.44E-04	0.385	5.609	74,096	2.2845	1785	85.87	62.16	0.9976	5.37E-04	0.355	3.652	91,279	5.4239	1121	8.865	492.58
3.50	166.97	59.61	1.0004	2.55E-04	0.384	5.609	71,333	2.3889	1757	83.60	62.18	0.9977	5.52E-04	0.354	3.652	88,874	5.5897	1110	8.840	487.71
3.60	161.52	59.81	0.9999	2.65E-04	0.383	5.609	68,769	2.4937	1730	81.49	62.21	0.9977	5.66E-04	0.353	3.652	86,653	5.7515	1100	8.817	483.08
3.70	156.45	59.99	0.9995	2.75E-04	0.381	5.609	66,392	2.5986	1704	79.52	62.22	0.9978	5.80E-04	0.352	3.652	84,602	5.9089	1091	8.796	478.68
3.80	151.73	60.15	0.9992	2.86E-04	0.380	5.609	64,189	2.7032	1679	77.69	62.24	0.9979	5.93E-04	0.352	3.652	82,708	6.0617	1082	8.777	474.52
3.90	146.20	60.34	0.9988	2.98E-04	0.378	5.609	61,623	2.8350	1650	75.55	62.26	0.9979	6.10E-04	0.351	3.652	80,509	6.2486	1072	8.756	469.55
4.00	141.06	60.51	0.9985	3.11E-04	0.377	5.609	59,249	2.9677	1622	73.55	62.28	0.9980	6.26E-04	0.350	3.652	78,483	6.4307	1062	8.736	464.83
4.10	136.28	60.66	0.9982	3.24E-04	0.375	5.609	57,056	3.1008	1595	71.70	62.29	0.9981	6.41E-04	0.349	3.652	76,616	6.6076	1053	8.719	460.36
4.20	131.83	60.80	0.9979	3.37E-04	0.374	5.609	55,030	3.2337	1570	69.98	62.31	0.9983	6.56E-04	0.348	3.652	74,896	6.7790	1045	8.704	456.14
4.30	127.69	60.92	0.9977	3.49E-04	0.373	5.609	53,157	3.3661	1546	68.38	62.32	0.9984	6.70E-04	0.347	3.652	73,310	6.9445	1037	8.693	452.16
4.40	123.84	61.03	0.9975	3.62E-04	0.371	5.609	51,426	3.4975	1524	66.89	62.33	0.9985	6.84E-04	0.346	3.652	71,847	7.1041	1030	8.684	448.42
4.50	120.25	61.13	0.9974	3.74E-04	0.370	5.609	49,825	3.6276	1502	65.51	62.34	0.9986	6.97E-04	0.345	3.652	70,496	7.2576	1023	8.676	444.87
4.60	116.92	61.22	0.9973	3.86E-04	0.369	5.609	48,346	3.7560	1482	64.22	62.35	0.9987	7.10E-04	0.345	3.652	69,250	7.4051	1016	8.668	441.53
4.70	113.81	61.31	0.9971	3.98E-04	0.368	5.609	46,977	3.8824	1463	63.03	62.35	0.9988	7.22E-04	0.344	3.652	68,099	7.5462	1010	8.661	438.36
4.80	110.91	61.38	0.9970	4.09E-04	0.367	5.609	45,709	4.0066	1445	61.92	62.36	0.9990	7.33E-04	0.343	3.652	67,038	7.6810	1005	8.655	435.38
4.90	108.20	61.45	0.9970	4.20E-04	0.366	5.609	44,536	4.1283	1428	60.89	62.37	0.9991	7.44E-04	0.343	3.652	66,055	7.8099	999	8.649	432.56
5.00	105.68	61.51	0.9969	4.31E-04	0.365	5.609	43,448	4.2472	1413	59.93	62.37	0.9992	7.55E-04	0.342	3.652	65,146	7.9330	995	8.643	429.90
5.10	103.33	61.57	0.9968	4.42E-04	0.364	5.609	42,441	4.3631	1398	59.04	62.38	0.9993	7.65E-04	0.342	3.652	64,303	8.0503	990	8.638	427.39
5.20	101.14	61.62	0.9968	4.52E-04	0.363	5.609	41,506	4.4759	1384	58.20	62.38	0.9994	7.74E-04	0.341	3.652	63,521	8.1620	986	8.633	425.03
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80

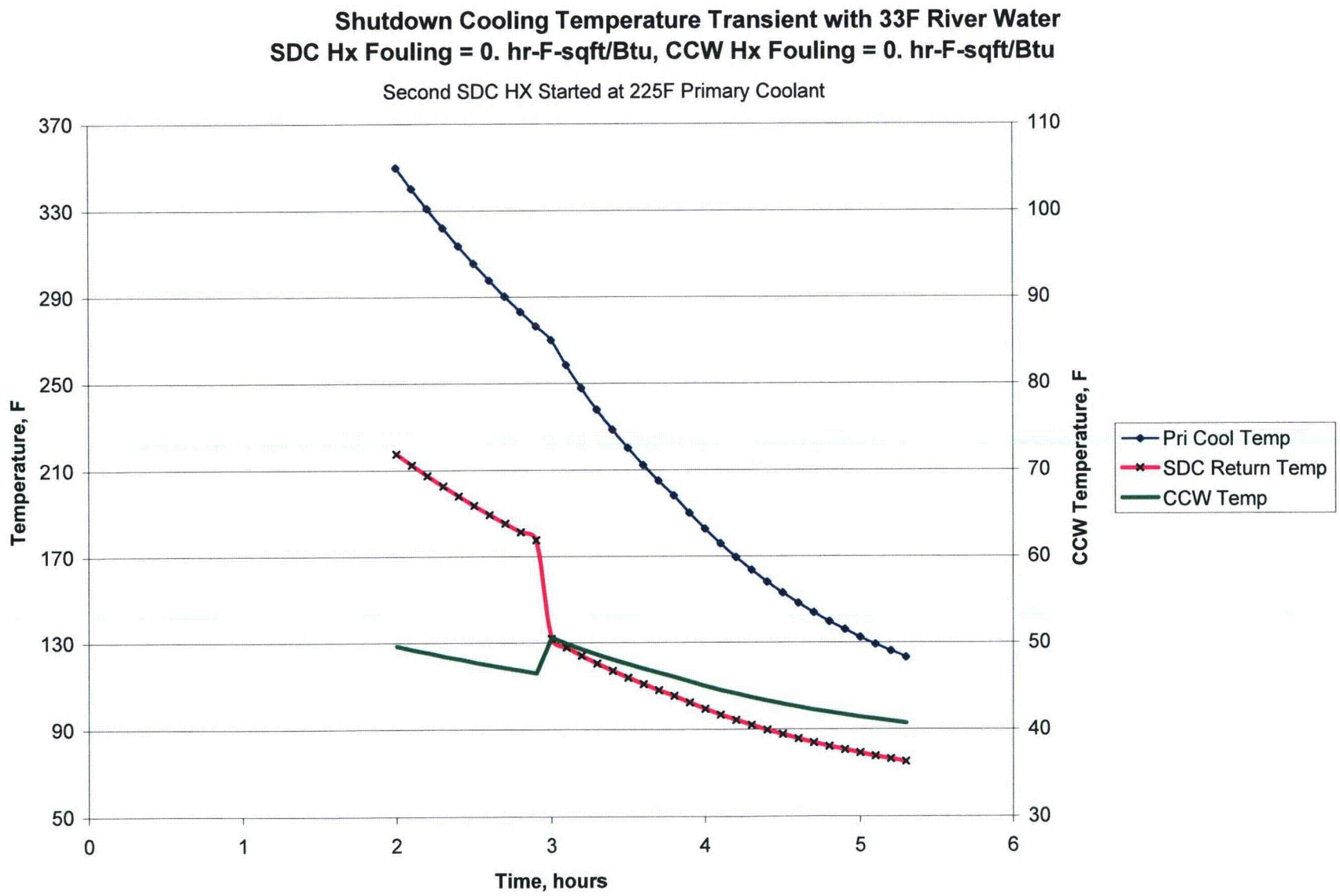
CCW HX Fouling 0

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate	Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX	CCW Temp
hrs	W	WCp	Cr	NTU	effectivenes	DT	Tt,o	W	WCp	Cr	NTU	effectivenes	DTs	Ts,o	Btu/hr			mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr	Ts,o
2.00	1,337,560	1,367,200	1.506	2.520	#N/A	132.47	217.53	908,157	907,971	0.664	2.520	0.664	199.46	249.07	181.11	217.53	249.07	7.358	188.46	8,100	3	62.82	49.60
2.10	1,345,935	1,372,773	1.511	2.498	#N/A	127.96	212.34	909,129	908,734	0.662	2.498	0.664	193.31	242.52	175.66	212.34	242.52	7.358	183.02	8,100	3	61.01	49.21
2.20	1,353,767	1,378,045	1.515	2.477	#N/A	123.69	207.34	910,043	909,457	0.660	2.477	0.664	187.41	236.24	170.44	207.34	236.24	7.358	177.80	8,100	3	59.27	48.83
2.30	1,361,096	1,383,036	1.520	2.456	#N/A	119.61	202.54	910,902	910,142	0.658	2.456	0.664	181.76	230.22	165.43	202.54	230.22	7.358	172.79	8,100	3	57.60	48.46
2.40	1,367,958	1,387,765	1.524	2.435	#N/A	115.74	197.92	911,711	910,792	0.656	2.435	0.664	176.35	224.45	160.62	197.92	224.45	7.358	167.98	8,100	3	55.99	48.10
2.50	1,374,385	1,392,248	1.528	2.415	#N/A	112.05	193.49	912,470	911,407	0.655	2.415	0.664	171.17	218.91	156.00	193.49	218.91	7.358	163.36	8,100	3	54.45	47.75
2.60	1,380,409	1,396,498	1.531	2.396	#N/A	108.54	189.24	913,184	911,989	0.653	2.396	0.664	166.20	213.61	151.58	189.24	213.61	7.358	158.93	8,100	3	52.98	47.41
2.70	1,386,057	1,400,530	1.535	2.377	#N/A	105.20	185.17	913,854	912,540	0.652	2.377	0.664	161.46	208.54	147.33	185.17	208.54	7.358	154.69	8,100	3	51.56	47.09
2.80	1,391,355	1,404,355	1.538	2.358	#N/A	102.02	181.26	914,484	913,060	0.650	2.358	0.663	156.91	203.68	143.27	181.26	203.68	7.358	150.63	8,100	3	50.21	46.77
2.90	1,396,326	1,407,983	1.541	2.341	#N/A	98.99	177.52	915,075	913,552	0.649	2.341	0.663	152.57	199.04	139.38	177.52	199.04	7.358	146.74	8,100	3	48.91	46.47
3.00	1,400,993	1,406,838	0.667	1.836	0.630	138.24	131.80	########	2,107,787	#N/A	#N/A	#N/A	92.27	142.82	194.48	131.80	142.82	7.358	201.84	8,100	3	67.28	50.55
3.10	1,409,111	1,413,553	0.670	1.806	0.627	130.78	127.74	########	2,108,971	#N/A	#N/A	#N/A	87.65	137.53	184.86	127.74	137.53	7.358	192.22	8,100	3	64.07	49.87
3.20	1,416,417	1,419,657	0.673	1.779	0.624	123.90	123.92	########	2,110,066	#N/A	#N/A	#N/A	83.36	132.59	175.90	123.92	132.59	7.358	183.25	8,100	3	61.08	49.23
3.30	1,423,000	1,425,207	0.675	1.753	0.621	117.57	120.33	########	2,111,081	#N/A	#N/A	#N/A	79.37	127.98	167.56	120.33	127.98	7.358	174.92	8,100	3	58.31	48.61
3.40	1,428,936	1,430,254	0.677	1.729	0.618	111.73	116.96	########	2,112,022	#N/A	#N/A	#N/A	75.66	123.70	159.80	116.96	123.70	7.358	167.16	8,100	3	55.72	48.04
3.50	1,434,294	1,434,843	0.679	1.706	0.616	106.35	113.79	########	2,112,897	#N/A	#N/A	#N/A	72.22	119.71	152.60	113.79	119.71	7.358	159.96	8,100	3	53.32	47.49
3.60	1,439,135	1,439,017	0.681	1.685	0.614	101.39	110.82	########	2,113,712	#N/A	#N/A	#N/A	69.03	116.00	145.91	110.82	116.00	7.358	153.26	8,100	3	51.09	46.97
3.70	1,443,512	1,442,813	0.682	1.665	0.611	96.82	108.04	########	2,114,471	#N/A	#N/A	#N/A	66.06	112.55	139.69	108.04	112.55	7.358	147.05	8,100	3	49.02	46.49
3.80	1,447,474	1,446,268	0.684	1.647	0.609	92.60	105.43	########	2,115,180	#N/A	#N/A	#N/A	63.31	109.35	133.92	105.43	109.35	7.358	141.28	8,100	3	47.09	46.04
3.90	1,451,976	1,450,214	0.685	1.625	0.607	87.70	102.35	########	2,116,014	#N/A	#N/A	#N/A	60.10	105.60	127.18	102.35	105.60	7.358	134.54	8,100	3	44.85	45.50
4.00	1,456,027	1,453,784	0.687	1.605	0.604	83.18	99.47	########	2,116,795	#N/A	#N/A	#N/A	57.13	102.12	120.93	99.47	102.12	7.358	128.29	8,100	3	42.76	44.99
4.10	1,459,674	1,457,015	0.688	1.586	0.602	79.02	96.77	########	2,117,528	#N/A	#N/A	#N/A	54.37	98.89	115.13	96.77	98.89	7.358	122.49	8,100	3	40.83	44.52
4.20	1,462,962	1,459,941	0.689	1.568	0.600	75.18	94.24	########	2,118,216	#N/A	#N/A	#N/A	51.82	95.89	109.76	94.24	95.89	7.358	117.12	8,100	3	39.04	44.07
4.30	1,465,927	1,462,592	0.690	1.552	0.598	71.64	91.87	########	2,118,862	#N/A	#N/A	#N/A	49.45	93.10	104.78	91.87	93.10	7.358	112.14	8,100	3	37.38	43.65
4.40	1,468,603	1,464,996	0.691	1.537	0.596	68.37	89.65	########	2,119,470	#N/A	#N/A	#N/A	47.26	90.52	100.16	89.65	90.52	7.358	107.52	8,100	3	35.84	43.26
4.50	1,471,022	1,467,179	0.692	1.522	0.594	65.35	87.58	########	2,120,043	#N/A	#N/A	#N/A	45.23	88.12	95.88	87.58	88.12	7.358	103.24	8,100	3	34.41	42.90
4.60	1,473,208	1,469,162	0.693	1.509	0.592	62.56	85.64	########	2,120,582	#N/A	#N/A	#N/A	43.34	85.89	91.91	85.64	85.89	7.358	99.27	8,100	3	33.09	42.55
4.70	1,475,188	1,470,966	0.693	1.496	0.591	59.98	83.82	########	2,121,090	#N/A	#N/A	#N/A	41.59	83.83	88.22	83.82	83.83	7.358	95.58	8,100	3	31.86	42.23
4.80	1,476,982	1,472,609	0.694	1.484	0.589	57.59	82.11	########	2,121,568	#N/A	#N/A	#N/A	39.98	81.91	84.81	82.11	81.91	7.358	92.17	8,100	3	30.72	41.93
4.90	1,478,609	1,474,108	0.695	1.473	0.588	55.38	80.51	########	2,122,018	#N/A	#N/A	#N/A	38.47	80.13	81.64	80.51	80.13	7.358	89.00	8,100	3	29.67	41.65
5.00	1,480,087	1,475,477	0.695	1.463	0.586	53.33	79.02	########	2,122,443	#N/A	#N/A	#N/A	37.07	78.47	78.69	79.02	78.47	7.358	86.05	8,100	3	28.68	41.39
5.10	1,481,431	1,476,729	0.696	1.453	0.585	51.43	77.62	########	2,122,844	#N/A	#N/A	#N/A	35.78	76.92	75.95	77.62	76.92	7.358	83.31	8,100	3	27.77	41.15
5.20	1,482,654	1,477,877	0.696	1.444	0.584	49.66	76.31	########	2,123,222	#N/A	#N/A	#N/A	34.57	75.49	73.40	76.31	75.49	7.358	80.75	8,100	3	26.92	40.92
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	#N/A	#N/A	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	1.436	1.435	#N/A	33.44	74.15	71.02	75.09	74.15	7.358	78.38	8,100	3	26.13	40.71

