



NUVERRA
ENVIRONMENTAL
SOLUTIONS

Therma-Flite TDU Unit #2

www.therma-flite.com

We put our energy behind sustainability.

www.nuverra.com

TDU EQUIPMENT INVENTORY UNIT #2

EQUIPMENT NUMBER	DESCRIPTION	LOCATION
FH-230	Live Bottom Feed Hopper #2	Installed Watford City Nuverra Facility
P-240	Putzmeister Solids Feed Pump #2	Installed Watford City Nuverra Facility
FH-330	Live Bottom Feed Hopper #2	Installed Watford City Nuverra Facility
P-340	Putzmeister Solids Feed Pump #2	Installed Watford City Nuverra Facility
HS-210	Thermal Desorption Unit #2	TF Shop Benicia
CS-220	Product Cooler #2	TF Shop El Dorado
HX-250	Heat Exchanger #2	TF Shop El Dorado
TH-270	Thermal Fluid Heater #2	TF Shop El Dorado
CH-250	Chiller #2	TF Shop El Dorado
FF-250	Condenser Fin Fan Cooler #2	TF Shop El Dorado
OWS-250	Oil / Water Separator #2	TF Shop El Dorado
T-250	Run Down Tank #2	TF Shop El Dorado
FF-280	Cooling Srew Fin Fan Cooler #2	TF Shop El Dorado
SC-600	Screw Conveyor	Installed Watford City Nuverra Facility
SC-601	Screw Conveyor	Installed Watford City Nuverra Facility
SC-602	Screw Conveyor	Installed Watford City Nuverra Facility
SC-603	Screw Conveyor	Installed Watford City Nuverra Facility
SC-604	Screw Conveyor - Rehydration	Installed Watford City Nuverra Facility
FH-430	Slop Oil Feed Hopper	Installed Watford City Nuverra Facility
P-440	Putzmeister TK-70 Slop Oil Pump	Installed Watford City Nuverra Facility







INSTRUMENT LINE TYPES

LINE TYPE	DESCRIPTION
	PNEUMATIC SIGNAL
	ELECTRIC SIGNAL
	HYDRAULIC SIGNAL
	CAPILLARY OR FILLED TUBE
	ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
	ELECTROMAGNETIC OR SONIC SIGNAL (UNGUIDED)
	INTERNAL SYSTEM LINK (SOFTWARE OR DATA LINK)
	MECHANICAL LINK

INSTRUMENT PRIMARY ELEMENTS

SYMBOL	DESCRIPTION
	SIGHT FLOW INDICATOR
	ROTAMETER
	FLOW ORIFICE
	SINGLE PORT PITOT
	VENTURI TUBE
	AVERAGING PITOT STATION
	TURBINE ELEMENT
	POSITIVE DISPLACEMENT FLOWMETER
	VORTEX SENSOR
	TARGET ELEMENT
	MASS FLOWMETER
	SONIC FLOWMETER
	MAG. FLOWMETER
	pH ELECTRODE ASSEMBLY

VALVES

SYMBOL	DESCRIPTION
	CHECK VALVE
	VALVE (UNDESIGNATED / GATE)
	THREE WAY VALVE
	FOUR WAY VALVE
	BALL VALVE
	GLOBE VALVE
	BUTTERFLY VALVE
	PLUG VALVE
	NEEDLE VALVE
	KNIFE GATE VALVE
	ROTARY VALVE
	PRESSURE RELIEF VALVE (SP-###)
	VACUUM RELIEF VALVE (SP-###)
	PRESSURE/VACUUM RELIEF VALVE (SP-###)
	RUPTURE DISC, FOR PRESSURE RELIEF (SP-###)
	RUPTURE DISC, FOR VACUUM RELIEF
	PRESSURE CONTROL VALVE (SELF CONTAINED)
	SHADED (OR FILLED IN) INDICATED NORMALLY CLOSED
	TEMPERATURE CONTROL VALVE
	AIR DAMPER
	WAFER CHECK VALVE

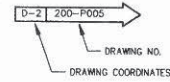
VALVE OPERATORS

SYMBOL	DESCRIPTION
	HAND OPERATOR
	FLOAT OPERATOR
	AIR DIAPHRAM OPERATOR
	POSITIONER
	SOLENOID OPERATOR
	CYLINDER OPERATOR
	PRESSURE BALANCED DIAPHRAM OPERATOR
	MOTOR OPERATOR

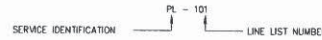
PIPING SYMBOLS

SYMBOL	DESCRIPTION
	CHEMICAL / DIAPHRAM SEAL
	SPECTACLE BLIND INSTALL DONUT IN LINE
	SPECTACLE BLIND INSTALL DISK IN LINE
	WELD CAP
	SCREWED CAP
	FLEXIBLE HOSE (SP-###)
	HOSE CONNECTION
	EXPANSION JOINT / FLEX CONNECTION
	REDUCER
	"Y" TYPE STRAINER WITH BLEED VALVE (SP-###)
	BLIND FLANGE
	HOSE CONNECTION WITH ENDCAP
	IN-LINE LUBRICATOR
	IN-LINE FILTER
	DETONATION / FLAME ARRESTER (SP-###)
	FLANGED CONNECTION
	FLANGED CONNECTION
	FLANGED CONNECTION

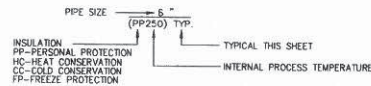
(2) FLOW LINE CROSS REFERENCE ARROWS:



PIPE LINE IDENTIFICATION



PIPE LINE SPECIFICATIONS



PROCESS EQUIPMENT

SYMBOL	DESCRIPTION
	ELECTRIC MOTOR
	HYDRAULIC MOTOR
	AIR MOTOR
	CENTRIFUGAL PUMP
	COMPRESSOR / BLOWER
	POSITIVE DISPLACEMENT PISTON PUMP
	POSITIVE DISPLACEMENT GEAR/LOBE PUMP
	DIAPHRAM POSITIVE DISPLACEMENT PUMP
	EDUCTOR / EJECTOR
	HEAT EXCHANGER
	ROLLER CONVEYOR
	BELT CONVEYOR
	SCREW CONVEYOR
	EQUIPMENT INSULATION
	HYDRAULIC CYLINDER
	AIR CYLINDER

INSTRUMENT AND FUNCTION SYMBOLS

FUNCTION	LOCATION			
	FIELD MOUNTED	PRIMARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY INACCESSIBLE TO OPERATOR
INDEPENDENT INSTRUMENTS				
DCS/PLC				
	LOOP NUMBER →	INSTRUMENT IDENTIFIER →		
		HH → H → L → LL →		

SERVICE IDENTIFICATION

AS - AIR SUPPLY
IA - INSTRUMENT AIR
PA - PLANT AIR
ES - ELECTRIC SUPPLY
GS - GAS SUPPLY
HYS - HYDRAULIC SUPPLY
HYR - HYDRAULIC SUPPLY
NS - INERT GAS SUPPLY
ST - STEAM SUPPLY
WS - WATER SUPPLY
CWS - COOLING WATER SUPPLY
CWR - COOLING WATER RETURN
HWS - HOT WATER SUPPLY
HWR - HOT WATER RETURN
VAC - VACUUM

