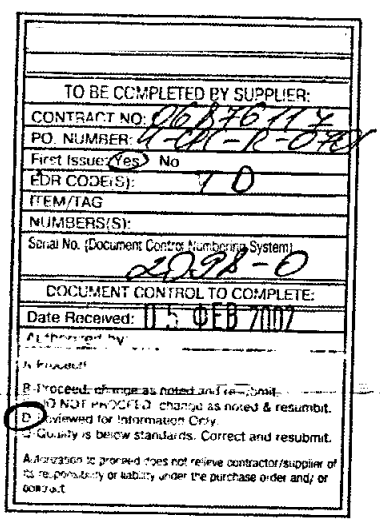
TECHNICAL APPENDIX

(3) TURBINE FUEL TOPPING PLANTS

VNIINEFTEMASH/ ECT SERVICE/ PETROFAC LLC - P-98070

FEBRUARY 1999



P-98070

TECHNICAL APPENDIX

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I. INTRODUCTION

I. INTRODUCTION

This Technical Proposal describes a Crude Topping Plant designed for diesel production. It describes one of three identical units to be supplied. Our goal is to provide a sound engineering design optimized to minimize operating costs and maximize flexibility of operations at an economical capital investment. The proposed design incorporates the most recent proven techniques from over forty years experience in the design, construction, and operation of gas and oil production equipment and refining processes. Emphasis has been placed on process design, material selection, and construction methods to ensure minimum downtime, and maximum plant life.

II. UNIT DESCRIPTION

(Revised 2/16/99)

II. UNIT DESCRIPTION

A. DESIGN BASIS

The design capacity of each of the crude oil distillation plants is 505 NCMD of 50.65°API Tengiz crude feed to produce 105 NCMD of turbine fuel. The unit is designed to fractionate the crude charge into naphtha, turbine fuel, and residue products. The turbine fuel product is sent to storage and the naphtha and residue products will be returned to the crude pipeline. The unit will be capable of operation at 50% of design capacity while producing specification product.

1. FEED AND PRODUCT CHARACTERISTICS

Crude Feed

Flowrate	505NCMD
Gravity	50.65°API
BL	ambient
Salt Content	40 mg/kg max

Naphtha Product

Flowrate	210 NCMD
Gravity	70.8°API
BL Temperature	49°C, max.
BL pressure	11 barg

Residue Product

Flowrate	190 NCMD
Gravity	32.0°API
BL Temperature	93°C, max.
BL Pressure	11 barg

Turbine Fuel

Turbine Fuel Output	105 NCMD
Gravity	47.2°API
Evaporation @ 250°C	100% vol., min.
Flash Point	41.7°C, min. (D-93 method)
BL Temperature	49°C, max.
BL Pressure	2.4 barg

A. DESIGN BASIS - continued -

2. UTILITY SPECIFICATIONS

Utilities are required at the battery limits of the plant at the following conditions:

a.	Electrical Power	380 volts, 3 phase, 50 hertz
b.	Utility Water	30 NCMD*

* Assumes Desalter included. Without Desalter usage is nil.

3. NORMAL OPERATING CONDITIONS

Ambient temperature, max.	40 °C
Ambient temperature, min.	-36 °C
Design wind velocity	4.6 m/s
Onstream Time	8,450 hr/yr

(Revised 2/16/99)

B. PROCESS DESCRIPTION

The following process description is for a crude oil distillation plant processing 50.65°API gravity Tengiz crude to produce 105 NCMD of turbine fuel. This process description should be read with reference to the Process Flow Diagram included in Section E.

Crude enters the plant through P-101 A/B, Crude Charge Pumps. Fresh water in the amount of 2 volume percent of the crude charge rate is injected to prevent salt deposition as the crude is heated. Crude is preheated in E-101, Crude/Cold Resid Exchanger, and E-102 A/B, Crude/Turbine Fuel Exchanger.

