

# PACIFIC GAS AND ELECTRIC COMPANY

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February 10, 1978

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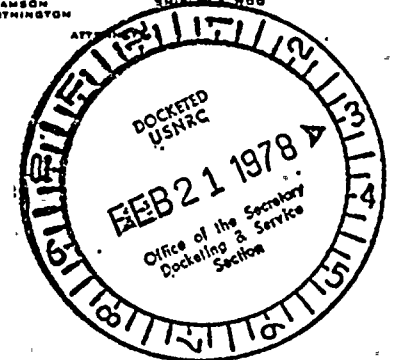
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Mr. John F. Stolz, Chief  
Light Water Reactors Branch No. 1  
Division of Project Management  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Re: Dockets 50-275-OL - 50-323-OL  
Diablo Canyon Units 1 and 2



Dear Mr. Stolz:

In a discussion on January 25, 1978 Mr. John Knox of the Regulatory Staff requested additional information for his review of the environmental qualification of the containment fan cooler (CFC) motors. He specifically asked for a heat-transfer analysis like the one Florida Power and Light provided in meetings on the St. Lucie Unit 1 license application.

The attached heat transfer analysis summaries for the Diablo Canyon CFC motor heat exchangers are the same type as those provided for St. Lucie. The analysis summaries document the capability of the Diablo Canyon CFC motor heat exchangers to provide cooling air to the motor inlet at the temperatures stated in our letter of January 19, 1978, for post-design basis accident and post-main steam line break containment conditions. We trust that this information is sufficient to complete the Staff review.

Kindly acknowledge receipt of the above material on the enclosed copy of this letter and return it to me in the enclosed addressed envelope.

A letter dated January 20, 1978 from C. Eicheldinger of Westinghouse to Dennis Allison transmitted forty copies of WCAP-9241 entitled "Evaluation of Reactor Coolant System for Postulated Loss of Coolant Accident for the Diablo Canyon Nuclear Power Plant" (proprietary) and twenty copies of WCAP-9242, the non-proprietary version of the same report. Also enclosed were:

1. One copy of Application for Withholding, AW-77-27 (non-proprietary).



Mr. John F. Stolz

2

February 10, 1978

2. One copy of Affidavit (non-proprietary).

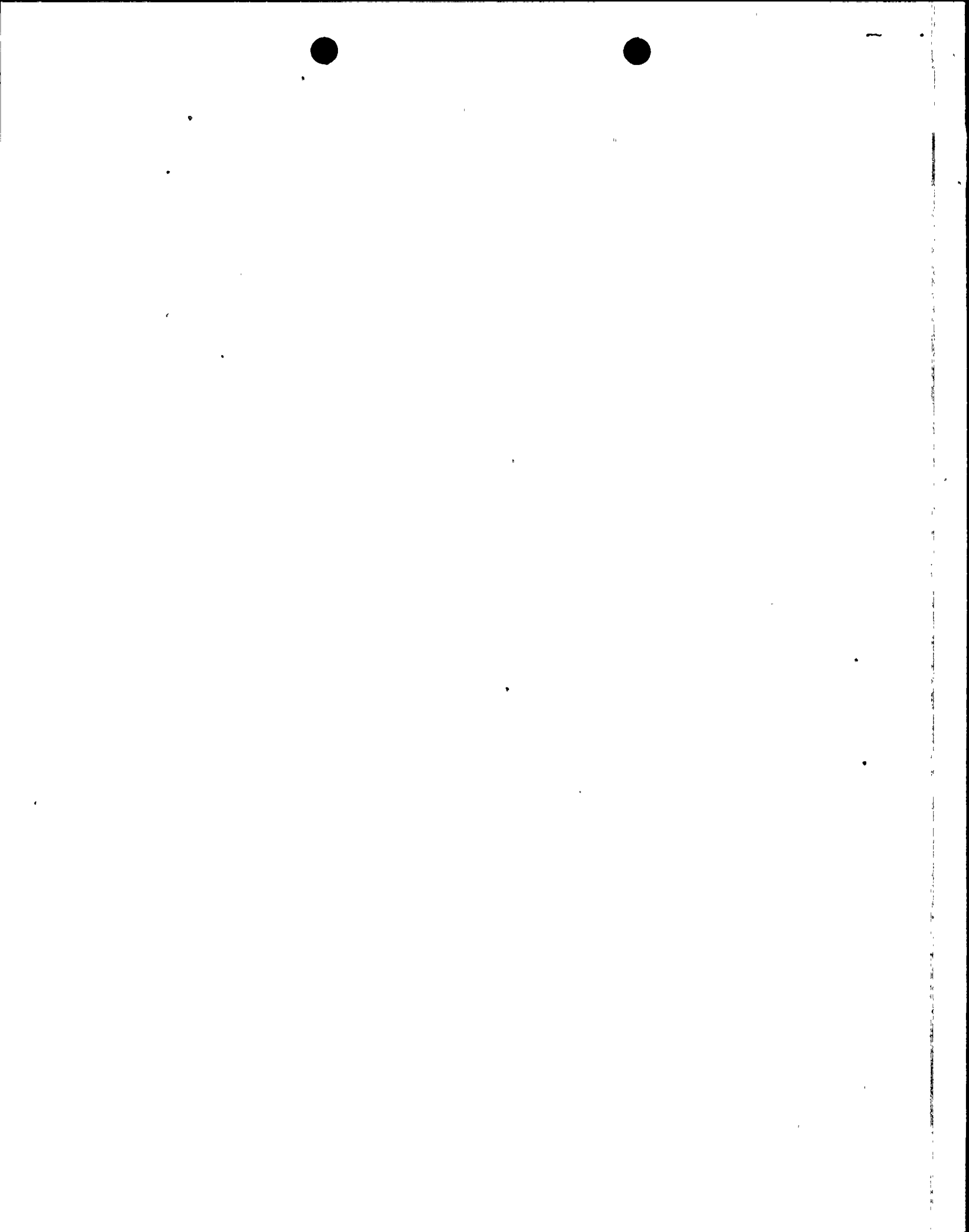
The above report provides information for the Staff's review of the Diablo Canyon reactor vessel supports analysis.