SERVICE IDENTIFICATION

PL - PROCESS LIQUID
PS - PROCESS SOLIDS/SLURRY
PV - PROCESS GAS/VAPOR
TFS - THERMAL FLUID SUPPLY
TFR - THERMAL FLUID RETURN
TFV - THERMAL FLUID VENT
HYR - HYDRAULIC SUPPLY

INSTRUMENT IDENTIFICATION

FIRST LETTER	SUCCEEDING LETTERS				
LETTER	PROCESS VARIABLE	MODIFIER	READOUT / PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER				
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE				
G	GAGING		GLASS		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER				
K	TIME / SCHEDULE			CONTROL STATION	
L	LEVEL				LOW
M	MOISTURE				MIDDLE
N	USER'S CHOICE	USER'S CHOICE	USER'S CHOICE		
O	USER'S CHOICE	ORIFICE			OPEN
P	PRESSURE		POINT (TEST)		
Q	QUANTITY	TOTAL			
R	RADIOACTIVITY		RECORD		
S	SPEED / FREQ.			SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VISCOSITY			VALVE	
W	WEIGHT / FORCE		WELL		
X	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	
Y	USER'S CHOICE		USER'S CHOICE		
Z	POSITION				

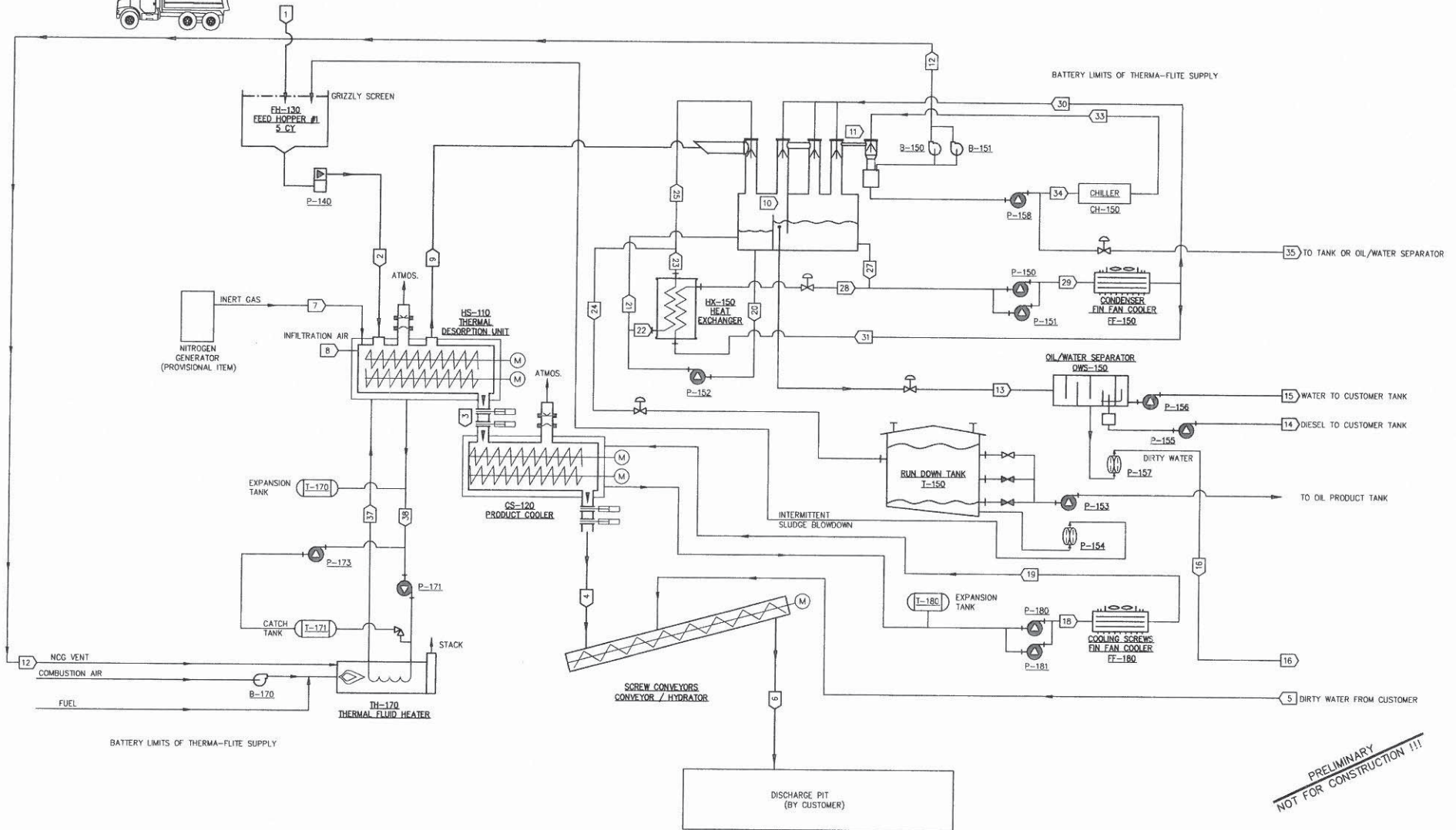
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NO.	DATE	DESCRIPTION	APP. NO.	13072
1	11/15/11	ISSUED FOR REVIEW	PEC	
2	11/15/11	ISSUED FOR REVIEW	ZHG	
3	11/15/11	ISSUED FOR REVIEW		

PIPING AND INSTRUMENTATION DIAGRAM LEGEND SINGLE TRAIN UNIT

CUSTOMER: MUVERRA
P.O. No: _____

The Screw Heat Exchanger Company
1400 Harbor Blvd., Brea, CA 92615
Tel: (951) 751-1888 Fax: (951) 751-1881
REV: NONE P&ID No: 13072D102 Rev: 1 of 8



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NO.	REV.	DATE	DESCRIPTION	DESIGNED BY	DATE
1			ISSUED FOR REVIEW		
2			ISSUED FOR REVIEW		
3			ISSUED FOR REVIEW		