More fresh water in the amount of 4 volume percent of the crude charge rate is added to the crude at this point and passed through a globe valve where it is well mixed prior to entering the Desalter, V-102. Salts are removed from the crude electrostatically in the desalter to a maximum of 5 ptb. The desalted oil is then preheated further by exchange with residue in E-106, Crude/Intermediate Residue Exchanger, and E-103, Crude/Hot Residue Exchanger.

The preheated crude enters H-101, Crude Heater, where it is heated to vaporize the lighter fractions (naphtha and turbine fuel). The crude liquid/vapor mixture exits the heater and flows to T-101, Crude Tower. H-101 has combination burners capable of burning both fuel oil and gas.

The Crude Tower has twenty-two (22) fractionation trays. The lighter fractions (vapors) flow up the tower through the trays and condense as they are cooled. The cooling rate is controlled by the reflux to the top tray of the Crude Tower.

The naphtha vapors and any water vapor that is present exit the Crude Tower at the top and flow to AC-101, Overhead Condenser. At this point, the naphtha and water vapors are partially condensed. The partially condensed materials flow to V-101, Overhead Accumulator. Water is separated from the naphtha in the Overhead Accumulator and flows into a boot attached to the accumulator. The water is then dumped to a process drain by means of an interface level control on the boot. The naphtha is pumped back to the top of the Crude Tower by P-104 A/B, Reflux Pumps, and is used to control the tower top temperature. The accumulated naphtha is level controlled from the reflux pump discharge and is sent to storage.

Note: The description above assumes a Desalter is installed. If the crude contains 40 mg/kg (40 ppm) or less salt it is not mandatory that a Desalter be installed. However, the Crude Tower overhead system will require additional corrosion inhibitor injection and careful pH control to avoid excessive corrosion rates.

(Revised 2/16/99)

B. PROCESS DESCRIPTION - continued -

Turbine Fuel is drawn as a liquid from a chimney tray below tray number 11 and enters the top of T-102, Turbine Fuel Stripper. The Turbine Fuel Stripper is a vertical vessel, 30" ID x 19'-6" S/FF with six (6) trays. The vapor from the turbine fuel stripper returns to the Crude Tower between tray eight and tray nine. The Turbine Fuel Stripper is reboiled in a separate coil in the Crude Heater, H-101. Turbine Fuel is pumped from the bottom of the Turbine Fuel Stripper by P-103 A/B, Turbine Fuel Pumps, through the Turbine Fuel Reboiler where it is heated and returns to the turbine fuel stripper bottom. The end point of the turbine fuel is controlled by the turbine fuel reflux rate and the flash point is controlled by the reboiling of the turbine fuel and stripping action of the Turbine Fuel Stripper. The turbine fuel product is level controlled from the stripper through the turbine fuel pumps, E-102, Crude/Turbine Fuel Exchanger, and AC-102, Turbine Fuel Cooler. A portion of turbine fuel is returned to tray 10 as bottom reflux on flow control. The cooled turbine fuel is then sent to storage.

The residue product flows from the Crude Tower bottom through E-103, Crude/Hot Resid Exchanger to P-102 A/B, Residue Pumps, through E-106 and E-101, Crude/Cold Resid Exchanger.

A small amount of vapor is produced from the Overhead Accumulator and sent to the heater.

The residue product flows from the Crude Tower bottom through E-103, Crude/Hot Resid Exchanger and is then pumped by P-102 A/B, Residue Pumps through E-106, Crude/Intermediate Resid Exchanger, and E-101, Crude/Cold Resid Exchanger to battery limits.

An instrument air package provides both instrument air and air for fuel oil atomization for the H-101, Crude Heater.

(Revised 2/16/99

C. UTILITY SUMMARY

1. ELECTRICAL

a.	Connected load	127 kW
b.	Maximum normal load	75 kW

2. FUEL CONSUMPTION

Fuel Oil	3.3 NCMD *

* Based upon dual fuel firing of H-101, 50% of duty from off-gas from overhead accumulator, and 50% from firing residue (Tengiz crude).