								SDCHx (per exchanger)							
Time	Step	Q(D)	P(pp)	Psdc	Total Q	dTrc	No SDC Hx	Tube				Shell			
hrs	hrs	mmBtu/hr				degF/hr		Q, gpm	Pi	Tt,i	Tt,o	Q, gpm	Pi	Ts,i	Ts,o
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
5.30	0.00	40.120	1.5	-71.02	-29.40	-26.73	1	3000	315	123.11	75.09	4246	95	40.71	74.15
7.29		36.194	1.5	-76.74	-115.78		2	3000	315	130.00	78.02	4246	95	41.22	77.37
				0.09											

Time	Tube									Shell										
hrs	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	Tt,ave	rho	Cp	mu	k	Vel	Re	Pr	h (Btu/hr-ft2-F)	kmetal	Udirty
5.30	99.10	61.66	0.9967	4.62E-04	0.362	5.609	40,640	4.5855	1370	57.43	62.38	0.9995	7.83E-04	0.341	3.652	62,796	8.2684	982	8.628	422.80

Time	SDC HX tube side							SDC HX shell side							SDC Duty (per Hx)	Tt,o Iterate	Ts,o Iterate			Qccw, other	CCW Duty	Total CCW Flow	# CCW Hx	CCW Duty per HX		CCW Temp
hrs	W	WCp	Cr	NTU	ffectivenes	DT	Tt,o	W	WCp	Cr	NTU	ffectivenes	DTs	Ts,o	Btu/hr					mmBtu/hr	mmBtu/hr	gpm		mmBtu/hr		Ts,o
5.30	1,483,768	1,478,930	0.696	1.435	0.583	48.02	75.09	########	2,123,579	1.436	1.435	#N/A	33.44	74.15	71.02	75.09	74.15			7.358	78.38	8,100	3	26.13		40.71


Shutdown Cooling Temperature Transient with 33F River Water
SDC Hx Fouling = 0. hr-F-sqft/Btu, CCW Hx Fouling = 0. hr-F-sqft/Btu
Second SDC HX Started at 225F Primary Coolant
Temperature, F
CCW Temperature, F
Time, hours
370
330
290
250
210
170
130
90
50
110
100
90
80
70
60
50
40
30
0
1
2
3
4
5
6
Pri Cool Temp
SDC Return Temp
CCW Temp

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

FC 05694

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 31 + 2 Attach
OPPD - Ft. Calhoun	
CALCULATION TITLE (Indicative of the Objective): Calculation of Minimum Reactor Coolant Cooldown Time Using Shutdown Cooling System	QA CATEGORY (✓) ☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				OPTIONAL WORK PACKAGE NO.
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	
17321.01	46	PM-44		

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION * REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
JE Gormely 3/6/91 JE Gormely	MA Iannucci 3-11-91	MA Iannucci 3-11-91	0			✓
CJ Barron 6/8/94	JH Hall 6/27/94	JH Hall 6/27/94	1	0		✓

DISTRIBUTION*

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	Fire File	✓			
	Job Book (Orig.)				
	OPPD	✓			
	J.E. Gormely	✓			
	MA Iannucci	✓			

FC 05694

A5010 62

/W.O./CALCULATION NO.	REVISION	PAGE
17321.01	0	2 OF 31

CLIENT / PROJECT: OPPD / Ft. Calhoun

QA CATEGORY / CODE CLASS:

SUBJECT / TITLE: Calc. of Minimum Reactor Coolant Cooldown Time Using Shutdown Cooling Sys.

OBJECTIVE OF CALCULATION

To calculate minimum reactor coolant cooldown time using shutdown cooling system in order to close Open Item No. 7, SDSD-RC-CCW-100 Rev. 0.

Reason for Rev. 1:
- Updated RW flow data from Ref. 6
- Degraded CCW flow data based on Ref 4
- Replace Ref. 8 data with Ref. 4 data

CALCULATION METHOD/ASSUMPTIONS

See page 3. / Assumptions:

1. HXers perform at service "U" values
2. Although Ref. 7 calc. is confirmation required, it is assumed that any changes in the heat load will not affect the results of this calc.

SOURCES OF DATA / EQUATIONS

Ref. 1: SDSD-SI-130 Rev. 0
Ref. 2: Technical Data Book III-27-1 Rev. 2
Ref. 3: J.P. Holman, Heat Transfer, 2nd Ed., McGraw-Hill
Ref. 4: SWEC Calc. No. 17321.01-PM-25A Rev. 1 CCW Flow Balance and RC-1 Performance (Normal, Startup, Shutdown), Marissa Iannucci (FC05666) ^ △1
Ref. 5: Technical Manual for Shutdown Heat Exchangers (FC05888)
Ref. 6: SWEC Calc. No. 17321.01-PM-41 Rev. 0 Raw Water Flows to CCW Heat Exchangers ~~for 1 and 2 pump operation & minimum River Water Flow~~ ~~M. Iannucci~~
Ref. 7: SWEC Calc. No. 17321.01-PM-24 Rev. 1 Component Cooling Water System Heat Loads and Flows, ~~M. Iannucci~~ ~~Ref 8: SWEC Calc. No. 17321.01-PM-42 Rev. 0,~~
Ref 9: USAR Table 9.7-2, R3, 7/89 ~~Ref 10:~~

CONCLUSIONS

~~1. With RC coolant temp. of 300°F, 1 SD HXer in service with CCW flow throttled to 2107 gpm & 3060 gpm RC flow, 3 CCW HXers in service w/ total CCW flow of 8703 gpm, & total raw water flow of 7313 gpm @ 90°F, and total heat load of 131.6 x 10^6 Btu/hr, CCW temp will be slightly less than 120°F coolside.~~

~~2. Reactor coolant can be cooled from 300°F to 130°F in 24 hours using 1 SD HXer, 90°F river water, 3 CCW HXers, 2 CCW pumps, 2 Raw Water pumps.~~ △1

Refer to Page 3

REVIEWER (S) COMMENTS

PREPARER	DATE
~~JE Bonnelly~~ NA	~~2/6/91~~
REVIEWER / CHECKER	DATE
INDEPENDENT REVIEWER	DATE

WEBSTER ENGINEERING CORPORATION FC 05694
CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 3
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

Conclusions:

1. Based on a RC temp of 300°F, 1 S.D. Heat Exchanger in Service, CCW flow throttled to 1962 gpm, 3000 gpm RC flow, 3 CCW Heat Exchangers in Service, total CCW flow of 8100 gpm, total RW flow of 7159 at 90°F, and a total CCW heat load of 131.6×10^6 BTU/hr; the CCW temperature will be maintained less than 120°F.

2. The RC system can be cooled from 300°F to 130°F within 24 hours using 1 S.D. Heat Exchanger, 90°F River Water, 3 CCW Heat Exchangers, 2 CCW pumps, and 2 RW pumps.

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 4
17321.01	46	PM-44		

Calculation Method:

Reactor Coolant System cooldown rate is assumed to be accurately modelled by the following equation from Ref. 1; Attachment 9:

$$\frac{dT_{RC}}{dt} = \frac{1}{RMC_p}\left(Q_D + P_{RP} + P_{LP} - Q_{HX}\right)$$

where Q_{HX} = heat removed by the shutdown cooling hxer(s), Btu/hr

$\frac{dT_{RC}}{dt}$ = the rate of temperature change of the reactor coolant system, °F/hr

RMC_p = the thermal capacitance of the primary system, the steam generators, and the shutdown cooling system, including all water and steel, $= 1.1 \times 10^6$ Btu/°F

Q_D = Core Fission Product Decay Heat, Btu/hr

P_{RP} = Primary pump work into system when $R_C \geq 200$ °F. $P_{RP} = 9.0 \times 10^6$ Btu/hr per pump with a maximum of two RC pumps operating with $200° \leq R_C \leq 300°$; no RC pumps when $R_C < 200$ °F.

P_{LP} = LPSI pump work into system $= 1.5 \times 10^6$ Btu/hr for two pumps

Decay heat is modelled by fitting a power curve to the data of Reference 2. It is assumed that the reactor is cooled from normal operating temp. to 300 °F, using steam dump, in 2½ hours, implying a cooldown rate of about 100 °F/hr.

dT_{RC}/dt from the equation above is used to approximate $\Delta T_{RC}/\Delta t$ for small increments of time Δt. At the end of the time increment, Q_D is recalculated, as is a new heat removal rate for the shutdown heat exchanger(s). Unknown temperatures and duties at the reduced reactor coolant temperature are recalculated using the effectiveness-NTU method of Reference 3, Section 10-6. dT_{RC}/dt is then recalculated.

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 5
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	46	PM-44		

In order to check the capability of the CCW system to maintain CCW supply temperature at or below 120 °F with 300 °F RC, Shutdown HXer overall heat transfer coefficient is calculated using the Seider and Tate correlation (Ref. 3, p. 162) to calculate film coefficients. The outside film coefficient is corrected with a factor developed by calculating the film coefficients at the design points of the HXer. LMTD for the divided flow Shutdown HXers is corrected from counterflow LMTD by the plot on p. 302 of Ref. 3. Service heat transfer coefficient is derived from the calculated (clean) heat transfer coefficient by the relation $R_f = \frac{1}{U_{dirty}} - \frac{1}{U_{clean}}$, where R_f is the overall fouling factor, and U_{dirty} & U_{clean} are the service and clean heat transfer rates respectively. (Ref. 3, p. 296)

CCW heat exchanger performance is calculated from design point service heat transfer coefficient using the effectiveness-NTU method.

The calculation time step is 0.1 hour from 2.5 to 10.5 hours because the change in temperature is relatively rapid (up to 40°F/hr). From 10.5 to 26.4 hours the time step is increased to 0.5 hours because the temperature change is slower (less than 4°F/hr).

1

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 6
17321.01	46	PM-44		

Calculation

The first part of the calculation is to determine the maximum heat transfer rate when shutdown cooling is initiated in order to verify the capability of the CCW HXers to handle the heat load with 90°F river water.

Since CCW flow, and temperatures of both the CCW & the reactor coolant differ greatly from the design specifications, shutdown cooling HXer performance at system initiation must be determined by calculating film coefficients at the abnormal conditions.