Very truly yours,

Philip A. Crane, Jr.

Attachments (40)

CC w/attachment: Service List



## HEAT EXCHANGER DESIGN PROGRAM

T. J. FAGAN 501-2Y29 EXT 7306

OPTIMIZING ENTIRE EXCHANGER

STURTEVANT WATER CIRCUITING

1.00 VELOCITY WATER CIRCUITING

ORIGINAL POST ACCIDENT CONDITIONS

271°F, 61.7 psia

LOCA

PACIFIC GAS AND ELECTRIC

## MOTOR COOLING SYSTEM PARAMETERS

MOTOR DIAMETER 33.25 INCHES LENGTH 54.00 INCHES A 32.00 INCHES  
B 52.00 INCHES C 54.00 INCHES D 37.00 INCHES E 24.00 INCHES

LOSSES 8.50 KILOWATTS

CONTAINMENT

TEMPERATURE 271.00 DEG F PRESSURE 61.696 PSIA  
PARTIAL PRESSURES AIR 19.146 PSIA WATER VAPOR 42.550 PSIA

DENSITIES AIR 0.07072 LBM/CU FT WATER VAPOR 0.10068 LBM/CU FT

MOTOR CASE

TEMPERATURE 263.40 DEG F SURFACE AREA 36.54 SQ FT  
PARTIAL PRESSURES AIR 24.175 PSIA WATER VAPOR 37.521 PSIA  
DENSITIES AIR 0.09024 LBM/CU FT WATER VAPOR 0.08951 LBM/CU FT  
CONVECTION COEFFICIENT 1.3771 BTU/HR-SQ FT-DEG F QCONV 298.98 BTU/HR  
MASS TRANSPORT COEFFICIENT 1.24382 FT/HR QMASS 26668.3 BTU/HR  
CONDENSATION RATE 28.47 LBM/HR

INSIDE CONVECTION COEFFICIENT 6.0000 BTU/HR-SQ FT-DEG F

BASE ENCLOSURE

TEMPERATURE 268.96 DEG F SURFACE AREA 44.43 SQ FT  
PARTIAL PRESSURES AIR 23.550 PSIA WATER VAPOR 41.146 PSIA  
DENSITIES AIR 0.07613 LBM/CU FT WATER VAPOR 0.09757 LBM/CU FT  
CONVECTION COEFFICIENT 3.7065 BTU/HR-SQ FT-DEG F QCONV 64.2 BTU/HR  
MASS TRANSPORT COEFFICIENT 15.9125 FT/HR QMASS 6377.3 BTU/HR  
CONDENSATION RATE 5.84 LBM/HR