JOB No.	13072
DESIGNED BY	PEC
CHECKED BY	
APPROVED BY	
DATE	08/10/01
PROJECT	LOW TEMP TDU PFD SINGLE TRAIN UNIT

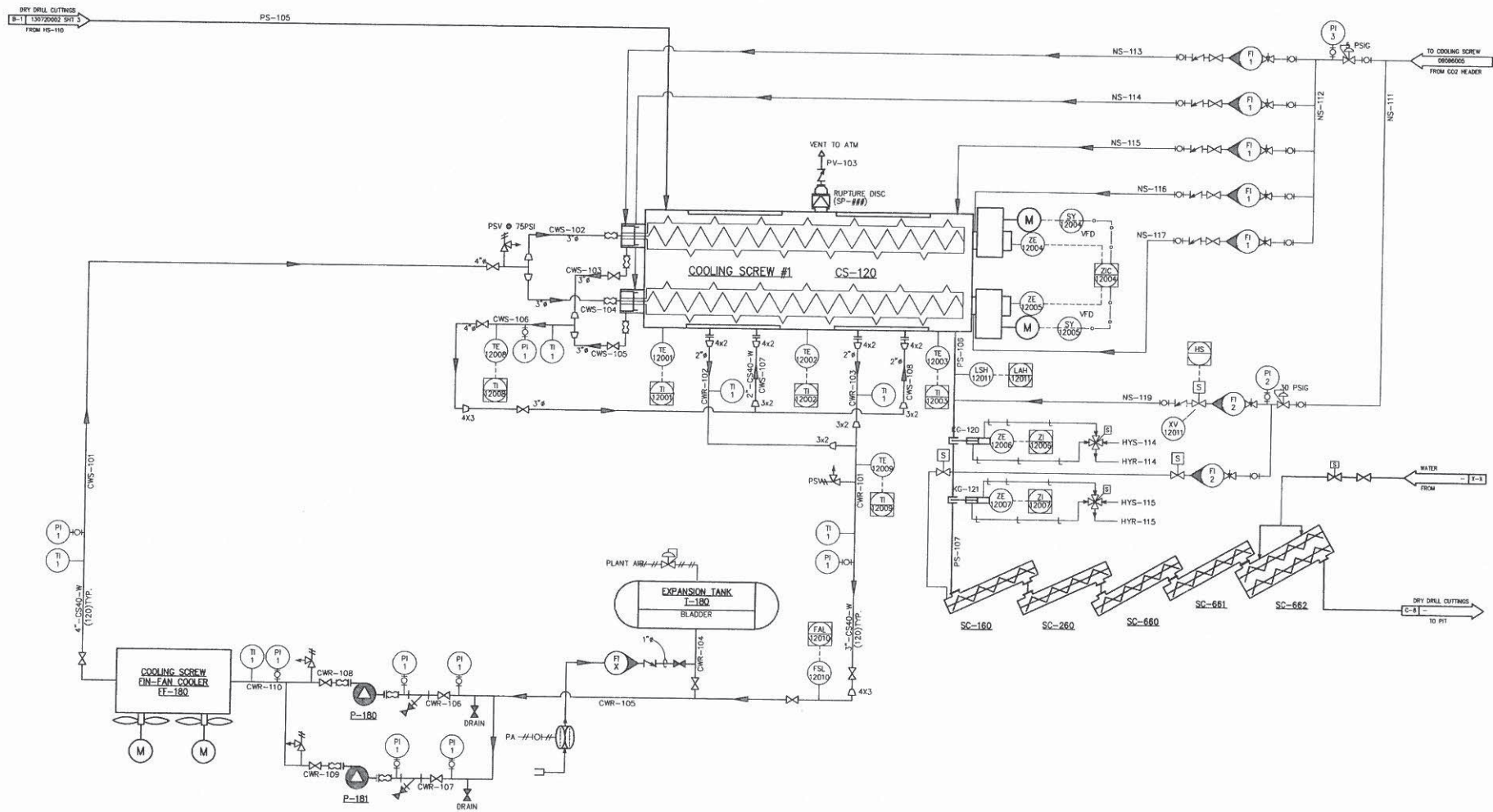
CUSTOMER: NUVERRA
P.O. No:

The Screw Heat Exchange Company
18000 W. Center Rd., Hayward, CA 94541
Tel: (510) 434-9888 Fax: (510) 434-9889

SCALE: NONE Plot No: 13084D101 Date: 1 Rev: 0

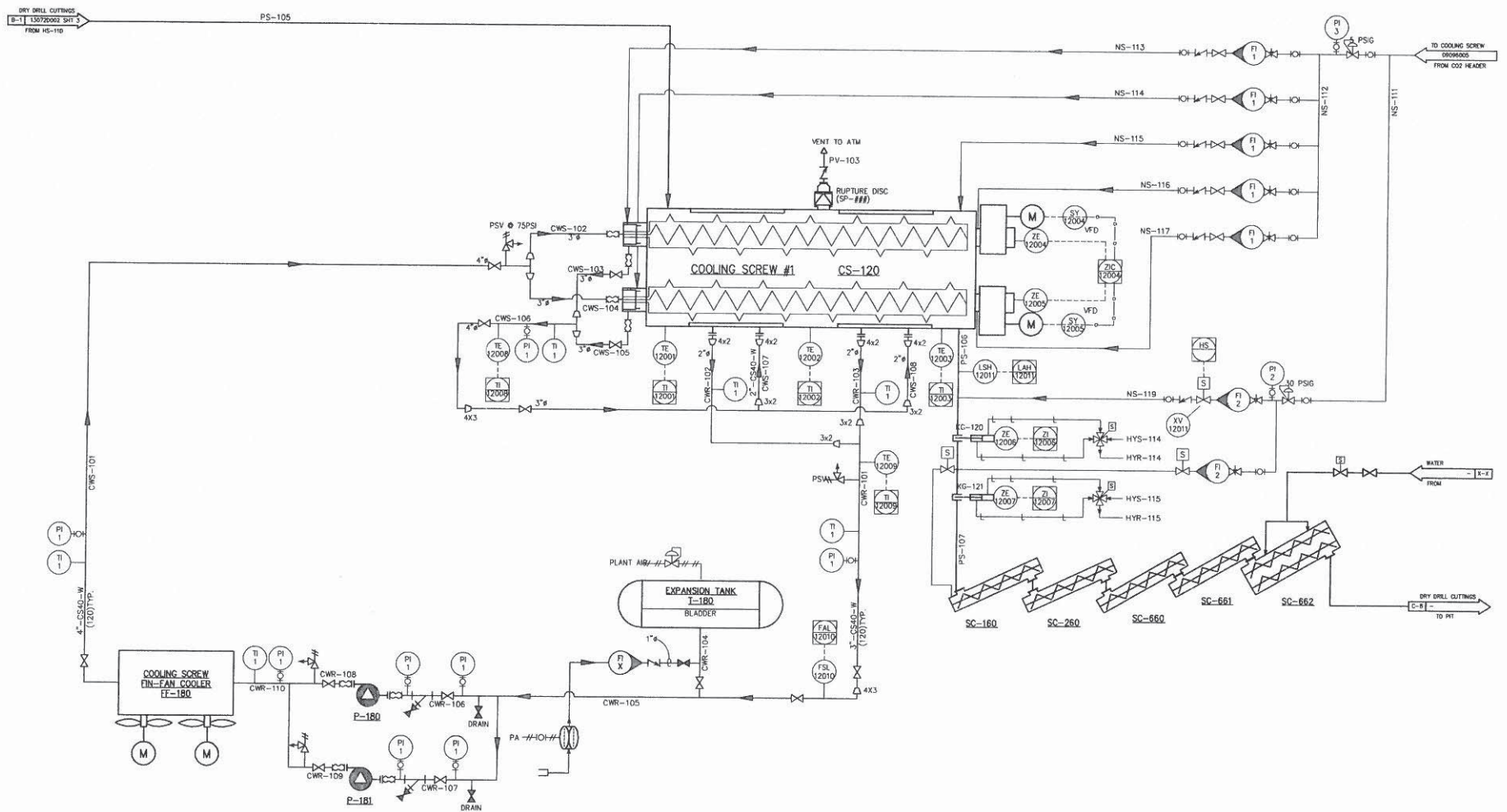
13084D101, low Temp TDU PFD/2008 08-26-13

130720102_A/N/A/M 12/20/13



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<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>	<p>NO. REV. BY DATE</p>
<p>1. PEC 12/20/13</p>	<p>1. ZHE 12/20/13</p>	<p>1. ZHE 12/20/13</p>	<p>1. ZHE 12/20/13</p>	<p>1. ZHE 12/20/13</p>	<p>1. ZHE 12/20/13</p>	<p>1. ZHE 12/20/13</p>	<p>1. ZHE 12/20/13</p>
<p>COOLING SCREW PAID SINGLE TRAIN UNIT</p>				<p>CUSTOMER: NUVERRA</p>			
<p>P.O. No:</p>				<p>Therma-Flo The Screw Heat Exchanger Company 18000 S. 180th St., Kent, WA 98032 Tel: (206) 851-1000</p>			
<p>SCALE: NONE</p>				<p>13072D102</p>			