The Seider and Tate correlation is (Ref 3, p. 162):

$$Nu_d = 0.027\, Re_d^{0.8}\, Pr^{1/3} \left(\frac{\mu}{\mu_w}\right)^{0.14}$$

where Nu_d = Nusselt No. = $\frac{hd}{K}$; Re_d = Reynolds No. = $\frac{\rho V d}{\mu}$; Pr = Prandtl No. = $\frac{C_p \mu}{K}$; h is the heat transfer (film) coefficient, Btu/hr-ft²-°F; d is the diameter, feet; K is the thermal conductivity, Btu/hr-ft-°F; ρ is the density, lbm/ft³; V is flow velocity, ft/hour; d is the diameter, ft; μ is the dynamic viscosity, lbm/ft-hr; and C_p is the specific heat at constant pressure, Btu/lbm-°F. $\left(\frac{\mu}{\mu_w}\right)^{0.14}$ is the ratio of the bulk viscosity to the viscosity at wall temp.; $\left(\frac{\mu}{\mu_w}\right)^{0.14}$ is approximated as unity. Since velocity on the shellside is very nonuniform and depends on the details of the internal baffling, a Reynolds number correction factor will be developed by calculating film coefficients, including a correction factor, f, for the outside film coefficient, for the shutdown HXers at design conditions. Then, the formula for overall heat transfer coefficient will be solved for f (using the manufacturers stated overall heat transfer coefficient)

All property data is for pure water and is from Ref. 3, p. 383. From Ref. 5, SD HXer tube OD is 0.750 in, tubes are 18 BWG ⇒ tube ID = 0.750 - 2(0.049) = 0.652 in, tube effective area is 5020 ft², 1040 tubes, Clean U is 487, service U is 320 Btu/hr-ft²-°F at design point conditions (4500 gpm ccw flow, 93°F inlet temp., 3000 gpm RC flow, 140°F inlet temp) Corresponding "mean" shell velocity (CCW) is 4.0 fps.

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 7
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	46	PM-44		

$Nu_d = 0.027\, Re_d^{0.8}\, Pr^{1/3} \left(\frac{\mu}{\mu_w}\right)^{0.14}$; since $Nu_d = \frac{hd}{K}$ and assuming $\left(\frac{\mu}{\mu_w}\right)^{0.14} \approx 1$;

$h = \frac{K}{d}\, 0.027\, Re_d^{0.8}\, Pr^{1/3}$

Tubeside, using design flow & Av. temp of 120°F:

$$h_i = \frac{0.375}{(0.652/12)}(0.027)\left(\frac{(0.652/12)(5.5)(3600)(61.54)}{1.24}\right)^{0.8}(3.3)^{1/3}$$

$= 1679.3$

Shellside, using design flow & Av. temp. of 100°F, with correction factor "f" to correct Reynolds number for flow around baffling, etc.:

$$h_o = \frac{0.364}{(0.75/12)}(0.027)\left(\frac{(0.75/12)(4)(f)(3600)(61.99)}{1.65}\right)^{0.8}(4.53)^{1/3}$$

$= 1092.8\,(f)^{0.8}$

$$U_o = \frac{1}{\frac{A_o}{A_i}\frac{1}{h_i} + \frac{A_o \ln(r_o/r_i)}{2\pi K L} + \frac{1}{h_o}} = 487 \quad \text{(Ref. 3, p. 295)}$$

$$487 = \frac{1}{\frac{(0.750)}{(0.652)}\frac{1}{(1679.3)} + \frac{5020 \ln(0.75/0.652)}{2\pi(9)(24.58)(1040)} + \frac{1}{1092.8(f)^{0.8}}}$$

$$\frac{1}{1092.8(f)^{0.8}} = \frac{1}{487} - \frac{(0.750)}{(0.652)}\frac{1}{(1679.3)} - \frac{5020 \ln(0.75/0.652)}{2\pi(9)(24.58)(1040)}$$

$= 0.00088212$

$$(f)^{0.8} = \frac{1}{(0.00088212)(1092.8)} = 1.0374$$

$f = 1.0470$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

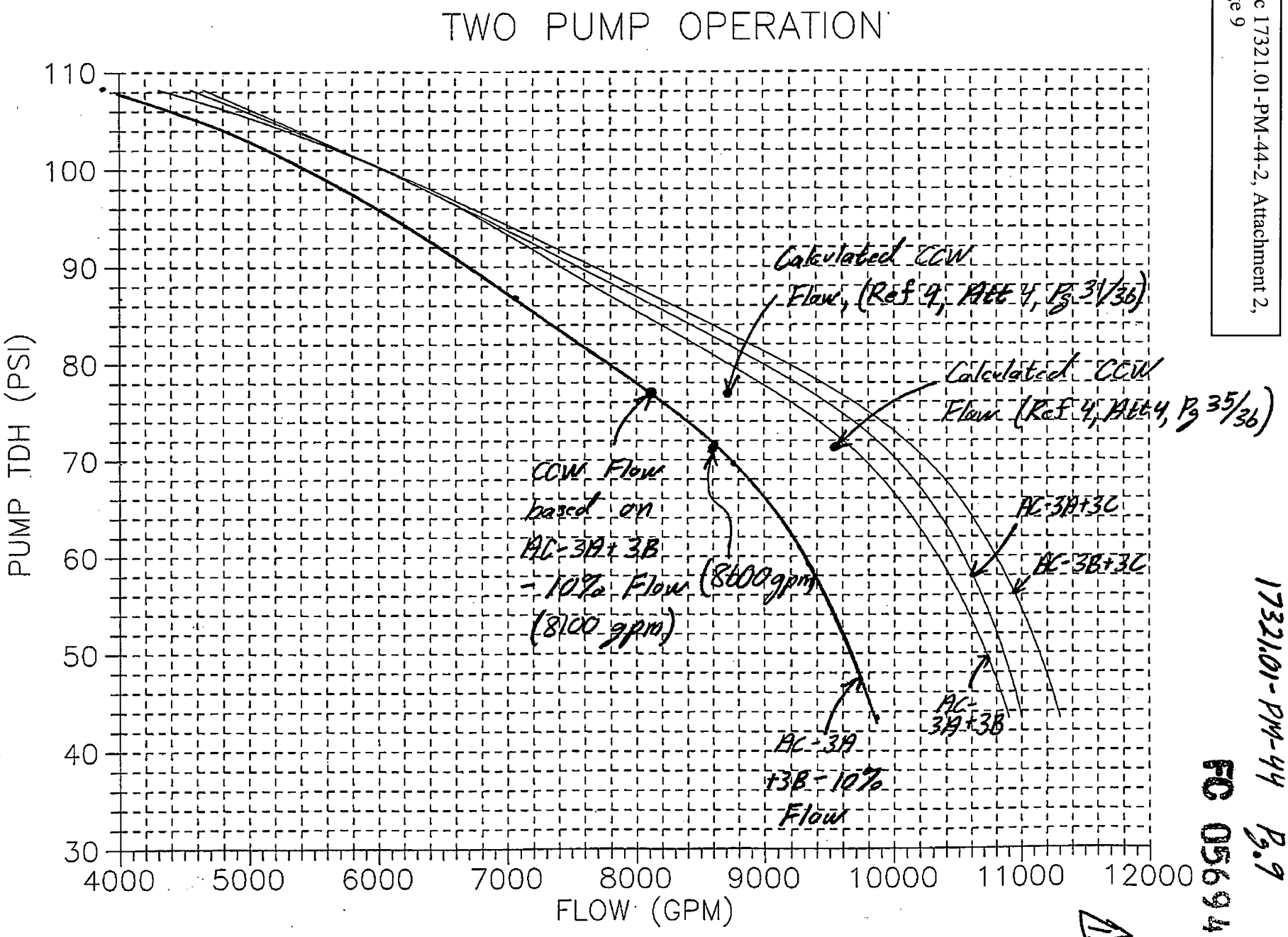
FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 8
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

• Determine CCW flow to S.D. heat exch. based on AC-3A + AC-3B pump curves -10% flow to account for degraded pump performance. As shown on Pg. 9 the calculated CCW flow from Ref 4 is 8703 gpm with a TDH of 77 psi. Conservatively assuming a TDH of 77 psi at a lower flow, the CCW flow corresponding to the degraded pump curve is approximately 8100 gpm. From Ref 4, Att 4, Pg 31/36 the calculated AC-4B flow is 2108 gpm. Correcting for the degraded pump curve:

$$Q = 2108\left(\frac{8100}{8703}\right) = 1962 \text{ gpm}$$



17321.01-PM-44 Pg. 9

FC 05694

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲ 5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 10
17321.01	46	PM-44		

Estimate of Shutdown Cooling HXer Performance with 300°F Reactor Coolant

- Only 1 SD HXer is assumed to be in operation when shutdown cooling is initiated. This is done in order to limit RC temp. change to 100°F/hr. and also to try to maintain component cooling water supply temperature to the tech. spec. limit of 120°F. For the same reasons, CCW flow to the SD HXer is assumed to be throttled to 2108 gpm (Ref. 4). RC flow to the shutdown HXer is assumed to be 3000 gpm (Ref. 5)

(1962 gpm (Refer to Pg. 8)

First, estimate average temps on both sides of HXer in order to determine fluid properties.

Tubeside (RC) - temp. in: 300°F
temp. out: 220°F (estimate)
Av. temp: 260°F

Shellside (CCW) - temp. in: 120°F (tech. spec. limit)
temp. out: 240 ~~235~~°F (estimate based on RC ΔT and flows)
~Av. temp: 180°F

Film coefficients

Tubeside - properties evaluated at average temp. of 260°F:

$$h_i = \frac{0.396}{(0.652/12)}(0.027)\left(\frac{(0.652/12)(5.5)(3600)(58.51)}{0.53}\right)^{0.8}\left(\frac{(1.015)(0.53)}{0.396}\right)^{1/3}$$
$$= 2501$$

Shellside - properties evaluated at average temp. of 180°F:

$$h_o = \frac{0.389}{(0.75/12)}(0.027)\left(\frac{(0.75/12)\left(\frac{2108}{4500}\right)(4)(1.0410)(3600)(60.57)}{0.84}\right)^{0.8}(2.16)^{1/3}$$

(1962) Velocity "ρ" from p. 7

$$= \cancel{869.3}\ 820.8$$

$$U_o = \frac{1}{\left(\frac{0.75}{0.652}\right)\frac{1}{2501} + \frac{5020\ \ln(0.75/0.652)}{2\pi(60)(24.58)(1040)} + \frac{1}{\cancel{869.3}\ 820.8}} = \cancel{488.3}\ 472.6$$

$$\Delta T_{mean} = \frac{(220-120)-(300-\cancel{235}\ 240)}{\ln[(220-120)/(300-\cancel{235}\ 240)]} = \cancel{81.85}\ 78.30\ °F$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 11
17321.01	46	PM-44		

From Ref 3, p 302, $R = \cancel{115}\ 120/80 = \cancel{1.44}\ 1.50$, $P = -80/-180 = 0.44$, and correction factor $\approx \cancel{0.72}\ 0.65$

Corrected LMTD $= \cancel{0.72}\ 0.65\ (\cancel{81.25}\ 78.30) = \cancel{58.5}\ 50.9\ °F$

From Ref 3, p.296, $R_f = \frac{1}{U_{dirty}} - \frac{1}{U_{clean}}$, where R_f is the overall fouling factor, and U_{dirty} & U_{clean} are the service and clean heat transfer rates respectively. From the design point data for the SD HXer (Ref 5):

$$R_f = \frac{1}{320} - \frac{1}{467} = 0.001072$$

For shutdown cooling initiation conditions

$$0.001072 = \frac{1}{x} - \frac{1}{\cancel{486.3}\ 472.6}; \quad x = \cancel{320.5}\ 313.7\ Btu/hr\text{-}ft^2\text{-}°F$$

$$Q = U_{dirty} A (\Delta T_{mean})_{corr.} = \cancel{320.5}\ 313.7 (5020)(\cancel{58.5}\ 50.9) = \cancel{84.1}\ 80.2 \times 10^6\ Btu/hr$$

$$\Delta T_{Tubeside} = \frac{Q}{\dot{m} C_p} = \frac{\cancel{84.1}\ 80.2 \times 10^6}{(3000)(7.48)(57.31)^{*}(1.02)(60)} = \cancel{66.9}\ 57.0\ °F$$

*ρ @ 300°F

This is less than the original estimate of 80 °F, so iterate:

Tubeside (RC) - temp. in: 300 °F
temp. out: 230 °F (estimate)
Av. temp.: 265 °F

Shellside (CCW) - temp. in: 120 °F (Tech. spec. limit)
temp. out: 230 ~~140~~ °F (estimate)
Av. temp: ~~170~~ 175 °F

Film coefficients

Tubeside - properties evaluated at average temp. of 265 °F:

$$h_i = \frac{0.396}{(0.652/12)}(0.027)\left(\frac{(0.652/12)(5.5)(3600)(58.31)}{0.52}\right)^{0.8}(1.33)^{1/3} = 2516$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲ 5010.55

CALCULATION IDENTIFICATION NUMBER				PAGE 12
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