INSIDE CONVECTION COEFFICIENT 1.0429 BTU/HR-SQ FT-DEG F

EXIT TEMPERATURE 130.94 DEG F

← AIR ENTERING MOTOR

COIL DESIGN PARAMETERS

F= 8.53 FINS/INCH TF= 0.0383 INCHES UB= 0.5253 INCHES DTO= 0.6437 INCHES  
DPI= 0.5491 INCHES IT= 0.4490 INCHES PI= 1.5000 INCHES PL= 1.2990 INCHES  
W= 30.30 INCHES H= 24.00 INCHES 8 ROWS VCF= 150.00 FPM VH= 4.303 FPS

AIR AND WATER INLET AND EXIT CONDITIONS

AIR IN → TAI= 149.86 DEG F PAIR= 61.696 PSI WAIR= 1.2291, +04 LB/HR ( 2731.33 SCFH )

WATER IN → TWI= 125.00 DEG F WWATER= 2.5110, +04 LB/HR ( 50.82 GPM )

AIR OUT → TAO= 128.76 DEG F WAO= 127.49 DEG F WAIR= 6.2214, +04 BTU/HR  
QWATER= 6.2411, +04 BTU/HR QHTF= 6.2416, +04 BTU/HR KHOA= 0.27798 LB/CU FT

