RAW

Box 10 191

ROGERS ENGINEERING CO., INC.
111 PINE STREET
SAN FRANCISCO, CA.

CALCULATION COVER SHEET

Job No. S-81014

DISCIPLINE PROCESS

Calc. No. P-II

No. of Sheets 214 thru 17

2 Thru P18 -- P35

TITLE BRAWLEY STUDY

SUBJECT
AIR COOLED STEAM CONDENSER

STATEMENT OF PROBLEM

CHECK OPTIMIZATION AT VARIOUS AIR INLET TEMPERATURES

Donated By:
Herbert Rogers Jr.
Rogers Engineering Co.

SOURCES OF DATA

PRELIMINARY HEAT BALANCE FOR DUTY TO AIR COOLED UNIT
STEAM CONDENSING CURVE

SOURCES OF FORMULAE & REFERENCES

PROPOSED POWER SALES VALUES

PRELIMINARY CALC ☒

FINAL CALC ☐

SUPERSEDES CALC NO. _____

0	PRELIMINARY OPTIMIZATION	P-Frazer	800181				
REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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SUBJECT BRAWLEYAIR COOLED STEAM CONDENSERSHEET NO. P14 OFJOB NO. S-81014BY BF DATE 6 Oct 51

CHKD. BY DATE

CHECK OPTIMIZATION AT VARIOUS AIR INLETS

Heat Duty vs TEMP

	STEAM	N.C. GAS
DUTY	104.0	0.6

	STEAM	N.C. GAS
FRAC. DUTY	0.9943	0.0057

°F	IN	OUT	OUT
140		128	122
124		78.26	78°F INLET AIR RISE = 46
16		49.74	44 Δt's
	33.74/29.75	5.74/46.81	Δt/LMTOS
	29.58	0.27	Wt/LMTD = 29.85 BHP

124 78.26 78°F INLET AIR RISE = 46

16 49.74 44 Δt's

33.74/29.75 5.74/46.81 Δt/LMTOS

29.58

0.27

Wt/LMTD = 29.85 BHP

AIR = $104.6 \div (0.24 \times 46) = 9.47 \times 10^6 \text{ LB/HR}$ (2.1 FANS $\times 125 \text{ cfm} = 263$)

FIN AREA @ STAB OF 7.5 = $104.6 \div (7.5 \times 29.85) = 0.467 \times 10^6 \text{ FT}^2$

140	128	122
124	84.23	84°F INLET AIR RISE = 40
16	43.77	38
	27.77/27.59	5.77/40.82
	27.43	0.23
		27.66 Wt/LMTD
		BHP
		AIR = $104.6 \div (0.24 \times 40) = 10.9 \times 10^6 \text{ LB/HR}$ (2.42 fans $\times 125 \text{ cfm} \approx 303$)
		FIN AREA = $104.6 \div (7.5 \times 27.66) = 0.504 \times 10^6 \text{ FT}^2$

124 84.23 84°F INLET AIR RISE = 40

16 43.77 38

27.77/27.59 5.77/40.82

27.43

0.23

27.66 Wt/LMTD BHP

AIR = $104.6 \div (0.24 \times 40) = 10.9 \times 10^6 \text{ LB/HR}$ (2.42 fans $\times 125 \text{ cfm} \approx 303$)

FIN AREA = $104.6 \div (7.5 \times 27.66) = 0.504 \times 10^6 \text{ FT}^2$

140	128	122
124	90.19	90°F INLET AIR RISE = 34
16	37.81	32
	21.91/25.48	5.81/34.82
	25.33	0.20
		25.53 Wt/LMTD
		BHP
		AIR = $104.6 \div (0.24 \times 34) = 12.8 \times 10^6 \text{ LB/HR}$ (2.85 fans $\times 125 \text{ cfm} \approx 356$)
		FIN AREA = $104.6 \div (7.5 \times 25.53) = 0.546 \times 10^6 \text{ FT}^2$

124 90.19 90°F INLET AIR RISE = 34

16 37.81 32

21.91/25.48 5.81/34.82

25.33

0.20

25.53 Wt/LMTD

BHP

AIR = $104.6 \div (0.24 \times 34) = 12.8 \times 10^6 \text{ LB/HR}$ (2.85 fans $\times 125 \text{ cfm} \approx 356$)

FIN AREA = $104.6 \div (7.5 \times 25.53) = 0.546 \times 10^6 \text{ FT}^2$

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SUBJECT BRAWLEYAIR COOLED STEAM CONDENSERSHEET NO. PISA OFJOB NO. 5-21614BY BEHNER DATE 7-2-78

CHKD. BY DATE

DERATE FOR 78°F DESIGN

NEGLECT N.C. GAS DUTY & TEMP.