Shellside - properties evaluated at average temp. of ~~170~~ 175 °F:

$$h_o = \frac{\cancel{0.386}\ .387}{(0.75/12)}(0.027)\left(\frac{(0.75/12)(\cancel{2166}\ 1962/\cancel{4500})(4)(1.0470)(3600)(\cancel{60.72}\ 60.68)}{\cancel{0.48}\ .86}\right)^{0.8}\left(\frac{\cancel{2.33}\ 2.25}{}\right)^{1/3}$$

$$= \cancel{892.6}\ 813.5$$

$$U_o = \frac{1}{\left(\frac{0.75}{0.652}\right)\frac{1}{2516} + \frac{5020\ \ln(0.75/0.652)}{2\pi(10)(24.58)(1040)} + \frac{1}{\cancel{892.6}\ 813.5}} = \cancel{479.4}\ 470.8$$

$$\Delta T_{mean} = \frac{(230-120)-(300-\cancel{220}\ 230)}{\ln[(230-120)/(300-\cancel{220}\ 230)]} = \cancel{94.20}\ 88.50$$

From Ref. 3, p. 302, $R = (120-\cancel{220}\ 230)/(230-300) = \cancel{1.43}\ 1.57$,
$P = (230-300)/(120-300) = 0.39$, and correction factor ≈ ~~0.84~~ 0.80

Corrected LMTD = ~~0.84~~ 0.80 (~~94.20~~ 88.50) = ~~79.1~~ 70.8

$$0.001072 = \frac{1}{x} - \frac{1}{\cancel{479.4}\ 470.8}\ ;\ x = \cancel{346.1}\ 312.9\ \text{Btu/hr-ft}^2\text{-°F}$$

$$Q = U_{eff.}A(\Delta T_{mean})_{corr} = \cancel{346.1}\ 312.9\,(5020)(\cancel{79.1}\ 70.8) = \cancel{125.8}\ 111.2 \times 10^6\ \text{Btu/hr}$$

$$\Delta T_{tubeside} = \frac{Q}{\dot{m}\,c_p} = \frac{\cancel{125.8}\ 111.2 \times 10^6\ \text{Btu/hr}}{(3000/7.48)(57.31)(1.02)(60)} = \cancel{89.43}\ 79.05\ °F$$

This is ~~much~~ greater than the assumed ΔT tubeside of 70 °F, so iterate one more time with an estimated ΔT of ~~76~~ 73 °F:

Tubeside (RC) - temp. in.: 300 °F
temp. out: ~~274~~ 227 °F (estimate)
Av. temp: ~~262~~ 263.5 °F

Shellside (CCW) - temp. in: 120 °F
temp. out: ~~230~~ 232 °F (estimate)
Av. temp.: ~~175~~ 176 °F

Film coefficients

Tubeside - properties evaluated at average temp. of ~~262~~ 263.5 °F:

$$h_i = \frac{0.396}{(0.652/12)}(0.027)\left(\frac{(0.652/12)(5.5)(3600)(\cancel{58.45}\ 58.42)}{0.52}\right)^{0.8}\left(\frac{\cancel{1.35}\ 1.34}{}\right)^{1/3}$$

$$= \cancel{2532}\ 2525$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲ 5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 13
17321.01	46	PM-44		

Shellside - properties evaluated at average temp. of ~~175~~ 176 °F:

$$h_o = \frac{0.388}{(0.75/12)}(0.027)\left(\frac{(0.75/12)\left(\frac{\cancel{2108}\ 1962}{4500}\right)(4)(1.0470)(3600)\left(\frac{\cancel{62.68}\ 60.66}{\cancel{0.87}\ 0.86}\right)}{\cancel{0.24}\ 2.23}\right)^{0.8}\left(\cancel{0.24}\ 2.23\right)^{1/3}$$

$= \cancel{8546}\ 813.0$

$$U_o = \frac{1}{\left(\frac{0.75}{0.652}\right)\left(\frac{1}{\cancel{2592}\ 2525}\right) + \frac{5020\ \ln(0.75/0.652)}{2\pi(10)(24.58)(1040)} + \frac{1}{\cancel{8546}\ 813.0}} = \cancel{484.9}\ 471.0$$

$$\Delta T_{mean} = \frac{(\cancel{224}\ 227 - 120) - (300 - \cancel{230}\ 232)}{\ln[(\cancel{224}\ 227 - 120)/(300 - \cancel{230}\ 232)]} = \cancel{85.88}\ 86.03\ °F$$

From Ref. 3, p. 302, $R = (120 - \cancel{230}\ 232)/(\cancel{224}\ 227 - 300) = \cancel{1.45}\ 1.53$,
$P = (\cancel{224}\ 227 - 300)/(120 - 300) = \cancel{0.42}\ 0.41$, and correction factor $\approx \cancel{0.78}\ 0.77$

Corrected LMTD $= \cancel{0.78}\ 0.77\ (\cancel{85.88}\ 86.03) = \cancel{67}\ 66.24\ °F$

$0.001072 = \frac{1}{x} - \frac{1}{\cancel{484.9}\ 471.0}$; $x = \cancel{319.1}\ 313.0$ Btu/hr-ft²-°F

$Q = U_{eff.} A (\Delta T_{mean})_{corr} = \cancel{319.1}\ 313.0\ (5020)(\cancel{67}\ 66.24) = \cancel{104.3}\ 104.1 \times 10^6$ Btu/hr

$$\Delta T_{tubeside} = \frac{Q}{mC_p} = \frac{\cancel{104.3}\ 104.1 \times 10^6\ \text{Btu/hr}}{(3000/7.48)(57.31)(1.02)(60)} = \cancel{76.28}\ 74.0\ \cancel{\approx 76°F} \approx 73°F$$

Initial heat rejection (1962) to CCW system, with 3000 gpm RC flows @ 300°F, ~~2108~~ gpm CCW flow at 120°F, and one SD HXer operational, will be about ~~107~~ 104 $\times 10^6$ Btu/hr

Evaluation of CCW HXer Capability

The following is an (7159) evaluation of CCW HXer capability to maintain 120°F (2056-2617) return temperature with 3 HXers operational, 90°F river water, and shutdown HXer duty at maximum as calculated above. Total Raw Water flow to the HXers* = ~~7313~~ gpm (Ref. 6) total ≈ ~~2450~~ gpm each. CCW flow to the HXers = ~~8703 gpm ≈ 2900 gpm each (Ref 4)~~ 8100 gpm (Refer to P. 14). Since these flows are not widely at variance (approximately 10 to 15% less) with the design flows for the CCW HXers, and temperatures somewhat greater than design, the effectiveness-NTU method will be used to estimate performance.

* assuming 2 raw water pumps operating

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 14
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

• Determine CCW flow to CCW heat exch. based on AC-3A + AC-3B pump curves -10% flow to account for degraded pump performance. As discussed on Pg. 8 the total CCW flow corresponding to the degraded pump curve is approximately 8100 gpm. From Ref 4, Pg 32/36 the calculated CCW heat exchanger flows are:

AC-1A = 2884 gpm
AC-1B = 2862 gpm
AC-1C = 2959 gpm

Correcting for the degraded pump curve:

$$AC\text{-}1A = 2884\left(\frac{8100}{8703}\right) = 2684 \text{ gpm}$$

$$AC\text{-}1B = 2862\left(\frac{8100}{8703}\right) = 2664 \text{ gpm}$$

$$AC\text{-}1C = 2959\left(\frac{8100}{8703}\right) = 2754 \text{ gpm}$$

EBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 15
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	46	PM-44		

From Ref. 7, the heat load on the on the CCW system, from other than the shutdown cooling HXer, is 23.846×10^6 Btu/hr. Adjustments to that are as follows:

Ref. 7 total	23.846	
Storage Pool HXer - 11 instead of 9×10^6 Btu/hr	+2	Ref. 9
RC Pump Seal & LO Coolers - 1.575 instead of 3.15 Btu/hr	-1.575	(2 RC Pump Op.)
Control Room Air Conditioners .88 instead of 0.218*	+0.662	Ref 9
	24.933×10^6 Btu/hr	

* Checkers comment - was 0.3×10^6 Btu/hr not 0.218 error is minor and is conservative in that it overstates heat load slightly.

Total heat transferred is therefore 106.7 + 24.933 = 131.633×10^6 Btu/hr. Heat transferred per CCW HXer is $131.633 \times 10^6 / 3$ = 43.877 say ~~44~~ $\times 10^6$ Btu/hr

Raw water mass flow rate is (~~2450~~ 2056 gpm / 7.48 g/ft³) × 62.11 lbm/ft³ × 60 m/h = ~~1.221~~ 1.024 × 10^6 lbm/hr

CCW water mass flow rate is (~~2800~~ 2754 gpm / 7.48 g/ft³) × 61.73 lbm/ft³ × 60 m/h = ~~1.436~~ 1.364 × 10^6 lbm/hr

Capacity rates are therefore (assuming cp ≈ 1 Btu/lbm - °F) ~~1.221~~ 1.024 × 10^6 Btu/hr - °F & 1.436 (1.364) × 10^6 Btu/hr - °F respectively and raw water is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{\cancel{1.221}\ 1.024 \times 10^6}{\cancel{1.436}\ 1.364 \times 10^6} = \cancel{0.850}\ 0.751$$

From the CCW HXer design data sheets, the service "U" is 233.6 Btu/hr and the effective area is 12,400 ft². From Ref. 3, p. 312, NTU = UA/Cmin = (233.6 × 12,400) / (1.22 1.024) × 10^6 = ~~1.312~~ 2.829. From the chart in Ref 3, p 311, effectiveness = ~~74~~ 81%

Effectiveness is also defined as the actual heat transfer divided by the maximum possible (with infinite HXer area) heat transfer, which is the capacity rate of the minimum fluid multiplied by the maximum temp. difference in the HXer.

CCW inlet temp., assuming a cold side temp of 120 °F, is calculated as follows:

$$\Delta T = (x - 120) = Q/mcp = (131.633 \times 10^6)/(\cancel{1.436} \times 10^6)(1)(3) = \cancel{30.56}\ 32.17\ °F$$

$$x = \cancel{150.56}\ 152.17\ °F$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 16
17321.01	46	PM-44		

Maximum temp. difference in the HXer is therefore inlet CCW temp. less inlet Raw Water temp. = ~~150.56~~ 152.17 - 90 = ~~60.56~~ 62.17 °F

Effectiveness = ~~74~~ 81 % = Actual heat transfer / (~~1.221~~ 1.024 × 10^6 Btu/hr-°F)(~~60.56~~ 62.17)

Actual heat transfer = ~~37.7 × 10^6~~ 51.6 × 10^6 Btu/hr

Since the duty per exchanger is only 44 × 10^6 Btu/hr, CCW supply temp. will be maintainable at slightly less than 120 °F with 90 °F raw water.

Estimate of Cooldown Time

In order to simplify the analysis, the effectiveness-NTU method will be used to estimate the performance of the SD Cooling HXer. Overall heat transfer coefficient when RC temp. is above 200 °F is based on the Made "C" data sheet for the HXers. (Ref. 5.) From that data sheet, clean heat transfer coefficient is 455.2 Btu/hr-ft²-°F, with 2250 gpm flow of RC at 212 °F inlet temp., and 2937 gpm CCW @ 95 °F inlet temp. Service heat transfer coefficient is calculated as follows:

$$R_F = 0.001072 = \frac{1}{U_{dirty}} - \frac{1}{U_{clean}}$$

$$\frac{1}{U_{dirty}} = 0.001072 + \frac{1}{455.2}$$

$$U_{dirty} = 305.9 \text{ Btu/hr-ft}^2\text{-°F}$$

This compares to the value calculated on p. ~~12~~ 13 of ~~311.1~~ 313.0 Btu/hr-ft²-°F.

RC mass flow rate (at average temp. of 250 °F) is calculated as follows:

$$\frac{(3000 \text{ gpm})(58.80 \text{ lbm/ft}^3)(60 \text{ m/hr})}{(7.48 \text{ g/ft}^3)} = 1.415 \times 10^6 \text{ lbm/hr}$$

CCW mass flow rate (at 120 °F) is calculated as follows:

$$\frac{(\cancel{2109}\ 1962 \text{ gpm})(61.73 \text{ lbm/ft}^3)(60 \text{ m/hr})}{(7.48 \text{ g/ft}^3)} = \cancel{7.044 \times 10^5}\ 9.715 \times 10^5 \text{ lbm/hr}$$

EBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 17
17321.01	46	PM-44		

Assuming $C_p \approx 1$ Btu/lbm-°F for both liquids, capacities are 1.415×10^6 & ~~(1.044×10^6)~~ 9.715×10^5 Btu/hr-°F respectively, and CCW is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{\cancel{1.044 \times 10^6}\ 9.715 \times 10^5}{1.415 \times 10^6} = \cancel{0.74}\ 0.69$$

From the SD HXer data sheets in Ref. 5, effective tube surface area is 5020 ft². From Ref. 3, p. 312,

$$NTU = UA/c_{min} = (305.9)(5020)/(\cancel{1.044 \times 10^5}\ 9.715 \times 10^5) = \cancel{1.47}\ 1.58$$

From the chart in Ref 3, p. 314, effectiveness = ~~57.5~~ 60 %

Effectiveness is also defined as the actual heat transfer divided by the maximum possible (with infinite HXer area) heat transfer, which is the capacity rate of the minimum fluid multiplied by the maximum temp. difference in the HXer.

$$\text{Effectiveness} = \cancel{57.5}\ 60.0\ \% = \frac{\text{Actual heat transfer}}{(C_{min})(T_{RC_{in}} - T_{CCW_{in}})}$$

$$\text{Actual heat transfer} = (\cancel{0.575}\ .60)(\cancel{1.044 \times 10^6}\ 9.715 \times 10^5)(T_{RC_{in}} - 120°F)$$
$$= \cancel{6.009 \times 10^5}\ 5.829 \times 10^5 (T_{RC_{in}} - 120)$$

As shutdown HXer load on the CCW system decreases due to decreasing RC temperature, the CCW inlet temperature will drop. As RC temperature drops, CCW flow to the shutdown coolers can also be increased without fear of either exceeding the max. allowable RC cooldown rate or exceeding the max. coolside CCW temp. of 120°F. It is hypothesized that when RC temp. has decreased to 250 ~~200~~ °F, CCW flow to the shutdown HXer can be increased by opening the throttle valve fully; at that point, CCW coolside temperature is estimated to be ~~120~~ 110 °F, and CCW flow is 4728 gpm (Ref. 8). SD HXer performance estimate is based on the effectiveness-NTU method applied to the service heat transfer coefficient at the design point (Mode B, Ref. 5), 320 Btu/hr-ft²-°F.