HEAT EXCHANGER CONDITIONS

WATER OUT AIR SIDE PRESSURE DROP

ARF= 0.932 ART= 0.560 PDA= 0.228 INCHES OF WATER PDR= 10.000 INCHES OF WATER

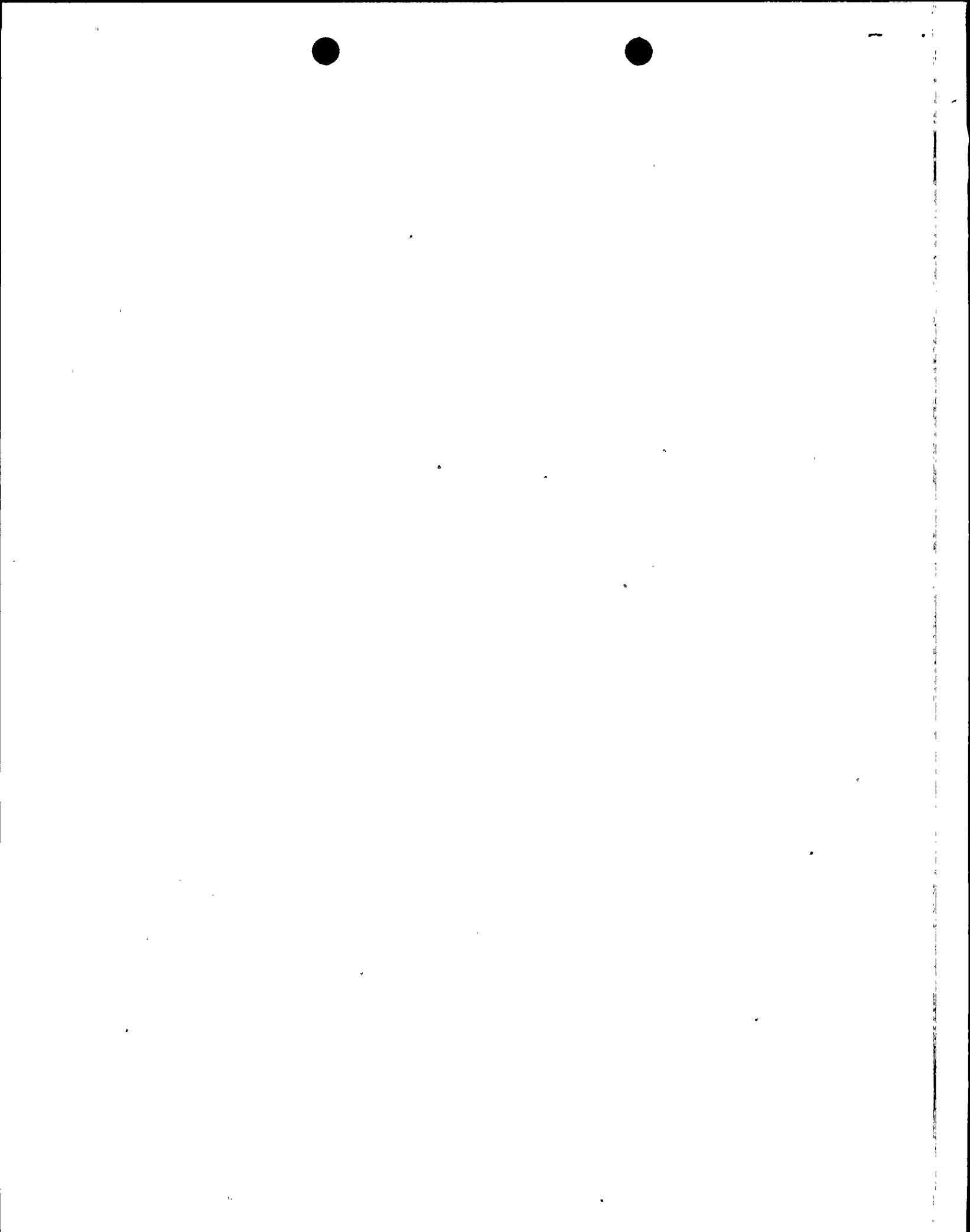
WATER SIDE PRESSURE DROP

WATER TEMPERATURE 126 DEG F

NRE= 3.383, +04 PDW= 3.886, +00 PSI

HEAT TRANSFER PARAMETERS

ATI= 46.00 SQ FT ATO= 53.93 SQ FT ACOL= 51.51 SQ FT  
AFIN= 729.02 SQ FT AAIR= 780.54 SQ FT  
HI= 1195.10 BTU/HR-SQ FT-DEG F FI= 0.00050 HR-SQ FT-DEG F/RTU



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KY= 215.00 BTU/HR-FT-DEG F      HC= 2500.00 BTU/HR-SQ FT-DEG F  
KF= 215.00 BTU/HR-FT-DEG F      HA= 10.889 BTU/HR-SQ FT-DEG F  
U= 7.66 BTU/HR-SQ FT-DEG F  
K= 149.47 BTU/HR-SQ FT FACE-DEG MED-ROW  
HA AUGMENTED BY 0.00 PERCENT      ETAF= 0.896

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THERMAL IMPEDANCES BASED ON TOTAL AIR SIDE AREA  
 $Q = (A_{AIR}/R_{TOT}) \cdot L \cdot M \cdot I \cdot D$