INLET AIR

78

Steam 140

AIR	124
	16

R	L
128	46
78	34
50	29.83

① ② X 56 ACHE % OF FULL
 + 44 CWT % OF FULL
 ① X
 ② X + TOTAL ALLOWABLE
 56 LOAD %
 56 + 44 = 100
 A
 C
 H
 E

90

140
124
16

128	34
90	22
38	25.43

0.74
6.85

66

70

35 + 44 = 79

106

140
124
16

128	24
100	22
28	21.44

0.52
0.72

86

88

21 + 44 = 65

104

140
124
16

128	20
104	8
24	19.73

0.43
0.66

69

70

16 + 44 = 60

110

140
124
16

128	14
110	2
18	16.98

0.30
0.57

63

64

10 + 44 = 54

55

56

80

140
124
16

128	44
80	32
48	29.13

0.96
0.98

53

62 66

70

140
124
16

128	54
70	42
58	32.61

1.17
1.093

72

84 90

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SUBJECT BRAWLEYAIR COOLED STEAM CONDENSERSHEET NO. P158 OF 14
JOB NO. 5-81-14
BY BEAMAN DATE 7 OCT 81
CHKD. BY DATECALC. ELECTRIC OUTTURN

78°F INLET AIR DESIGN ± 56% LOADING				OPER 7800 HRS/YR	PERIOD
TEMP °F	ANNUAL	EST. KW	AIR COND. EFFECT	KW @	KW
INLET AIR FRACTIONS	(FULL)	(1)	DERATE (2)	DERATE	1000 S
78	0.50 - 0.50	10,000		10,000	3900
78	0.50		-0-		
	0.26			8710	2028
90	0.24	9800	0.79	7,742	
	0.15			6,991	1170
100	0.09	9,600	0.65	6,240	
	0.04			6,000	312
104	0.05	9,600	0.60	5,760	
	0.05			4,529	390
110	<0.01	9700	0.34	3,298	

EXISTING PLANT AUXILIARIES 748 KW X 7800

NEW CONDENSER FANS 263 BHP ~ 213 KW X 7800

KW TO SALE

Σ 68,807
= (5,800)
= (1,660)
= 61,239

- ① DERATE DUE GEN AIR COOLER VS COLD WATER TEMPERATURE
2 FANS REQ'D ABOVE 110 WHICH IMPROVES CAPABILITY
- ② BASED ON EFFECT OF AVAILABLE AIR RISE X LMTD RATIO FOR
ACHE AT OFF DESIGN INLET ASSUMING HOLDING TERMINAL
AIR OUT DIFFERENCE CONSTANT. AIR LOAD + CWT LOAD % = DERATE
SEE CALC. SHEET P15A, 16A & 17A

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SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. 15C OF

JOB NO. 5-81014

BY BF DATE 9 DEC 81

CHKD. BY DATE

CALC ELECTRIC OUTTURN				OPER	PERIOD
78°F INLET AIR DESIGN @ 66% LOADING				HRS FOR	KW
TEMP OF		KW DERATE		INTERVAL	1000'S
INLET AIR					
78		10,000	- 0 -	19 000	3900
78	0.24			9,214	2028
90		9800	0.86	8428	18,686
	0.15			7625	8805
100		9600	0.69	6624	
	0.04			6336	312
104		9600	0.63	6048	1976
	0.05			5692	390
110		9700	0.55	5335	2220
				Σ	70,687
EXISTING AUX					(5830)
FANS 251 KW x 7800					(1958)
Net for Sale					62,899

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SUBJECT BRAWLEY
AIR COOLED STEAM CONDENSER

SHEET NO. 15D OF
JOB NO. 5-81014
BY PF DATE 9 DEC 81
CHKD. BY DATE

CALL ELECTRIC OUTTURN				OPER HRS	PERIOD
78°F INLET AIR DESIGN @ 70% LOADING				FOR	KW
TEMP °F			KW DERATE	INTERVAL	1000's
INLET AIR					
78	10000			3900	39,000
78	101000	- 0 -	10,000		
			9312	2028	18,885
90	9800	0.88	8624		
			7,672	1170	8,976
100	9600	0.70	6720		
			6432	312	2,007
104	9600	0.64	6144		
			5788	390	2,257
110	9700	0.56	5432		
			Σ		71,125
EXISTING AUX					(5830)
FANS 266 KW X 7800 HRS					(2075)
Not for Sale					63,220

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SUBJECT BRAWLEYAIR COOLED STEAM CONDENSERSHEET NO. P16A OFJOB NO. 5-8114BY BF DATE 7 OCT 71

CHKD. BY DATE

DERATE FOR 84°F DESIGN

INLET AIR	STEAM	R I S E	L M T D	① R I S E R A T I O	② L M T D R A T I O	X 56	POINT TOTAL ALLOWANCE LOAD %	A C C E
84	140 <u>124</u> 16	128 <u>84</u> 44	40 AT/LMTD				44 - 3 OF LOAD	
90	140 <u>124</u> 16	128 <u>90</u> 38	34 22/25.43	0.85	0.92	56 + 44 = 100		66 70
100	140 <u>124</u> 16	128 <u>100</u> 28	24 12/21.44	0.60	0.77	44 + 44 = 88		95.6 98.7
104	140 <u>124</u> 16	128 <u>104</u> 24	20 8/19.73	0.50	0.71	26 + 44 = 70		74 76
110	140 <u>124</u> 16	128 <u>110</u> 18	14 2/16.98	0.35	0.61	20 + 44 = 64		67 69
80	140 <u>120</u> 20	128 <u>80</u> 48	40 28/31.98	1.0	1.155	12 + 44 = 56		58
70	140 <u>110</u> 30	128 <u>70</u> 58	40 28/42.47	1.0	1.53	64 + 44 = 108		59 44 15
115	140 <u>124</u> 16	128 <u>115</u> 13	9 3/14.4	.225	.52	85 + 44 = 129		7 8 8