13072102.MAK/AM 12/20/13



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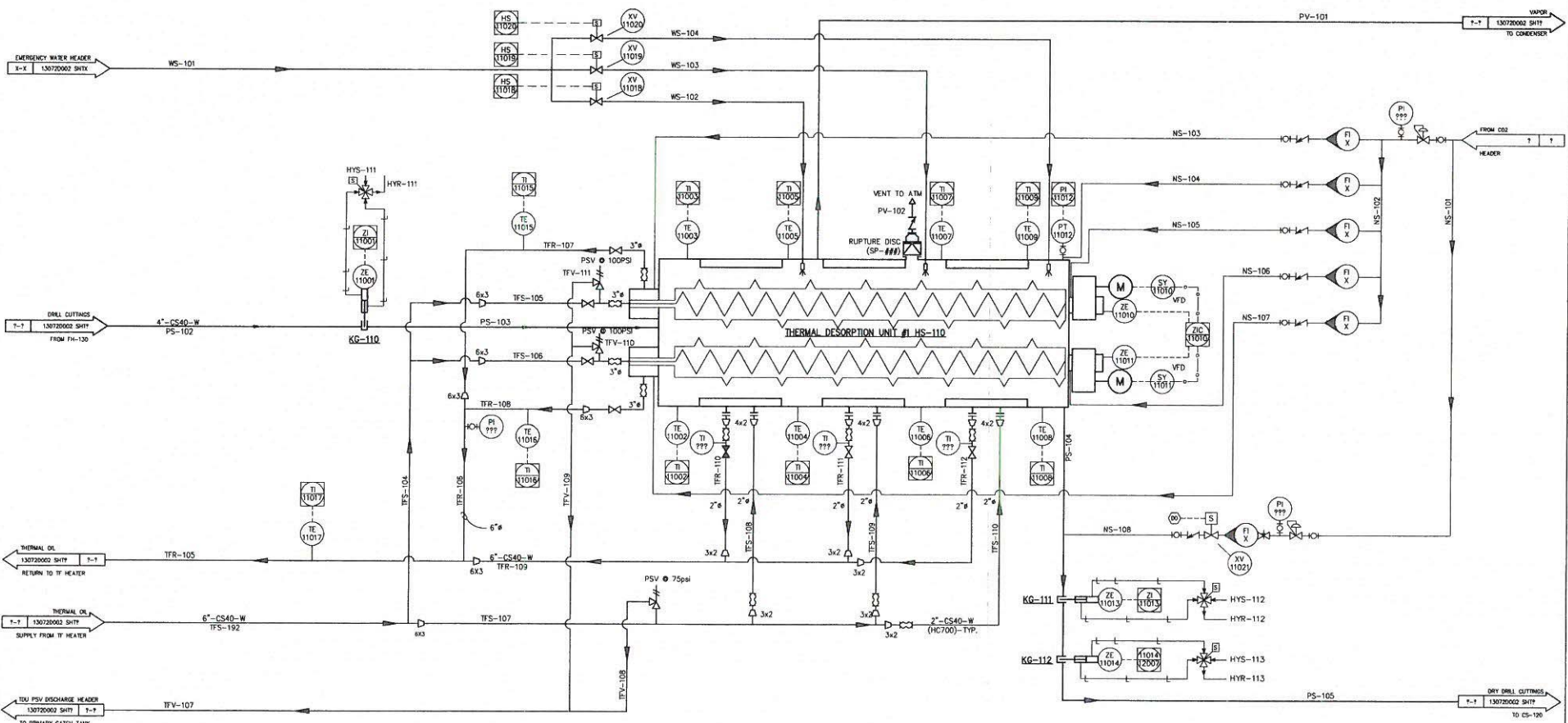
REV	DATE	DESCRIPTION	APP'D BY
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2	12/20/13	DESIGN CHANGES FOR REVIEW	ZMG
3	12/20/13	DESIGN CHANGES FOR REVIEW	
4	12/20/13	DESIGN CHANGES FOR REVIEW	

CUSTOMER: NUVERRA
P.O. No: _____

Therma-Fite
The Screw Heat Exchange Company
18800 E. 15th Ave., Suite 100
Denver, CO 80232
Tel: (303) 555-1888
Fax: (303) 555-1885

COOLING SCREW
P&ID
SINGLE TRAIN UNIT

REV: NONE P&ID No: 13072102 DWG. 4



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THERMAL DESORPTION UNIT
P&ID
SINGLE TRAIN UNIT

CUSTOMER: NUVERRA
P.O. No: []

The Screw Heat Exchanger Company
18100 E. 1st Ave.
Denver, CO 80202
Tel: (303) 440-8800
Fax: (303) 440-8801

SCALE: NONE
DATE: 13072D102
PAGE: 3

13072D102.dwg/rev 12/26/13

INSTRUMENT LINE TYPES	
LINE TYPE	DESCRIPTION
	PNEUMATIC SIGNAL
	ELECTRIC SIGNAL
	HYDRAULIC SIGNAL
	CAPILLARY OR FILLED TUBE
	ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
	ELECTROMAGNETIC OR SONIC SIGNAL (UNGUIDED)
	INTERNAL SYSTEM LINK (SOFTWARE OR DATA LINK)
	MECHANICAL LINK

INSTRUMENT PRIMARY ELEMENTS	
SYMBOL	DESCRIPTION
	SIGHT FLOW INDICATOR
	ROTAMETER
	FLOW ORIFICE
	SINGLE PORT PITOT
	VENTURI TUBE
	AVERAGING PITOT STATION
	TURBINE ELEMENT
	POSITIVE DISPLACEMENT FLOWMETER
	VORTEX SENSOR
	TARGET ELEMENT
	MASS FLOWMETER
	SONIC FLOWMETER
	MAG. FLOWMETER
	pH ELECTRODE ASSEMBLY

VALVES	
SYMBOL	DESCRIPTION
	CHECK VALVE
	VALVE (UNDESIGNATED / GATE)
	THREE WAY VALVE
	FOUR WAY VALVE
	BALL VALVE
	GLOBE VALVE
	BUTTERFLY VALVE
	PLUG VALVE
	NEEDLE VALVE
	KNIFE GATE VALVE
	ROTARY VALVE
	PRESSURE RELIEF VALVE (SP-###)
	VACUUM RELIEF VALVE (SP-###)
	PRESSURE/VACUUM RELIEF VALVE (SP-###)
	RUPTURE DISC. FOR PRESSURE RELIEF (SP-###)
	RUPTURE DISK. FOR VACUUM RELIEF
	PRESSURE CONTROL VALVE (SELF CONTAINED)
	SHADED (OR FILLED IN) INDICATED NORMALLY CLOSED
	TEMPERATURE CONTROL VALVE
	AIR DAMPER
	WATER CHECK VALVE

