	ENGINEERING & PROJECTS EXCELLENCE CENTRE (EPEC)	VOLUME- IV	Section No.	
		WHRUR PROJECT	Vol. No.	IV
			Revision No.	0

VOLUME – IV

DRAWINGS, PFDs, P&IDs, LAYOUT, FLOW SCHEMES

FOR

WHRU REPLACEMENT PROJECT



OIL AND NATURAL GAS CORPORATION LIMITED INDIA

FORMAT No.	Ref. PROCEDURE No.	FORMAT ISSUE No.	FORMAT REV. No.	FORMAT REV. DATE:
OES/SOF/049B		03	00	26.02.2018


	ENGINEERING & PROJECTS EXCELLENCE CENTRE (EPEC)	VOLUME- IV	Section No.	
			Vol. No.	IV
		WHRUR PROJECT	Revision No.	0

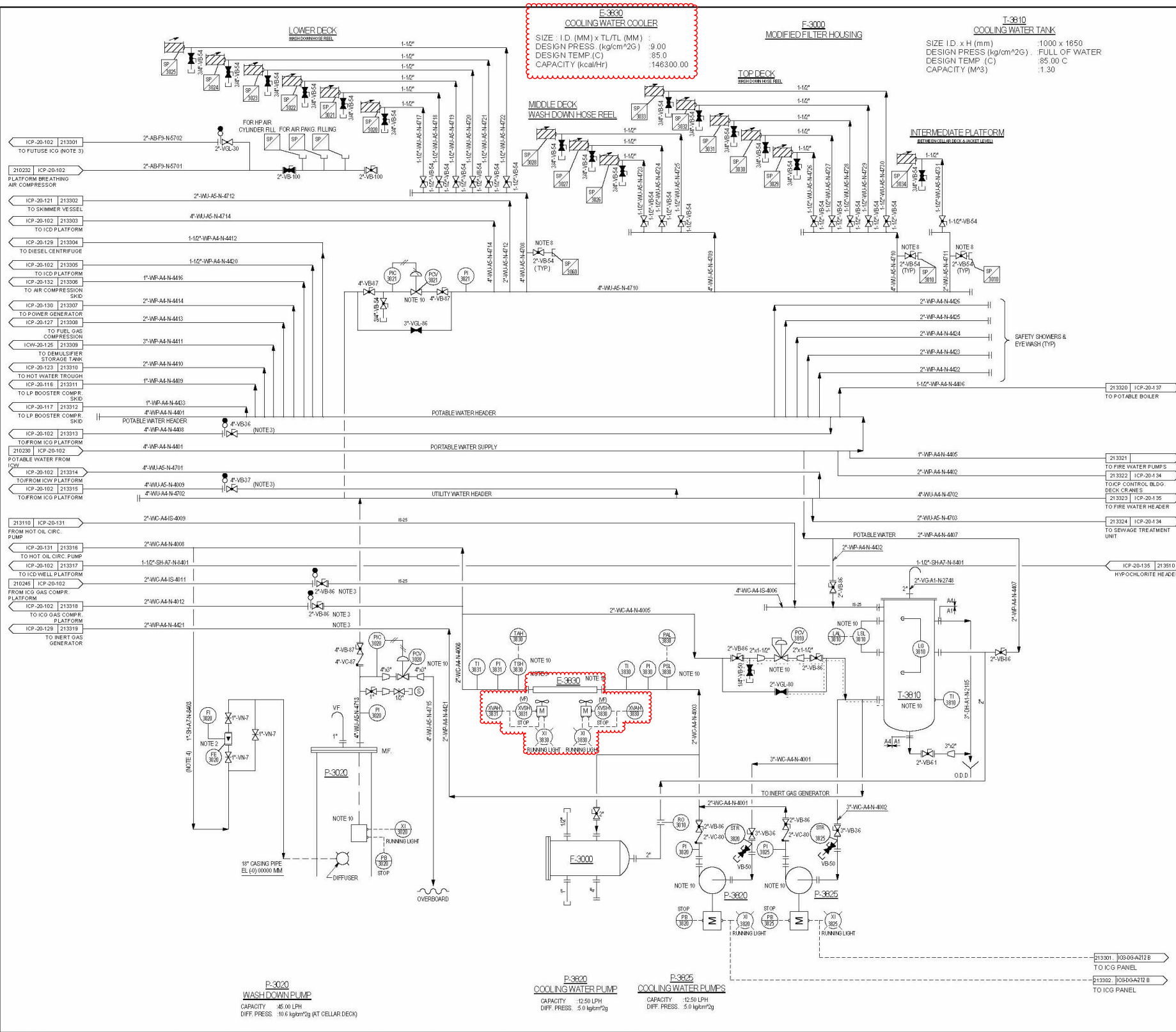
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FOR BIDDING

FILENAME ICP-20-133



- NOTES :**
- 1. LINE FOR INJECTING HYPOCHLORITE INTO UTILITY WATER SHALL BE PROTECTED AGAINST MECHANICAL DAMAGE AT BOAT LANDING AREA BY GUARDED PIPE ALL THROUGH.
 - 2. FI-3020 SHALL BE LOCATED ON CELLAR DECK.
 - 3. DELETED
 - 4. COOLING WATER SYSTEM SHOWN IS INDICATIVE ONLY. DESIGN OF THE SYSTEM TO BE FINALIZED DEPENDING ON FINAL COOLING WATER REQUIREMENT.
 - 5. FOR GENERAL NOTES REFER DWG. NO. 20-101.
 - 6. DELETED
 - 7. DELETED
 - 8. PROVIDE SUITABLE TAPPINGS FOR SAND MET AND WATER FLUSHING CONNECTIONS.
 - 9. E-3030 INLET/OUTLET FLANGES ARE 300 DIA PIPEWORK TO HAVE SIMILAR MATING FLANGES.
 - 10.

REPLACEMENT SCOPE

E	DIGITIZED TO SPID 2009 BY CGC	25/02/12	DRP	GNK		
D	UPDATED TO AS BUILT & DIGITIZED BY LTC	16/12/02	RRP	JFL	RSS	
C	UPDATED TO AS BUILT & CONVERTED TO CAD BY ICC	15-05-05				
B	GENERAL REVISION	05-11-87				
A	APPROVED FOR CONSTRUCTION	24-08-87				
3	INCORPORATED CLIENTS CHANGE REQUEST	17-08-87				
2	ISSUED FOR CONSTRUCTION	01-05-87				
REV	DESCRIPTION	DATE	DWN	CHKD	APPD	APPD

VENDOR: VENDOR CODE: 602499



CONTRACT NO.: M/R/M/H/M/L/S/T/K/R/O/P/8/D/4/41/0/1/150C10003/PB-11009

CLIENT: **Oil & Natural Gas Corporation Ltd. India**

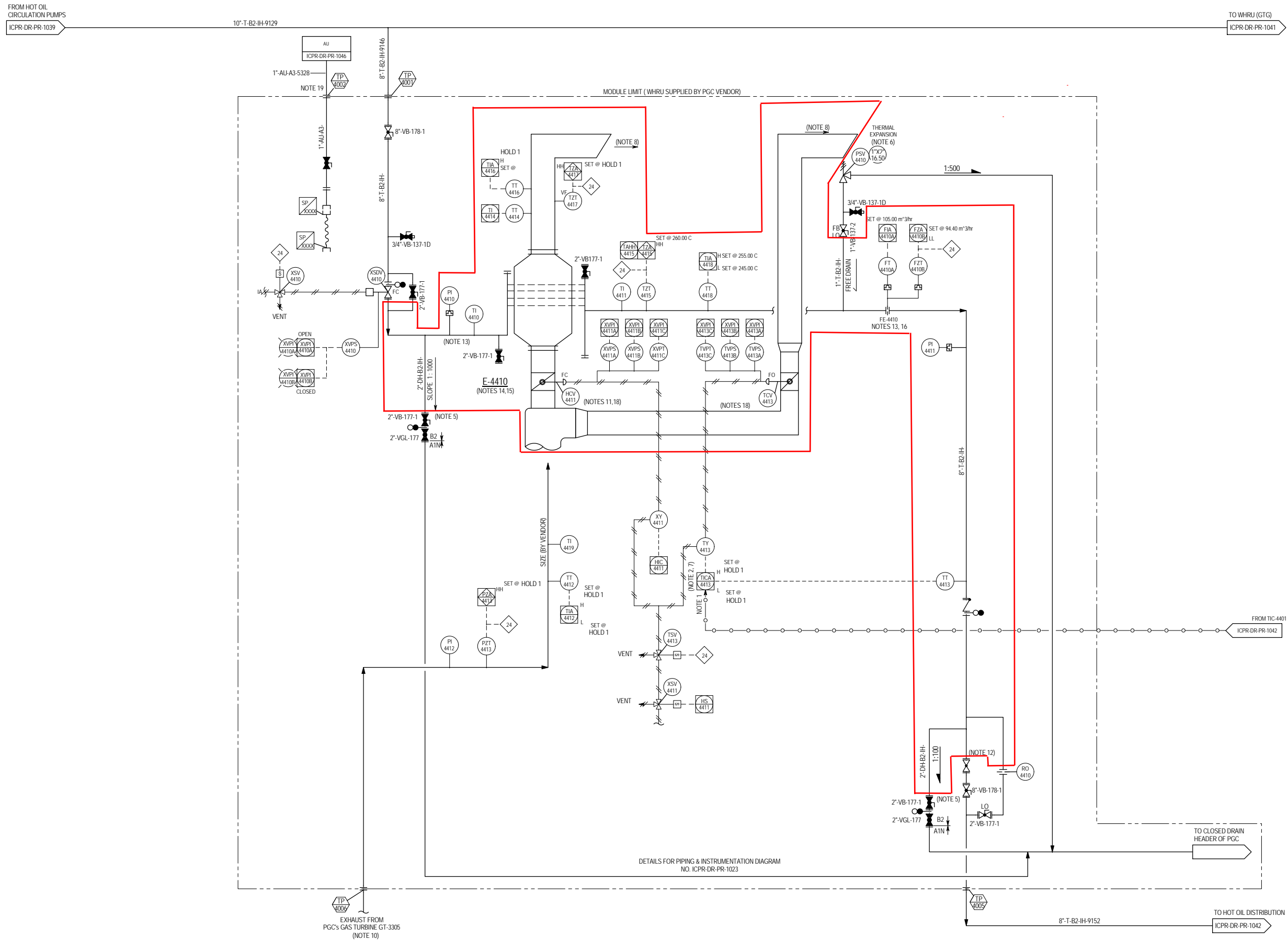
MHS - ICP COMPLEX

TITLE
PIPING AND INSTRUMENTATION DIAGRAM
UTILITY POTABLE COOLING
WATER SYSTEM

DRAWING NUMBER:	SCALE: NTS	REV
ICP-20-133		E
	ORIG. DWG. SIZE: A1	

DISCLAIMER: The subject drawing has been digitized into standard SP-P&ID format under stipulated contract from source information received through above referred previous details by maintaining same information.

E-4410
GAS COMPRESSOR WHRU
DUTY :13.500 MW(NOTE 4)
DESIGN PRESS. :TUBE: 16.50 kg/cm²g
DESIGN TEMP. :TUBE: 500.00 C (HOLD 1)
TRIM :B2
MOC :P22 SEAMLESS (TUBE)



NOTES :

- TEMPERATURE SET POINT FROM MASTER TEMPERATURE CONTROLLER
- TEMPERATURE CONTROL ON WHRU COIL/BYPASS DAMPERS
- VENT FOR SYSTEM FILL/DRAINAGE LOCATED AT HIGH POINT
- EXCLUSIVE 10% DESIGN MARGIN. IN ADDITION OF 10% MARGIN ON SURFACE AREA SHALL ALSO BE CONSIDERED.
- LOW POINT DRAIN LOCATION BY PIPING BASED ON LAYOUT.
- STANDARD ORIFICE SIZE FOR THERMAL SAFETY VALVE SHALL BE CONSIDERED
- IN ALL THE CASES TO ACHIEVE OPTIMUM CONTROL ON THE SYSTEM'S HEAT & MASS BALANCE, OPERATOR SHALL ADJUST SET POINT OF (TT-4413, TT-4433), PDCV-4501 (PDT-4501) AND DUMP COOLER OIL TEMPERATURE (TT-4561).
- EXHAUST TO SAFE LOCATION.
- ITEMS MARKED AS VF SHALL BE FURNISHED BY WHRE VENDOR.
- GAS TURBINE DUCTWORK IS VENDOR FURNISHED AS PART OF GT-3305 PACKAGE.
- HCV-4411 SHALL BE FULL SEALING TYPE.
- GLOBE VALVE WITH LIMITED STOP TO ENSURE THAT GLOBE VALVE WILL NOT FULLY OPENED
- ALL PRESURE LEVEL AND FLOW INSTRUMENTS ON HOT OIL SERVICE SHALL BE DIAPHRAM SEAL
- LOCATED AT COMPRESSOR MODULE.
- E-4410 SHALL BE ARRANGED AS TO BE FREE DRAINING AND THE HOT OIL TUBES SHALL BE DESIGNED TO RUN DRY.
- ADEQUATE UPSTREAM/DOWNSTREAM STRAIGHT LENGTH TO BE PROVIDED.
- ALL LOW POINT DRAINS SHALL BE PIPED TO FACILITATE DRAINING OF SYSTEM HOLD - UP INTO DRUMS WHENEVER REQUIRED.
- PERCENTAGE OPENING INDICATION TO BE PROVIDED IN CENTRAL CONTROL PANEL FOR DIVERTER VALVE TCV-4413 AND HCV-4411.
- FOR WASTE HEAT RECOVERY UNIT (WHRU) CLEANING.
- VENDOR TO CONFIRM THE PIPING & INSTRUMENTATION DIAGRAM.

HOLDS:

- DETAILS PENDING VENDOR DATA



Note: Instrument Air lines are not included in the Scope of replacement.