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SUBJECT BRAWLEYAIR COOLED STEAM CONDENSERSHEET NO. P-16B OFJOB NO. S-81014BY B. F. Smith DATE 7 Oct 81

CHKD. BY DATE

CALC. ELECTRIC OUTTURN84°F INLET AIR DESIGN ± 5% LOADINGTEMP OF ANNUAL EST KW AIR COND. KW @
INLET AIR FRACTIONS (FULL) (1) EFFECT FRACTION LOSS (2) DERATEOPER
7800 HPI/YR
SPLIT FOR
TEMP
INTERVAL PERIOD
KW
1000 S

84	0.64 - 0.64	10,000	- 0 -	10,000	4992	49,920	
84	0.64	0.12			9312	936	8,716
90	0.24		9,800	0.88	8,624		
		0.15			7672	1170	8,976
100	0.09		9,600	0.70	6,720		
		0.04			6432	312	2,007
104	0.05		9,600	0.64	6144		
		0.05			5877	390	2,257
110	< 0.01		9,700	0.56	5432		

EXISTING PLANT AUXILIARIES 748 KW x 7800

NEW CONDENSER FANS 3038 HPN (246 KW x 7800)

KW TO SALES

2	71,876
=	(5,830)
=	(1,920)
=	64,126

NOTES SEE CALC SHEET P-15B

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SUBJECT BRAWLEY
AIR COOLED STEAM CONDENSER

SHEET NO. 16 C OF
JOB NO. 5-81014
BY BF DATE 9 DEC 81
CHKD. BY DATE

CALC ELECTRIC OUTTURN						
84°F INLET AIR DESIGN @ 66% LOADING						
TEMP OF INLET AIR			KW DERATE		OPER HRS FOR INTERVAL	PERIOD KW 1000'S
84	0.64	10,000			4992	49,920
84			-0-	10,000		
				9,684	936	9,065
90		9,800	0.956	9368		
				8,236	1170	9,636
100		9,600	0.74	7104		
				6768	312	2112
104		9,600	0.67	6432		
				6029	390	2351
110		9,700	0.58	5626		
				Σ		73084
EXIST AUX						(5830)
FANS 290 KW X 7800						(2262)
KW to Sales						64,992

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SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P17A OF

JOB NO. 5-E1014

BY AF DATE 7-2-77

CHKD. BY DATE

DERATE FOR -90°F DESIGN

INLET AIR		R I S E	L M T D	① R I S E R A T I O	② L M T D R A T I O	X56
90	Steam 140 <u>124</u> 16	128 <u>90</u> 38	34 22/25.43			+44 = % OF LOAD
						POINT TOTAL ALLOWABLE LOAD % A CH E
100	140 <u>124</u> 16	128 <u>100</u> 28	24 12/21.44	0.71 0.84		58+44 = 100
						33+44 = 77
104	140 <u>124</u> 16	128 <u>104</u> 24	20 8/19.73	0.59 0.78		83 86
						26+44 = 70
110	140 <u>124</u> 16	128 <u>110</u> 18	14 2/16.98	0.41 0.67		74 76
						15+44 = 59
80	140 <u>104</u> 26	128 <u>80</u> 48	34 22/35.88	1.0 1.41		62 63
						79
70	140 <u>104</u> 36	128 <u>70</u> 58	34 22/46.12	1.0 1.81		102
115	140 <u>124</u> 16	128 <u>115</u> 13	9 3/14.4	.26 .566		78 10 10

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SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P17B OF

JOB NO. S-81014

BY B. Frawley DATE 7 OCT 81

CHKD. BY DATE

CALC. ELECTRIC OUTTURN

90°F INLET AIR DESIGN @ 56% LOADING

TEMP ANNUAL EST KW AIR COND KW @
INLET AIR FRACTIONS FULL LOAD(1) FRACTION LOSS(2) DERATE

OPER 7800 HR/YR PERIOD
SPLIT FOR KW
INTERVAL 1000 S

90	0.76	-0.76	9,800	-0-	9,800	5928	58,094
90	0.76	0.15			8,596	1170	10,057
100	0.09		9,600	0.77	7,392		
		0.04			7,056	312	2,201
104	0.05	0.05	9,600	0.70	6,720		
					6,221	390	2,426
110	<0.01		9,700	0.59	5,723		

Σ

72,778
(5,830)
(2,250)
64,698

EXISTING PLANT AUXILIARIES 748 KW X 7800 =
NEW CONDENSER FANS N 356 BHP N 289 KW X 7800 =
KW TO SALES

NOTES: SEE CALL SHEET P15B

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SUBJECT BRAWLEY

AIR COOLED HEAT EXCHANGER

SHEET NO. P.17C OF

JOB NO. S-81214

BY B.F. DATE 9 DEC 81

CHKD. BY DATE

CALC ELECTRIC OUTTURN

90°F INLET AIR DESIGN @ 66% LOADING

TEMP °F		KW		OPER HRS		PERIOD
INLET AIR		DERATE		FOR PERIOD		KW 1000's
90	0.76	9,800		5928		58094
90		-0-	9800			
			8884	1170		10394
100		9,600	0.83	7968		
			7536	312		2351
104		9,600	0.74	7104		
			6559	390		2558
110		9,700	0.62	6014		
Σ						73397
Exit AUX						(5830)
FANS 341 KW x 7800						(2660)
Net to Sales						64907