PIPING SYMBOLS	
SYMBOL	DESCRIPTION
	CHEMICAL / DIAPHRAM SEAL
	SPECTACLE BLIND INSTALL DONUT IN LINE
	SPECTACLE BLIND INSTALL DISK IN LINE
	WELD CAP
	SCREWED CAP
	FLEXIBLE HOSE (SP-###)
	HOSE CONNECTION
	EXPANSION JOINT / FLEX CONNECTION
	REDUCER
	"Y" TYPE STRAINER WITH BLEED VALVE (SP-###)
	BLIND FLANGE
	HOSE CONNECTION WITH ENDCAP
	IN-LINE LUBRICATOR
	IN-LINE FILTER
	DETONATION / FLAME ARRESTOR (SP-###)
	FLANGED CONNECTION
	FLANGED CONNECTION
	FLANGED CONNECTION

PROCESS EQUIPMENT	
SYMBOL	DESCRIPTION
	ELECTRIC MOTOR
	HYDRAULIC MOTOR
	AIR MOTOR
	CENTRIFUGAL PUMP
	COMPRESSOR / BLOWER
	POSITIVE DISPLACEMENT PISTON PUMP
	POSITIVE DISPLACEMENT GEAR/LOBE PUMP
	DIAPHRAM POSITIVE DISPLACEMENT PUMP
	EDUCTOR / EJECTOR
	HEAT EXCHANGER
	ROLLER CONVEYOR
	BELT CONVEYOR
	SCREW CONVEYOR
	EQUIPMENT INSULATION
	HYDRAULIC CYLINDER
	AIR CYLINDER

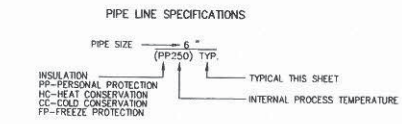
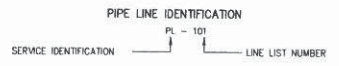
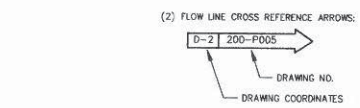
SERVICE IDENTIFICATION	
AS - AIR SUPPLY	PL - PROCESS LIQUID
IA - INSTRUMENT AIR	PS - PROCESS SOLIDS/SLURRY
PA - PLANT AIR	PV - PROCESS GAS/VAPOR
ES - ELECTRIC SUPPLY	TS - THERMAL FLUID SUPPLY
GS - GAS SUPPLY	TR - THERMAL FLUID RETURN
HYS - HYDRAULIC SUPPLY	TFV - THERMAL FLUID VENT
HYR - HYDRAULIC SUPPLY	HYR - HYDRAULIC SUPPLY
NS - INERT GAS SUPPLY	
ST - STEAM SUPPLY	
WS - WATER SUPPLY	
CWS - COOLING WATER SUPPLY	
CWR - COOLING WATER RETURN	
HWS - HOT WATER SUPPLY	
HWR - HOT WATER RETURN	
VAC - VACUUM	

INSTRUMENT IDENTIFICATION

FIRST LETTER		SUCCEEDING LETTERS			
LETTER	PROCESS VARIABLE	MODIFIER	READOUT / PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER				
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE				
G	GAGING		GLASS		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER				
K	TIME / SCHEDULE			CONTROL STATION	
L	LEVEL				LOW
M	MOISTURE				MIDDLE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	
O	USER'S CHOICE		ORIFICE		OPEN
P	PRESSURE		POINT (TEST)		
Q	QUANTITY	TOTAL			
R	RADIOACTIVITY		RECORD		
S	SPEED / FREQ.			SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VISCOSITY			VALVE	
W	WEIGHT / FORCE		WELL		
X	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	
Y	USER'S CHOICE		USER'S CHOICE		
Z	POSITION				

VALVE OPERATORS

SYMBOL	DESCRIPTION
	HAND OPERATOR
	FLOAT OPERATOR
	AIR DIAPHRAM OPERATOR
	POSITIONER
	SOLENOID OPERATOR
	CYLINDER OPERATOR
	PRESSURE BALANCED DIAPHRAM OPERATOR
	MOTOR OPERATOR



FUNCTION	LOCATION			
	FIELD MOUNTED	PRIMARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY INACCESSIBLE TO OPERATOR
INDEPENDENT INSTRUMENTS	XXX XXXX	XXX XXXX	XXX XXXX	XXX XXXX
DCS/PLC		XXX XXXX	XXX XXXX	XXX XXXX