2	DIGITIZED TO SPID 2009 BY CGC	25.06.12	PVR	GNK		
1	APPROVED FOR CONSTRUCTION (AFC)	30.12.09	SNS	SLT	MYK	
01	ISSUED FOR APPROVAL (IFA)	16.10.09	SNS	WYS	MYK	
0	ISSUED FOR APPROVAL (IFA)	23.07.09	RR	AA	MYK	
A	ISSUED FOR CLIENT COMMENTS (IFC)	14.05.09	SNS	WYS	MYK	
REV.	DESCRIPTION	DATE	DWN	CHKD	APPD	APPD
VENDOR:			VENDOR CODE: 602489			



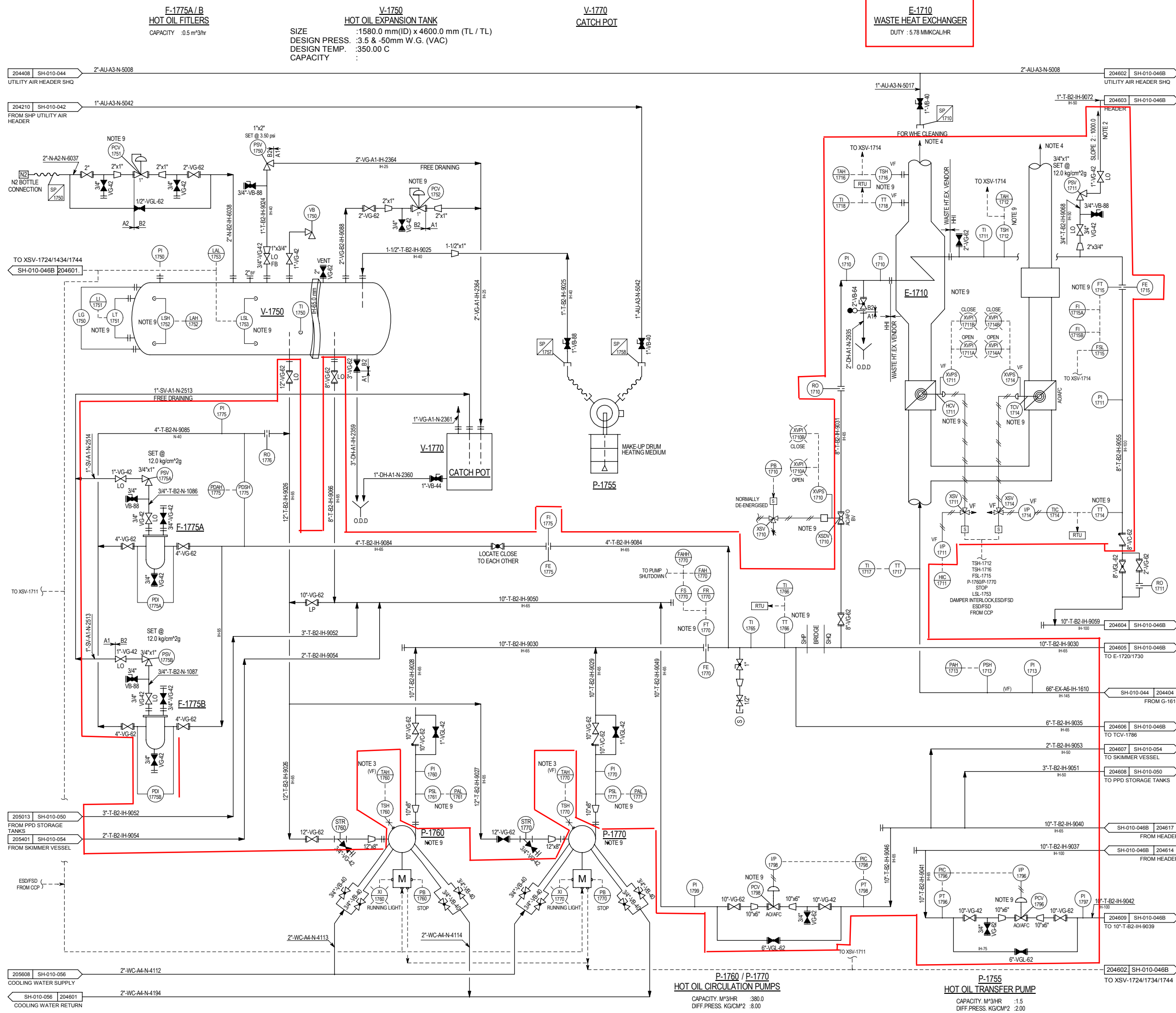
CONTRACT NO.: MR/MH/MM/LSTK/RO/P&ID/44/10/Y15OC10003/PB-11009

CLIENT:	Oil & Natural Gas Corporation Ltd. India
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MHS - ICPR COMPLEX

TITLE	PIPING & INSTRUMENTATION DIAGRAM
	WHRU - GAS COMPRESSOR

DRAWING NUMBER:	ICPR-DR-PR-1040	SCALE: NTS	REV.
		ORIG. DWG SIZE: A1	2



NOTES :

- ALL BLOCK PIPING SECTIONS SHALL BE PROVIDE WITH LOW POINT DRAINS THE LOCATION OF ALL LOW POINT DRAINS SHALL BE CHECKED FOR PLACING OF DRUMS BENEATH THEM CONVENIENTLY TO FACILITATE DRAINING OF SYSTEM HOLDUP WHEN EVER REQUIRED.
- PSV-17111, 1721, 1731, 1741 OUTLETS TO THE MAIN HEADER & THE MAIN DISCHARGING INTO V-1760 TO BE FREE DRAINING WITHOUT ANY POCKETS.
- LINES TO BE FREE DRAINING WITHOUT ANY POCKETS.
- EXHAUST FROM WASTE RECOVERY UNITS SHALL BE ROUTED TO A SAFE LOCATION.
- LOCATE FI-1715, 1725, 1735, 1745 CLOSE TO GLOBE VALVE IN OUTLET LINE OF E-1710, E-1720, E-1730, E-1740.
- LOCATE FI-1781 AND FI-1791 CLOSE TO BYPASS VALVES.
- DELETED.
- P-1755 IS DRIVEN BY AIR OPERATED MOTOR.

Note: Instrument Air lines are not included in the Scope of replacement.

H	DIGITIZED TO SPMD 2009 BY CGC	02/08/12	PVR	GNK		
G	UPDATED TO AS BUILT & DIGITISED BY LTC	16/06/03	RRP	JPL	RSS	
F	CONVERTED TO CAD BY ICC	15/05/95				
E	AS BUILT	01/11/85				
D	GENERAL REVISION/CLIENT COMMENT	15/02/85				
B	GENERAL REVISION					
A	ISSUED FOR CONSTRUCTION	28/06/84				
2	INCORPORATED EIL COMMENTS & REISSUED FOR APPROVAL	13/04/84				
REV.	DESCRIPTION	DATE	OWN	CHKD	APPD	APPD
VENDOR:			VENDOR CODE: 602489			

VENDOR:  VENDOR CODE: 602489

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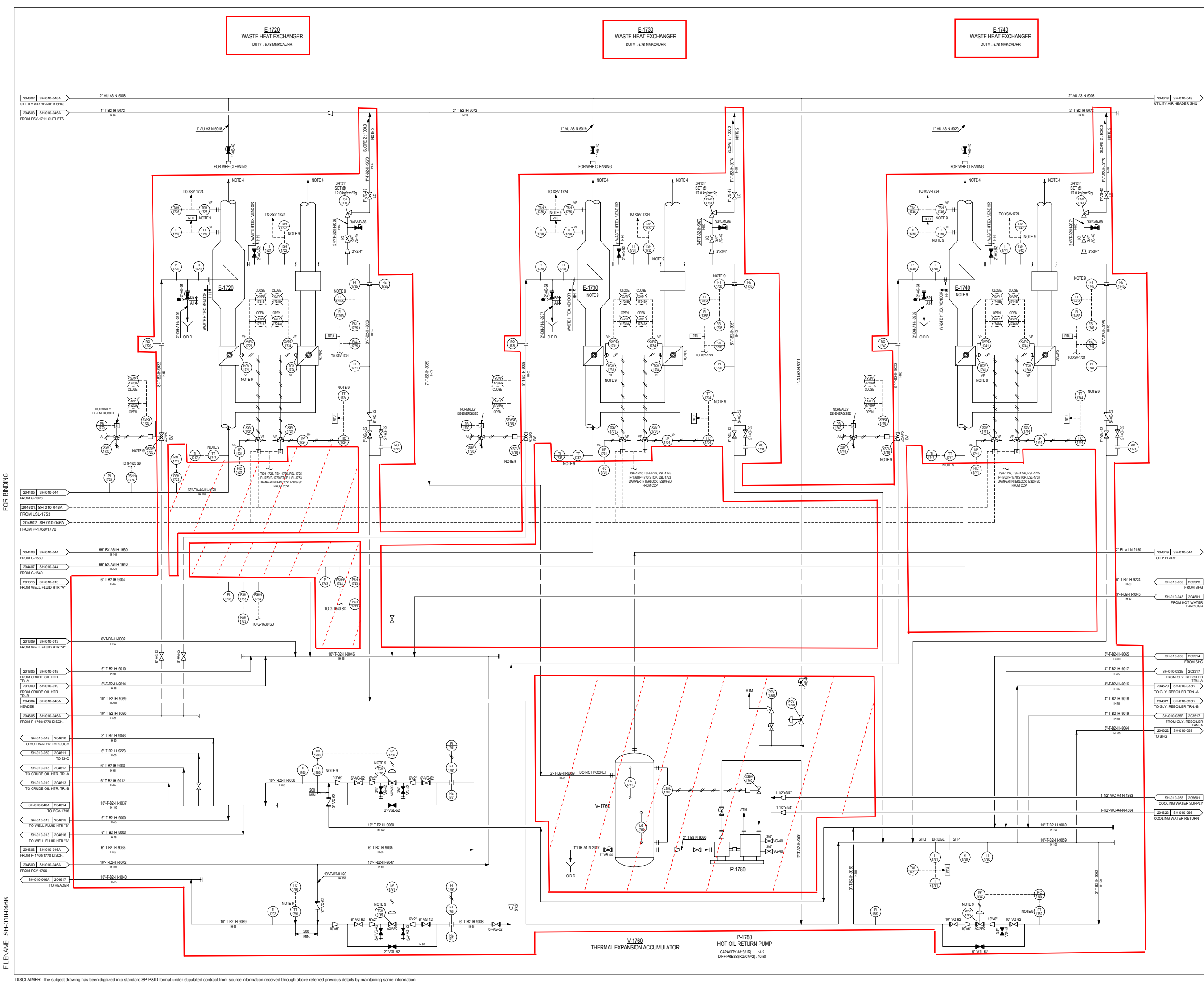
CONTRACT NO.: MR/MH/MM/LSTK/RO/P&ID/44/10/Y150C10003/PB-11009

CLIENT:  **Oil & Natural Gas Corporation Ltd. India**

MHS - SHP COMPLEX	
TITLE	PIPING & INSTRUMENTATION DIAGRAM
HOT OIL SYSTEM (1/2)	

DRAWING NUMBER: SH-010-046A	SCALE: NTS	REV.
	ORIG. DWG SIZE: A1	H

DISC1 AIMER: The subject drawing has been digitized into standard SP-P&ID format under stipulated contract from source information received through above referred previous details by maintaining same information



NOTES :

1. ALL BLOCK PIPING SECTIONS SHALL BE PROVIDED WITH LOW POINT DRAINS THE LOCATION OF ALL LOW POINT DRAINS SHALL BE CHECKED FOR PLACING OF DRAINS BENEATH THEM CONVENIENTLY TO FACILITATE DRAINING OF SYSTEM INCLUDING WHEN EVER REQUIRED.
2. PSH-1711, 1721, 1731, 1741 OUTLETS TO THE MAIN HEADER & THE MAIN DISCHARGING INTO V-1760 TO BE FREE DRAINING WITHOUT ANY POCKETS.
3. LINES TO BE FREE DRAINING WITHOUT ANY POCKETS.
4. EXHAUST FROM WASTE RECOVERY UNITS SHALL BE ROUTED TO A SAFE LOCATION.
5. LOCATE PRT-1715, 1725, 1735, 1745 CLOSE TO GLOBE VALVE IN OUTLET LINE OF E-1710, E-1720, E-1730, E-1740.
6. LOCATE P-1781 AND P-1791 CLOSE TO BYPASS VALVES.
7. OBELETED.
8. P-1755 IS DRIVEN BY AIR OPERATED MOTOR.
- 9.

REPLACEMENT SCOPE

Note: Striked out portion is not included in the Scope of replacement.

Note: Instrument Air lines are not included in the Scope of replacement.

H	DIGITIZED TO SPDD 2009 BY CGC	020812	PVR	GNK	
G	UPDATED TO AS BUILT & DIGITISED BY LTC	160603	RPP	JPL	RSS
F	CONVERTED TO CAD BY ICC	150505			
E	AS BUILT	011185			
D	GENERAL REVISION / CLIENT COMMENT	150225			
B	GENERAL REVISION				
A	ISSUED FOR CONSTRUCTION	280504			
Z	INCORPORATED SL COMMENTS & REISSUED FOR APPROVAL	130404			
REV.	DESCRIPTION	DATE	DWN	CHKD	APPD
VENDOR:			VENDOR CODE: 602489		
 CONTRACT NO.: M/RM/HM/ML/STK/ROP&D/4410Y150C1003/PB-11009					
CLIENT:  Oil & Natural Gas Corporation Ltd. India					
MHS - SHP COMPLEX					
TITLE PIPING & INSTRUMENTATION DIAGRAM HOT OIL SYSTEM (2/2)					
DRAWING NUMBER SH-010-046B			SCALE: NTS REV. H		

FILENAME: SH-010-046B

DISCLAIMER: The subject drawing has been digitized into standard SP-P&ID format under stipulated contract from source information received through above referred previous details by maintaining same information.

M.E.BOILERS LTD.
Client: R.G.T

job no. MEB 257
sheet no. DD0/2/2 A
date 10/9/87
made by AW
approved by

TECHNICAL SPECIFICATION FOR
SERPENTINE BOILER TUBE COIL

REFERENCE DATA

Coil name THERMAL FLUID H/X Drawing no. 257JO/1A

COIL FORM (SERPENTINE COILS)

gas / fluid flow		contra
gas flow direction		horizontal
fluid flow direction		horizontal
arrangement		in-line
pitch in direction of gas flow	mm	116.8
pitch normal to gas flow	mm	80
number of tubes in direction of gas flow		20 *
number of tubes normal to gas flow		40
number of parallel flows		40

TUBE DATA

tube form		solid fins
tube outside diameter	mm	38.1
fin height	mm	6.35
fins per inch		5.5

MECHANICAL DESIGN DATA

Design code		ASME VIII
Tube material		A312 TP310
Tube ordering thickness	mm	2.64
Calc press / temp	N/mm ² / °C	1.2/340

PROCESS DATA (100% MCR, normal operation)

Heating surface (including any fins) m ²		1812
Fluid inlet/outlet temperatures	°C	160 / 250
Fluid inlet/outlet pressures	barg	7.0 / 5.7

COMMENTS

* ARRANGED AS TWO BANKS OF 10 TUBES EACH.

SECTION 3.2

BECORIT & HERWEG
TECHNICAL DATA SHEET
MULTILOUVRE DAMPERS

Date. 9.2.88

To: M E Boilers Ltd.	Your Ref: 257/ENQ 004
Project: Ruston India	Our Ref: 03004
<u>Operating Conditions</u>	
Number of Unit 3	Duct Height 3400mm
Number per unit 1	Width 1100mm
Ref. number DEAL 2258	Orientation Vertical
Duty Bypass Isolation	Lining -
Fluid medium TEG	Pressure norm. 188mm wg
Dust burden -	Pressure max. 254mm wg
Nature of dust -	Pressure diff. closed 7
Flow rate 248400 kg/hr	Temp. norm. 453 deg.C
	Temp max. 481 deg.C
<u>Design Specification</u>	<u>Material Selection</u>
Total weight 1025 kg	Frame Stainless steel 304L
No. of Blades 3	Blade " " "
Pressure drop 6mm wg	Blade Seal Inconel 601
Closing time Variable	Bearings Glacier
Sealing efficiency 99.95%	Blade shafts 316 st.st.
Fan size -	Shaft size 55 dia
Fan power r'qmnts -	
Actuator type Pneumatic : M29602/325/QM914/QM409	
Positioner Martonair : M/1842- 0.2 to 1.0 kg/cm ²	
Actuator power r'qmnts 5 kg/cm ²	Limit Switches Zone 1 open/close
Manual operation -	Limit Switch Type Sq d 9007-BR61B2-M15
Comments:	
1. Air consumption per cycle : 38,250 cu.cm free air	
2. Damper arranged to fail safe open by counterweight on loss of power	

SECTION 3.1

BECORIT & HERWEG
TECHNICAL DATA SHEET
MULTILOUVRE DAMPERS

Date. 9.2.88.....