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SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. D17D OF
JOB NO. S-81014
BY BF DATE 9 DEC 81
CHKD. BY DATE

CALC ELECTRIC OUTTURN					OPER HRS	
90°F INLET AIR DESIGN @ 70% LOADING					FOR PERIOD	
TEMP°F			KW	DERATE		
INLET AIR						
90	0.76	9800			5928	58094
90			-0-	9800		
				9028	1170	10563
100		9600	0.86	8256		
				7776	312	2426
104		9600	0.76	7296		
				6703	390	2614
110		9700	0.63	6111		
				Σ		73,697
EXIST AUX						(5830)
FANS 361 KW X 1800						(2816)
Net to Sales						65,051

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SUBJECT BRAWLEY
AIR COOLED STEAM CONDENSER

SHEET NO. P18 OF
 JOB NO. S-81014
 BY P. F. Finner DATE 7 OCT 91
 CHKD. BY DATE

DESIGN INLET OF	78	RECOMMENDED			56 1.18 56 1.06 70
		84	90	56	
INSTRUMENTED COSTS	10 ⁶ \$				125 70
ESTIMATE CONDENSER	1.57	1.8	2.1	will Redo	
DUCTING 48" ϕ , 16" ϕ & 4" PIPE	0.8	0.8	0.8		
STEAM VALVE & CONTROL SYS	0.1	0.1	0.1		
10 ⁶ \$ TOTAL INSTALLED COST	2.47	2.7	3.0		
Δ	0.23		0.3		
Δ			Δ		
SALES 10 ⁶ \$/YR					
@ \$0.077/KWH	4.72	0.22	4.94	0.04	4.98
Δ	0.12	2.1	0.06	0.02	
	4.84	0.16	5.00	-0.0	5.00
Δ	0.02		0.04	0.01	
	4.86	0.18	5.04	-0.03	5.01

} 56% LOADING
 } 66% LOADING
 } 70% LOADING

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SUBJECT BRADLEYAIR COOLED STEAM CONDENSERSHEET NO. P19 OF ...JOB NO. S-21014BY RF DATE 5 DEC 71CHKD. BY ... DATE ...CHECK ON WORST DAY AT CONTROL SPECIFIC POINTSFANS - ONE L/G = 2.726 TAB $\frac{1}{4}$ = 1.363

TIME	DAY	TEMP °F	WET	ENTHALPHY R-		No	GRAMS		Calc gpm
				IN	OUT		IN	OUT AWI	
12M10	85	67	31.6	69.1	13.75	1	70	290 220	165.8
2A	86	68	32.4	69.9	13.75	1	74	295 221	166.6
4	80	67	31.6	70.6	14.3	1	78	295 217	163.5
6	84	69	33.3	70.8	13.75	1	82	296 214	161.3
8	98	79	41.6	79.1	13.75	1	120	340 220	165.8
10	109	80	43.7	79.7	13.2	1	108	345 237	178.6
12N	117	82	45.9	68.9	13.2	2	108	260 152	229.1
2P	118	83	47.0	65.0	13.2	2	114	265 151	227.6
4	116	83	47.0	65.0	13.2	2	118	265 147	221.6
6	113	84	45.2	66.2	13.2	2	130	272 142	214.0
8	100	76	39.6	75.6	13.2	1	96	320 224	168.8
10	92	72	35.8	73.3	13.75	1	86	310 224	168.8

12 POINT Σ = 2231.5 $\div$ 12 = 186.0 gpm Ave

CHECK FOR TYPICAL SUMMER DAY

TIME	DRY	WET	IN	OUT	R- (2%)	IN	OUT	AWI	Calc
									2PM
12M10	88	70	34.1	71.5	13.75	82	300	218	164.3
2A	79	71	34.1	71.5	↓	94	300	206	155.2
4	74	71	35.0	72.5		110	308	198	149.2
6	73	68	32.4	69.9		95	295	200	150.7
8	76	69	33.3	70.8		95	295	200	150.7
10	90	73	36.7	74.2		95	315	223	168.1
12N	99	75	38.6	76.0	↓ (40%)	92	325	233	175.6
2P	104	74	37.7	73.7		78	314	236	177.9
4	108	76	39.6	75.6		84	330	246	185.4
6	108	75	38.6	74.6		78	324	246	185.4
8	104	74	37.7	73.7		78	320	242	182.4
10	95	68	32.4	69.9	13.75	60	295	235	177.1