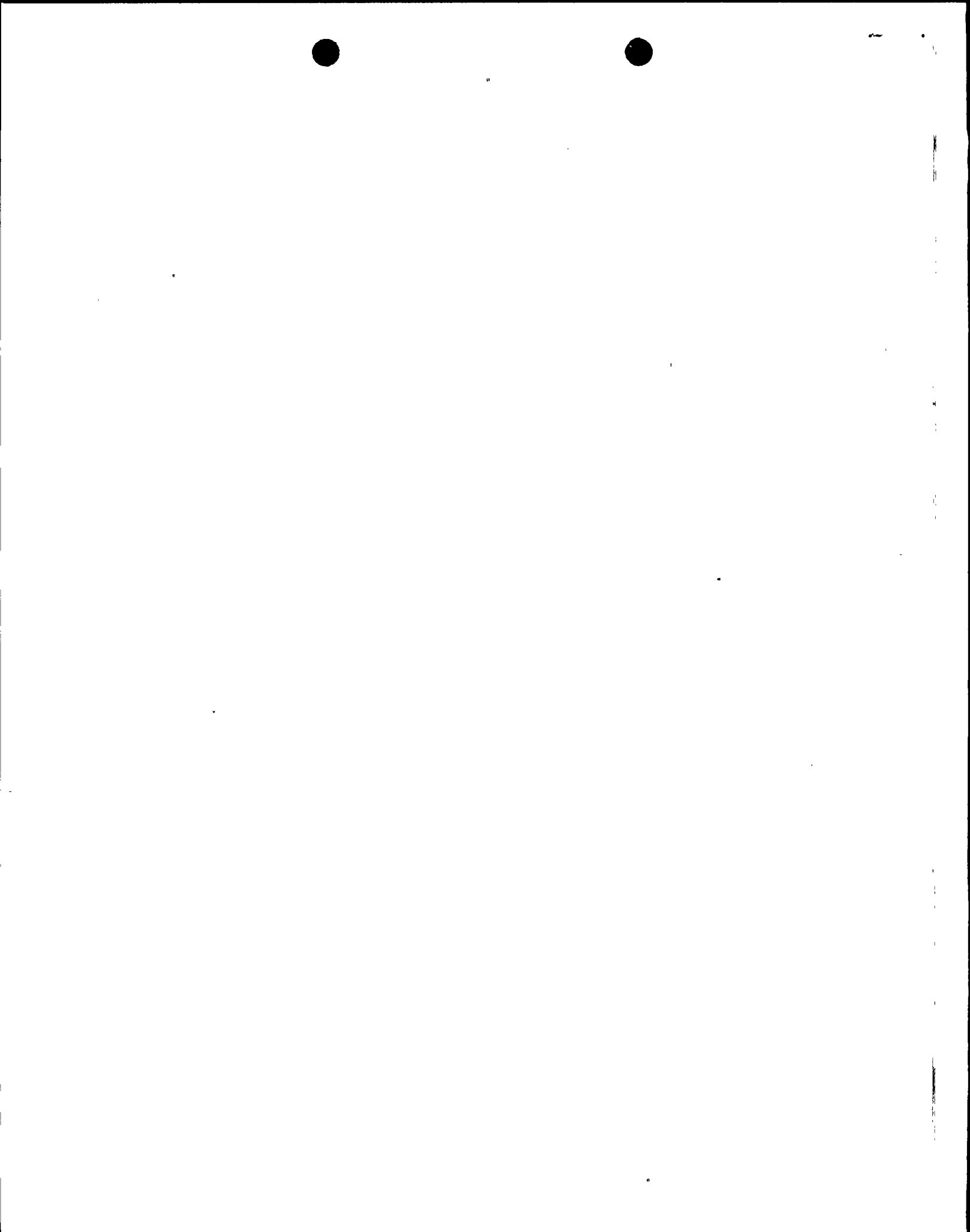
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TUBE SIDE CONVECTION	0.01425	HR-SQ FT-DEG F/8TU	10.88	PERCENT
TUBE SIDE FOULING	0.00848	HR-SQ FT-DEG F/8TU	6.50	PERCENT
TUBE METAL CONDUCTION	0.00329	HR-SQ FT-DEG F/8TU	0.22	PERCENT
CONTACT IMPEDANCE	0.00579	HR-SQ FT-DEG F/8TU	4.43	PERCENT
COLLAR CONDUCTION	0.00004	HR-SQ FT-DEG F/8TU	0.03	PERCENT
AIR SIDE CONVECTION AND FIN EFFICIENCY	0.10174	HR-SQ FT-DEG F/8TU	77.94	PERCENT
TOTAL	0.13055	HR-SQ FT-DEG F/8TU		

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SPOILER HEIGHT 0.0000 INCHES  
CORRUGATIONS PER PITCH 3  
HA AUGMENTED BY 0.00 PERCENT  
PDA AUGMENTED BY 0.00 PERCENT  
GRATZ NUMBER 0.00

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HEAT EXCHANGER DESIGN PROGRAM  
T. J. FAGAN 501-2Y29 EXT 7306

OPTIMIZING ENTIRE EXCHANGER

IRRELEVANT WATER CIRCUITING

1.00 VELOCITY WATER CIRCUITING

NEW POST ACCIDENT CONDITIONS

ASSUMED 326°F, 110 psia

(STREAMLINE BREAK)

PACIFIC GAS AND ELECTRIC

MOTOR COOLING SYSTEM PARAMETERS  
MOTOR DIAMETER 33.25 INCHES LENGTH 54.00 INCHES A 32.00 INCHES  
B 52.00 INCHES C 54.00 INCHES D 37.00 INCHES E 24.00 INCHES

LOSSES 8.50 KILOWATTS

CONTAINMENT

TEMPERATURE 326.00 DEG F PRESSURE 110.000 PSIA  
PARTIAL PRESSURES AIR 12.479 PSIA WATER VAPOR 97.521 PSIA

DENSITIES AIR 0.04287 LBH/CU FT WATER VAPOR 0.22033 LBH/CU FT  
MOTOR CASE

TEMPERATURE 321.77 DEG F SURFACE AREA 36.54 SQ FT  
PARTIAL PRESSURES AIR 18.074 PSIA WATER VAPOR 91.926 PSIA  
DENSITIES AIR 0.06243 LBH/CU FT WATER VAPOR 0.20836 LBH/CU FT  
CONVECTION COEFFICIENT 1.0409 BTU/HR-SQ FT-DEG F UCONV 160.88 BTU/HR  
MASS TRANSPORT COEFFICIENT 13.6205 FT/HR QMASS 38815.1 BTU/HR