To: M E Boilers Ltd	Your Ref: 257/ENQ 004
Project: Rustons India	Our Ref: 03004
<u>Operating Conditions</u>	
Number of Unit 3	Duct Height 2600mm
Number per unit 1	Width 2600mm
Ref. number DEAl 2257	Orientation Horizontal
Duty Boiler Isolation	Lining -
Fluid medium TEG	Pressure norm. 188mm wg
Dust burden -	Pressure max. 254mm wg
Nature of dust -	Pressure diff. closed 7
Flow rate 248400' kg/hr	Temp. norm. 453 deg.C
	Temp max. 481 deg.C
<u>Design Specification</u>	<u>Material Selection</u>
Total weight 1375 kg	Frame Stainless steel 304L
No. of Blades 2	Blade " " "
Pressure drop 2mm wg	Blade Seal Inconel 601
Closing time Variable	Bearings Glacier
Sealing efficiency 99.95%	Blade shafts 316 st.st.
Fan size -	Shaft size 65 dia
Fan power r'qmnts -	
Actuator type Pneumatic : M29801/325/QM915/QM410	
Positioner Martonair : M/1842 - 0.2 to 1.0 kg/cm ²	
Actuator power r'qmments 5 kg/cm ²	Limit Switches Zone 1 open/close
Manual operation -	Limit Switch Type Sq D. 9007-BR61B2-M15

Comments:

1. Air consumption per cycle : 68,000 cu.cm free air
2. Damper arranged to fail safe close by counterweight on loss of power



SPECIFICATION SHEET SHELL AND TUBE EXCHANGER

Revisions	Date Issued	Origin	Checked	Approved
0	9-Jun-16	RKP/BSB	RKP/BSB	APS/AH

TMX Job No.	PZ0241
TMX Doc. No.	ICPR-PZ0241-MD-00001
Sheet No.	1 of 8
Project	MHS Re-development (Phase-II)
Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Exchanger	Item No.	E-4410
2	Size	Refer GA Drawing	Connected in	N.A. Parallel N.A. Series
3	Surf./Unit(Eff.)	3,194.6	Surf./Shell(Eff.)	3,194.6 m2
4	PERFORMANCE OF ONE UNIT - Design Case (NOTES 1, 2, 8, 9)			
5	Fluid Allocation		Shell Side	Tube Side
6	Fluid Name		GT Exhaust	Hot Oil (NOTES 1, 2)
7	Fluid Quantity, Total		152,211.5	136,056
8	Vapor(In/Out)		152,211.5	-
9	Liquid		-	136,056
10	Steam		-	-
11	Water		-	-
12	Noncondensable		-	-
13	Temperature(In/Out)		534	251.8
14	Specific Gravity		NOTE 9 Condition CASE 2	
15	Viscosity			
16	Molecular Weight-Vapor			
17	Molecular Weight-Noncondensable			
18	Specific Heat			
19	Thermal Conductivity		NOTE 8	
20	Latent Heat			
21	Inlet Pressure			
22	Velocity			
23	Pressure Drop, Allow./Calc.			
24	Fouling Resistance(Min.)		0.00017	0.00034
25	Heat Exchanged	13.5	MW	MTD(Corrected) 362.4 (CO), 147.1 (COUNTER) °C
26	Transfer Rate, Service	23.7 (CO), 26.7 (COUNTER)	Clean VTA	W/m2 °C
27	CONSTRUCTION OF ONE SHELL			
28			Shell Side	Tube Side
29	Design/Test Press.	kg/cm2 G	0.05	16.5
30	Design Temp.(In/Out)	°C	600	439
31	No. Passes per Shell		1	13
32	Corrosion Allowance	mm	0	1.5
33	Connections	In	2"3 x 1-1/2" 150# SO RF	8" 300# (Oil Header)
34	Size &	Out	2 x 1-1/2" 150# SO RF	8" 300# (Oil Header)
35	Rating	Drain & Vent	-	2 x 2" 300# (on Header)
36	Tube No.(858)	OD 33.4 mm	Thk. 2.77 mm	Length 4380 mm Pitch 85.5 X 80 Angle 56.2
37	Tube Type	Seamless with welded fins	Material	2-1/4Cr-1Mo(Tube) + SS Type 410S (Fin)
38	Shell	SS Type 316 (Ducting)	OD	N.A.
39	Channel or Bonnet	N.A.	Shell Cover	N.A.
40	Tubesheet-Stationary	5	Channel Cover	N.A.
41	Floating Head Cover	N.A.	Tubesheet-Floating	N.A.
42	Baffles-Cross	N.A.	Impingement Protection	N.A.
43	Baffles-Long	-	%Cut	N.A.
44	Supports-Tube	SS Type 316	Spacing	N.A.
45	Bypass Seal Arrangement	N.A.	Seal Type	N.A.
46	Expansion Joint	SS Type 316	Type	Tubesheet
47	Gasket-Shell Side	E Glass ladder tape	Tube Side	Spiral Wound SS316L
48	Code Requirements	ASME SEC. VIII DIV. 1	Stamp	"U"
49	Weight / WHRU Assembly	40,000 kg	Filled with Water	-
50	Notes ;			42510 kg
51				
52				
53				
54				
55				



SPECIFICATION SHEET SHELL AND TUBE EXCHANGER

Revisions	Date Issued	Origin	Checked	Approved	TMX Job No.	PZ0241
0	9-Jun-16	RKP/BSB	RKP/BSB	APS/AH	TMX Doc. No.	ICPR-PZ0241-MD-00001
					Sheet No.	3 of 8
					Project	MHS Re-development (Phase-II)
					Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Exchanger			Item No.	E-4410	
2	Size	Refer GA Drawing	Type	Coiled Bundle in Stack	Connected in	N.A.	Parallel
3	Surf./Unit(Eff.)	3,194.6	m2 Shells/Unit	1	Surf./Shell(Eff.)	3,194.6	m2
4	PERFORMANCE OF ONE UNIT - Normal Turn Down Duty Case (NOTES 1,2,8,9)						
5	Fluid Allocation				Shell Side		Tube Side
6	Fluid Name				GT Exhaust		Hot Oil (NOTE 1)
7	Fluid Quantity, Total		kg/hr		50,229.8		141,158
8	Vapor(In/Out)		kg/hr		50,229.8	50,229.8	-
9	Liquid		kg/hr		-	-	141,158
10	Steam		kg/hr		-	-	-
11	Water		kg/hr		-	-	-
12	Noncondensable		kg/hr		-	-	-
13	Temperature(In/Out)		°C		534	234.8	205
14	Specific Gravity						
15	Viscosity		cp				
16	Molecular Weight-Vapor						
17	Molecular Weight-Noncondensable						
18	Specific Heat		kcal/kg °C				
19	Thermal Conductivity		W/m °C				
20	Latent Heat		kJ/kg @ °C		-		-
21	Inlet Pressure		kg/cm2 Abs.		Atm. + ΔP		7 - 6
22	Velocity		m/sec		3.6 (across tube bundle)		1.32
23	Pressure Drop, Allow./Calc.		kg/cm2		150 mmAq	57	1.0
24	Fouling Resistance(Min.)		m2 °C/W		0.00017		0.00034
25	Heat Exchanged	4.717	MW		MTD(Corrected)	235 (CO), 44.3 (COUNTER)	°C
26	Transfer Rate, Service	22.2 (CO), 21.8 (COUNTER)			Clean	VTA	W/m2 °C
27	CONSTRUCTION OF ONE SHELL						
28					Shell Side		Tube Side
29	Design/Test Press.	kg/cm2 G			0.05		16.5
30	Design Temp.(In/Out)	°C			600		439
31	No. Passes per Shell				1		13
32	Corrosion Allowance	mm			0		1.5
33	Connections	In			2 3/4 x 1-1/2" 150# SO RF		8" 300# (Oil Header)
34	Size &	Out			2 x 1-1/2" 150# SO RF		8" 300# (Oil Header)
35	Rating	Drain & Vent			-		2 x 2" 300# (on Header)
36	Tube No.(858)	OD 33.4 mm	Thk.	2.77 mm	Length	4380 mm	Pitch
37	Tube Type	Seamless with welded fins			Material	2-1/4Cr-1Mo(Tube) + SS Type 410S (Fin)	85.5 X 80
38	Shell	SS Type 316 (Ducting)	OD	N.A.	Shell Cover	N.A.	Angle
39	Channel or Bonnet	N.A.			Channel Cover	N.A.	56.2
40	Tubesheet-Stationary	5			Tubesheet-Floating	N.A.	
41	Floating Head Cover	N.A.			Impingement Protection	N.A.	
42	Baffles-Cross	N.A.			%Cut	N.A.	Spacing
43	Baffles-Long	-	N.A.		Seal Type	N.A.	N.A.
44	Supports-Tube	SS Type 316			Type	Tubesheet	
45	Bypass Seal Arrangement	N.A.			Tube-Tubesheet Joint	Rested	
46	Expansion Joint	SS Type 316			Type	N.A.	
47	Gasket-Shell Side	E Glass ladder tape	Tube Side	Spiral Wound SS316L			Floating Head
48	Code Requirements	ASME SEC. VIII DIV. 1			Stamp	"U"	TEMA Class
49	Weight / WHRU Assembly	40,000 kg	Filled with Water			42510 kg	N.A.
50	Notes ;						
51							
52							
53							
54							
55							

Revisions	Date Issued	Origin	Checked	Approved
0	9-Jun-16	RKP/BSB	RKP/BSB	APS/AH

TMX Job No.	PZ0241
TMX Doc. No.	ICPR-PZ0241-MD-00001
Sheet No.	4 of 8
Project	MHS Re-development (Phase-II)
Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Exchanger			Item No.		E-4410				
2	Size	Refer GA Drawing	Type	Coiled Bundle in Stack	Connected in	N.A.	Parallel	N.A. Series			
3	Surf./Unit(Eff.)	3,194.6	m2	Shells/Unit	1	Surf./Shell(Eff.)	3,194.6	m2			
4	PERFORMANCE OF ONE UNIT - Minimum Duty Case (NOTES 1,2,8,9)										
5	Fluid Allocation				Shell Side		Tube Side				
6	Fluid Name				GT Exhaust		Hot Oil (NOTE 1)				
7	Fluid Quantity, Total			kg/hr	39,744.1		141,158				
8	Vapor(In/Out)			kg/hr	39,744.1	39,744.1	-	-			
9	Liquid			kg/hr	-	-	141,158	141,158			
10	Steam			kg/hr	-	-	-	-			
11	Water			kg/hr	-	-	-	-			
12	Noncondensable			kg/hr	-	-	-	-			
13	Temperature(In/Out)			°C	534	237.9	215	250			
14	Specific Gravity				NOTE 9		NOTE 8				
15	Viscosity			cp							
16	Molecular Weight-Vapor										
17	Molecular Weight-Noncondensable										
18	Specific Heat			kcal/kg °C							
19	Thermal Conductivity			W/m °C							
20	Latent Heat			kJ/kg @ °C	-		-				
21	Inlet Pressure			kg/cm2 Abs.	Atm. + ΔP		7 - 6				
22	Velocity			m/sec	3.2 (across tube bundle)		1.33				
23	Pressure Drop, Allow./Calc.			kg/cm2	150 mmAq	58	1.0	0.84			
24	Fouling Resistance(Min.)			m2 °C/W	0.00017		0.00034				
25	Heat Exchanged	3,692		MW	MTD(Corrected)		216.4 (CO), 33.3 (COUNTER) °C				
26	Transfer Rate, Service	21.1 (CO), 20.2 (COUNTER)			Clean	VTA	W/m2 °C				
27	CONSTRUCTION OF ONE SHELL										
28					Shell Side		Tube Side				
29	Design/Test Press.	kg/cm2 G		0.05	16.5						
30	Design Temp.(In/Out)	°C		600	439						
31	No. Passes per Shell			1	13						
32	Corrosion Allowance	mm		0	1.5						
33	Connections	In		2 3/4 x 1-1/2" 150# SO RF	8" 300# (Oil Header)						
34	Size &	Out		2 x 1-1/2" 150# SO RF	8" 300# (Oil Header)						
35	Rating	Drain & Vent		-	2 x 2" 300# (on Header)						
36	Tube No. (858)	OD 33.4 mm		Thk.	2.77 mm	Length	4380 mm	Pitch	85.5 X 80	Angle	56.2
37	Tube Type	Seamless with welded fins			Material	2-1/4Cr-1Mo(Tube) + SS Type 410S (Fin)					
38	Shell	SS Type 316 (Ducting)		OD	N.A.	Shell Cover	N.A.				
39	Channel or Bonnet	N.A.				Channel Cover	N.A.				
40	Tubesheet-Stationary	5				Tubesheet-Floating	N.A.				
41	Floating Head Cover	N.A.				Impingement Protection	N.A.				
42	Baffles-Cross	N.A.				%Cut	N.A.	Spacing	N.A.		
43	Baffles-Long	-	N.A.			Seal Type	N.A.				
44	Supports-Tube	SS Type 316			Type	Tubesheet					
45	Bypass Seal Arrangement	N.A.			Tube-Tubesheet Joint		Rested				
46	Expansion Joint	SS Type 316			Type	N.A.					
47	Gasket-Shell Side	E Glass ladder tape		Tube Side	Spiral Wound SS316L			Floating Head	N.A.		
48	Code Requirements	ASME SEC. VIII DIV. 1			Stamp	"U"		TEMA Class	N.A.		
49	Weight / WHRU Assembly	40,000	kg	Filled with Water	-	42510		kg			
50	Notes ;										
51											
52											
53											
54											
55											



SPECIFICATION SHEET SHELL AND TUBE EXCHANGER

Revisions	Date Issued	Origin	Checked	Approved	TMX Job No.	PZ0241
0	9-Jun-16	RKP/BSB	RKP/BSB	APS/AH	TMX Doc. No.	ICPR-PZ0241-MD-00001
					Sheet No.	5 of 8
					Project	MHS Re-development (Phase-II)
					Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Exchanger				Item No.	E-4410			
2	Size	Refer GA Drawing	Type	Coiled Bundle in Stack		Connected in	N.A.	Parallel	N.A.	Series
3	Surf./Unit(Eff.)	3,194.6	m2 Shells/Unit	1		Surf./Shell(Eff.)	3,194.6		m2	
4	PERFORMANCE OF ONE UNIT - Design Case (NOTES 1,2,8,9)									
5	Fluid Allocation					Shell Side	Tube Side			
6	Fluid Name					GT Exhaust	Hot Oil (NOTE 1)			
7	Fluid Quantity, Total			kg/hr		174,072.4	136,056			
8	Vapor(In/Out)			kg/hr		174,072.4	174,072.4	-	-	
9	Liquid			kg/hr		-	-	136,056	136,056	
10	Steam			kg/hr		-	-	-	-	
11	Water			kg/hr		-	-	-	-	
12	Noncondensable			kg/hr		-	-	-	-	
13	Temperature(In/Out)			°C		510	257.5	107	250	
14	Specific Gravity					As per NOTE 9 CASE 1 Condition		NOTE 8		
15	Viscosity			cp						
16	Molecular Weight-Vapor									
17	Molecular Weight-Noncondensable									
18	Specific Heat			kcal/kg °C						
19	Thermal Conductivity			W/m °C						
20	Latent Heat			kJ/kg @ °C		-		-		
21	Inlet Pressure			kg/cm2 Abs.		Atm. + ΔP		7 - 6		
22	Velocity			m/sec		13.54 (across tube bundle)		1.18		
23	Pressure Drop, Allow./Calc.			kg/cm2		150 mmAq	149	1.0	0.950	
24	Fouling Resistance(Min.)			m2 °C/W		0.00017		0.00034		
25	Heat Exchanged		13.5	MW		MTD(Corrected)	345 (CO), 146.2 (COUNTER) °C			
26	Transfer Rate, Service	24.09 (CO),	27.2 (COUNTER)			Clean	VTA		W/m2 °C	
27	CONSTRUCTION OF ONE SHELL									
28						Shell Side	Tube Side			
29	Design/Test Press.	kg/cm2 G				0.05	16.5			
30	Design Temp.(In/Out)	°C				600	439			
31	No. Passes per Shell					1	13			
32	Corrosion Allowance	mm				0	1.5			
33	Connections	In				2"/3 x 1-1/2" 150# SO RF	8" 300# (Oil Header)			
34	Size &	Out				2 x 1-1/2" 150# SO RF	8" 300# (Oil Header)			
35	Rating	Drain & Vent				-	2 x 2" 300# (on Header)			
36	Tube No.(858)	OD 33.4 mm		Thk.	2.77 mm	Length	4380 mm	Pitch	85.5 X 80	Angle 56.2
37	Tube Type	Seamless with welded fins				Material	2-1/4Cr-1Mo(Tube) + SS Type 410S (Fin)			
38	Shell	SS Type 316 (Ducting)		OD	N.A.	Shell Cover	N.A.			
39	Channel or Bonnet	N.A.				Channel Cover	N.A.			
40	Tubesheet-Stationary	5				Tubesheet-Floating	N.A.			
41	Floating Head Cover	N.A.				Impingement Protection	N.A.			
42	Baffles-Cross	N.A.				%Cut	N.A.	Spacing	N.A.	
43	Baffles-Long	-	N.A.			Seal Type	N.A.			
44	Supports-Tube	SS Type 316				Type	Tubesheet			
45	Bypass Seal Arrangement	N.A.				Tube-Tubesheet Joint	Rested			
46	Expansion Joint	SS Type 316				Type	N.A.			
47	Gasket-Shell Side	E Glass ladder tape		Tube Side	Spiral Wound SS316L			Floating Head	N.A.	
48	Code Requirements	ASME SEC. VIII DIV. 1				Stamp	"U"	TEMA Class	N.A.	
49	Weight / WHRU Assembly	40,000	kg	Filled with Water		-	42510	kg		
50	Notes ;									
51										
52										
53										
54										
55										