12 POINTS Σ 2022 $\div$ 12 = 168.5

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SUBJECT BRADLEY

AIR COOLED STEAM CONDENSED

SHEET NO. P20 OF

JOB NO. S-81014

BY AF DATE 5 DEC 61

CHKD. BY DATE

CHECK ON WINTER DAY AT CONTROL SPECIFIC POINTS

	OF		ENTHALPY		FANS	GRAMS			GPM
TIME	DRY	WET	IN	OUT	R- NO	IN	OUT	AWT	Calc
12 MID	61	47	18.7	62.0	15.9	1	26	250 224	168.8
2 A	59	52	21.4	64.7	15.9		46	265 219	165.1
4	54	48	19.2	62.5	15.9		40	250 210	158.3
6	53	47	18.7	62.0	15.9		40	248 208	156.8
8	70	54	22.6	61.6	15.4		36	248 212	159.8
10	83	66	26.5	64.0	13.75		40	260 220	165.8
12 N	90	62	27.9	65.3			44	270 226	170.3
2 P	90	61	27.2	64.7			40	265 225	169.6
4	88	61.4	27.4	64.9			43	265 222	167.3
6	72	56.5	24.2	66.2	15.4		44	272 228	171.8
8	66	49.5	20	63.3	15.9		27	250 223	168.1
10	62	61	22.2	70.5	15.9		78	295 217	163.5

$\Sigma 12 \text{ POINTS} = 1985.2 \div 12 = 165.4 \text{ Ave}$

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SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. 221 OF
 JOB NO. S-31014
 BY BR DATE 5 DEC 51
 CHKD. BY DATE

CHECK STEAM CONDENSED AT CONTROL SPECIFIC POINTS

WORST DAY TURB@6" Hg Abs - Steam Condensed Full $\approx 205,000 \frac{LB}{HR}$

AUX Steam COND $\approx 13,000$

	°F	C.W.T.	ACHE	Σ	AUX Steam COND	COND	gpm of Condensate
TIME	DRY	%LOAD	%LOAD	%LOAD	STEAM LIMITING PERIOD, LB		
12M	85	36 42	56 64	98 106	213,900		427.8
2A	86	38 42	56 62	98 104	↓		427.3
4	80	36 44	64 74	108	218,000		436.0
6	84	42	56 68	98	213,900		427.8
8	98	42	30	72	160,600		321.2
10	109	40	14	54	123,700		247.4
12N	117	40	4	44	103,200		206.4
2P	118	40	3	43	101,100		202.2
4	116	40	5 5	45	105,200		210.4
6	113	40	8	48	111,400		222.8
8	100	41	26	67	150,300		300.6
10	92	42	40	82	181,100		362.2

CONDENSATE $\approx [3,792,600 \frac{LB}{DAY} \div (1440 \times 8.34)] \times 43 = 135.8 \text{ gpm Ave}$
 ≈ 315.8

CALL EVAP $[-186.0 + 135.8 = 50.2 \text{ gpm Short Ave} \times 1440 = 72,280 \text{ gal Short}]$

Rogers

SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P22 OF
 JOB NO. 5-21014
 BY AE DATE 5 DEC 81
 CHKD. BY DATE

84°F @ 56%

check for TYPICAL SUMMER DAY AT CONTROL SPECIFIC POINTS

TIME	CWT		ACHE		Steam LIMITING Feed $\frac{lb}{hr}$
	DRY	% LOAD	% LOAD	% LOAD	
12M	88	42	46	88	193,400
2A	79	42	66	108	218,000
4	74	42	76	118	↓
6	73	42	76	118	
8	76	42	72	114	
10	90	42	44	86	189,300
12N	99	42	24	66	148,300
2P	104	40	20	60	136,000
4	108	40	14	54	123,700
6	108	40	14	54	↓
8	104	40	20	60	
10	95	42	34	76	168,800

CONDENSATE 4,192,400 $\div (1440 \times 8.34) \times 0.43 = 149.7$ gpm Ave

Calc EVAP $[-168.7 + 149.7 = 18.8$ gpm Short $\times 1440 = 27,072$ gal Short

Rogers

SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P23 OF

JOB NO. S-81014

BY BE DATE 7 DEC 31

CHKD. BY DATE

check for typical WINTER DAY at control specific points

TIME	DRY	CWT % LOAD	ACHE % LOAD	Σ	STEAM LIMITING PERIOD LB/HR
12 MID	61	51	60	111	218,000
2 A	59	51	60	↓	↓
4	54	51	60	↓	↓
6	53	51	60	↓	↓
8	70	48	60	↓	↓
10	83	42	60	↓	↓
12 N	90	42	44	86	189,300
2 P	90	42	44	↓	↓
4	88	42	48	90	197,500
6	72	48	60	108	218,000
8	66	50	60	110	↓
10	62	51	60	111	↓

CONDENSATE $[5,076,200 \text{ LB/DAY} \div (1440 \times 8.34)] \times 0.43 = 181.7 \text{ AVE}$

Calc EVAPORATION $(-165.4 + 181.7) = 16.3 \text{ LONG}$
 $\times 1440 = 23,472 \text{ gal LONG}$
 each DAY

Rogers

SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P24 OF

JOB NO. S-71014

BY BE DATE 7 DEC 11

CHKD. BY DATE

Check Worst Day @ 84°F & 66% of Load at Design

TIME	DRY	CWT	ACHE		
12M	85	42	63	100+	218,000
2A	86		59	↓	↓
4	80		70+	↓	↓
6	84		66	↓	↓
8	98		39	81	179,000
10	109	42	23	65	146,200
12N	117	40	8	48	111,400
2P	118			↓	↓
4	116			↓	↓
6	113			↓	↓
8	100	41	36	77	170,800
10	92	42	50	92	201,600

$$40.30.4 [1440 \times 8.34] \times 0.43 = 144.3$$

$$186.0 - 144.3 = 41.7 \text{ short } \times 1440 = 60048 \text{ gal Short}$$

Rogers

SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P.25 OF

JOB NO. 5-81014

BY BF DATE 7 DEC 71

CHKD. BY DATE

Check For Typical Summer Day @ 90°F DESIGN (X66%)