LOOP NUMBER → XXX XXXX → INSTRUMENT IDENTIFIER

HH
H
L
LL → INSTRUMENT ALARMS/SWITCHES

130720102.dwg/12/10/13

NO.	DATE	BY	DESCRIPTION	APP. NO.	13072
1	12/10/13	PEC	DESIGN	1	
2	12/10/13	ZHG	CHECKED	1	
3	12/10/13		APPROVED	1	

PIPING AND INSTRUMENTATION DIAGRAM LEGEND SINGLE TRAIN UNIT

CUSTOMER: NUVERRA

P.O. No: _____

Therma-Flite

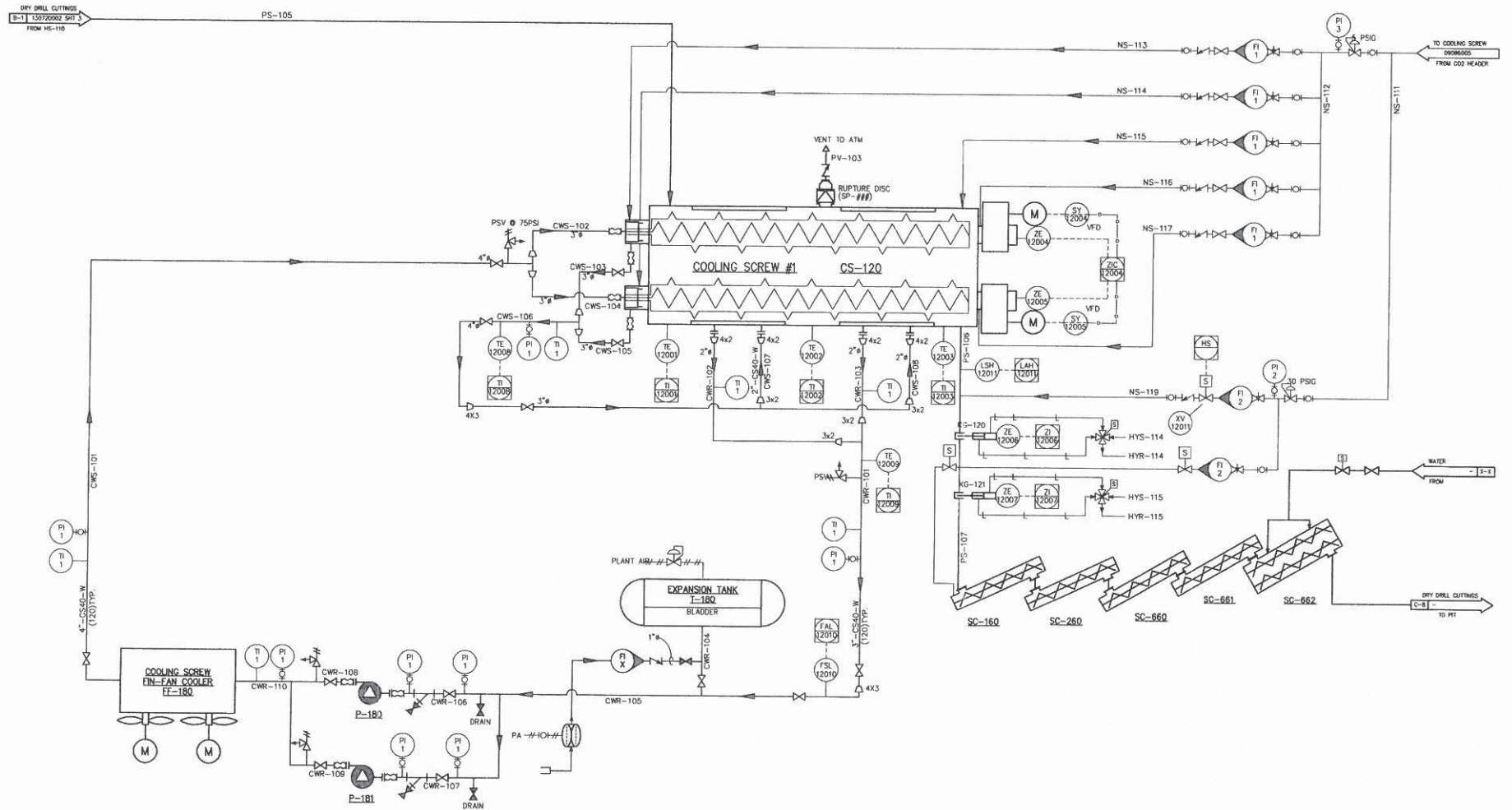
The Crown Heat Exchange Company

14000 West 14th Street, Denver, CO 80202, USA

Phone: (303) 555-5666 Fax: (303) 555-5665

SCALE: NONE DRAWING NO: 130720102 SHEET: 1 OF 1

13072D102 - REV 04/12/2013



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NO.	REV.	DATE	DESCRIPTION	BY	CHK.
1	1	04/12/2013	ISSUED FOR REVIEW	PEC	
2	2	04/12/2013	ISSUED FOR REVIEW	ZHG	
3	3	04/12/2013	ISSUED FOR REVIEW		
4	4	04/12/2013	ISSUED FOR REVIEW		

13072
 COOLING SCREW
 PAID
 SINGLE TRAIN UNIT

CUSTOMER: NUVERVA
 P.O. No: _____

 The Screw Heat Exchange Company
 18000 Harbor Blvd
 Newark, CA 94560
 Telephone: (925) 932-8888
 Fax: (925) 932-8881
 BOLD: NONE
 13072D102 Rev 4

PROCESS INPUT	
FEED TO HEATER	200 TPD
SOLIDS COMPONENT OF FEED	60%
WATER COMPONENT OF FEED	15%
DIESEL COMPONENT OF FEED	25%
THERMAL DESORPTION UNIT	
FEED MATERIAL TEMPERATURE	60 DEG F
FEED MATERIAL DENSITY	110 LBS/CUFT
OUTLET MATERIAL TEMPERATURE	95 LBS/CUFT
OUTLET MATERIAL TEMPERATURE	350 DEG F
OUTLET VAPOR TEMPERATURE	400 DEG F
THERMAL OIL SUPPLY TEMPERATURE	700 DEG F
THERMAL OIL FLOW	560 GPM
INERT GAS TO FEEDER	40 CFM
AIR INFILTRATION TO HEATER	1 CFM
SOLIDS CARRYOVER TO CONDENSER	60 LBS/HR
COOLING SCREW	
COOLING WATER FLOW	250 GPM
OUTLET MATERIAL TEMPERATURE	200 DEG F
OUTLET MATERIAL DENSITY	100 LBS/CUFT
COOLING SCREW FIN FAN COOLER	
AIR FLOW TO COOLER	80,000 CFM
AIR AMBIENT TEMPERATURE	90 DEG F
CONDENSER 1ST STAGE	
LIQUID TO 1ST STAGE CONDENSER	33 GPM
VAPOR OUT/LIQUID OUT DELTA T	15 DEG F
LIQUID CARRYOVER TO 2ND CONDENSER	70%
SOLIDS REMOVAL	90%
COOLING LIQUID TO HEAT EXCHANGER	50 GPM
CONDENSER 2ND STAGE	
LIQUID TO 2ND STAGE CONDENSER	300 GPM
VAPOR OUT/LIQUID OUT DELTA T	15 DEG F
DIESEL SEPARATION EFFICIENCY	0%
SOLIDS REMOVAL	90%
CONDENSER FIN FAN COOLER	
AIR TO CONDENSER	169,000 CFM
AMBIENT AIR TEMPERATURE	90 DEG F
POLISHER	
LIQUID TO POLISHER	3 GPM
LIQUID TO POLISHER TEMPERATURE	55 DEG F
VAPOR OUT/LIQUID OUT DELTA T	15 DEG F
SOLIDS REMOVAL	0%

HEAT EXCHANGER SPECIFICATION	
CONDENSER FIN FAN COOLER	
COLD SIDE FLOW (AIR)	169,000 ACFM
COLD SIDE INPUT TEMPERATURE	95 DEG F
COLD SIDE OUTPUT TEMPERATURE	115 DEG F
HOT SIDE FLOW (60/40 DIESEL/WATER)	168,000 LBS/HR
HOT SIDE INPUT TEMPERATURE	141 DEG F
HOT SIDE OUTPUT TEMPERATURE	110 DEG F
HEAT EXCHANGED	3,700,000 BTU/HR
UA (CALCULATED)	183,000

HEAT EXCHANGER SPECIFICATION	
COOLING SCREW FIN FAN COOLER	
COLD SIDE FLOW (AIR)	80,000 ACFM
COLD SIDE INPUT TEMPERATURE	95 DEG F
COLD SIDE OUTPUT TEMPERATURE	110 DEG F
HOT SIDE FLOW (WATER)	250 GPM
HOT SIDE INPUT TEMPERATURE	118 DEG F
HOT SIDE OUTPUT TEMPERATURE	108 DEG F
HEAT EXCHANGED	1,130,000 BTU/HR
UA (CALCULATED)	109,000

HEAT EXCHANGER SPECIFICATION	
SPIRAL HEAT EXCHANGER	
COLD SIDE FLOW (40% WATER, 60% DIESEL)	50 GPM
COLD SIDE INPUT TEMPERATURE	130 DEG F
COLD SIDE OUTPUT TEMPERATURE	178.1 DEG F
HOT SIDE FLOW (DIESEL)	37 GPM
HOT SIDE INPUT TEMPERATURE	190 DEG F
HOT SIDE OUTPUT TEMPERATURE	282 DEG F
HEAT EXCHANGED	800,000 BTU/HR
UA (CALCULATED)	99.50

SYSTEM HEAT BALANCE	
INPUT FROM THERMAL OIL HEATER	5,170,000
OUTPUT FROM COOLER	-334,000
COOLING SCREW FIN FAN HEAT REJECTION	-836,000
OUTPUT TO RUNDOWN TANK	-62,000
OUTPUT TO OIL WATER SEPARATOR	-330,000
CONDENSER FIN FAN HEAT REJECTION	-3,592,000
POLISHER	-16,000
VENT	0