SPECIFICATION SHEET SHELL AND TUBE EXCHANGER

Revisions	Date Issued	Origin	Checked	Approved	TMX Job No.	PZ0241
0	9-Jun-16	RKP/BSB	RKP/BSB	APS/AH	TMX Doc. No.	ICPR-PZ0241-MD-00001
					Sheet No.	6 of 8
					Project	MHS Re-development (Phase-II)
					Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Exchanger			Item No.	E-4410	
2	Size	Refer GA Drawing	Type	Coiled Bundle in Stack	Connected in	N.A.	Parallel
3	Surf./Unit(Eff.)	3,194.6	m2 Shells/Unit	1	Surf./Shell(Eff.)	3,194.6	m2
4	PERFORMANCE OF ONE UNIT - Design Case (NOTES 1,2,8,9)						
5	Fluid Allocation				Shell Side		Tube Side
6	Fluid Name				GT Exhaust		Hot Oil (NOTES 2, 3)
7	Fluid Quantity, Total		kg/hr		147,427.9		136,056
8	Vapor(In/Out)		kg/hr		147,427.9	147,427.9	-
9	Liquid		kg/hr		-	-	136,056
10	Steam		kg/hr		-	-	-
11	Water		kg/hr		-	-	-
12	Noncondensable		kg/hr		-	-	-
13	Temperature(In/Out)		°C		540	250.5	107
14	Specific Gravity						
15	Viscosity		cp				
16	Molecular Weight-Vapor						
17	Molecular Weight-Noncondensable						
18	Specific Heat		kcal/kg °C				
19	Thermal Conductivity		W/m °C				
20	Latent Heat		kJ/kg @ °C		-	-	-
21	Inlet Pressure		kg/cm2 Abs.		Atm. + ΔP		7 - 6
22	Velocity		m/sec		11.9 (across tube bundle)		1.18
23	Pressure Drop, Allow./Calc.		kg/cm2		150 mmAq	117	1.0
24	Fouling Resistance(Min.)		m2 °C/W		0.00017		0.00034
25	Heat Exchanged	13.5	MW		MTD(Corrected)		366.7 (CO), 147.3 (COUNTER) °C
26	Transfer Rate, Service	23.7 (CO), 26.6 (COUNTER)			Clean	VTA	W/m2 °C
27	CONSTRUCTION OF ONE SHELL						
28					Shell Side		Tube Side
29	Design/Test Press.	kg/cm2 G			0.05		16.5
30	Design Temp.(In/Out)	°C			600		439
31	No. Passes per Shell				1		13
32	Corrosion Allowance	mm			0		1.5
33	Connections	In			2" / 3 x 1-1/2" 150# SO RF		8" 300# (Oil Header)
34	Size &	Out			2 x 1-1/2" 150# SO RF		8" 300# (Oil Header)
35	Rating	Drain & Vent			-		2 x 2" 300# (on Header)
36	Tube No.(858)	OD 33.4 mm	Thk.	2.77 mm	Length	4380 mm	Pitch
37	Tube Type	Seamless with welded fins			Material	2-1/4Cr-1Mo(Tube) + SS Type 410S (Fin)	Angle
38	Shell	SS Type 316 (Ducting)	OD	N.A.	Shell Cover	N.A.	
39	Channel or Bonnet	N.A.			Channel Cover	N.A.	
40	Tubesheet-Stationary	5			Tubesheet-Floating	N.A.	
41	Floating Head Cover	N.A.			Impingement Protection	N.A.	
42	Baffles-Cross	N.A.			%Cut	N.A.	Spacing
43	Baffles-Long	-	N.A.		Seal Type	N.A.	
44	Supports-Tube	SS Type 316			Type	Tubesheet	
45	Bypass Seal Arrangement	N.A.			Tube-Tubesheet Joint	Rested	
46	Expansion Joint	SS Type 316			Type	N.A.	
47	Gasket-Shell Side	E Glass ladder tape	Tube Side	Spiral Wound SS316L			Floating Head
48	Code Requirements	ASME SEC. VIII DIV. 1			Stamp	"U"	TEMA Class
49	Weight / WHRU Assembly	40,000 kg	Filled with Water		-	42510 kg	
50	Notes ;						
51							
52							
53							
54							
55							



SPECIFICATION SHEET SHELL AND TUBE EXCHANGER

Revisions	Date Issued	Origin	Checked	Approved
0	5 OCT '09	YSP	YSP	MUA

TMX Job No.	PZ0241
TMX Doc. No.	ICPR-PZ0241-MD-00001
Sheet No.	7 of 8
Project	MHS Re-development (Phase-II)
Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Unit (WHRU)
2	Item No.	E-4410

4 NOTES ;

- 5 1. HYTHERM 500 SHALL BE ASSUMED FOR HOT OIL.
- 6 2. WHRU DESIGN SHALL ENSURE THAT HOT OIL WILL NOT BE SUBJECTED TO A TEMPERATURE ABOVE
- 7 THE MAXIMUM ALLOWABLE FILM TEMPERATURE OF 360 °C.
- 8 3. MAXIMUM ALLOWABLE PRESSURE DROP OF TOTAL WHRU PACKAGE IS 150 mmAq. THE WHRU PACKAGE
- 9 BATTERY LIMIT IS FROM INLET AT EXHAUST DUCT UP TO EXHAUST STACK.
- 10 4. VENDOR SHALL DESIGN THE WHRU TUBES SUCH THAT TUBES ARE CAPABLE OF RUNNING DRY IN THE
- 11 EVENT OF MAL-FUNCTION AT FULL EXHAUST FLOW.
- 12 5. THE WHRU SHALL BE FREE DRAINING TO AVOID DEGRADATION OF HOT OIL DURING UPSETS.
- 13 6. THE INSULATION PROVIDED EXTERNALLY SHALL BE SUITABLE FOR EXHAUST FLUE GAS OPERATING
- 14 CONDITIONS. EXTERNAL INSULATION (240 MM THICK) WILL BE PROVIDED BY OTHERS.
- 15 7. VENDOR NEEDS TO DESIGN THE WHRU FOR MAXIMUM DUTY CASES, AND ENSURE GUARANTEE OF
- 16 OPERATION FOR ALL CASES INCLUDING TURNDOWN CASE.
- 17 8. HOT OIL (HYTHERM-500) PROPERTIES AT DIFFERENT TEMPERATURES (16 °C TO 300 °C) MAY BE
- 18 OBTAINED BASED ON INTERPOLATION.

Hot Oil Properties (to be confirmed with Supplier)					
Temp.	Density	Viscosity	Specific Heat	Thermal Cond.	
°C	kg/m ³	cp	kJ/kg °C	W/m °C	
300	683.8	0.970	2.9361	0.11011	
263	706.0	1.266	2.7968	0.11269	
255	711.5	1.330	2.7675	0.11316	
250	715.0	1.370	2.7507	0.11339	
237.63	723.0	1.450	2.7089	0.11409	
230	728.1	1.502	2.6824	0.11454	
220	734.8	1.571	2.6478	0.11514	
215	738.2	1.605	2.6305	0.11544	
210	741.5	1.639	2.6131	0.11574	
205	744.9	1.673	2.5958	0.11603	
200	748.2	1.708	2.5774	0.11633	
180	761.6	1.846	2.5036	0.11752	
160	775.4	2.015	2.4281	0.11865	
155	778.9	2.058	2.4088	0.11892	
150	782.0	2.100	2.3907	0.11921	
135	791.4	5.890	2.3394	0.12008	
120	800.9	9.680	2.2889	0.12095	
110	807.1	12.207	2.2553	0.12153	
107	809.0	12.965	2.2452	0.12171	
100	813.4	14.733	2.2216	0.12212	
90	819.7	17.260	2.1884	0.12270	
80	826.0	19.787	2.1562	0.12328	
50	845.2	27.367	2.0538	0.12270	
30	857.8	32.420	1.9855	0.12153	
16	866.4	35.957	1.9377	0.12072	



SPECIFICATION SHEET SHELL AND TUBE EXCHANGER

Revisions	Date Issued	Origin	Checked	Approved
0	9-Jun-16	RKP/BSB	RKP/BSB	APS/AH

TMX Job No.	PZ0241
TMX Doc. No.	ICPR-PZ0241-MD-00001
Sheet No.	8 of 8
Project	MHS Re-development (Phase-II)
Location	Mumbai High Field, India

1	Service of Unit	Waste Heat Recovery Unit (WHRU)
2	Item No.	E-4410
3		

4 NOTES ; (CONTINUATION)

5 9. TYPICAL CONDITIONS OF GT EXHAUST GAS ARE SHOWN AS FOLLOWS AT THE INLET OF WHRU.

6 VENDOR SHALL CHECK ALL OF 3 CASES FOR THE MAXIMUM SURFACE AREA REQUIRED FOR WHRU,
7 IDENTIFY THE CONTROLLING CASE, AND COMPLETE THE DATASHEET FOR THE SAME CASE.

8	GT Exhaust Conditions				
9	Case ID		CASE 1	CASE 2	CASE 3
10	Ambient Temperature	°C	16	36.7	40
11	Exhaust Gas Flow	kg/hr	176,544	153,749	149,673
12	Exhaust Temperature	°C	510	534	540
13	Exhaust Gas Analysis				
14	Argon (A)	Vol. %	0.89	0.86	0.85
15	Carbon Dioxide (CO2)	Vol. %	3.16	3.1	3.09
16	Water (H2O)	Vol. %	7.25	10.93	11.96
17	Nitrogen (N2)	Vol. %	74.59	71.66	70.85
18	Oxygen (O2)	Vol. %	14.11	13.45	13.25
19	Total	Vol. %	100	100	100
20					
21					
22					
23					
24					
25					
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EE CREST

HHI PO # H-SH3-F919
BROACH JOB 84914
△ 5/16/84

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Div.	Job	PO/Req.
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WASTE HEAT
DATA SHEET - ~~SHELL AND TUBE~~ HEAT EXCHANGER (MKS)

Sheet 1 of 1

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ) (V)
4	SIZE			CONNECTED IN	PARALLEL
5	SURFACE/UNIT (GROSS) $(\frac{1}{1000}) \text{ m}^2$	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) $(\frac{1}{1000}) \text{ m}^2$	①
6	RATED PLATFORM ELCC LOAD PERFORMANCE OF ONE UNIT				
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM-500	
9	FLUID QUANTITY TOTAL	kg/h 67,784		103,897	
10	VAPOR (IN/OUT)	kg/h 67,784	kg/h 67,784	0	0
11	LIQUID	kg/h 0	kg/h 0	103,897	103,897
12	STEAM	kg/h 0	kg/h 0	0	0
13	WATER	kg/h 0	kg/h 0	0	0
14	NONCONDENSABLE	kg/h 0	kg/h 0	0	0
15	TEMPERATURE (IN/OUT) °C	515.56	191.11 △	160.0	250.0
16	SPECIFIC GRAVITY, LIQUID	—	—	0.7755	0.71475
17	VISCOSITY, LIQUID cP	—	—	1.6275	0.75
18	MOLECULAR WEIGHT, VAPOR	28.5	28.5	—	—
19	MDL WT. NONCONDENSABLE	—	—	—	—
20	SPECIFIC HEAT kcal/kg °C	0.2741	0.2528	0.5795	0.6565
21	THERMAL COND. kcal/m °C h	0.048683	0.031629	0.1049	0.1003
22	LATENT HEAT kcal/kg AT °C	—		—	
23	INLET PRESSURE kg/cm ² Gauge	—		—	
24	VELOCITY m/s	19.76	12.108	1.9202	2.103
25	PRESS. DROP, ALLOW./CALC. ④ kg/cm ²	/ 6.238 △ ②		1.4	/ 1.132 △
26	FOULING RESIST. (MIN.) m ² °C h/kcal	0.0002		0.0004 △	
27	HEAT EXCHANGED kcal/h	5,777,000		HTD CORRECTED °C 109.34	
28	TRANSFER RATE, ③ kcal/m ² °C h SERVICE	EXTENDED- 15.7 △		BARE- 342.86	

NOTES: ① SURFACE REQUIRED - 154.1 m² (BARE) 3369.47 m² (EXTENDED)
SURFACE AUDIL - 177.44 m² (BARE), 3877.27 m² (EXTENDED)
② - SHELL SIDE PRESS IN INCH WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE)
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE



HHI PO # H-SH3-F919
BROACH JOB 84914
△ 5/16/84

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WASTE HEAT
DATA SHEET - ~~SHELL AND TUBE~~ HEAT EXCHANGER (MKS)