TIME	DRY				
12M	88	42	61	1004	218,000
2A	79				
4A	74				
6	73				
8	76				
10	90		56	98	213,900
12N	99		35 35	77	170,800
2P	104	40	26 24	66	148,300
4	108		18 18	58	131,900
6	108		14 14	58	
8	104		26 24	66	148,300
10	95	42	43 43	85	187,200

OK

$$0.85 \text{ Condenser } 4444.6 \div [1,440 \times 8.34] \times 0.43 = 159.1 \text{ gpm Ave}$$

$$\text{EVAP } 168.5 - 159.1 = 9.4 \text{ gpm Ave Short}$$

$$\times 1440 = 13,536 \text{ gal Short ea Day}$$

Rogers

SUBJECT BRAWLEY
AIR COOLED STEAM CONDENSER

SHEET NO. P26 OF OF
 JOB NO. S-81014
 BY BF DATE 7 DEC 21
 CHKD. BY DATE

Check Typical Summer Day @ 84°F & 66% of Load at Design

TIME	DRY						
12 MID	88	42	57	99	215,900		
2 A	79		70	100+	218,000		
4	74						
6	73						
8	76						
10	90		53 51	95 93	207,700	203700	
12 N	99		52 52	86 72	177,000	160600	
2 P	104	40	30 23	70 63	156,500	142150	
4	108		24 17	64 57	144,200	129800	
6	108		24 17	57		129900	
8	104		30 23	70 63	156,500	142150	
10	95	42	44 41	86 83	189,300	183200	

$$\text{Condensate } 4526.6 \div \left[\frac{4,359,000}{1440 \times 8.34} \right] \times 0.43 = 162.0 \text{ gpm Ave}$$

$$\text{EVAP} - 168.5 + 162.0 = 6.5 \text{ gpm short} \times 1440 = 9360 \text{ gal day short}$$

$$- 168.5 + 158 = 10.5 \times 1440 = 17895 \text{ short}$$

Rogers

SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO. P27 OF
 JOB NO. S-91014
 BY BF DATE 7 DEC
 CHKD. BY DATE

Overhead view
 Check Typical Summer Day @ 84°F & 70% of load @ Design

TIME	DRY	CWT	ACHE				
12 MID	88	42.38	62	100	100+	218,000	218,000
2A	79						
4	74						
6	72						
8	76						
10	90	36	58	55	74	191	205,700
12N	99		42	34	78	70	185,200
2P	104	40	30	25	66	61	156,500
4	108		28	18	64	54	152,400
6	108		28	18	64	54	131,900
8	104		30	25	66	61	156,500
10	95	42.38	58	42	84	70	177,500

0.88 $4617 \div [1440 \times 8.34] \times 0.43 = 165.3$
 12.8 4436.8 158.9 39742

Evap - 168.5 + 165.3 = 3.2 gpm Short x 1440 = 4608 gal Short

0.86 $4485.8 \div [1440 \times 8.34] \times 0.43 = 160.6$
 4292.8 153.7

EVAP - 153.9 + 160.6 = 6.7 Long OK
~~4.9 Long~~ → 1728 Short

154.9

Rogers

SUBJECT BRAWLEYAIR COOLED STEAM CONDENSERSHEET NO. P28 OF JOB NO. S-81014BY BF DATE 7 DEC 81CHKD. BY DATE

38%
36%
Check on WORST DAY at Reschedule on CWT

	°F	ENTHALPY			FANS	GRAINS			Calc	
TIME	DRY	WET	IN	OUT	R	No	IN	OUT	Δwci	gpm
12 MID	85	67	31.6	66.1	12.66	1	70	270	200	150.7
2A	86	68	32.4	66.9		1	74	275	201	151.5
4	80	67	31.6	66.1		1	78	270	192	144.7
6	84	69	33.3	67.8		1	82	280	198	149.2
8	98	79	41.6	76.1		1	120	325	205	154.5
10	109	80	43.7	76.7	12.1	1	108	330	222	167.3
12N	117	82	45.9	82.1		2	108	250	142	214.0
2P	118	83	47.0	83.4		2	114	260	146	220.
4	116	83	47.0	83.4		2	118	260	142	214
6	113	84	48.2	84.6		2	130	263	133	200.5
8	100	76	39.6	72.6		1	96	310	214	161.3
10	92	72	35.8	70.3	12.66	1	86	296	210	158.3

Σ 2086 ÷ 12 = 173.8 gpm Ave EVAP.