CONDENSATION RATE 43.42 LBH/HR

INSIDE CONVECTION COEFFICIENT 6.0000 BTU/HR-SQ FT-DEG F

BASE ENCLOSURE

TEMPERATURE 324.91 DEG F SURFACE AREA 44.43 SQ FT  
PARTIAL PRESSURES AIR 13.944 PSIA WATER VAPOR 96.056 PSIA  
DENSITIES AIR 0.04797 LBH/CU FT WATER VAPOR 0.21720 LBH/CU FT  
CONVECTION COEFFICIENT 0.6564 BTU/HR-SQ FT-DEG F UCONV 31.7 BTU/HR  
MASS TRANSPORT COEFFICIENT 8.6506 FT/HR QMASS 8943.1 BTU/HR

CONDENSATION RATE 10.03 LBH/HR

INSIDE CONVECTION COEFFICIENT 1.0433 BTU/HR-SQ FT-DEG F

EXIT TEMPERATURE 132.67 DEG F ← AIR ENTERING MOTOR

COIL DESIGN PARAMETERS

F = 8.50 FINS/INCH TF = 0.0080 INCHES DB = 0.6250 INCHES DTO = 0.6437 INCHES  
DTI = 0.5491 INCHES TI = 0.0490 INCHES PT = 1.5000 INCHES PL = 1.2990 INCHES  
N = 30.00 INCHES H = 24.00 INCHES 8 ROWS VCF = 88.27 FPM VW = 4.303 FPS

AIR AND WATER INLET AND EXIT CONDITIONS.  
AIR IN TAI = 155.60 DEG F PAIR = 110.000 PSI AAIR = 1.2291 +04 LB/HR ( 2731.33 SCFH )  
WATER IN TWI = 125.00 DEG F WATER = 2.5110 +04 LB/HR ( 50.82 GPM )  
TAE = 129.63 DEG F TWE = 128.06 DEG F OAIR = 7.6590 +04 BTU/HR  
OAWATER = 7.6833 +04 BTU/HR OHTF = 7.6839 +04 BTU/HR RHOA = 0.48174 LB/CU FT

HEAT EXCHANGER CONDITIONS

AIR OUT WATER SURF AIR SIDE PRESSURE DROP  
ARF = 0.932 ART = 0.560 PDA = 0.151 INCHES OF WATER PDR = 10.000 INCHES OF WATER