4246 gpm (Refer to Page 18)

RC mass flow rate (at average temp. of ~~165~~ 190 °F) is calculated as follows (On Page 19):

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 18
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17472.01	PM	44		

• Determine CCW flow to S.D. heat exchanger based on AC-3A and AC-3B pump curves - 10% flow to account for degraded pump performance. As shown on Pg. 9 the calculated CCW flow from Ref 4 is 9577 gpm with a TDH of 71.8 psi. Conservatively assuming a TDH of 71.8 psi at a lower flow, the CCW flow corresponding to the degraded pump curve is approximately 8600 gpm. From Ref. 4, Att 4, Pg 35/36 the calculated AC-4B flow is 4728 gpm. Correcting for the degraded pump curve

$$Q = 4728\left(\frac{8600}{9577}\right) = 4246 \text{ gpm}$$

1

EBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲ 5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 19
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	46	PM-44		

$$\frac{(3000\,gpm)(\cancel{60.42}\,60.34\,lbm/ft^3)(60\,min/h)}{7.48\,g/ft^3} = \cancel{1.4655\times10^6}\ 1.452\times10^6\ lbm/hr$$

CCW mass flow rate (@ ~~100~~ 110 °F) is calculated as follows:

$$\frac{(\cancel{4728}\ 4246\,gpm)(\cancel{61.99}\ 61.86\,lbm/ft^3)(60\,min/h)}{7.48\,g/ft^3} = \cancel{2.351}\ 2.107\times10^6\ lbm/hr$$

Assuming $C_p \approx 1$ Btu/lbm-°F for both liquids, capacities are ~~1.4655~~ & ~~2.351~~ $\times10^6$ Btu/hr-°F respectively, and reactor coolant is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{\cancel{1.4655}\ 1.452\times10^6}{\cancel{2.351}\ 2.107\times10^6} = \cancel{0.623}\ .689$$

$$NTU = \frac{UA}{C_{min}} = \frac{320(5020)}{\cancel{1.4655}\ 1.452\times10^6} = \cancel{1.096}\ 1.106$$

From the chart in Ref. 3, p. 314, effectiveness = ~~54.56~~ 52 %

$$\text{Effectiveness} = \cancel{54.58\%}\ 52.0 = \frac{\text{Actual heat transfer}}{(C_{min})(T_{RCin} - T_{ccwin})}$$

$$\text{Actual heat transfer} = (\cancel{0.5458}\ 0.52)(\cancel{1.4655}\ 1.452\times10^6)(T_{RCin} - \cancel{100}\ 110\,°F)$$

$$= \cancel{8.438\times10^5}\ 7.55\times10^5\,(T_{RCin} - \cancel{100}\ 110)$$

(Go to Pg 20)

A power curve was fitted to data picked off the curve shown in Ref 2, which shows a curve of decay heat as a percent of full power vs. time after shutdown. "Full power" is taken to mean 1500 MW_{th} = 5.118×10^9 Btu/hr. The following chart shows the values picked off the curve as well as predicted values from the equation Power (Btu/hr) = $(68.762\times10^6)(t^{-0.32306})$ where t is time after reactor trip, hrs

t, hours	Ref. 2 %-age	Extension MMBtu/hr	Predicted Power MMBtu/hr
2.5	0.98	50.2	51.1
3.5	0.90	46.1	45.9
4.5	0.83	43.5	42.3
5	0.80	41.0	40.9
10	0.63	32.3	32.7
15	0.55	28.2	28.7
20	0.51	26.1	26.1
25	0.48	24.6	24.3

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 20
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

(Insert for Pg 19) (4 pages)

- When the RC temperature drops to 180°F, the CCW temperature is estimated to be 100°F and the CCW flow remains 4246 gpm to the S.D. heat exchanger. S.D. Heat Exchanger performance estimate is based on the effectiveness-NTU method applied to the service heat transfer coefficient at the design pt (Mode B, Ref 5), 320 BTU/hr-ft²-F.

RC mass flow rate (at average temp = 150°F) is calculated as follows:

$$\frac{(3000\ gpm)(61.19\ lbm/ft^3)(60\ min/hr)}{7.48\ g/ft^3} = 1.472\times10^6\ lbm/hr$$

CCW mass flow rate (at average temp = 100°F) is calculated as follows:

$$\frac{(4246\ gpm)(61.99\ lbm/ft^3)(60\ min/hr)}{7.48\ g/ft^3} = 2.111\times10^6\ lbm/hr$$

1

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 21
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

Assuming $C_p \approx 1$ BTU/lbm-°F for both liquids, capacites are 1.472×10^6 and 2.111×10^6 BTU/hr-°F, respectively, and RC is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{1.472 \times 10^6}{2.111 \times 10^6} = .6973$$

$$NTU = UA/C_{min} = \frac{320(5020)}{1.472 \times 10^6} = 1.091$$

From Ref. 3, Pg 314, effectiveness = 52%

$$\text{Effectiveness} = 52\% = \frac{\text{Actual heat transfer}}{(C_{min})(T_{RC_{in}} - T_{CCW_{in}})}$$

$$\text{Actual Heat Transfer} = (0.52)(1.472 \times 10^6)(T_{RC_{in}} - 100)$$

$$= 7.65 \times 10^5 (T_{RC_{in}} - 100)$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

▲5010.65

FC 05694

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 22
17321.01	PM	44		

- When the RC temperature drops to 135°F, the CCW temperature is estimated to be 96°F and the CCW flow remains 4246 gpm to the S.D. heat exchanger. S.D. Heat Exchanger performance estimate is based on the effectiveness-NTU method applied to the service heat transfer coefficient at the design pt (Mode B, Ref 5) 320 BTU/hr-ft²-F.

RC mass flow rate (at average temp. = 135°F) is calculated as follows:

$$\frac{(3000\ gpm)(61.46\ lbm/ft^3)(60\ min/hr)}{7.48\ g/ft^3} = 1.479\times10^6\ lbm/hr$$

CCW mas flow rate (at average temp = 96°F) is calculated as follows:

$$\frac{(4246\ gpm)(62.05\ lbm/ft^3)(60\ min/hr)}{7.48\ g/ft^3} = 2.113\times10^6\ lbm/hr$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 23
17321.01	PM	44		

Assuming $C_p \approx 1$ BTU/lbm-F for both liquids, capacities are 1.479×10^6 and 2.113×10^6 BTU/hr-F, respectively, and RC is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{1.479 \times 10^6}{2.113 \times 10^6} = 0.700$$

$$NTU = UA/C_{min} = \frac{320(5020)}{1.479 \times 10^6} = 1.086$$

From Ref 3, Pg 314, effectiveness = 52%

$$\text{Effectiveness} = 52\% = \frac{\text{Actual Heat Transfer}}{(C_{min})(T_{RC_{in}} - T_{CCW\,in})}$$

$$\text{Actual Heat Transfer} = (.52)(1.479 \times 10^6)(T_{RC_{IN}} - 96)$$

$$= 7.69 \times 10^5 (T_{RC_{in}} - 96)$$

(Return to Page 19)

EBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 24
17321.01	46	PM-44		

The power curve was fitted to the data using an internal program in a Hewlett Packard HP-45X calculator. The coefficient of correlation was -0.998413. Coefficient of determination = (coefficient of correlation)^2 = 0.996828. (1.0... is a perfect fit)

The following is a summary of equations used to model reactor coolant system cooldown:

Decay Heat (Q_d), Btu/hr = $(68.762E6)(t^{-0.32305})$, t hours after reactor trip.

Pump Heat (P_p), Btu/hr = 19.5E6 for $T_{RC} > 200$, 1.5E6 for $T_{RC} \leq 200$.

Heat Rejected to Shutdown HXer (Q_{hx}), Btu/hr = ~~(-6.003E5)~~ $(T_{RC}-120)$ for $T_{RC} > 250$; ~~(-8.439E-5)~~ $(-7.55E5)(T_{RC}-110)$ for $T_{RC} \leq 250$ and $T_{RC} > 180$; $(-5.829E5)(T_{RC}-100)$ for $T_{RC} \leq 180$ and $T_{RC} > 135$; $(-7.69E5)(T_{RC}-96)$ for $T_{RC} \leq 135$ 1

$$dT_{RC}/dt\ (°F/hr) = \frac{(Q_d + P_p + Q_{hx})}{1.1 \times 10^6}$$

ΔT(°F) $\approx dT_{RC}/dt\ (\Delta t)$ where Δt is a small time step in hours.

The above equations were implemented in a spreadsheet program. It was hypothesized that shutdown cooling would be initiated 2½ hours after reactor trip, at T_{RC} = 300 °F (implying a cooldown rate of 100 °F/hr up to that time. From 2½ to 10½ hours after reactor trip, time steps of 0.1 hour were used; from 10½ to 26½ hours, time steps of 0.5 hour were used. After 24 hours of shutdown cooling, (26.5 hours after reactor trip) this simulation indicated that T_{RC} would be ~~130.5~~ 130.03 say 130 °F. 1

EBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 25
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

Verification that (Tcw)cold can be maintained at ≤ ~~100~~ 110 °F ⚠ when TRC ≤ ~~200~~ 250 °F.

First, assume (Tccw)cold is ~~100~~ 110 °F. TRC is ~~200~~ 250 °F and heat transferred to the CCW through the shutdown cooler is (~~8.438×10^5~~ 7.55×10^5)(TRC − ~~100~~ 110) = (~~8.438×10^5~~ 7.55×10^5)(~~100~~ 140) = (~~8.438×10^7~~ 10.57×10^7) Btu/hr. Heat from other sources is the 24.933×10^6 Btu/hr from p. XX 15 less letdown HXer (2.6×10^6 Btu/hr), SI Tank Leakage Coolers (2.4×10^6 Btu/hr), RC Pump Seal & LO Coolers (1.575×10^6 Btu/hr) & Storage Pool HXer (11×10^6 Btu/hr) for a limited period of time. (24.933×10^6) − (2.6+2.4+1.575+11)10^6 = 7.358 × 10^6 Btu/hr. 113.06. Total is therefore (7.358×10^6) + (~~84.38×10^6~~ 105.7×10^6) = ~~91.738~~ 113.06×10^6 Btu/hr. Assuming 3 CCW HXers in service, heat transfer per CCW HXer is ~~91.738~~ 113.06 ÷ 3 = ~~30.58~~ 37.69 × 10^6 Btu/hr.

Raw water mass flow rate per HXer is as calculated on p. 15 (Refer 8); ~~1.221~~ 1.024 × 10^6 lbm/hr. Total CCW flow to 3 CCW HXers ~~(Refer 8)~~ is ~~7577 gpm~~ 8600 gpm (Refer to Pg 18). CCW mass flow rate per HXer is ~~5.7~~ 8600 gpm/(2.420/ft^3 × 3)) × ~~61.99~~ 61.86 lbm/ft^3 × 60 m/h = ~~1.587×10^6~~ 1.422 × 10^6 lbm/hr.

Assuming Cp ≈ 1 Btu/lbm-°F for both liquids, capacities are ~~1.221×10^6~~ 1.024 × 10^6 & ~~1.587×10^6~~ 1.422 × 10^6 Btu/hr-°F respectively, and raw water is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{\cancel{1.221} \; 1.024 \times 10^6}{\cancel{1.587} \; 1.422 \times 10^6} = \cancel{0.769} \; 0.7201$$

NTU = UA/Cmin = (233.6)(12,400)/~~1.221~~ 1.024 × 10^6 = ~~2.372~~ 2.829. From the chart in Ref 3, p. 311, effectiveness = ~~73.9%~~ 82.0

Effectiveness is also defined as the actual heat transfer divided by the maximum possible (with infinite HXer area) heat transfer, which is the capacity rate of the minimum fluid multiplied by the maximum temp. difference in the HXer.