Check Typ Summer Day Similar Reschedule

TIME	DRY	WET	IN	OUT	R	1	IN	OUT	Δwci	gpm
12M	88	70	34.1	68.61 71.5 69.61	12.66		82	285 300 285	248 203	164.3
2A	79	71	34.1	71.5 69.51			94	300 290	206 191	155.2
4	74	71	35.0	72.5 66.91			110	308 276	198 180	149.2
6	73	68	32.4	69.4 67.81			95	295 291	200 181	150.7
8	76	69	33.3	70.8 71.21			95	295 298.5	200 186	150.7
10	90	73	36.7	74.2 75.11			95	318 308.5	228 203.5	168.1
12N	99	75	38.6	76.0 70.48			92	325 290	233 216.5	175.6
2P	104	74	37.7	73.7 72.6	12.1		78	344 336	236 218	172.9
4	108	76	39.6	75.6 71.58			84	330 301	245 222	185.4
6	108	75	38.6	74.6 70.68			78	324 316	246 223	185.4
8	104	74	37.7	73.7 66.51			78	320 274	242 218	182.4
10	95	68	32.4	69.7	12.66		60	295	235 214	177.1

Σ 2022 ÷ 12 = 168.5 gpm Ave Avg: 204.6

$$\Sigma \frac{2456}{12} \text{ gpm} \left(\frac{1}{7000} \right) (44000) (0.0161) (7.48) = 154.9 \text{ gpm}$$

Rogers

SUBJECT BRAWLEY

AIR COOLED STEAM CONDENSER

SHEET NO P29 OF

JOB NO. 5-21014

BY RF DATE 7 DEC 57

CHKD. BY DATE

Check Worst Day Day @ 84°F & 70% of Load at Design
Revised

	DRY	CWT	ACHE				
12 MID	85	42 38	58	100 + 100 +	218,000	218,000	
2A	86		66				
4	80		74				
6	84		70				
8	98		(39) 36	1774 (81) 78	179,000	170,800	164700
10	109	42 36	(23) 17	5952 (65) 59	146,200	133,900	121700
12 N	117	40 38	(86) 46	4644 (45) 46	111,400	107,300	103200
2P	118		(5) 7	43 45	not cond		101200
4	116		(11) 7	45 47			105300
6	113		(43) 32	7870 (81) 73	179,000	172,900	113500
8	100	41					156500
10	92	42 36	50	86 92	201,600	189,300	189300

Condensate $4046.8 \div [1440 \times 8.34] \times 0.43 = 144.9$ Ave

EVAP $-1860 + 144.9 = 41.1 \times 1440 = 59,184$ gal short

0.75
Condensate $3936.2 \div [1440 \times 8.24] \times 0.43 = 140.9$
7855

EVAP $-173.8 + 140.9 = 32.9 \times 1440 = 47,376$ SHORT
51523

Rogers

SUBJECT BRAWLEY

AIR COOLE STEAM CONDENSER

SHEET NO. P30 OF

JOB NO. S-51014

BY BF DATE 7 DEC 81

CHKD. BY DATE

Check For Worst Day @ 90°F Design & 50% Load
& 70% Load

TIME	DRY	Resched.	90°F 50%	90°F 70%	90°F 50%	90°F 70%
12M	85	42 38 68	100+	100	218,000	218,000
2A	86	42	66			
4	88	44	79			
6	84	42	70			
8	98	42	38 52 80	90	177,000	197,500
10	109	40 36	17 31 57	67	129,800	150,300
12N	117	38	8	48	46	111,400
2D	118					
4	116					
6	113					
8	100	41	33 49 74	57	164,700	191,300
10	92	42 36	52 66 94	100+	205,700	218,000

40°F 42 wet
90°F 50 dry
→ 3989.6 $[1440 \times 8.34] \times 0.43 = 142.8$ Ave

$142.8 - 186 = 43.2 \times 1440 = 62,208$

40°F 42
30°F 36 wet
90°F 70 dry
→ 4116.6 $[1440 \times 8.34] \times 0.43 = 147.4$

$147.4 - 173.8 = 26.4 \times 1440 = 38016$

3989.6

Rogers

SUBJECT BRAULEYAIR COOLED STEAM CONDENSERSHEET NO. P31 OF JOB NO. 5-71014BY AF DATE 7055CHKD. BY DATE

Check on Worst Day at Reduced Power heading 48%

TIME	°F DRY	CWT		ACHE		CONDENSATE	
		% LOAD	% LOAD	% LOAD	% LOAD	PERIOD LB	
12M	85	0	48	48		111,400	222.8 gpm Ave
2A	86	0	48				
4	80	0	48				
6	84	0	48				
8	98	19	29				
10	109	35	13				
12N	117	44	4				
2P	118	45	3				
4	116	43	5				
6	113	40	8				
8	100	22	26				
10	92	8	40				

TIME			ENTHALPHY		R	FANS	GRAINS		AWI	EVAP
	DRY	Wet	IN	OUT		No	IN	OUT		CALC
12M	85	67	31.6	37.9	2.3	1	70	125	55	gpm 41.5
2A	86	68	32.4	38.7			74	130	56	42.2
4	80	67	31.6	37.9			78	129	51	38.4
6	84	69	33.3	39.6			82	135	53	39.9
8	98	79	41.6	51.1	3.5		120	292	172	129.6
10	109	80	43.7	75.9	11.8		108	324	216	162.8
12N	117	82	45.9	65.3	14.3	2	108	270	162	244.1 245.2
2P	118	83	47.0	66.9	14.6	2	114	280	166	250.2
4	116	83	47.0	66.1	14.0	2	118	270	152	229.1
6	113	84	48.2	66.2	13.2	2	130	270	140	211.0
8	106	76	39.6	62.2	8.3	1	96	250	154	116.1
10	92	72	35.8	48.1	4.5	1	86	180	94	70.8