STREAM	TDU AND COOLING SCREW								CONDENSER AND SEPARATION										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
DESC	TOTAL SYSTEM INPUT	INPUT TO TDU	TDU SOLIDS OUTPUT	COOLING SCREW DISCHARGE	DIRTY WATER SUPPLY	TOTAL SOLIDS OUTPUT	INERT GAS TO TDU	INFILTRATION AIR	TDU OUTPUT TO CONDENSER (2-PHASE)	CONDENSER 1ST STG. TO CONDENSER (2-PHASE)	CONDENSER 2ND STG. TO POLISHER	CONDENSER VENT	OIL/WATER TO SEPARATOR	DIESEL FROM SEPARATOR	WATER FROM SEPARATOR	DIRTY WATER FROM SEPARATOR	CS COOLING WATER RETURN	CS COOLING WATER SUPPLY	
TEMP (°F)	60°F	60°F	55°F	200°F	AMBIENT	190°F	60°F	60°F	400°F	264°F	121°F	70°F	133°F	133°F	133°F	133°F	106°F	100°F	
PRESSURE	-	-	1" W.C.	ATM	40 PSIG	-	< 35 PSIG	-	1" W.C.	1" W.C.	1" W.C.	15" W.C.	2" W.C.	30 PSIG	30 PSIG	30 PSIG	20 PSIG	70 PSIG	
FLOW (VOLUME)	2.5 ACFM	2.5 ACFM	1.7 ACFM	1.7 ACFM	2 GPM	1.7 ACFM	1 ACFM	40 ACFM	1,740 ACFM	1285 ACFM	53 ACFM	42 CFM	11 GPM	5 GPM	6 GPM	2 GPH (INTERMITTENT)	250 GPM	250 GPM	
FLOW (lb/HR)	16,667	16,667	10,197	10,197	1001	-	4	184	6699	5488	211	148	5279	2792	2482	(INTERMITTENT)	-	-	
SOLIDS (lb/HR)	10,000	10,000	9,969	9989	-	11,198	-	-	60	6	0.6	0.6	5	-	-	5	-	-	
WATER (lb/HR)	2,500	2,500	0	0	1001	1001	-	-	2500	2500	20	3.1	2482	0	2482	(INTERMITTENT)	-	-	
DIESEL (lb/HR)	4,167	4,167	208	208	-	208	-	-	3951	2794	5	0.6	2792	2792	0	0	-	-	

MATERIAL CONSTANTS	
WATER LATENT HEAT OF VAPORIZATION	970 BTU/LB
WATER BOILING POINT	212 DEG F
WATER LIQUID DENSITY	62.4 LBS/CUFT
WATER VAPOR DENSITY @ 212 DEG F	0.0367 LBS/CUFT
WATER HEAT CAPACITY LIQUID	1 BTU/LB-F
WATER HEAT CAPACITY VAPOR	0.45 BTU/LB-F
DIESEL LATENT HEAT OF VAPORIZATION	175 BTU/LB
DIESEL BOILING POINT (AVERAGE)	450 DEG F
DIESEL LIQUID DENSITY	58.0 LB/CUFT
DIESEL VAPOR DENSITY @ 68 DEG F	0.2259 LB/CUFT
DIESEL HEAT CAPACITY LIQUID	0.47 BTU/LB-F
DIESEL HEAT CAPACITY VAPOR	0.57 BTU/LB-F
50/50 WATER/GLYCOL DENSITY (S.G. 1.07)	66.8 LBS/CUFT
50/50 WATER/GLYCOL HEAT CAPACITY	0.84 BTU/LB-F
NITROGEN DENSITY @ 59 DEG F	0.074 LBS/CUFT
NITROGEN HEAT CAPACITY	0.248 BTU/LB-F
AIR DENSITY @ 68 DEG F	0.0753 LBS/CUFT
AIR HEAT CAPACITY	0.24 BTU/LB-F
THERMAL FLUID HEAT CAPACITY	0.59 BTU/LB-F
SOLIDS GRAIN DENSITY	252 LBS/CUFT
SOLIDS HEAT CAPACITY	0.23 BTU/LB-F

STREAM	STAGE #1 CONDENSER RECIRCULATION LOOP						STAGE #2 CONDENSER RECIRCULATION LOOP					POLISHER							
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
DESC	DIESEL FROM CONDENSER STAGE 1	CONDENSER STAGE 1 CIRCULATION	CONDENSER DIESEL TO HX	CONDENSER DIESEL HX OUT	CONDENSER DIESEL TO RUNDOWN TANK	DIESEL TO STAGE 1 CONDENSER SPRAYS		DIESEL/WTR. FROM STAGE 2 CONDENSER	DIESEL/WTR. FROM STAGE 1 HX	DIESEL/WTR. TO CONDENSER FIN FAN	DIESEL/WTR. TO STAGE 1 CONDENSER SPRAY	DIESEL/WTR. TO STAGE 1 HX		CHILLED WATER TO CONDENSER	WATER TO CHILLER	LIQUID OUT FROM POLISHER LOOP		THERMAL OIL SUPPLY	THERMAL OIL RETURN
TEMP (°F)	249°F	249°F	249°F	157°F	157°F	157°F		133°F	148°F	135°F	106°F	106°F		55°F	67°F	67°F		700°F	654°F
PRESSURE	ATM	50 PSIG	50 PSIG	30 PSIG	ATM	30 PSIG		ATM	ATM	55 PSIG	30 PSIG	30 PSIG		40 PSIG	60 PSIG	60 PSIG		65 PSIG	25 PSIG
FLOW (VOLUME)	51.5 GPM	16 GPM	35.5 GPM	35.5 GPM	2.5 GPM	33 GPM		300 GPM	50 GPM	350 GPM	300 GPM	50 GPM		3 GPM	3 GPM	0.03 GPM		560 GPM	560 GPM
FLOW (lb/HR)	25,061	7,789	17,272	17,272	1208	17,272		144,464	24,075	168,524	147,374	24,075		1,480	1,480	16		-	-
SOLIDS (lb/HR)	1,110	345	765	765	54	711		147	25	163	172	25		-	-	-		-	-
WATER (lb/HR)	-	-	-	-	-	-		67,760	11,260	75,213	78,819	11,260		283	283	13		-	-
DIESEL (lb/HR)	23,951	7,444	16,507	16,507	1154	15,353		76,557	12,970	84,978	89,533	12,970		1,197	1,197	3		-	-

NOTE: FLOW TO STAGE #1 CONDENSER SPRAYS (30) IS 300GPM AT 30 PSI, WOULD BE 345 GPM AT 40 PSI.