CCW inlet temp., assuming a cold side temp. of ~~100~~ 110 °F, is calculated as follows –

$$\Delta T = (X - \cancel{100}\ 110) = Q/\dot{m}c_p = \cancel{30.58 \times 10^6}\ 37.69 \times 10^6 / (\cancel{1.587}\ 1.422 \times 10^6)(1) = \cancel{19.3°F}\ 26.5°F$$

$$X = \cancel{119.3}\ 136.5\ °F$$

EBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 26
17321.01	46	PM-44		

Maximum temp. difference in the HXer is therefore inlet CCW temp. less inlet raw water temp. = ~~119.2~~ 136.5 − 90 = ~~29.2~~ 46.5 °F.

Effectiveness = ~~75.9~~ 82.0% = Actual heat transfer rate / (~~1.221~~ 1.024 × 10^6 Btu/hr-°F)(~~38.5~~ 46.5 °F)

Actual heat transfer = ~~31.0~~ 39.0 × 10^6 Btu/hr

~~This is about 10% less capability than the duty would be with an hypothesized 100°F CCW coldside temp. & 200°F RC temp. Thus CCW coolside temp would be slightly more than 100°F, and SD HXer duty and RC cooldown rate slightly less than calculated above.~~

~~When Rc = 135°F, SD HXer duty will be substantially lower. Assuming (Tccw)cold = 100°F, SD HXer duty is (8.438×10^5)(Tc − 100) = (8.438×10^5)(35) = 29.533×10^6 Btu/hr Heat from other sources is as calculated on p. 16, plus 11.0×10^6 Btu/hr for storage pool HXer back in service. Total is therefore (7.358×10^6 + 11.0×10^6 + 29.533×10^6) = 47.891×10^6 Btu/hr Assuming 3 CCW HXers in service, heat transferred per CCW HXer is (47.891 × 10^6) ÷ 3 ≈ 15.96×10^6 Btu/hr CCW hot side temp, assuming a cold side temp. of 100°F, is calculated as follows —~~

~~ΔT = (x − 100) = Q/mCp = (15.96×10^6)/(1.587×10^6)(1) = 10.06°F~~
~~x = 110.06 °F~~

~~Maximum temp. difference in the HXer is therefore inlet CCW temp. less inlet raw water temp. = 110.06 − 90 = 20.06°F~~

~~Effectiveness = 75.9% = Actual heat transfer rate / (1.221 × 10^6 Btu/hr-°F)(20.06°F)~~

~~Actual heat transfer rate = 18.59 × 10^6 Btu/hr~~

~~This is about 20% more capability than the duty would be with an hypothesized 100°F CCW coldside temp. & 135°F RC temp. Thus CCW coolside temp would be slightly less than 100°F, and SD HXer duty and RC cooldown rate slightly more than calculated previously. Thus it is judged that the assumption of 100°F CCW coolside temperature~~

EBSTER ENGINEERING CORPORATION
ALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 27
17321.01	PM	44		

~~when RC temperature is 200 °F or less is conservative.~~

The actual heat transfer exceeds the required duty with 110°F CCW and 250°F RC temps. Therefore the assumed conditions are conservative over the range $250° > T_{RC} > 180°F$.

1

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 28
17321.01	PM	44		

Verification that $(T_{ccw})_{cold}$ can be maintained at $\leq 100°F$ when $T_{RC} \leq 180°F$

Assume that $(T_{ccw})_{cold} = 100°F$, $T_{RC} = 180°F$, and heat transfered to the CCW through the shutdown cooler is $7.65 \times 10^5 (T_{RC} - 100) = 7.65 (80) \times 10^5 = 6.12 \times 10^7$ BTU/hr. As above, total CCW heat load is $(7.358 \times 10^6) + (61.2 \times 10^6) = 68.56 \times 10^6$ BTU/hr. Assuming 3 CCW Heat Exchangers in Service, heat transfered per CCW Ht Ex is $68.56 \times 10^6 \div 3 = 22.85 \times 10^6$ BTU/hr.

RW mass flow rate is 1.024×10^6 lbm/hr, as above. CCW mass flow rate per Ht Ex is $(8600 \text{ gpm} / 7.48 \text{ gal/ft}^3 \times 3) \times 61.99 \text{ lbm/ft}^3 \times 60 \text{ min/hr} = 1.425 \times 10^6$ lbm/hr.

Assuming $C_p \approx 1$ BTU/lbm-°F for both liquids, capacities are 1.024×10^6 and 1.425×10^6 BTU/hr-F respectively, and RW is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{1.024 \times 10^6}{1.425 \times 10^6} = .7186$$

1

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 29
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

$NTU = UA/C_{min} = (233.6)(12,400)/1.024\times10^6 = 2.829$

From Ref 3, Pg 311, effectiveness = 82.0%

As above, calculate maximum possible heat transfer

$DT = (x-100) = q/\dot{m}c_p = 22.86\times10^6/(1.425\times10^6)(1) = 16.04°F$

$x = 116.04°F$

Maximum DT is therefore $116.04°F - 90°F = 26.04°F$

$$\text{Effectiveness} = .82 = \frac{\text{Actual Heat Transfer}}{(1.024\times10^6)(26.04)}$$

Actual Heat Transfer $= 21.87\times10^6$ BTU/hr

The actual heat transfer is slightly less (≈4%) less than the required duty with 100°F CCW. However, the assumed conditions are approx. correct at $T_{RC} = 180°F$ and are used over the range $180°F > T_{RC} > 135°F$. These conditions will be conservative over the majority of the temperature range.

1

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 30
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17321.01	PM	44		

Verification that $(T_{ccw})_{cold}$ can be maintained at $\leq 96°F$ when $T_{RC} \leq 135°F$

Assume that $(T_{ccw})_{cold} = 96°F$, $T_{RC} = 135°F$ and heat transfered to the CCW through the shutdown cooler is $7.69 \times 10^5 (T_{RC} - 96) = 7.69 \times 10^5 (39) = 2.999 \times 10^7$ BTU/hr. As above, total CCW heat load is $(7.358 \times 10^6) + (29.99 \times 10^6) = 37.35 \times 10^6$ BTU/hr. Assuming 3 CCW Heat Exchangers in Service, heat transfered per CCW heat exchanger is $37.35 \times 10^6 \div 3 = 12.45 \times 10^6$ BTU/hr.

RW mas flow rate is 1.024×10^6 lbm/hr, as above. CCW mass flow rate per Ht. Ex. is $8600 \text{ gpm} / (7.48 \text{ gal/ft}^3 \times 3) \times 62.05 \text{ lbm/ft}^3 \times 60 \text{ min/hr} = 1.427 \times 10^6$ lbm/hr

Assuming $C_p = 1$ BTU/lbm-F for both liquids, capacities are 1.024×10^6 and 1.427×10^6 BTU/hr-F, respectively, and RW is the minimum fluid.

$$\frac{C_{min}}{C_{max}} = \frac{1.024 \times 10^6}{1.427 \times 10^6} = .7176$$

WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

FC 05694

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 31
17321.01	PM	44		

$NTU = UA/C_{min} = (233.6)(12{,}400)/1.024\times10^6 = 2.829$ △1

From Ref 3, Pg 311, effectiveness = 82.0%

As Above, calculate maximum possible heat transfer

$DT = (x - 96) = q/\dot{m}c_p = 12.45\times10^6/(1.427\times10^6)(1) = 8.72°F$

$x = 104.72°F$

Maximum DT is therefore 104.72°F - 90°F = 14.72°F

$$\text{Effectiveness} = .82 = \frac{\text{Actual Heat Transfer}}{(1.024\times10^6)(14.72)}$$

Actual Heat Trans = 12.36×10^6 BTU/hr

The actual heat transfer is slightly less (≈ 1%) than the required duty with 96°F CCW. However, the assumed conditions are approximately correct at T_{RC} = 135°F and are used over the range 135°F > T_{RC} > 130°F. These conditions will be conservative over the majority of the temperature range.

	B	C									
2- Time (t) hours after Reactor Trip	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50
5- Temp. (Trc) @Time t, Degress, F	300.00	296.88	293.87	290.97	288.16	285.46	282.85	280.33	277.90	275.55	273.29
8- Decay heat (Qd), BTU/hr	5.114E+07	5.050E+07	4.989E+07	4.930E+07	4.875E+07	4.822E+07	4.771E+07	4.722E+07	4.676E+07	4.631E+07	4.588E+07
11- Pump heat (Pp), BTU/hr	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07
14- Heat rejected to S.D. HXer (Qhx), BTU/hr	-1.049E+08	-1.031E+08	-1.014E+08	-9.966E+07	-9.802E+07	-9.644E+07	-9.492E+07	-9.345E+07	-9.204E+07	-9.067E+07	-8.935E+07
16- Sum(Qd+Pp+Qhx), BTU/hr	-3.428E+07	-3.311E+07	-3.196E+07	-3.085E+07	-2.977E+07	-2.873E+07	-2.771E+07	-2.673E+07	-2.578E+07	-2.486E+07	-2.398E+07
18- d(Trc)/dt, Degrees F/hr	-31.16	-30.10	-29.06	-28.05	-27.07	-26.12	-25.19	-24.30	-23.44	-22.60	-21.80
20- Delta T, Degrees F	-3.12	-3.01	-2.91	-2.80	-2.71	-2.61	-2.52	-2.43	-2.34	-2.26	-2.18

Note: This Attachment has been replaced in its entirety

17321.01-PM-44
ATT 1
PG 1 OF 18

FC 05694

3.60	3.70	3.80	3.90	4.00	4.10	4.20	4.30	4.40	4.50	4.60	4.70
271.11	269.01	266.98	265.03	263.14	261.32	259.57	257.88	256.25	254.67	253.16	251.69
4.546E+07	4.506E+07	4.467E+07	4.430E+07	4.394E+07	4.359E+07	4.325E+07	4.292E+07	4.261E+07	4.230E+07	4.200E+07	4.171E+07
1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07
-8.808E+07	-8.686E+07	-8.568E+07	-8.454E+07	-8.344E+07	-8.238E+07	-8.136E+07	-8.037E+07	-7.942E+07	-7.850E+07	-7.762E+07	-7.676E+07
-2.312E+07	-2.230E+07	-2.150E+07	-2.074E+07	-2.000E+07	-1.929E+07	-1.860E+07	-1.795E+07	-1.731E+07	-1.670E+07	-1.612E+07	-1.555E+07
-21.02	-20.27	-19.55	-18.85	-18.18	-17.54	-16.91	-16.31	-15.74	-15.19	-14.65	-14.14
-2.10	-2.03	-1.95	-1.89	-1.82	-1.75	-1.69	-1.63	-1.57	-1.52	-1.47	-1.41

Z

4.80	4.90	5.00	5.10	5.20	5.30	5.40	5.50	5.60	5.70	5.80	5.90
250.28	248.91	244.89	241.12	237.59	234.27	231.16	228.25	225.51	222.93	220.52	218.25
4.143E+07	4.115E+07	4.088E+07	4.062E+07	4.037E+07	4.012E+07	3.988E+07	3.964E+07	3.941E+07	3.919E+07	3.897E+07	3.875E+07
1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07
-7.594E+07	-1.049E+08	-1.018E+08	-9.900E+07	-9.633E+07	-9.383E+07	-9.148E+07	-8.928E+07	-8.721E+07	-8.527E+07	-8.344E+07	-8.173E+07
-1.501E+07	-4.423E+07	-4.146E+07	-3.888E+07	-3.646E+07	-3.421E+07	-3.210E+07	-3.013E+07	-2.829E+07	-2.658E+07	-2.497E+07	-2.347E+07
-13.65	-40.21	-37.69	-35.34	-33.15	-31.10	-29.18	-27.39	-25.72	-24.16	-22.70	-21.34
-1.36	-4.02	-3.77	-3.53	-3.31	-3.11	-2.92	-2.74	-2.57	-2.42	-2.27	-2.13

AV

6.00	6.10	6.20	6.30	6.40	6.50	6.60	6.70	6.80	6.90	7.00	7.10
216.11	214.11	212.22	210.44	208.77	207.20	205.71	204.31	202.99	201.75	200.57	199.46
3.854E+07	3.834E+07	3.814E+07	3.794E+07	3.775E+07	3.756E+07	3.738E+07	3.719E+07	3.702E+07	3.684E+07	3.667E+07	3.650E+07
1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.950E+07	1.500E+06
-8.012E+07	-7.860E+07	-7.718E+07	-7.583E+07	-7.457E+07	-7.338E+07	-7.226E+07	-7.121E+07	-7.021E+07	-6.927E+07	-6.838E+07	-6.755E+07
-2.207E+07	-2.076E+07	-1.954E+07	-1.839E+07	-1.732E+07	-1.632E+07	-1.539E+07	-1.451E+07	-1.369E+07	-1.293E+07	-1.221E+07	-2.954E+07
-20.07	-18.87	-17.76	-16.72	-15.75	-14.84	-13.99	-13.19	-12.45	-11.75	-11.10	-26.86
-2.01	-1.89	-1.78	-1.67	-1.57	-1.48	-1.40	-1.32	-1.24	-1.18	-1.11	-2.69