Sheet 2 of

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ) (V)
4	SIZE			CONNECTED IN/	PARALLEL
5	SURFACE/UNIT (GROSS) $\frac{\text{sq ft}}{\text{unit}}$, m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) $\frac{\text{sq ft}}{\text{shell}}$, m ²	①
6	MIN CONT ELEC LOAD	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM-500	
9	FLUID QUANTITY TOTAL	kg/h	⑤ 62,869 △	103,897	
10	VAPOR (IN/OUT)	kg/h	⑤ 62,869 △ ⑤ 62,869 △	0	0
11	LIQUID	kg/h	0	0	103,897 103,897
12	STEAM	kg/h	0	0	0 0
13	WATER	kg/h	0	0	0 0
14	NONCONDENSABLE	kg/h	0	0	0 0
15	TEMPERATURE (IN/OUT)	°C	421.11	180.0 △	160.0 222
16	SPECIFIC GRAVITY, LIQUID		—	—	0.775 0.7328
17	VISCOSITY, LIQUID	cp	—	—	1.6275 0.9307
18	MOLECULAR WEIGHT, VAPOR		28.5	28.5	— —
19	MOL. WT. NONCONDENSABLE		—	—	— —
20	SPECIFIC HEAT	kcal/kg °C	0.2679	0.2521	0.5795 0.6337
21	THERMAL COND.	kcal/m ² °C h	0.044053	0.031152	0.1049 0.1017
22	LATENT HEAT kcal/kg AT	°C	—	—	— —
23	INLET PRESSURE	kg/cm ² Gauge			
24	VELOCITY	m/s	△ 16.8645	10.9276 △	1.9202 2.0422
25	PRESS. DROP, ALLOW./CALC. ④	kg/cm ²		/ 5.0471 ④ ②	1.4 / 1.1334
26	FOULING RESIST. (MIN.)	m ² °C h/kcal	0.0002		0.0004 △
27	HEAT EXCHANGED	kcal/h	3,913,000 △		HTD CORRECTED, °C 77.9374
28	TRANSFER RATE, ③	kcal/m ² FCH SERVICE	EXTENDED - 14.9227 △ BARE - 325.8017		

NOTES: ① SURFACE REQUIRED - 154.1 m² (BARE) 3364.47 m² (EXTENDED)
SURFACE AVAIL - 177.44 m² (BARE), 3877.27 m² (EXTENDED)
② - SHELL SIDE PRESS IN INCH WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE) △ ⑤ BY PASS 0.45 Kg
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE FOR 3,913,000 Kcal/hr DUTY
△ ⑥ PRESS DROP NO BYPASS = 5.313" WATER



HHI PO # H-SH3-F019
BROACH JOB 84914
Δ 5/16/84

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WASTE HEAT
DATA SHEET - ~~SHELL AND TUBE~~ HEAT EXCHANGER (MKS)

Sheet 4

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ) (M)
4	SIZE			CONNECTED IN	(PARALLEL)
5	SURFACE/UNIT (GROSS) (EFF.) , m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) (EFF.) , m ²	①
6	27.8 °C AMB, 2270 KW LOAD ALT DESIGN CASE NO. 2 PERFORMANCE OF ONE UNIT				
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM-500	
9	FLUID QUANTITY TOTAL	kg/h	65,645	87,513	
10	VAPOR (IN/OUT)	kg/h	65,645	65,645	0
11	LIQUID	kg/h	0	0	87,513
12	STEAM	kg/h	0	0	0
13	WATER	kg/h	0	0	0
14	NONCONDENSABLE	kg/h	0	0	0
15	TEMPERATURE (IN/OUT)	°C	459.4	193.89 Δ	164.6
16	SPECIFIC GRAVITY, LIQUID		—	—	0.7724
17	VISCOSITY, LIQUID	cp	—	—	1.62
18	MOLECULAR WEIGHT, VAPOR		28.5	28.5	—
19	MDL. WT. NONCONDENSABLE		—	—	—
20	SPECIFIC HEAT	kcal/kg·°C	0.2704	0.253	0.5834
21	THERMAL COND.	kcal/m·°C·h	0.04611	0.03184	0.1047
22	LATENT HEAT	kcal/kg AT	—	—	—
23	INLET PRESSURE	kg/cm ² Gauge			
24	VELOCITY	m/s	17.85	11.85	1.6459
25	PRESS. DROP ALLOW./CALC. ④	kg/cm ²	/ 5.7587 ②		1.4 / 0.82
26	FOULING RESIST. (MIN.)	m ² ·°C·h/kcal	0.0002		0.0004 Δ
27	HEAT EXCHANGED	kcal/h	4,551,120 Δ		MTD CORRECTED, °C 91.88 Δ
28	TRANSFER RATE, ③	kcal/m ² ·°C·h SERVICE	EXTENDED - 14.722 Δ		BASE - 321.436 Δ

NOTES: ① SURFACE - REQUIRED - 154.1 m² (BASE) 3369.47 m² (EXTENDED)
SURFACE AVAILABLE - 177.44 m² (BASE), 3877.27 m² (EXTENDED)
② - SHELL SIDE PRESS IN INCH WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE)
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE



HHI PO # H-SH3-F919
BROACH JOB 84914
Δ 5/16/84

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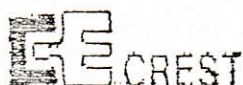
Div.	Job	PO/Req.	

WASTE HEAT
DATA SHEET - ~~SHELL AND TUBE~~ HEAT EXCHANGER (MKS)

Sheet 3 of 3

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ) (V)
4	SIZE			CONNECTED IN	PARALLEL
5	SURFACE/UNIT (GROSS) (FT²) m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) (FT²) m ²	①
6	40°C A.M.B., 2000 kW LOAD ALT. DESIGN CASE NO. 1 PERFORMANCE OF ONE UNIT				
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM-500	
9	FLUID QUANTITY TOTAL	kg/h	61,400	87,513	
10	VAPOR (IN/OUT)	kg/h	61,400	61,400	0
11	LIQUID	kg/h	0	0	87,513
12	STEAM	kg/h	0	0	0
13	WATER	kg/h	0	0	0
14	NONCONDENSABLE	kg/h	0	0	0
15	TEMPERATURE (IN/OUT)	°C	478	191.11 Δ	164.6
16	SPECIFIC GRAVITY, LIQUID		—	—	0.7724
17	VISCOSITY, LIQUID	cp	—	—	1.62
18	MOLECULAR WEIGHT, VAPOR		28.5	28.5	—
19	MOL. WT. NONCONDENSABLE		—	—	—
20	SPECIFIC HEAT	kcal/kg·°C	0.2716	0.2529	0.5834
21	THERMAL COND.	kcal/m ² ·°C·h	0.0471	0.0317	0.1047
22	LATENT HEAT kcal/kg AT	°C	—	—	—
23	INLET PRESSURE	kg/cm ² Gauge			
24	VELOCITY	m/s	17.0373	10.9433	1.6459
25	PRESS. DROP, ALLOW./CALC. ④	kg/cm ²	/ 5.1392 ②		1.4 / 0.82
26	FOULING RESIST. (MIN.)	m ² ·°C·h/kcal	0.0002		0.0004 Δ
27	HEAT EXCHANGED	kcal/h	4,601,520 Δ		MTD CORRECTED, °C 93.79 Δ
28	TRANSFER RATE, ③	kcal/m ² ·°C·h	SERVICE - 14.582 Δ		BASE - 318.38 Δ

NOTES: ① - SURFACE REQUIRED - 154.1 m² (BASE) 3369.47 m² (EXTENDED)
SURFACE AVAILABLE - 177.44 m² (BASE), 3877.27 m² (EXTENDED)
② - SHELL SIDE PRESS IN INCH WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE)
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE



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Always refer to this number

Div.	Job	PO/Req.	

WASTE HEAT DATA SHEET - SHELL AND TUBE HEAT EXCHANGER (MKS)

Sheet 5 of 5

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH C	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ)
4	SIZE			CONNECTED IN	PARALLEL
5	SURFACE/UNIT (GROSS) EFFI , m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) EFFI , m ²	①
6	100% TURBINE LOAD 27.8 °C AMBIENT PERFORMANCE OF ONE UNIT				
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM - 500	
9	FLUID QUANTITY TOTAL kg/h	⑤	56,337 Δ	87,513	
10	VAPOR (IN/OUT) kg/h	⑤	56,337 Δ	⑤	56,337 Δ
11	LIQUID kg/h	0	0	87,513	87,513
12	STEAM kg/h	0	0	0	0
13	WATER kg/h	0	0	0	0
14	NONCONDENSABLE kg/h	0	0	0	0
15	TEMPERATURE (IN/OUT) °C	501.7	187.78 Δ	164.6	250.0
16	SPECIFIC GRAVITY, LIQUID	—	—	0.7724	0.71475
17	VISCOSITY, LIQUID cP	—	—	1.62	0.75
18	MOLECULAR WEIGHT, VAPOR	28.5	28.5	—	—
19	MOL. WT. NONCONDENSABLE	—	—	—	—
20	SPECIFIC HEAT kcal/kg °C	0.2731	0.2526	0.5834	0.6565
21	THERMAL COND. kcal/m °C h	0.048373	0.03151	0.1047	0.10032
22	LATENT HEAT kcal/kg AT °C	—		—	
23	INLET PRESSURE kg/cm ² Gauge				
24	VELOCITY m/s	16.187 Δ	9.959 Δ	1.646	1.7678
25	PRESS. DROP, ALLOW./CALC. ④ kg/cm ²	/ Δ 4.4345 ⑥ ②		1.4	/ 0.82
26	FOULING RESIST. (MIN.) m ² °C h/kcal	0.0002		0.0004 Δ	
27	HEAT EXCHANGED kcal/h	4,633,231		MTC CORRECTED, °C 95.818	
28	TRANSFER RATE, ③ kcal/m ² FOH SERVICE	EXTENDED - 14.372 Δ		BASE - 313.786 Δ	

NOTES: ① SURFACE REQUIRED - 154.1 m^2 (BASE) 3364.47 m^2 (EXTENDED)
SURFACE AVAILABLE - 177.44 m^2 (BASE), 3877.27 m^2 (EXTENDED)
② - SHELL SIDE PRESS IN INCH WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE)
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE ⑤ BYPASS 4.491 kg/sec TO NOT
EXCEED 250 °C FLUID OUT TEMP
⑥ PRESS DROP NO BYPASS = 7.34 IN H_2O Δ



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Always refer to this number

Div.	Job	PO/Req.	

WASTE HEAT
DATA SHEET - ~~SHELL AND TUBE~~ HEAT EXCHANGER (MKS)

Sheet 6 of 6

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ) (V)
4	SIZE			CONNECTED IN	(PARALLEL)
5	SURFACE/UNIT (GROSS) (EFF) , m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) (EFF) , m ²	①
6	75% TURBINE LOAD 27.8 °C AMBIENT PERFORMANCE OF ONE UNIT				
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM-500	
9	FLUID QUANTITY TOTAL	kg/h	⑤ 65,971 Δ	87,513	
10	VAPOR (IN/OUT)	kg/h	⑤ 65,971 Δ	⑤ 65,971 Δ	0 0
11	LIQUID	kg/h	0	0	87,513 87,513
12	STEAM	kg/h	0	0	0 0
13	WATER	kg/h	0	0	0 0
14	NONCONDENSABLE	kg/h	0	0	0 0
15	TEMPERATURE (IN/OUT)	°C	463.3	194.44 Δ	164.6 250.0
16	SPECIFIC GRAVITY, LIQUID		—	—	0.7724 0.71475
17	VISCOSITY, LIQUID	cp	—	—	1.62 0.75
18	MOLECULAR WEIGHT, VAPOR		28.5	28.5	— —
19	MDL. WT. NONCONDENSABLE		—	—	— —
20	SPECIFIC HEAT	kcal/kg-°C	0.2706	0.253	0.5834 0.6565
21	THERMAL COND.	kcal/m ² °C-h	0.04632	0.03184	0.1047 0.10032
22	LATENT HEAT	kcal/kg AT	—	—	— —
23	INLET PRESSURE	kg/cm ² Gauge			
24	VELOCITY	m/s	18.303 Δ	11.914 Δ	1.646 1.7678
25	PRESS. DROP ALLOW./CALC. ④	kg/cm ²	/ 5.82897 Δ ⑥ ②		1.4 / 0.82
26	FOULING RESIST. (MIN.)	m ² °C-h/kcal	0.0002		0.0004 Δ
27	HEAT EXCHANGED	kcal/h	4,633,231		MTD CORRECTED, °C 93.276 Δ
28	TRANSFER RATE, ③	kcal/m ² °C-h	SERVICE: EXTENDED - 14.764 Δ		BASE - 322.338 Δ

NOTES: ① SURFACE - REQUIRED - 154.1 m² (BASE) 3364.47 m² (EXTENDED)
SURFACE AVAILABLE - 177.44 m² (BASE), 3877.27 m² (EXTENDED)
② - SHELL SIDE PRESS IN INCH WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE) Δ BYPASS 0.045 KG/SEC TO A
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE ⑤ EXCEED 250°C FLUID OUT TEM
⑥ PRESS DROP NO BYPASS = 5.858 INCH H₂O Δ



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Δ 5/16/84

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Div.	Job	PO/Req.	

WASTE HEAT
DATA SHEET - ~~SHELL AND TUBE~~ HEAT EXCHANGER (MKS)

Sheet 7 of 7

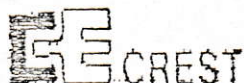
1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ)
4	SIZE			CONNECTED IN	PARALLEL
5	SURFACE/UNIT (GROSS) (FT²) , m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) (FT²) , m ²	①
6	50% TURBINE LOAD 27.8 °C AMBIENT	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM-500	
9	FLUID QUANTITY TOTAL	kg/h		87,513	
10	VAPOR (IN/OUT)	kg/h	58,297	58,297	0
11	LIQUID	kg/h	0	0	87,513
12	STEAM	kg/h	0	0	0
13	WATER	kg/h	0	0	0
14	NONCONDENSABLE	kg/h	0	0	0
15	TEMPERATURE (IN/OUT)	°C	422.8	184.44 Δ	164.6
16	SPECIFIC GRAVITY, LIQUID		—	—	0.7724
17	VISCOSITY, LIQUID	cp	—	—	1.62
18	MOLECULAR WEIGHT, VAPOR		28.5	28.5	—
19	MOL. WT. NONCONDENSABLE		—	—	—
20	SPECIFIC HEAT	kcal/kg °C	0.268	0.2524	0.5834
21	THERMAL COND.	kcal/m °C h	0.04414	0.03133	0.1047
22	LATENT HEAT kcal/kg AT	°C	—	—	—
23	INLET PRESSURE	kg/cm ² Gauge			
24	VELOCITY	m/s	15.13185	10.30605	1.6459
25	PRESS. DROP, ALLOW./CALC. ④	kg/cm ²	/ 4.4736 Δ ②		1.4 / 0.82
26	FOULING RESIST. (MIN.)	m ² °C h/kcal	0.0002		0.0004 Δ
27	HEAT EXCHANGED	kcal/h	3,591,000		MTD CORRECTED °C 75.616
28	TRANSFER RATE, ③	kcal/m ² °C h	SERVICE: EXTENDED- 14.115 Δ		BASE- 308.176

NOTES: ① SURFACE REQUIRED - 154.1 m² (BASE) 3369.47 m² (EXTENDED)
SURFACE AVAILABLE - 177.44 m² (BASE), 3877.27 m² (EXTENDED)

② - SHELL SIDE PRESS IN INCH WATER COLUMN

③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE)

④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE



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BROACH JOB 84914
▲ 5/16/84

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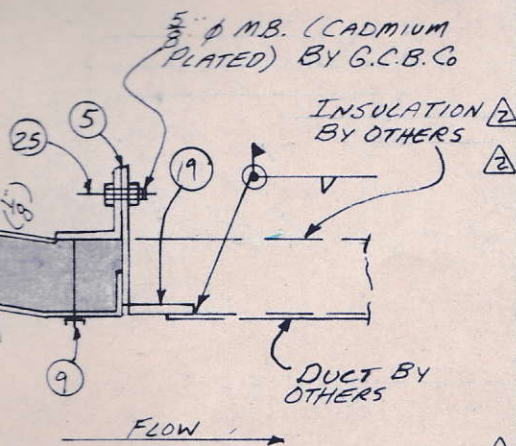
Div. Job PO/Req.