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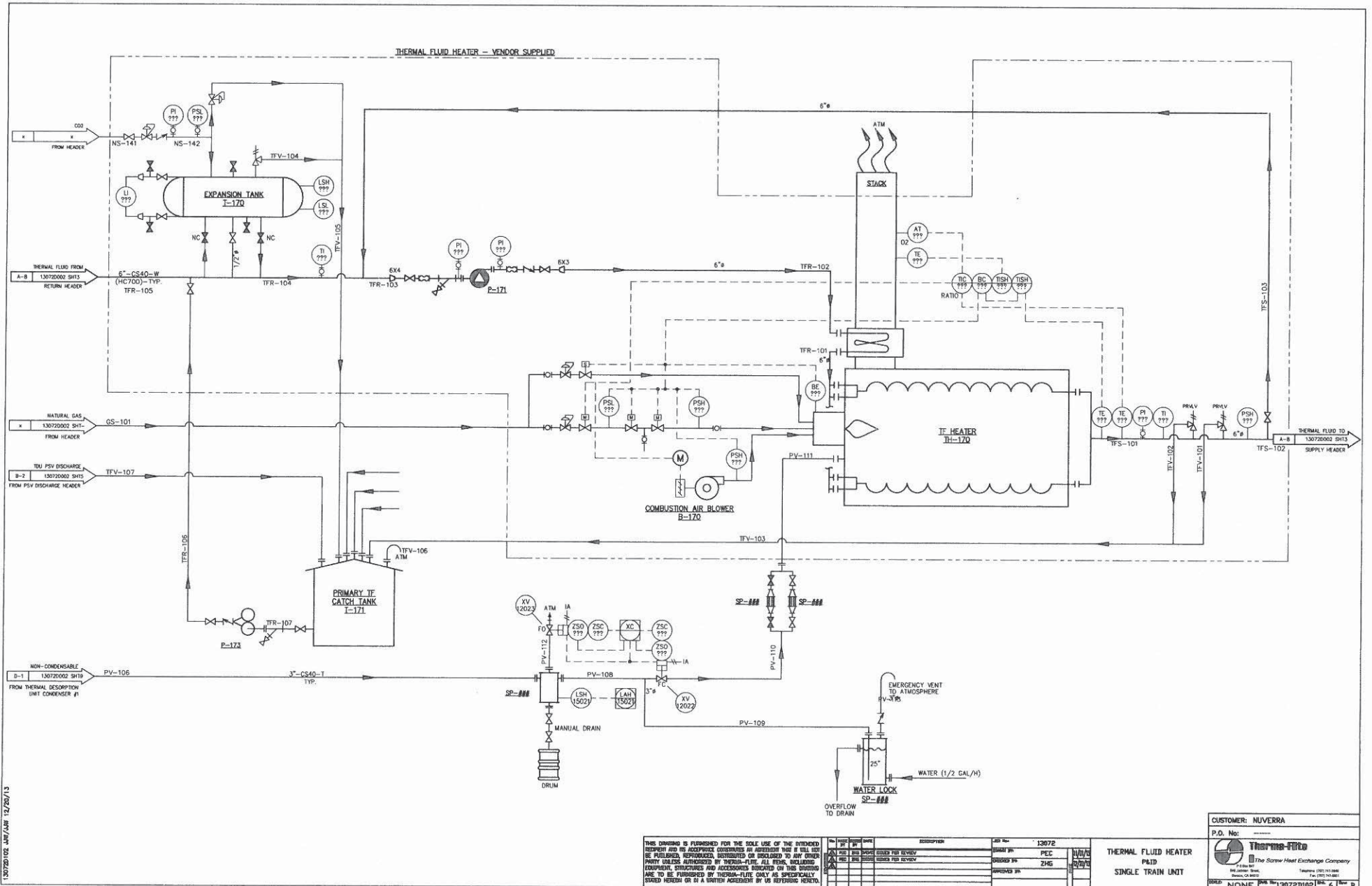
REV	DATE	DESCRIPTION	APP'D BY
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2	08/21/96	ISSUED FOR REVIEW	
3	08/21/96	ISSUED FOR REVIEW	

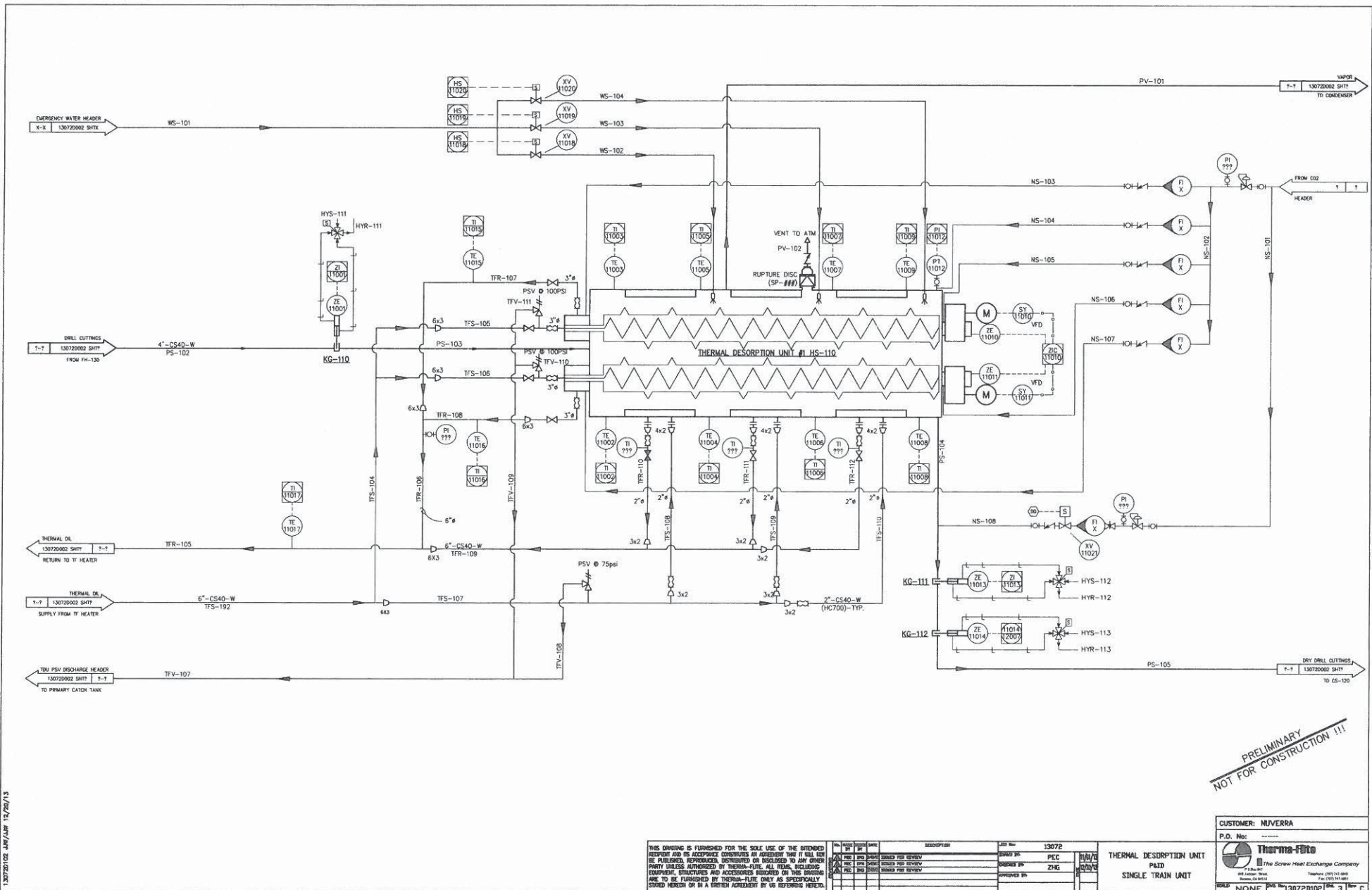
LDV TEMP TDU
PFD CHARTS
SINGLE TRAIN UNIT

CUSTOMER: NUVERRA
P.O. No: _____

Thermo-Flo
The Screw Heat Exchanger Company
7130 W. 14th St.
Brea, CA 92615
Tel: (951) 841-0881

REV: NONE DWG NO: 13084J101 SHEET 2 OF 8





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2	01/07/14	ISSUED FOR REVIEW	ZHG	
3		ISSUED FOR REVIEW		
4		ISSUED FOR REVIEW		

THERMAL DESORPTION UNIT
P&ID
SINGLE TRAIN UNIT

CUSTOMER: MIVERRA
P.O. No: 13072

 The Screw Heat Exchange Company
 11111 1/2 Ave. 107
 10000 S. 10th Street
 Brea, CA 92603
 Phone: (949) 541-8888
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