12 POINTS = $1575.7 \div 12 = 131.3$ Ave EVAP $131.3 \div 28 = 103.3 \div 222.8 = 0.46$ Required Frac (MIN) $131.3 \div 222.8 = 0.589$ represents
40000 gallon
in hour

Rogers

SUBJECT FLAWLEYAIR COOLED STEAM CONDENSERSHEET NO. P-3 OF JOB NO. 5-51014BY RF DATE 7/15/21CHKD. BY DATE

CHECK ON WORST DAY @ Reduced Power loading (486)
using 2 speed CWT fan to cut evaporation

TIME	DRY WET	ENTHALPHY			NO FANS	GRAINS			Calc gpm
		IN	OUT	R		IN	OUT	Δwi	
12M			37.9	2.3	1				41.5
2A			38.7						42.2
4			37.9						38.4
6			39.6						39.9
8			57.1	3.5					129.6
10			75.9	16.8					162.8
12N		45.9	71.8	14.3	①	108	300	192	197.3
2P		48.0	73.5	14.6		114	320	206	211.7
4		47.0	72.4	14.6		118	305	187	192.2
6		48.2	72.1	13.2		130	302	172	176.7
8		39.6	62.2	8.3					116.1
10		39.8	48.1	4.5					76.8

$$\Sigma = 1420.2 \div 12 = 118.3$$

$$\textcircled{1} \frac{1}{6} \sim 1.812 \quad \text{AIR FLOW} \sim 60,000 \text{ LB/HR}$$

$$118.3 \div 222.8 = .53$$

$$118.3 - 28 = 90.3 \div 222.8 = 0.41 \quad \text{by USING SURGE}$$

198.2

Rogers

SUBJECT BRANKLEY

AIR COOLED STEAM CONDENSER

SHEET NO. 233 OF

JOB NO. 5-21014

BY E.F. DATE 7 DEC 3

CHKD. BY DATE

Check for typical Summer Day @ 48% LOADING

TIME	°F		ENTHALPY			No FANS	GRAINS			Calc EVAP gpm
	DRY	WET	IN	OUT	R		IN	OUT	AWC	
12M	88	70	34.1	40.4	2.3	1	82	140	58	43.7
2A	79	71	34.1	40.4			94	140	46	34.7
4	74	71	35.0	41.3			110	145	35	26.3
6	73	68	32.4	38.7			95	130	35	26.3
8	76	69	33.3	39.6			95	136	41	30.9
10	90	73	36.7	46.0	3.4		95	168	73	55.0
12N	99	75	38.6	60.4	8.0		92	243	151	113.8
2P	104	74	37.7	64.7	9.9		78	265	187	140.9
4	108	76	39.6	70.4	11.3		84	295	211	159
6	108	75	38.6	69.4	11.3		78	290	212	159.8
8	104	74	37.7	64.7	9.9		78	265	187	140.9
10	95	68	32.4	49.0	6.1		60	183	123	92.7

$$1024 \div 12 = 85.3 \text{ gpm Ave EVAP}$$

$$85.3 \div 222.8 = 0.38 \text{ Required frac (MIN)}$$

Rogers

SUBJECT BRAWLEY
AIR COOLED STEAM CONDENSER

SHEET NO. P24 OF
JOB NO. 5-1214
BY BF DATE 7 DEC 1
CHKD. BY DATE

Check For Typical Summer Day @ 48% Loading

TIME	°F DRY	CWT %LOAD	ACHE %LOAD	Σ %LOAD	Period LB	
12M	88	- 0 -	45	45	111,400	222.9 gpm Ave
2A	79	- 0 -				
4	74	- 0 -				
6	73	- 0 -				
8	76	- 0 -				
10	90	4	44			
12N	99	21	27			
2P	104	28	20			
4	108	33	15			
6	108	33	15			
8	104	28	20			
10	95	14	34

Rogers

SUBJECT BRAWLEYSHEET NO. P35 OF JOB NO. 5-61014BY RF DATE 7 DEC 91CHKD. BY DATE

CWT	R=		
1,640	17.70	33,272	390,600
12740	-0-	-0-	-0%-
14350	2.3	33,272	
12740	1.36	17,445	19% LOAD
14350	3.5	50,717	
12740	10.73	136,710	35%
14350	11.8	169,982	
12740		171,864	44
14350	14.3	205,136	
12740	13.2	175,770	45
14350	14.6	209,042	
12740	13.18	167,958	43
14350	14.0	201,230	
12740	12.26	156,240	40
14350	13.2	189,510	
12740	6.75	85,932	22
14350	8.3	119,204	
12740	2.46	31,248	8
14350	4.5	64,520	
12740	1.2	15,624	4
14350	3.4	48,896	
12740	6.44	82,026	21
14350	8.0	115,298	
12740	8.58	109,368	28
14350	9.9	142,640	
12740	10.11	128,898	33
14350	11.3	162,170	
12740	4.29	54,634	14
14350	6.1	87,956	
12740	18.4	234,360	60
14350	18.6	267,632	
12740	16.86	214,830	55
14350	17.29	248,102	