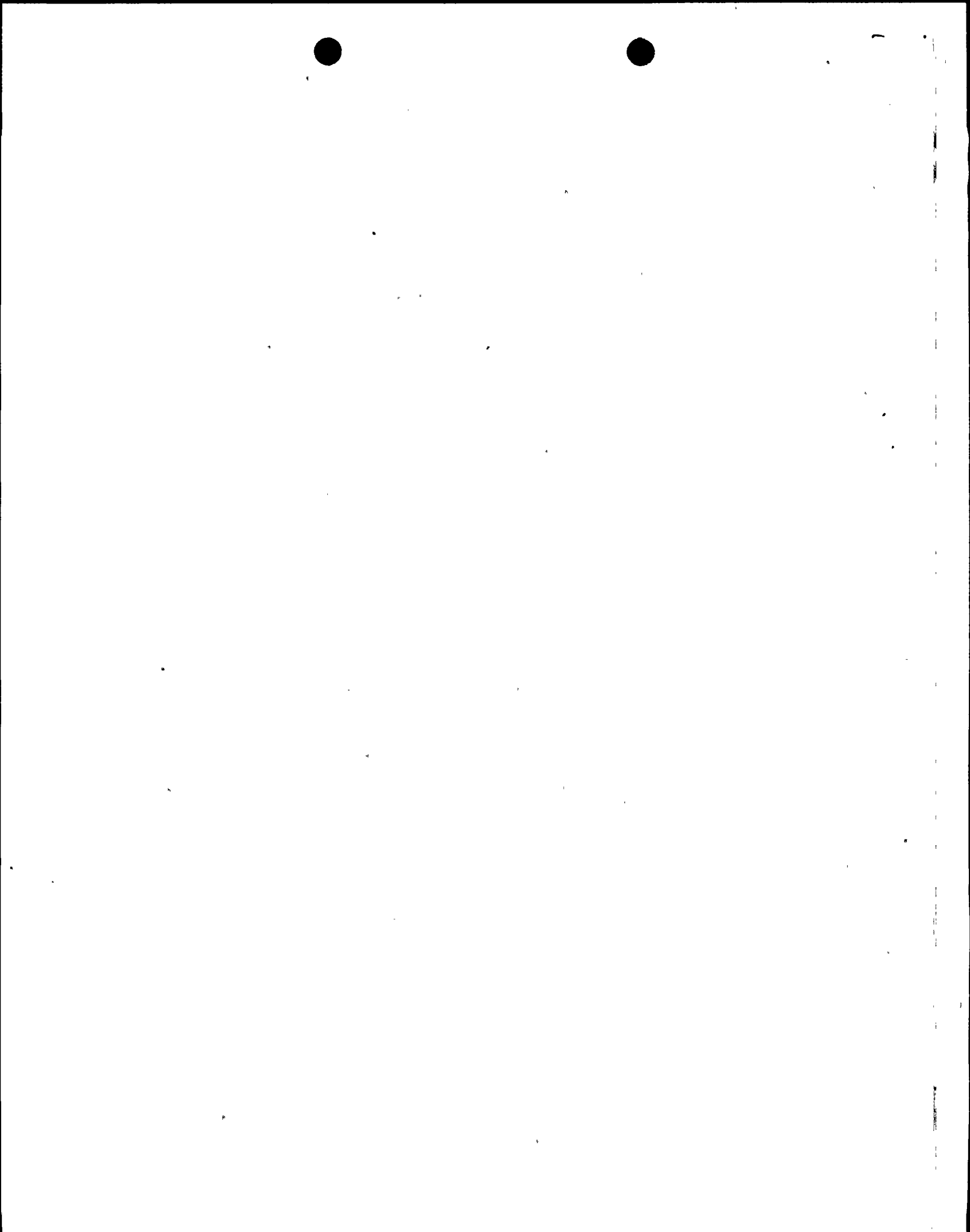
WATER SIDE PRESSURE DROP

WATER TEMPERATURE 127 DEG F

NRE = 3.383 +04 PDW = 3.886 +00 PSI

HEAT TRANSFER PARAMETERS

ATI = 46.00 SQ FT ATO = 53.93 SQ FT ACOL = 51.51 SQ FT  
AFIA = 729.02 SQ FT AAIR = 780.54 SQ FT  
HI = 1195.10 BTU/HR-SQ FT-DEG F FI = 0.00050 HR-SQ FT-DEG F/BTU



KT= 215.00 BTU/HR-FT-DEG F      HC= 2500.00 BTU/HR-SQ FT-DEG F  
KF= 215.00 BTU/HR-FT-DEG F      HA= 10.889 BTU/HR-SQ FT-DEG F  
U= 7.56 BTU/HR-SQ FT-DEG F  
K= 142.47 BTU/HR-SQ FT FACE-DEG MED-ROW  
HA AUGMENTED BY 0.00 PERCENT      FTAF= 0.896

THERMAL IMPEDANCES BASED ON TOTAL AIR SIDE AREA  
 $Q = (A \cdot A_{AIR} / R_{TOT}) \cdot \Delta T_{MID}$

TUBE SIDE CONVECTION	0.01420 HR-SQ FT-DEG F/BTU	10.88 PERCENT
TUBE SIDE FOULING	0.00848 HR-SQ FT-DEG F/BTU	6.50 PERCENT
TUBE METAL CONDUCTION	0.00029 HR-SQ FT-DEG F/BTU	0.22 PERCENT
CONTACT IMPEDANCE	0.00579 HR-SQ FT-DEG F/BTU	4.43 PERCENT
COLLAR CONDUCTION	0.00004 HR-SQ FT-DEG F/BTU	0.03 PERCENT
AIR SIDE CONVECTION AND FIN EFFICIENCY TOTAL	0.10174 HR-SQ FT-DEG F/BTU	77.94 PERCENT
	0.13055 HR-SQ FT-DEG F/BTU	

SPOILER HEIGHT 0.0000 INCHES  
CORRUGATIONS PER PITCH 3  
HA AUGMENTED BY 0.00 PERCENT  
PDA AUGMENTED BY 0.00 PERCENT  
GRATZ NUMBER 0.00