BF

7.20	7.30	7.40	7.50	7.60	7.70	7.80	7.90	8.00	8.10	8.20	8.30
196.78	194.26	191.90	189.69	187.62	185.68	183.85	182.14	180.53	179.02	176.84	174.80
3.634E+07	3.618E+07	3.602E+07	3.586E+07	3.571E+07	3.556E+07	3.541E+07	3.527E+07	3.512E+07	3.498E+07	3.484E+07	3.471E+07
1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06
-6.552E+07	-6.362E+07	-6.184E+07	-6.017E+07	-5.860E+07	-5.713E+07	-5.576E+07	-5.446E+07	-5.325E+07	-6.045E+07	-5.878E+07	-5.722E+07
-2.768E+07	-2.594E+07	-2.432E+07	-2.281E+07	-2.139E+07	-2.008E+07	-1.885E+07	-1.770E+07	-1.663E+07	-2.397E+07	-2.244E+07	-2.101E+07
-25.16	-23.58	-22.11	-20.73	-19.45	-18.25	-17.13	-16.09	-15.11	-21.79	-20.40	-19.10
-2.52	-2.36	-2.21	-2.07	-1.94	-1.83	-1.71	-1.61	-1.51	-2.18	-2.04	-1.91

8.40	8.50	8.60	8.70	8.80	8.90	9.00	9.10	9.20	9.30	9.40	9.50
172.89	171.10	169.42	167.85	166.37	164.99	163.69	162.47	161.33	160.25	159.24	158.29
3.457E+07	3.444E+07	3.431E+07	3.418E+07	3.406E+07	3.393E+07	3.381E+07	3.369E+07	3.357E+07	3.346E+07	3.334E+07	3.323E+07
1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06
-5.576E+07	-5.439E+07	-5.311E+07	-5.190E+07	-5.078E+07	-4.972E+07	-4.872E+07	-4.779E+07	-4.692E+07	-4.609E+07	-4.532E+07	-4.459E+07
-1.969E+07	-1.845E+07	-1.730E+07	-1.622E+07	-1.522E+07	-1.428E+07	-1.341E+07	-1.260E+07	-1.184E+07	-1.114E+07	-1.048E+07	-9.862E+06
-17.90	-16.77	-15.72	-14.75	-13.83	-12.99	-12.19	-11.46	-10.77	-10.12	-9.52	-8.97
-1.79	-1.68	-1.57	-1.47	-1.38	-1.30	-1.22	-1.15	-1.08	-1.01	-0.95	-0.90

CE

9.60	9.70	9.80	9.90	10.00	10.10	10.20	10.30	10.40	10.50	11.00	11.50
157.39	156.55	155.75	155.00	154.29	153.62	152.99	152.39	151.83	151.30	148.76	146.89
3.311E+07	3.300E+07	3.289E+07	3.279E+07	3.268E+07	3.258E+07	3.247E+07	3.237E+07	3.227E+07	3.217E+07	3.169E+07	3.124E+07
1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06
-4.390E+07	-4.326E+07	-4.265E+07	-4.207E+07	-4.153E+07	-4.102E+07	-4.054E+07	-4.008E+07	-3.965E+07	-3.924E+07	-3.730E+07	-3.587E+07
-9.289E+06	-8.753E+06	-8.254E+06	-7.788E+06	-7.352E+06	-6.946E+06	-6.566E+06	-6.212E+06	-5.881E+06	-5.571E+06	-4.114E+06	-3.135E+06
-8.44	-7.96	-7.50	-7.08	-6.68	-6.31	-5.97	-5.65	-5.35	-5.06	-3.74	-2.85
-0.84	-0.80	-0.75	-0.71	-0.67	-0.63	-0.60	-0.56	-0.53	-2.53	-1.87	-1.43

FO 05694

12.00	12.50	13.00	13.50	14.00	14.50	15.00	15.50	16.00	16.50	17.00	17.50
145.47	144.34	143.43	142.66	141.99	141.39	140.86	140.36	139.90	139.47	139.06	138.68
3.081E+07	3.041E+07	3.002E+07	2.966E+07	2.931E+07	2.898E+07	2.867E+07	2.837E+07	2.808E+07	2.780E+07	2.753E+07	2.728E+07
1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06
-3.478E+07	-3.392E+07	-3.322E+07	-3.263E+07	-3.212E+07	-3.167E+07	-3.126E+07	-3.088E+07	-3.053E+07	-3.020E+07	-2.988E+07	-2.959E+07
-2.472E+06	-2.016E+06	-1.698E+06	-1.471E+06	-1.306E+06	-1.182E+06	-1.087E+06	-1.011E+06	-9.489E+05	-8.967E+05	-8.517E+05	-8.122E+05
-2.25	-1.83	-1.54	-1.34	-1.19	-1.07	-0.99	-0.92	-0.86	-0.82	-0.77	-0.74
-1.12	-0.92	-0.77	-0.67	-0.59	-0.54	-0.49	-0.46	-0.43	-0.41	-0.39	-0.37

18.00	18.50	19.00	19.50	20.00	20.50	21.00	21.50	22.00	22.50	23.00	23.50
138.31	137.95	137.62	137.29	136.98	136.68	136.38	136.10	135.83	135.57	135.31	135.07
2.703E+07	2.679E+07	2.656E+07	2.634E+07	2.612E+07	2.592E+07	2.572E+07	2.552E+07	2.533E+07	2.515E+07	2.497E+07	2.480E+07
1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06
-2.931E+07	-2.904E+07	-2.878E+07	-2.853E+07	-2.829E+07	-2.806E+07	-2.783E+07	-2.762E+07	-2.741E+07	-2.721E+07	-2.701E+07	-2.683E+07
-7.769E+05	-7.449E+05	-7.157E+05	-6.888E+05	-6.638E+05	-6.406E+05	-6.188E+05	-5.984E+05	-5.791E+05	-5.610E+05	-5.439E+05	-5.276E+05
-0.71	-0.68	-0.65	-0.63	-0.60	-0.58	-0.56	-0.54	-0.53	-0.51	-0.49	-0.48
-0.35	-0.34	-0.33	-0.31	-0.30	-0.29	-0.28	-0.27	-0.26	-0.25	-0.25	-0.24

DE					DJ
24.00	24.50	25.00	25.50	26.00	26.50
134.83	133.13	131.96	131.12	130.50	130.03
2.463E+07	2.447E+07	2.431E+07	2.415E+07	2.400E+07	2.385E+07
1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06	1.500E+06
-2.986E+07	-2.855E+07	-2.765E+07	-2.701E+07	-2.653E+07	-2.617E+07
-3.728E+06	-2.588E+06	-1.843E+06	-1.354E+06	-1.031E+06	-8.182E+05
-3.39	-2.35	-1.68	-1.23	-0.94	-0.74
-1.69	-1.18	-0.84	-0.62	-0.47	N/A

```
B2: (F2) 2.5
B5: (F2) 300
B8: (S3) 68762000*B2^-0.32306
B11: (S3) 19500000
B14: (S3) -582900*(B5-120)
B16: (S3) +B8+B11+B14
B18: (F2) +B16/1100000
B20: (F2) +B18*(C2-B2)
```

← Initial time and RC temp.

```
C2: (F2) +B2+0.1
C5: (F2) +B5+B20
C8: (S3) 68762000*C2^-0.32306
C11: (S3) 19500000
C14: (S3) -582900*(C5-120)
C16: (S3) +C8+C11+C14
C18: (F2) +C16/1100000
C20: (F2) +C18*(D2-C2)
```

← 0.1 hour time steps

```
Z2: (F2) +Y2+0.1
Z5: (F2) +Y5+Y20
Z8: (S3) 68762000*Z2^-0.32306
Z11: (S3) 19500000
Z14: (S3) -755000*(Z5-110)
Z16: (S3) +Z8+Z11+Z14
Z18: (F2) +Z16/1100000
Z20: (F2) +Z18*(AA2-Z2)
```

← Revised Q_{hx} based on 110°F CCW (T_{RC} < 250°F)

```
AV2: (F2) +AU2+0.1
AV5: (F2) +AU5+AU20
AV8: (S3) 68762000*AV2^-0.32306
AV11: (S3) 1500000 ← Revised Pp for TRC < 200°F
AV14: (S3) -755000*(AV5-110)
AV16: (S3) +AV8+AV11+AV14
AV18: (F2) +AV16/1100000
AV20: (F2) +AV18*(AW2-AV2)
```

```
BF2: (F2) +BE2+0.1
BF5: (F2) +BE5+BE20
BF8: (S3) 68762000*BF2^-0.32306
BF11: (S3) 1500000
BF14: (S3) -765000*(BF5-100)
BF16: (S3) +BF8+BF11+BF14
BF18: (F2) +BF16/1100000
BF20: (F2) +BF18*(BG2-BF2)
```

← Revised Q_{hx} based on 100°F CCW (T_{RE} < 180°F)

```
CE2: (F2) +CD2+0.5
CE5: (F2) +CD5+CD20
CE8: (S3) 68762000*CE2^-0.32306
CE11: (S3) 1500000
CE14: (S3) -765000*(CE5-100)
CE16: (S3) +CE8+CE11+CE14
CE18: (F2) +CE16/1100000
CE20: (F2) +CE18*(CF2-CE2)
```

← Revised time step = 0.5 hour

FC 05694

```
DE2: (F2) +DD2+0.5
DE5: (F2) +DD5+DD20
DE8: (S3) 68762000*DE2^-0.32306
DE11: (S3) 1500000
DE14: (S3) -769000*(DE5-96)
DE16: (S3) +DE8+DE11+DE14
DE18: (F2) +DE16/1100000
DE20: (F2) +DE18*(DF2-DE2)
```

← Revised Q_{hx} based on 96°F CCW (T_{RC} < 135°F)

17321.01-PM-44
ATT 1

PG 17 OF 18

```
DJ2: (F2) +DI2+0.5
DJ5: (F2) +DI5+DI20
DJ8: (S3) 68762000*DJ2^-0.32306
DJ11: (S3) 1500000
DJ14: (S3) -769000*(DJ5-96)
DJ16: (S3) +DJ8+DJ11+DJ14
DJ18: (F2) +DJ16/1100000
DJ20: (F2) '      N/A
```

) ΔT = N/A for last time step.

FC 05694

	A	B	C	D	E
1	Time, t, hours after				
2	reactor trip	2.5	2.6	2.7	2.8
3	.....				
4	Temp., Trc, @ time t,				
5	degrees F	300.00	296.60	293.33	290.17
6	.....				
7	Decay heat, Qd,				
8	Btu/hr	5.114E+7	5.050E+7	4.989E+7	4.930E+7
9					
10	Pump heat, Pp,				
11	Btu/hr	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12					
13	Heat rejected to				
14	SD HXer, Qhx, Btu/hr	-1.081E+8	-1.060E+8	-1.040E+8	-1.022E+8
15	==========				
16	Sum (Qd+Pp+Qhx),Btu/hr	-3.741E+7	-3.601E+7	-3.466E+7	-3.335E+7
17					
18	dTrc/dt, degrees F/hr	-34.01	-32.74	-31.51	-30.32
19					
20	Delta t, degrees F	-3.40	-3.27	-3.15	-3.03

17321.01-PM-44
Attachment 2
Pg. 2 of 18

FC 05694

	F	G	H	I	J	K	L
1							
2	2.9	3.0	3.1	3.2	3.3	3.4	3.5
3							
4							
5	287.14	284.23	281.42	278.72	276.12	273.63	271.23
6							
7							
8	4.875E+7	4.822E+7	4.771E+7	4.722E+7	4.676E+7	4.631E+7	4.588E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-1.003E+8	-9.858E+7	-9.690E+7	-9.528E+7	-9.372E+7	-9.222E+7	-9.078E+7
15							
16	-3.209E+7	-3.087E+7	-2.969E+7	-2.856E+7	-2.747E+7	-2.642E+7	-2.541E+7
17							
18	-29.17	-28.06	-26.99	-25.96	-24.97	-24.01	-23.10
19							
20	-2.92	-2.81	-2.70	-2.60	-2.50	-2.40	-2.31

1

17321.01-PM-44
Attachment 2
Pg. 3 of 18

FC 05694

	M	N	O	P	Q	R	
1							
2	3.6	3.7	3.8	3.9	4.0	4.1	4.2
3							
4							
5	268.92	266.70	264.56	262.50	260.53	258.62	256.80
6							
7							
8	4.546E+7	4.506E+7	4.467E+7	4.430E+7	4.394E+7	4.359E+7	4.325E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-8.939E+7	-8.806E+7	-8.678E+7	-8.554E+7	-8.436E+7	-8.322E+7	-8.212E+7
15							
16	-2.443E+7	-2.350E+7	-2.261E+7	-2.175E+7	-2.092E+7	-2.013E+7	-1.937E+7
17							
18	-22.21	-21.37	-20.55	-19.77	-19.02	-18.30	-17.61
19							
20	-2.22	-2.14	-2.06	-1.98	-1.90	-1.83	-1.76

17321.01-PM-44
Attachment 2
Pg. 4 of 18

FC 05694

	T	U	V	W	X	Y	Z
1							
2	4.3	4.4	4.5	4.6	4.7	4.8	4.9
3							
4							
5	255.03	253.34	251.71	250.14	248.63	247.17	245.77
6							
7							
8	4.292E+7	4.261E+7	4.230E+7	4.200E+7	4.171E+7	4.143E+7	4.115E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-8.106E+7	-8.004E+7	-7.907E+7	-7.812E+7	-7.722E+7	-7.634E+7	-7.550E+7
15							
16	-1.864E+7	-1.794E+7	-1.727E+7	-1.662E+7	-1.601E+7	-1.542E+7	-1.485E+7
17							
18	-16.94	-16.31	-15.70	-15.11	-14.55	-14.02	-13.50
19							
20	-1.69	-1.63	-1.57	-1.51	-1.46	-1.40	-1.35