WASTE HEAT
DATA SHEET - SHELL AND TUBE HEAT EXCHANGER (MKS)

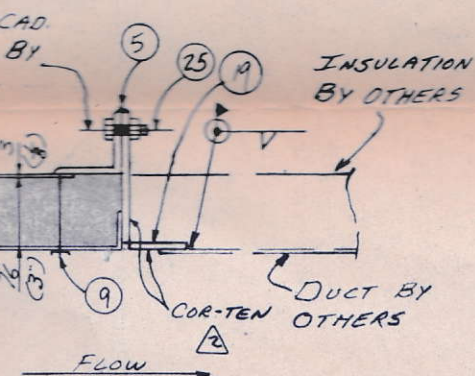
Sheet 8 of

1	CUSTOMER	HYUNDAI / ONGC		EQUIPMENT TAG NO. E1710/20/30/4	
2	PLANT LOCATION	INDIA / SH COMPLEX PH 3		MANUFACTURER G.C. BROACH CO	
3	SERVICE OF UNIT	HOT OIL HEATING		TYPE	HORZ (HORIZ) (V)
4	SIZE			CONNECTED IN	PARALLEL
5	SURFACE/UNIT (GROSS) $\frac{\text{ft}^2}{\text{ft}^2}$, m ²	①	SHELL/UNIT 1	SURFACE/SHELL (GROSS) $\frac{\text{ft}^2}{\text{ft}^2}$, m ²	①
6	25% TURBINE LOAD 27.8°C AMBIENT	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION	SHELL SIDE		TUBE SIDE	
8	FLUID CIRCULATED	TURBINE EXHAUST		HY THERM - 500	
9	FLUID QUANTITY TOTAL kg/h	48,826		87,513	
10	VAPOR (IN/OUT) kg/h	48,826	48,826	0	0
11	LIQUID kg/h	0	0	87,513	87,513
12	STEAM kg/h	0	0	0	0
13	WATER kg/h	0	0	0	0
14	NONCONDENSABLE kg/h	0	0	0	0
15	TEMPERATURE (IN/OUT) °C	390.0	176.11	164.6	215.0
16	SPECIFIC GRAVITY, LIQUID	—	—	0.7724	0.7384
17	VISCOSITY, LIQUID cP	—	—	1.62	0.9833
18	MOLECULAR WEIGHT, VAPOR	28.5	28.5	—	—
19	MOL. WT. NONCONDENSABLE	—	—	—	—
20	SPECIFIC HEAT kcal/kg-°C	0.2658	0.252	0.5834	0.62653
21	THERMAL COND. kcal/m-°C-h	0.04238	0.04238	0.1047	0.1021
22	LATENT HEAT kcal/kg AT °C	—		—	
23	INLET PRESSURE kg/cm ² Gauge				
24	VELOCITY m/s	12.2	8.45	1.646	1.707
25	PRESS. DROP, ALLOW./CALC. ④ kg/cm ²	/ 3.1433 Δ ②		1.4	/ 0.822
26	FOULING RESIST. (MIN.) m ² -h/kcal	0.0002		0.0004 Δ	
27	HEAT EXCHANGED kcal/h	2678,760		HTD CORRECTED, °C 60.07	
28	TRANSFER RATE, ③ kcal/m ² -h-°C	POH-SERVICE: EXTENDED - 13.254 Δ BARE - 289.383			

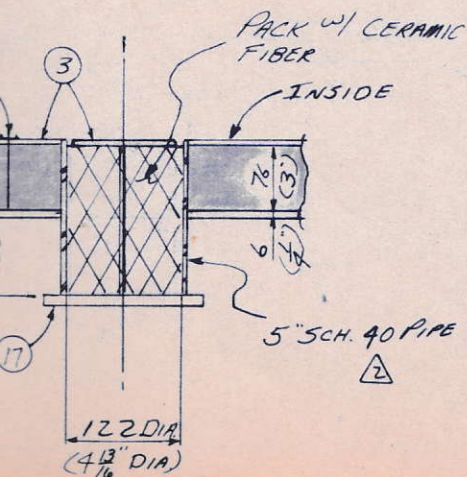
NOTES: ① - SURFACE REQUIRED - 154.1 m² (BARE) 3369.47 m² (EXTENDED)
SURFACE AUDIL - 177.44 m² (BARE), 3877.27 m² (EXTENDED)
② - SHELL SIDE PRESS IN 100" WATER COLUMN
③ - BASED ON REQUIRED SURFACE (UNIT HAS 15% EXCESS SURFACE)
④ - PRESS DROP IS FOR UNIT WITH 15% EXTRA SURFACE



SECTION F-F



SECTION G-G



COIL SPECIFICATIONS:

INLET: (1)

8"-300* RF-WNF, PER SA-105 w/ SCH 40 BORE

OUTLET: (1)

SAME AS ABOVE.

DESIGN CONDITIONS: 12 KG/CM² @ 385°C

(171 P.S.I.G. @ 725°F.)

HYDROSTATIC TEST: 19.4 KG/CM² @ AMBIENT TEMP (MIN 16°C)

(276 P.S.I.G. @ AMBIENT TEMP. (MIN. 60°F)

RADIOGRAPH:

100%

CODE STAMP:

ASME. SECTION VIII.

STRESS RELIEVE:

NONE.

CORROSION ALLOWANCE: .0591" (1.5mm)

TUBES:

12'-2" O.D. X .11" MIN. WALL WELDED CARBON STEEL
TUBES PER SA-178, GR. A X 9'-2 LG. w/ 72'-1" HI. X .05" THK.
C.S. FINS PER FT.44'-SAME AS ABOVE, EXCEPT w/ 72'-1 1/4" HI. X .05" THK. C.S.
FINS PER FT.

FITTINGS:

2'-8" STD. WT. WELDING CAP, PER SA-234, WRB.

2'-1" 3000* F.S. CPLG. w/ PLUG, PER SA-105.

HEADER MATERIAL:

8 5/8" O.D. X .322" AV. WALL CARBON STEEL TUBES, PER SA-106,
GR. B.

GENERAL SPECIFICATIONS:

- ① 5'-6" O.D. DAMPER. SEE PROPER BILL OF MATERIAL w/ TAG* FOR EACH WASTE HEAT RECOVERY UNIT. (1)
- ② 5'-0" O.D. DAMPER. SEE PROPER BILL OF MATERIAL w/ TAG* FOR EACH WASTE HEAT RECOVERY UNIT. (1)
- ③ *16 GA. TYPE 304 S.S. LINER
- ④ BOLTED FIELD JOINT
- ⑤ ALL DOORS AND BOLTED JOINTS TO BE GASKETED OR HAVE AMPLE "STALASTIC" CEMENT APPLIED FOR POSITIVE SEAL AGAINST INTERNAL PRESSURE.
- ⑥ 3" THK. MINERAL WOOL
- ⑦ REFRACTORY MIX No. 1, PER G.C.B. Co. SPEC. 102
- ⑧ REFRACTORY 1-6 LV MIX.
- ⑨ TYPE 310 S.S. CERAMIC FIBER ANCHORS
- ⑩ 1" THK 8* DENSITY CERAMIC FIBER BLANKET.
- ⑪ CARBON STEEL CERAMIC FIBER ANCHORS
- ⑫ FERLAM EXPANSION JOINT. (1)
- ⑬ TYPE 304 S.S. BULLHORN ANCHORS.
- ⑭ HEADER VENT CONN. 1"-3000* CPLG w/ PLUG. (2) SEE COIL SPECS.
- ⑮ LIFT LOGS. (6)
- ⑯ DUCT ACCESS DOOR 18" X 18". (1)
- ⑰ FUTURE SOOTBLOWER CONNS. (16)
- ⑱ ALL EXTERIOR STEEL SURFACES (EXCEPT HEADERS & TUBE EXTENSIONS) TO BE WHITE METAL SANDBLASTED & PAINTED ONE COAT CARBOZINC II 3 MILS D.F.T., ONE COAT CARBOLINE 190 HB 2-5 MILS D.F.T. (GREY) & ONE COAT

DETAIL A
RICAL TOP & BOTTOM

- CARBOLINE 190 HB 5-8 MILS. DFT. (WHITE). HEADERS & TUBE
EXTENSIONS SURFACES TO BE WHITE METAL SANDBLASTED &
PAINTED ONE COAT CARBOZINC II 2-3 MILS DFT. & 2 COATS
CARBOLINE 4631 ALUMINUM $\frac{1}{2}$ TO 1 MIL DFT, PER COAT.
- (19) COMPANION FLANGE. (3)
 - (20) ALL INTERNAL STEEL JOINTS TO BE $\frac{1}{8}$ " CONTINUOUS SEAL
WELDED FOR INTERNAL PRESSURE.
 - (21) COVER ALL INTERIOR STEEL SURFACES W/ MASTIC,
BEFORE INSTALLING CERAMIC FIBER & MINERAL WOOL.
 - (22) TEMPERATURE SWITCH CONN. $1\frac{1}{2}$ "-150* RF-FLG. (1)
 - (23) TEMPERATURE TRANSMITTER CONN. $1\frac{1}{2}$ "-150* RF-FLG. (1)
 - (24) MISC. CONNS. 1"-3000* C/LG. W/ PLUG. (8)
 - (25) BOLTED SHOP JOINT.

Reference Drawings;

For Unit E-1710

D-84914-1A---General Layout & Assembly

B-84914-10A--Piping & Instrument Diagram

A-84914-10B--Bill of Material: Instr., Cntl. & Acc.

B-84914-10J--Wiring Diagram

For Unit E-1720

D-84914-1B---General Layout & Assembly

B-84914-10C--Piping & Instrument Diagram

A-84914-10D--Bill of Material: Instr., Cntl. & Acc.

B-84914-10K--Wiring Diagram

For Unit E-1730

D-84914-1B---General Layout & Assembly

B-84914-10E--Piping & Instrument Diagram

A-84914-10F--Bill of Material: Instr., Cntl. & Acc.

B-84914-10M--Wiring Diagram

For Unit E-1740

D-84914-1B---General Layout & Assembly

B-84914-10G--Piping & Instrument Diagram

A-84914-10H--Bill of Material: Instr., Cntl. & Acc.

B-84914-10N--Wiring Diagram

SOLD TO: HYUNDAI HEAT INDUSTRIES Co. LTD.

No. UNITS: ONE PER TAG DWN, 3 PER DWN # D-84914-1B (4 TOTAL)

TAG: E-1710

P.O. No.: H-SH3-F019

SERVICE: WASTE HEAT RECOVERY

LOCATION: SH COMPLEX, INDIA

ESTIMATED SHIPPING WEIGHT: 82,000 LBS.

**PROCESS
HEATERS
BROACH**

THE G. C. BROACH COMPANY • 7667 E. 46th PLACE • TULSA, OKLA. 74145

w/ DWG. # B-84914-1C,
LOADING & ANCHOR BOLT PLAN.

	DWN	<u>ADD</u>	<u>4/5/84</u>
	CHK	<u>MS</u>	<u>4/6/84</u>
	APPR.	<u>T</u>	<u>5/1/84</u>
	SCALE	<u>1"=1'-0"</u>	

GENERAL LAYOUT & ASSEMBLY

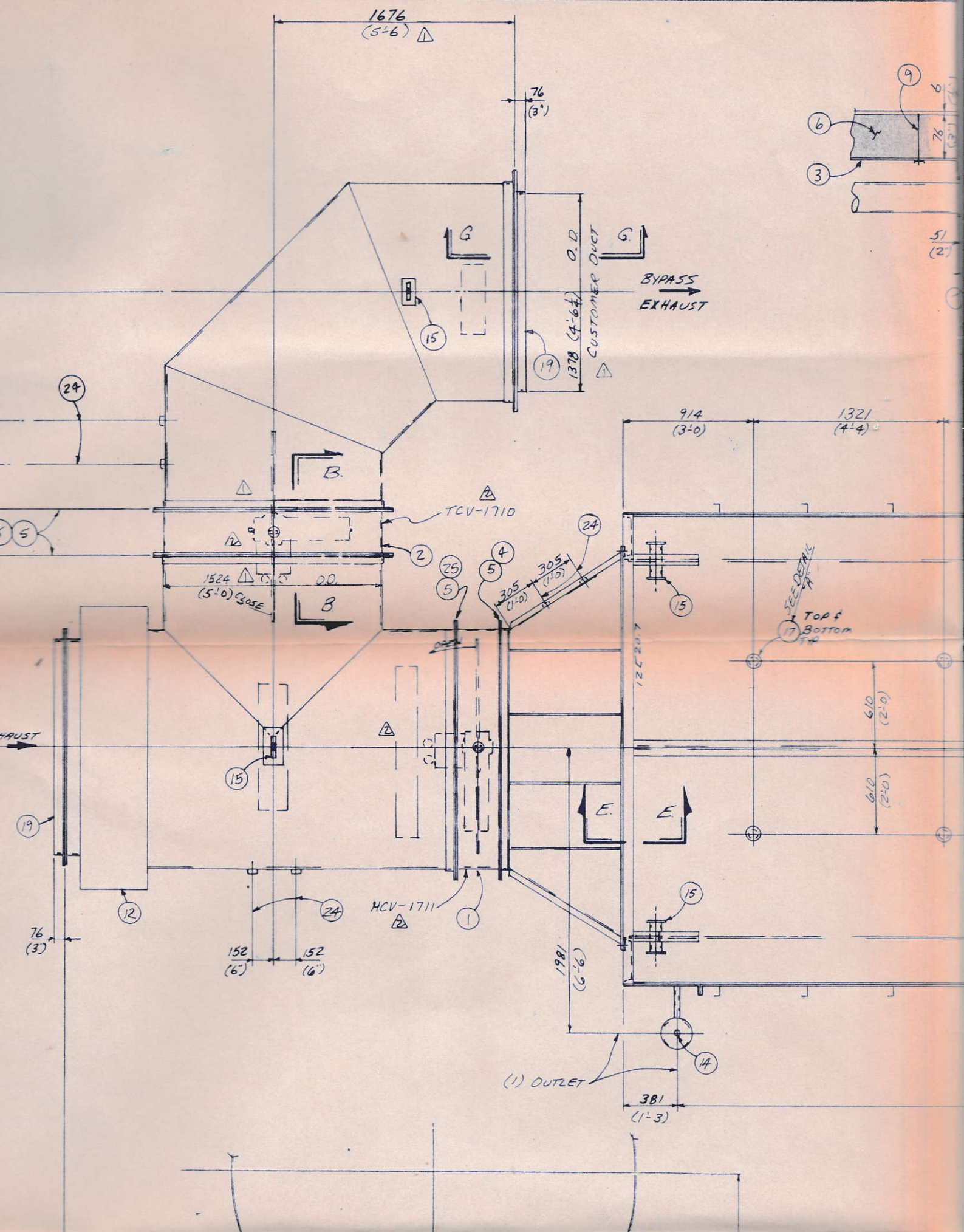
WASTE HEAT RECOVERY UNIT

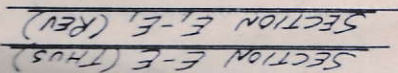
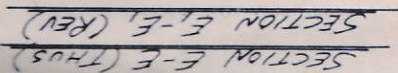
(TAG # E-1710)

JOB
NO. 84914

DWG.
NO. D-84914-1A

REV.
NO. 2



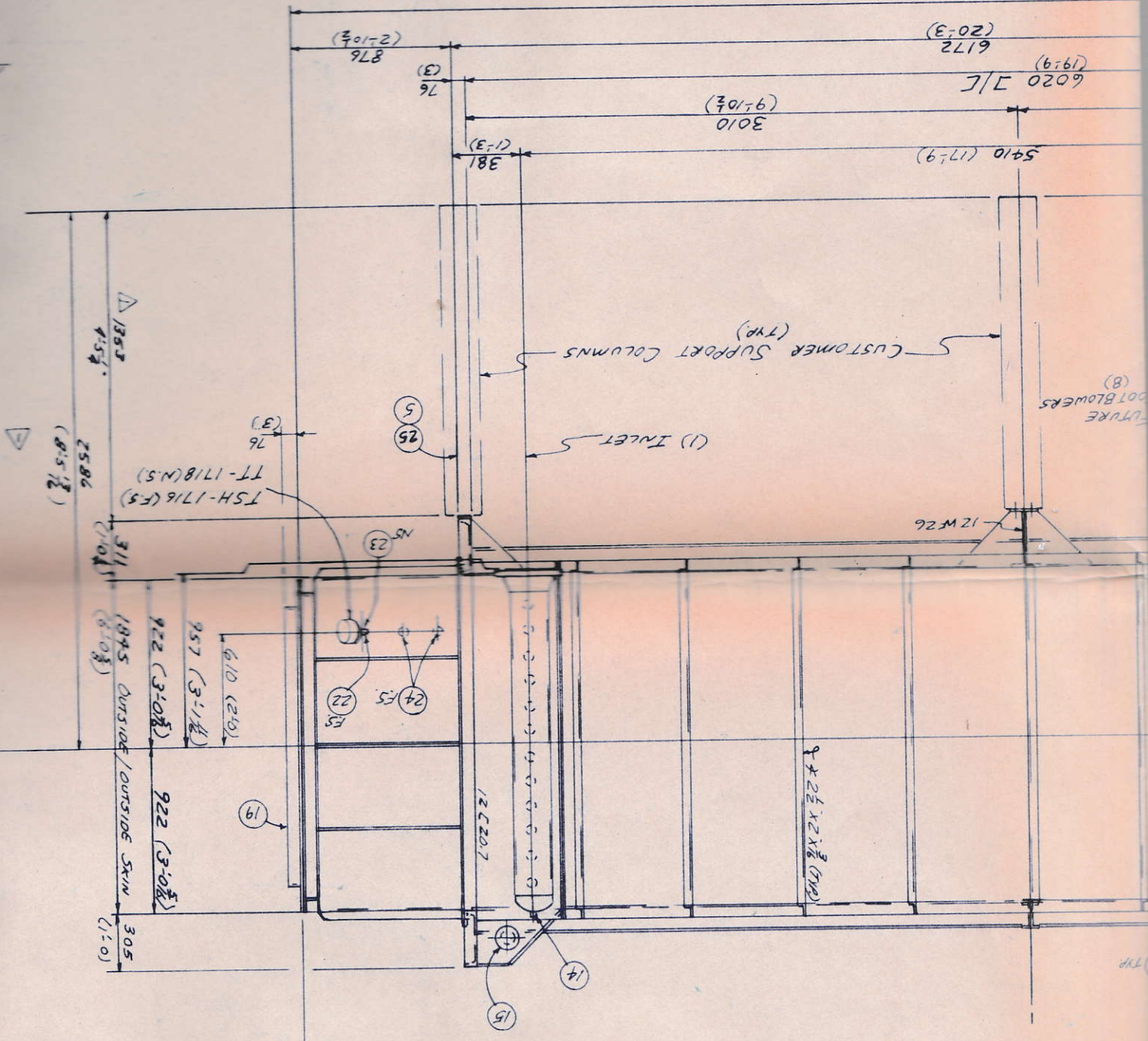


APPR.

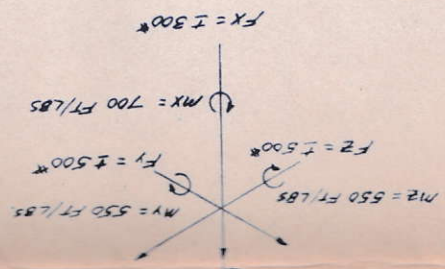
1095	4/6/20
1	9/1/24

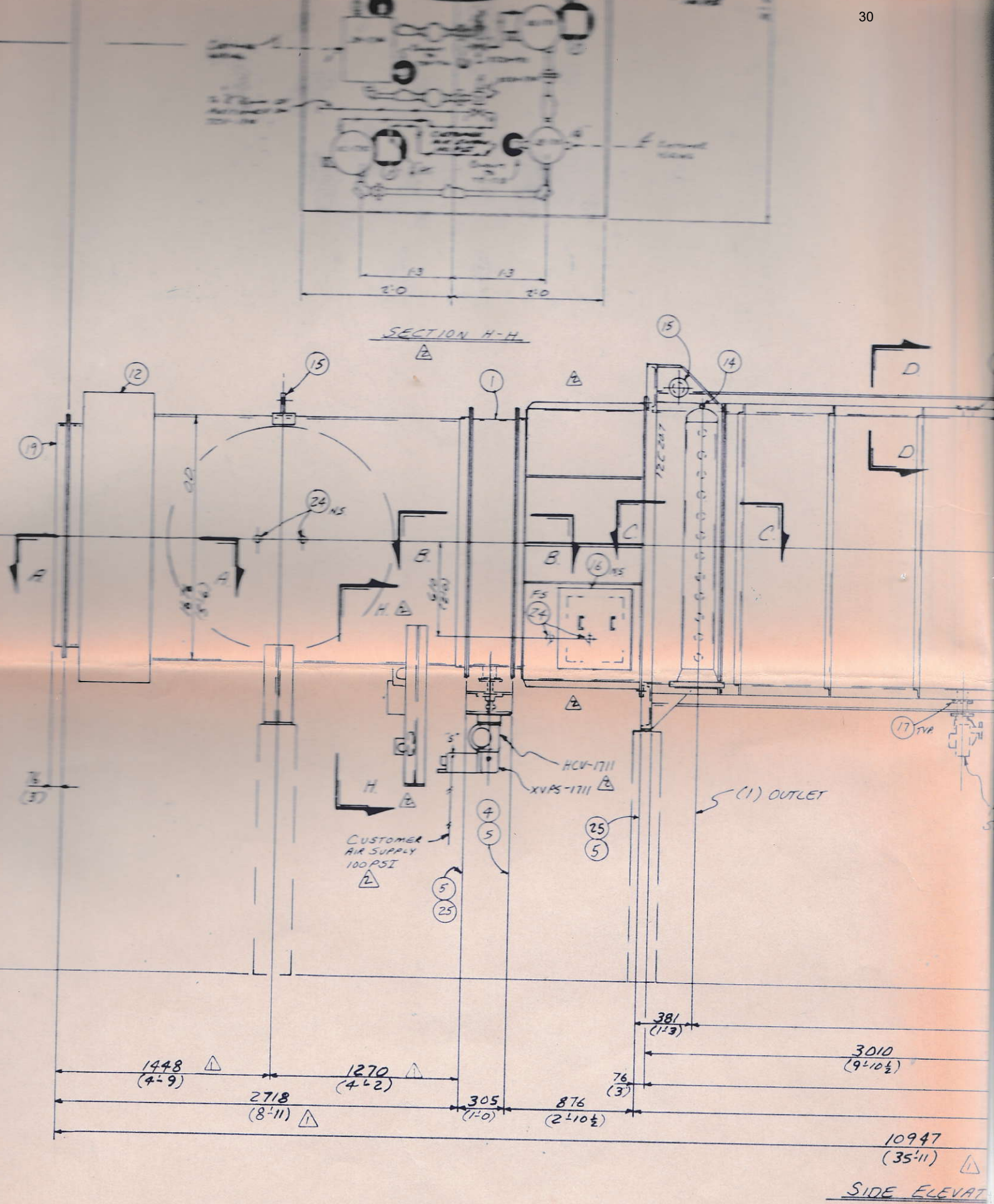
VISIONS	

NOTE



ALLOWABLE NOZZLE LOADING DIAGRAM
(INLET & OUTLET MANIFOLDS)