1

17321.01-PM-44
Attachment 2
Pg. 5 of 18

FC 05694

	AA	AB	AC	AD	AE	AF	
1							
2	5.0	5.1	5.2	5.3	5.4	5.5	5.6
3	.....	.....	.....	.....	.....	.....	.....
4							
5	244.42	243.12	241.87	240.66	239.49	238.37	237.29
6	.....	.....	.....	.....	.....	.....	.....
7							
8	4.088E+7	4.062E+7	4.037E+7	4.012E+7	3.988E+7	3.964E+7	3.941E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-7.469E+7	-7.391E+7	-7.316E+7	-7.243E+7	-7.173E+7	-7.106E+7	-7.041E+7
15	==========	==========	==========	==========	==========	==========	==========
16	-1.431E+7	-1.379E+7	-1.329E+7	-1.281E+7	-1.235E+7	-1.192E+7	-1.150E+7
17							
18	-13.01	-12.53	-12.08	-11.65	-11.23	-10.83	-10.45
19							
20	-1.30	-1.25	-1.21	-1.16	-1.12	-1.08	-1.05

17321.01-PM-44
Attachment 2
Pg. 6 of FC 05694

	AH	AI	AJ	AK	AL	AM	AN
1							
2	5.7	5.8	5.9	6.0	6.1	6.2	6.3
3							
4							
5	236.24	235.24	234.26	233.32	232.41	231.54	230.69
6							
7							
8	3.919E+7	3.897E+7	3.875E+7	3.854E+7	3.834E+7	3.814E+7	3.794E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-6.978E+7	-6.918E+7	-6.859E+7	-6.803E+7	-6.748E+7	-6.696E+7	-6.645E+7
15							
16	-1.109E+7	-1.071E+7	-1.034E+7	-9.983E+6	-9.643E+6	-9.318E+6	-9.006E+6
17							
18	-10.08	-9.73	-9.40	-9.08	-8.77	-8.47	-8.19
19							
20	-1.01	-0.97	-0.94	-0.91	-0.88	-0.85	-0.82

FC 05694

	AO	AP	AQ	AR	AS	AT	AU
1							
2	6.4	6.5	6.6	6.7	6.8	6.9	7.0
3							
4							
5	229.87	229.08	228.31	227.57	226.86	226.16	225.49
6							
7							
8	3.775E+7	3.756E+7	3.738E+7	3.719E+7	3.702E+7	3.684E+7	3.667E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-6.596E+7	-6.548E+7	-6.502E+7	-6.458E+7	-6.415E+7	-6.373E+7	-6.333E+7
15							
16	-8.707E+6	-8.421E+6	-8.146E+6	-7.883E+6	-7.630E+6	-7.388E+6	-7.155E+6
17							
18	-7.92	-7.66	-7.41	-7.17	-6.94	-6.72	-6.50
19							
20	-0.79	-0.77	-0.74	-0.72	-0.69	-0.67	-0.65

17321.01-PM-44
Attachment 2
Pg. 8 of 18

FC 05694

	AV	AW	AX	AY	AZ	BA	BB
1							
2	7.1	7.2	7.3	7.4	7.5	7.6	7.7
3							
4							
5	224.84	224.21	223.60	223.01	222.43	221.88	221.34
6							
7							
8	3.650E+7	3.634E+7	3.618E+7	3.602E+7	3.586E+7	3.571E+7	3.556E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-6.294E+7	-6.256E+7	-6.219E+7	-6.184E+7	-6.149E+7	-6.116E+7	-6.083E+7
15							
16	-6.933E+6	-6.719E+6	-6.514E+6	-6.317E+6	-6.128E+6	-5.947E+6	-5.773E+6
17							
18	-6.30	-6.11	-5.92	-5.74	-5.57	-5.41	-5.25
19							
20	-0.63	-0.61	-0.59	-0.57	-0.56	-0.54	-0.52

17321.01-PM-44
Attachment 2
Pg. 9 of 18

FC 05694

	BC	BD	BE	BF	BG	BH	BI
1							
2	7.8	7.9	8.0	8.1	8.2	8.3	8.4
3							
4							
5	220.81	220.30	219.81	219.33	218.86	218.40	217.96
6							
7							
8	3.541E+7	3.527E+7	3.512E+7	3.498E+7	3.484E+7	3.471E+7	3.457E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-6.052E+7	-6.021E+7	-5.991E+7	-5.963E+7	-5.934E+7	-5.907E+7	-5.881E+7
15							
16	-5.606E+6	-5.445E+6	-5.291E+6	-5.143E+6	-5.001E+6	-4.864E+6	-4.733E+6
17							
18	-5.10	-4.95	-4.81	-4.68	-4.55	-4.42	-4.30
19							
20	-0.51	-0.50	-0.48	-0.47	-0.45	-0.44	-0.43

17321.01-PM-44
Attachment 2
Pg. 10 of 18

FC 05694

	BJ	BK	BL	BM	BN	BO	BP
1							
2	8.5	8.6	8.7	8.8	8.9	9.0	9.1
3							
4							
5	217.53	217.11	216.71	216.31	215.92	215.54	215.18
6							
7							
8	3.444E+7	3.431E+7	3.418E+7	3.406E+7	3.393E+7	3.381E+7	3.369E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-5.855E+7	-5.830E+7	-5.805E+7	-5.781E+7	-5.758E+7	-5.736E+7	-5.713E+7
15							
16	-4.606E+6	-4.485E+6	-4.368E+6	-4.255E+6	-4.147E+6	-4.043E+6	-3.943E+6
17							
18	-4.19	-4.08	-3.97	-3.87	-3.77	-3.68	-3.58
19							
20	-0.42	-0.41	-0.40	-0.39	-0.38	-0.37	-0.36

1

17321.01-PM-44
Attachment 2
Pg. 11 of 18

FC 05694

	BQ	BR	BS	BT	BU	BV	BW
1							
2	9.2	9.3	9.4	9.5	9.6	9.7	9.8
3							
4							
5	214.82	214.47	214.13	213.79	213.47	213.15	212.84
6							
7							
8	3.357E+7	3.346E+7	3.334E+7	3.323E+7	3.311E+7	3.300E+7	3.289E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-5.692E+7	-5.671E+7	-5.650E+7	-5.630E+7	-5.611E+7	-5.592E+7	-5.573E+7
15							
16	-3.847E+6	-3.754E+6	-3.664E+6	-3.578E+6	-3.495E+6	-3.415E+6	-3.338E+6
17							
18	-3.50	-3.41	-3.33	-3.25	-3.18	-3.10	-3.03
19							
20	-0.35	-0.34	-0.33	-0.33	-0.32	-0.31	-0.30

1

17321.01-PM-44
Attachment 2
Pg. 12 of 18

FC 05694

	BX	BY	BZ	CA	CB	CC	CD
1							
2	9.9	10.0	10.1	10.2	10.3	10.4	10.5
3	.....	.....	.....	.....	.....	.....	.....
4							
5	212.54	212.24	211.95	211.67	211.39	211.12	210.85
6	.....	.....	.....	.....	.....	.....	.....
7							
8	3.279E+7	3.268E+7	3.258E+7	3.247E+7	3.237E+7	3.227E+7	3.217E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-5.555E+7	-5.537E+7	-5.520E+7	-5.503E+7	-5.486E+7	-5.470E+7	-5.454E+7
15	==========	==========	==========	==========	==========	==========	==========
16	-3.263E+6	-3.192E+6	-3.122E+6	-3.055E+6	-2.991E+6	-2.929E+6	-2.868E+6
17							
18	-2.97	-2.90	-2.84	-2.78	-2.72	-2.66	-2.61
19							
20	-0.30	-0.29	-0.28	-0.28	-0.27	-0.27	-1.30

1

FC 0569

	CE	CF	CG	CH	CI	CJ	CK
1							
2	11.0	11.5	12.0	12.5	13.0	13.5	14.0
3							
4							
5	209.55	208.38	207.33	206.37	205.49	204.67	203.91
6							
7							
8	3.169E+7	3.124E+7	3.081E+7	3.041E+7	3.002E+7	2.966E+7	2.931E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7
12							
13							
14	-5.376E+7	-5.306E+7	-5.242E+7	-5.185E+7	-5.132E+7	-5.083E+7	-5.037E+7
15							
16	-2.566E+6	-2.317E+6	-2.112E+6	-1.939E+6	-1.793E+6	-1.667E+6	-1.559E+6
17							
18	-2.33	-2.11	-1.92	-1.76	-1.63	-1.52	-1.42
19							
20	-1.17	-1.05	-0.96	-0.88	-0.81	-0.76	-0.71

17321.01-PM-44
Attachment 2
Page 14 of 18

FC 05694

	CL	CM	CN	CO	CP	CQ	CR
1							
2	14.5	15.0	15.5	16.0	16.5	17.0	17.5
3							
4							
5	203.20	202.54	201.91	201.32	200.76	200.22	199.71
6							
7							
8	2.898E+7	2.867E+7	2.837E+7	2.808E+7	2.780E+7	2.753E+7	2.728E+7
9							
10							
11	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.950E+7	1.500E+6
12							
13							
14	-4.995E+7	-4.955E+7	-4.917E+7	-4.882E+7	-4.848E+7	-4.816E+7	-8.413E+7
15							
16	-1.464E+6	-1.380E+6	-1.306E+6	-1.239E+6	-1.179E+6	-1.124E+6	-5.536E+7
17							
18	-1.33	-1.25	-1.19	-1.13	-1.07	-1.02	-50.33
19							
20	-0.67	-0.63	-0.59	-0.56	-0.54	-0.51	-25.16

FC 05694

	CS	CT	CU	CV	CW	CX	
1							
2	18.0	18.5	19.0	19.5	20.0	20.5	21.0
3	.....	.....	.....	.....	.....	.....	.....
4							
5	174.55	158.92	149.18	143.07	139.21	136.73	135.10
6	.....	.....	.....	.....	.....	.....	.....
7							
8	2.703E+7	2.679E+7	2.656E+7	2.634E+7	2.612E+7	2.592E+7	2.572E+7
9							
10							
11	1.500E+6	1.500E+6	1.500E+6	1.500E+6	1.500E+6	1.500E+6	1.500E+6
12							
13							
14	-6.290E+7	-4.972E+7	-4.150E+7	-3.634E+7	-3.308E+7	-3.099E+7	-2.962E+7
15	==========	==========	==========	==========	==========	==========	==========
16	-3.437E+7	-2.143E+7	-1.344E+7	-8.507E+6	-5.458E+6	-3.572E+6	-2.403E+6
17							
18	-31.25	-19.48	-12.22	-7.73	-4.96	-3.25	-2.18
19							
20	-15.62	-9.74	-6.11	-3.87	-2.48	-1.62	-1.09

1

FC 05694

	CZ	DA	DB	DC	DD	DE	
1							
2	21.5	22.0	22.5	23.0	23.5	24.0	24.5
3							
4							
5	134.01	133.25	132.69	132.27	131.92	131.63	131.38
6							
7							
8	2.552E+7	2.533E+7	2.515E+7	2.497E+7	2.480E+7	2.463E+7	2.447E+7
9							
10							
11	1.500E+6	1.500E+6	1.500E+6	1.500E+6	1.500E+6	1.500E+6	1.500E+6
12							
13							
14	-2.870E+7	-2.805E+7	-2.759E+7	-2.723E+7	-2.694E+7	-2.669E+7	-2.648E+7
15							
16	-1.676E+6	-1.222E+6	-9.366E+5	-7.553E+5	-6.385E+5	-5.617E+5	-5.098E+5
17							
18	-1.52	-1.11	-0.85	-0.69	-0.58	-0.51	-0.46
19							
20	-0.76	-0.56	-0.43	-0.34	-0.29	-0.26	-0.23

17321.01-PM-44
Attachment 2
Page 17 of 18

FC 05694

	DG	DH	DI	DJ
1				
2	25.0	25.5	26.0	26.5
3	.....	.....	.....	.....
4				
5	131.15	130.93	130.73	130.53
6	.....	.....	.....	.....
7				
8	2.431E+7	2.415E+7	2.400E+7	2.385E+7
9				
10				
11	1.500E+6	1.500E+6	1.500E+6	1.500E+6
12				
13				
14	-2.628E+7	-2.610E+7	-2.593E+7	-2.576E+7
15	==========	==========	==========	==========
16	-4.734E+5	-4.468E+5	-4.265E+5	-4.102E+5
17				
18	-0.43	-0.41	-0.39	-0.37
19				
20	-0.22	-0.20	-0.19	9.88

1

FC 05694

```
B2: 2.5
C2: B2+.1
D2: C2+.1
B5: 300
C5: B5+B20
B8: 68.762E6*B2^-.32306
C8: 68.762E6*C2^-.32306
B11: IF(B5>200,19.5e6,1.5e6)
C11: IF(C5>200,19.5e6,1.5e6)
B14: IF(B5>200,-6.003e5*(B5-120),-8.438e5*(B5-100))
C14: IF(C5>200,-6.003e5*(C5-120),-8.438e5*(C5-100))
B16: B8+B11+B14
C16: C8+C11+C14
B18: B16/1.1e6
C18: C16/1.1e6
B20: B18*(C2-B2)
```