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*****A M CUELLAR ENG & MFG CO INC *****
*                               SUGARLAND, TEXAS                               *
*                               SHEET NO. 1 OF                               *
*                               PROPOSAL NO. 8709                             *
*                               DATE 09/21/87                               *
1*CUSTOMER HYUNDAI HEAVY INDUSTRIES CO., LTD.      ITEM E-2880
2*PLANT LOCATION ICP PLATFORM COMPLEX, INDIA      PURCH INQ NORFQ-QY-088-TQ61
3*SERVICE HOT OIL TRIM COOLER                    PURCH ORD NO PS-QH-088-TQ61
4*SIZE-TYPE 13F-0410-2042-MD      HORIZ      FRCD/      DRAFT      *NO BAYS 1
5*SURFACE:EXTENDED      3008.09      SQ FT *BARE      142.2      SQ FT
6*HEAT EXCHANGED      2.0953      MM BTU/HR *MTD      184.18      DEG F
7*SERVICE RATE:EXTENDED 3.78202 *BARE 79.9991      BTU/HR-SQ FT-DEG F
8***** PERFORMANCE DATA *****
9*                               TUBE SIDE                               *
10*FLUID CIRCULATED HYTHERM 500      *SGL-OUT 0.968
11*TOTAL FLUID ENTERING      179454      LB/HR*POUR POINT --
12*                               IN      OUT      *BP -- DP -- DEG F
13*TEMPERATURE DEG F      340.3      320      *SPHT-OUT 0.58BTU/LB-DEG F
14*LIQUID      LB/HR      179454      179454      *LATENT HEAT --
15*VAPOR      LB/HR,MW      *T.C.-OUT .067 BTU/H-FT-F
16*NON COND LB/HR,MW      *OPER PRESSURE 100 PSIA
17*STEAM      LB/HR      *ALLOW PRES DROP 10.0 PSIG
18*WATER      LB/HR      *CALC PRESS DROP 8.9 PSIG
19*VISCOSITY      CP      2.09      2.31      *FOULING, INSIDE .002 HR-FT2-OF/B
20***** AIR SIDE *****
21*AIR QUANTITY      24189.4      SCFM *ALTITUDE 50 FT
22*AIR QUANTITY/FAN      12892.3      ACFM *TEMP IN 104.0 DEG F
23*STATIC PRESSURE      .439      IN H2O *TEMP OUT 183.9 DEG F
*FACE VELOCITY      700      SFPM *MINIMUM AMB DEG F
24***** DESIGN-MATERIALS-CONSTRUCTION *****
25*DESIGN PRESS 135.1PSIG *TEST PRESS 202.7PSIG *DESIGN TEMP 644 DEG F
26*DESIGN PRESS 135.1PSIG *TEST PRESS 202.7PSIG *DESIGN TEMP 644 DEG F
27*TUBE BUNDLE *HEADER *TUBE
28*SIZE 4' X 10' *ROWS 3 *TYPE FAB BOX, PLUG *MATERIAL CARBON STEEL
29*NO/BAY 1 *MATERIAL SA-516-70 *ASTM SA-179
30*ARRANGEMENT *PASSES 2 CNTR *OD 1.00 IN *WALL .109 IN
31*BUNDLES 1 PARALLEL *PLUG-DESIGN SHLD. *NO/COIL 56*LTH 10 FT
32*BAYS 1 PARALLEL *MATL C. STEEL *PITCH 2.2500' IN TRI
33*BUNDLE FRAME FAB CHANL *GASKET MATL SOFT IRON *FIN
34*MISCELLANEOUS *CORR ALLOW .125 *TYPE EMBEDDED
35*STRUCTURE MOUNT-STRUCT. *SIZE IN NOZ 4 IN *MATERIAL ALUMINUM
36*SURFACE PREP NOTE 50 *SIZE OUT NOZ 4 IN *OD 2.250 IN*THK .016 IN
37*LOUVERS NO *RATING-FACING 300# R.F. *NO/IN 10
38*CODE-ASME VIII STAMP- YES SPECS API-661
39***** MECHANICAL EQUIPMENT *****
40*FAN *DRIVER *SPEED REDUCER
41*MFR-MODEL CHECO 515 *TYPE ELECTRIC MOTOR *TYPE FAN MOUNTED ON MOTOR SHAFT
42*NO/BAY 2 *HP/FAN 1.6 *NO/BAY 2 *HP/DRVR 3 *NO/BAY 2
43*DIA 42 IN*RPM 955 *RPM 1000 *MODEL SUSPENDED
44*NO BLADES 4 *PTCH ADJ*ENCLOSURE EX. PR. & WEATHER*AGMA HP RATING N.A.
45*BLADE MATERIAL ALUM *VLT/PH/CY 415/3/50 *RATIO N.A.
46*HUB MATERIAL ALUM *MFR TOSHIBA *MFR N.A.
47*CONTROL ACTION ON AIR FAILURE:FAN PITCH N.A. *LOUVERS NONE
48*NOTES:
49* UNIT TO BE SHOP ASSEMBLED AND MOUNTED ON SKID FOR SHIPMENT.
* HEADER BOXES AND ALL STRUCTURAL STEEL PARTS TO BE HOT DIPPED GALVANIZED.
51* FANS TO BE AXIAL TYPE AND MOUNTED ON ELECTRIC MOTOR SHAFT - NO VEE BELTS.
52* ELECTRIC MOTORS TO BE PROTECTED BY MURPHY MODEL No. VS-2-EX VIBRATION SWITCHES.
53* NOISE LEVEL AND RUN-IN TEST IN SHOP ARE PROVIDED FOR THIS UNIT.
54* MATERIAL FOR HEADER BOXES TO BE SA-516-70 and TO CONTAIN 0.25% MAX.
55* NON-DESTRUCTIVE EXAMINATION TO BE IN ACCORDANCE WITH SPECIFICATION No. HMTD-ACHE-01
56*
57*PLOT AREA 4' W 10' L 8' H*STRUCTURE HEIGHT/PLENUM DEPTH
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*****A M CUELLAR ENG & MFG CO INC *****
*                                     SUGARLAND, TEXAS
*                                     SHEET NO. 1 OF
*                                     PROPOSAL NO 8709
*                                     DATE 09/21/87
1*CUSTOMER HYUNDAI HEAVY INDUSTRIES CO., LTD. ITEM E-2880
2*PLANT LOCATION ICP PLATFORM COMPLEX, INDIA PURCH INQ NO RFQ-QY-088-TQ61*
3*SERVICE HOT OIL TRIM COOLER PURCH ORD NO PS-QH-088-TQ61*
4*SIZE-TYPE 13F-0410-2042-MD HORIZ. FRCD DRAFT *NO BAYS 1
5*SURFACE:EXTENDED 279.461 SQ M *BARE 13.21 SQ M
6*HEAT EXCHANGED 528,000 KG CAL/HR *MTD 102.32 DEG C
7*SERVICE RATE:EXTENDED 18.47 *BARE 390.57 KG CAL / HR -SQ M-DEG C
8***** PERFORMANCE DATA *****
9* TUBE SIDE
10*FLUID CIRCULATED HYTHERM 500 *DENSITY, KG/M3 775
11*TOTAL FLUID ENTERING 22.61 KG/S *POUR POINT --
12* IN OUT *BP -- DP -- DEG C
13*TEMPERATURE DEG C 171.278 160 *SPHT-OUT .579 KG CAL/KG-°C
14*LIQUID KG/ S 22.61 22.61 *LATENT HEAT --
15*VAPOR KG/ S,MW *T.C.-OUT .0997 KG CAL/HR-M-°C
16*NON COND KG/ S,MW *OPER PRESSURE 6 KG/CM2 G
17*STEAM KG/ S *ALLOW PRES DROP .7 KG/CM2 G
18*WATER KG/ S *CALC PRESS DROP .63KG/CM2 G
19*VISCOSITY CP 2.09 2.31 *FOULING, INSIDE .0004HR-M-°C/KG CAL
20***** AIR SIDE *****
21*AIR QUANTITY 11.4174 SM3/S *ALTITUDE 15 M
22*AIR QUANTITY/FAN 6.08516 AM3/S *TEMP IN 40.0 DEG C
23*STATIC PRESSURE 11.13 MM WATER COL. *TEMP OUT 84.4 DEG C
24*FACE VELOCITY 3.556 SM/S *MINIMUM AMB DEG C
***** DESIGN-MATERIALS CONSTRUCTION *****
26*DESIGN PRESS 9.5 KG/CM2G *TEST PRESS 14.3KG/CM2G *DESIGN TEMP 340 DEG C
27*TUBE BUNDLE *HEADER *TUBE
28*SIZE 1.22M X 3.05M ROWS 3 *TYPE FAB BOX, PLUG *MATERIAL CARBON STEEL
29*NO/BAY 1 *MATERIAL SA-516-70 *ASTM SA-179
30*ARRANGEMENT *PASSES 2 CNTR *OD 25.4 MM *WALL 2.77 MM
31*BUNDLES 1 PARALLEL *PLUG-DESIGN SHOULDER *NO/COIL 56*LTH 3.05 M
32*BAYS 1 PARALLEL *MATL C. STEEL *PITCH 57.15 MM TRI
33*BUNDLE FRAME FAB CHANL *GASKET MATL SOFT IRON *FIN
34*MISCELLANEOUS *CORR ALLOW 3.175 *TYPE EMBEDDED
35*STRUCTURE MOUNT-S*STRUCT. *SIZE IN NOZ 101.6 MM *MATERIAL ALUMINUM
36*SURFACE PREP NOTE 50 *SIZE OUT NOZ 101.6 MM *OD 57.15 MM*THK .406 MM
37*LOUVERS NO *RATING-FACING 300# R.F. *NO/MM 0.394
38*CODE-ASME VIII STAMP-YES SPECS API-661
39***** MECHANICAL EQUIPMENT *****
40*FAN *DRIVER *SPEED REDUCER
41*MFR-MODEL CHECO 515 *TYPE ELECTRIC MOTOR *TYPE FAN MOUNTED ON MOTOR SHAFT
42*NO/BAY 2 *HP/FAN 1.6 *NO/BAY 2 *HP/DRVR 3 *NO/BAY 2
43*DIA 1.07 M *RPM 955 *RPM 1000 *MODEL SUSPENDED
44*NO BLADES 4 *PTCH ADJ *ENCLOSURE EX. PR. & WEATHERAGMA HP RATING N.A.
45*BLADE MATERIAL ALUM *VLT/PH/CY 415/3/50 *RATIO N.A.
46*HUB MATERIAL ALUM *MFR TOSHIBA *MFR N.A.
47*CONTROL ACTION ON AIR FAILURE:FAN PITCH N.A. *LOUVERS NONE
48*NOTES:
49*UNIT TO BE SHOP ASSEMBLED AND MOUNTED ON SKID FOR SHIPMENT.
50*HEADER BOXES AND ALL STRUCTURAL PARTS TO BE HOT DIPPED GALVANIZED.
51*FANS TO BE AXIAL TYPE AND MOUNTED ON ELECTRIC MOTOR SHAFT - NO VEE BELTS.
52*ELECTRIC MOTORS TO BE PROTECTED BY MURPHY MODEL No. VS-2-EX VIBRATION SWITCHES.
53*NOISE LEVEL AND RUN-IN TEST IN SHOP ARE PROVIDED FOR THIS UNIT.
54*MATERIAL FOR HEADER BOXES TO BE SA-516-70 AND TO CONTAIN 0.25% C MAX.
55*NON-DESTRUCTIVE EXAMINATION TO BE IN ACCORDANCE WITH SPECIFICATION No. HMTD-ACHE-01
56*
57*PLOT AREA 1.22 W 3.05 L 2.44 H*STRUCTURE HEIGHT/PLENUM DEPTH
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*****A M CUELLAR ENG & MFG CO INC *****
*          SUGARLAND, TEXAS          SHEET NO. 1 OF *
*          PROPOSAL NO 8730          *
*          DATE 09/21/87              *
1*CUSTOMER HYUNDAI HEAVY INDUSTRIES CO., LTD.  ITEM E-3880 *
2*PLANT LOCATION BOMBAY HIGH SOUTH-ICP PLATFORM  PURCH INQ NO RFQ-QY-088-TQ52*
3*SERVICE COOLING WATER COOLER  PURCH ORD NO PS-QH-088-TQ52 *
4*SIZE-TYPE 14F-0410-2042MD  HORIZ  FRCD.  DRAFT  *NO BAYS 1 *
5*SURFACE:EXTENDED 3974.98  SQ FT *BARE 187.9  SQ FT *
6*HEAT EXCHANGED .5806  MM BTU/HR *MTD 22.71  DEG F *
7*SERVICE RATE:EXTENDED 6.43228 *BARE 136.059  BTU/HR-SQ FT-DEG F *
8***** PERFORMANCE DATA *****
9*          TUBE SIDE
10*FLUID CIRCULATED COOLING WATER  *SGL-OUT .988 *
11*TOTAL FLUID ENTERING 27558  LB/HR*POUR POINT -- *
12*          IN  OUT  *BP -- DP -- DEG F *
13*TEMPERATURE DEG F 149 129.2 *SPHT-OUT 1.00BTU/LB-DEG F*
14*LIQUID LB/HR 27558 27558 *LATENT HEAT -- *
15*VAPOR LB/HR,MW *T.C.-OUT .370 BTU/H-FT-OF *
16*NON COND LB/HR,MW *OPER PRESSURE 86 PSIA *
17*STEAM LB/HR *ALLOW PRES DROP 14.2 PSIG
18*WATER LB/HR *CALC PRESS DROP 9.7 PSIG
19*VISCOSITY CP .435 .52 *FOULING, INSIDE .001 HR-FT2-OF/Btu
20***** AIR SIDE *****
21*AIR QUANTITY 22116 SCFM *ALTITUDE 50 FT *
22*AIR QUANTITY/FAN 11787.4  ACFM *TEMP IN 104.0 DEG F *
23*STATIC PRESSURE .558  IN H2O *TEMP OUT 128.2 DEG F *
*FACE VELOCITY 640 SFPM *MINIMUM AMB DEG F *
25***** DESIGN-MATERIALS-CONSTRUCTION *****
26*DESIGN PRESS 128 PSIG *TEST PRESS 192 PSIG *DESIGN TEMP 185 DEG F *
27*TUBE BUNDLE *HEADER *TUBE
28*SIZE 4' x 10' *ROWS 4 *TYPE FAB BOX, PLUG *MATERIAL CARBON STEEL
29*NO/BAY 1 *MATERIAL SA-516-70 *ASTM SA-179
30*ARRANGEMENT *PASSES 10 CNTR *OD 1.00 IN *WALL .109 IN
31*BUNDLES 1 PARALLEL *PLUG-DESIGN SHLD. *NO/COIL 74*LTH 10 FT
32*BAYS 1 PARALLEL * MATL C. STEEL *PITCH 2.2500 IN TRI
33*BUNDLE FRAME FAB CHANL *GASKET MATL SOFT IRON *FIN
34*MISCELLANEOUS *CORR ALLOW .125 *TYPE EMBEDDED
35*STRUCTURE MOUNT-STRUCT. *SIZE IN NOZ 2 IN *MATERIAL ALUMINUM
36*SURFACE PREP NOTE 50 *SIZE OUT NOZ 2 IN *OD 2.250 IN*THK .016 IN
37*LOUVERS NO *RATING-FACING 300# R.F. *NO/IN 10
38*CODE-ASME VIII STAMP- YES SPECS API-661
39***** MECHANICAL EQUIPMENT *****
40*FAN *DRIVER *SPEED REDUCER
41*MFR-MODEL CHECO 515 *TYPE ELECTRIC MOTOR *TYPE FAN MOUNTED ON MOTOR SHAFT
42*NO/BAY 2 *HP/FAN 1.8*NO/BAY 2 *HP/DRVR 3 *NO/BAY 2
43*DIA 42 IN*RPM 955 *RPM 1000 *MODEL SUSPENDED
44*NO BLADES 4 *PTCH ADJ*ENCLOSURE EX. PR. & WEATHERAGMA HP RATING N.A.
45*BLADE MATERIAL ALUM *VLT/PH/CY 415/3/50 *RATIO N.A.
46*HUB MATERIAL ALUM *MFR TOSHIBA *MFR N.A.
47*CONTROL ACTION ON AIR FAILURE:FAN PITCH N.A. *LOUVERS NONE
48*NOTES:
49*UNIT TO BE SHOP ASSEMBLED AND MOUNTED ON SKID FOR SHIPMENT.
*HEADER BOXES AND ALL STRUCTURAL STEEL PARTS TO BE HOT DIPPED GALVANIZED.
51*FANS TO BE AXIAL TYPE AND MOUNTED ON ELECTRIC MOTOR SHAFT - NO VEE BELTS.
52*ELECTRIC MOTORS TO BE PROTECTED BY MURPHY MODEL No. VS-2-EX VIBRATION SWITCHES.
53*NOISE LEVEL AND RUN-IN TEST IN SHOP ARE PROVIDED FOR THIS UNIT.
54*MATERIAL FOR HEADER BOXES TO BE SA-516-70 AND TO CONTAIN 0.25% C MAX.
55*NON-DESTRUCTIVE EXAMINATION TO BE IN ACCORDANCE WITH SPECIFICATION No. HMTD-ACHE-01.
56*
57*PLOT AREA 4' W 10' L 8' H*STRUCTURE HEIGHT/PLENUM DEPTH
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*****A M CUELLAR ENG & MFG CO INC *****
*          SUGARLAND, TEXAS          SHEET NO. 1 OF *
*                                     PROPOSAL NO 8730 *
*                                     DATE 09/21/87    *
1*CUSTOMER HYUNDAI HEAVY INDUSTRIES CO., LTD.      ITEM E-3830 *
2*PLANT LOCATION BOMBAY HIGH SOUTH-ICP PLATFORM    PURCH INQ NO RFQ-QY-088-TQ52*
3*SERVICE COOLING WATER COOLER                    PURCH ORD NO PS-QH-088-TQ52 *
4*SIZE-TYPE 14F-0410-2042-MD HORIZ FRCD DRAFT *NO BAYS 1 *
5*SURFACE:EXTENDED 369.288 SQ M *BARE 17.45 SQ M *
6*HEAT EXCHANGED 146,300 KG CAL/HR *MTD 12.62 DEG C *
7*SERVICE RATE:EXTENDED 31.41 *BARE 664.28 KG CAL/ HR - SQ M-DEG C *
8***** PERFORMANCE DATA *****
9* TUBE SIDE
10*FLUID CIRCULATED COOLING WATER * DENSITY 986.7 KG/Cu M *
11*TOTAL FLUID ENTERING 3.47 KG/S *POUR POINT -- *
12* IN OUT *BP -- DP -- DEG C *
13*TEMPERATURE DEG C 65 54 *SPHT-OUT 1.0KG CAL/ KG-°C *
14*LIQUID KG/ S 3.47 3.47 *LATENT HEAT -- *
15*VAPOR KG/ S,MW *T.C.-OUT .551 KG CAL/HR-M-°C *
16*NON COND KG/ S,MW *OPER PRESSURE 5.0 KG/SQ CM *
17*STEAM KG/ S *ALLOW PRES DROP 1.0 KG/SQ CM *
18*WATER KG/ S *CALC PRESS DROP .68 KG/SQ CM *
19*VISCOSITY CP .435 .52 *FOULING, INSIDE .0002 HR-M2-°C/KG CAL
20***** AIR SIDE *****
21*AIR QUANTITY 10.4388 SM3/S *ALTITUDE 15 M *
22*AIR QUANTITY/FAN 5.56366 AM3/S *TEMP IN 40.0 DEG C *
23*STATIC PRESSURE 14.12 MM WATER COL *TEMP OUT 53.4 DEG C *
24*FACE VELOCITY 3.2512 SM/S *MINIMUM AMB DEG C *
25***** DESIGN-MATERIALS CONSTRUCTION *****
26*DESIGN PRESS 9.0 KG/CM2G*TEST PRESS 13.5 KG/CM2G *DESIGN TEMP 85 DEG C *
27*TUBE BUNDLE *HEADER *TUBE *
28*SIZE 1.22MX3.05M*ROWS 4 *TYPE FAB BOX, PLUG *MATERIAL CARBON STEEL *
29*NO/BAY 1 *MATERIAL SA-516-70 *ASTM SA-179 *
30*ARRANGEMENT *PASSES 10 CNTR *OD 25.4 MM *WALL 2.77 MM *
31*BUNDLES 1 PARALLEL *PLUG-DESIGN SHOULDER *NO/COIL 74*LTH 3.05 M *
32*BAYS 1 PARALLEL * MATL C. STEEL *PITCH 57.15 MM TRI *
33*BUNDLE FRAME FAB CHANL *GASKET MATL SOFT IRON *FIN *
34*MISCELLANEOUS *CORR ALLOW 3.175 *TYPE EMBEDDED *
35*STRUCTURE MOUNT-STRUCT *SIZE IN NOZ 50.8 MM *MATERIAL ALUMINUM *
36*SURFACE PREP NOTE 50 *SIZE OUT NOZ 50.8 MM *OD 57.15 MM*THK .406 MM *
37*LOUVERS NO *RATING-FACING 300# R.F. *NO/MM 0.394 *
38*CODE-ASME VIII STAMP-YES SPECS API-661 *
39***** MECHANICAL EQUIPMENT *****
40*FAN *DRIVER *SPEED REDUCER *
41*MFR-MODEL CHECO 515 *TYPE ELECTRIC MOTOR *TYPE FAN MOUNTED ON MOTOR SHAFT *
42*NO/BAY 2 *HP/FAN 1.8 *NO/BAY 2 * HP/DRVR 3 *NO/BAY 2 *
43*DIA 1.07 M*RPM 955 *RPM 1000 *MODEL SUSPENDED *
44*NO BLADES 4 *PTCH ADJ*ENCLOSURE EXP PR & WEATHER *AGMA HP RATING N.A. *
45*BLADE MATERIAL ALUM *VLT/PH/CY 415/3/50 *RATIO N.A. *
46*HUB MATERIAL ALUM *MFR TOSHIBA *MFR N.A. *
47*CONTROL ACTION ON AIR FAILURE:FAN PITCH N.A. *LOUVERS NONE *
48*NOTES:
49*UNIT TO BE SHOP ASSEMBLED AND MOUNTED ON SKID FOR SHIPMENT.
50*HEADER BOXES AND ALL STRUCTURAL STEEL PARTS TO BE HOT DIPPED GALVANIZED.
51*FANS TO BE AXIAL TYPE AND MOUNTED ON ELECTRIC MOTOR SHAFT- NO VEE BELTS.
52*ELECTRIC MOTOR ARE TO BE PROTECTED BY MURPHY MODEL No. VS-2-EX VIBRATION SWITCHES.
53*NOISE LEVEL AMD RUN-IN TEST IN SHOP ARE PROVIDED FOR THIS UNIT.
54*MATERIAL FOR HEADER BOXES TO BE SA-516-70 AND TO CONTAIN 0.25% C MAX.
55*NON-DESTRUCTIVE EXAMINATION TO BE IN ACCORDANCE WITH SPECIFICATION No. HMTD-ACHE-01
56*
57*PLOT AREA 1.22MW 3.05M 2.44MH*STRUCTURE HEIGHT/PLENUM DEPTH
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