3. UTILITY WATER CONSUMPTION

Desalter Water	10-30 NCMD**

** Based on salt content in the crude.

(Revised 2/16/99)

D. EQUIPMENT SUMMARY

VESSELS/HEATERS

ITEM NO.	DESCRIPTION
T-101	**Crude Tower** **Size:** 1219 mm ID x 18288 mm S/S w/2:1 S.E. Heads and 2438 mm skirt. **Design Pressure:** 5.3 barg @ 371°C **Material:** SA-516-70 **No. Trays:** 22 + chimney tray 2 - 18" (457 mm) Man-ways
T-102	**Turbine Fuel Stripper** **Size:** 762 mm OD x 5944 mm S/FF and 1829 mm skirt. **Design Pressure:** 5.3 barg @ 316°C **Material:** SA-516-70 **No. Trays:** 6 valve type (Cartridge) 1 - 18" (457 mm) Man-way (Top Flange)
V-101	**Overhead Accumulator** **Size:** 1219 mm ID x 2438 mm S/S w/324 mm OD x 762 mm Boot **Design Pressure:** 5.3 barg @ 121°C **Material:** SA-516-70 2 - Saddles and Supports 1 - 18" (457 mm) Man-way
V-102 (Optional)	**Desalter** **Size:** 1981 mm ID x 2438 mm S/S **Design Pressure:** 16.2 barg @ 149°C **Material:** SA-516-70 1 - 18" (457 mm) Man-way
H-101	**Crude Heater** **Duty:** 2.329 mm kcal/hr **Type:** Vertical cylinder type w/radiant and convection sections **Fuel:** Natural Gas (burner management system included) or Fuel Oil.

(Revised 2/16/99)

D. **EQUIPMENT SUMMARY - continued -**

SHELL AND TUBE HEAT EXCHANGERS

ITEM NO.	DESCRIPTION
41 PK X 001 ~~E~~-101	**Cold Resid/Crude Exchanger** **Type:** BEU **Duty:** 0.257mm kcal/hr **Size:** 330 mm ID x 6096 mm **Surface:** 53.1 m^2
E-102 A/B	**Turbine Fuel Product + Reflux/Crude** **Type:** BEU **Duty:** 0.469 mm kcal/hr **Size:** 330 mm ID x 6096 mm **Surface:** 106.1 m^2
E-103	**Hot Resid/Crude** **Type:** BEU **Duty:** 0.215 mm kcal/hr **Size:** 330 mm ID x 6096 mm **Surface:** 53.1 m^2
E-104 (Optional)	**Desalter Water Exchanger** **Type:** Double Pipe **Duty:** 0.04 mm kcal/hr **Size:** 60 mm OD x 4877 mm **Surface:** 2.4 m^2
E-106	**Intermediate Resid/Crude** **Type:** BEU **Duty:** 0.215 mm kcal/hr **Size:** 330 mm ID x 6096 mm **Surface:** 53.1 m^2

(Revised 2/16/99)

D. EQUIPMENT SUMMARY - continued -

AIR COOLERS

ITEM NO.	DESCRIPTION	
AC-101 *	**Overhead Condenser**	
	Duty: 1.821 mm kcal/hr	
	Design Air Temperature:	35°C
	Outlet Temperature:	49°C
AC-102 *	**Turbine Fuel Cooler**	
	Duty: 0.11 mm kcal/hr	
	Design Air Temperature:	35°C
	Outlet Temperature:	49°C

* Combined in same structure.

(Revised 2/16/99)

D. EQUIPMENT SUMMARY - continued -

PUMPS AND COMPRESSORS

ITEM NO.	DESCRIPTION
P-101 A/B	**Crude Charge Pumps** **Type:** Vertical In-Line Centrifugal **Duty:** 27.0 m^3/hr @ 11.0 bar ΔP **Motor:** 14.9 kW
P-102 A/B	**Residue Pumps** **Type:** Vertical In-Line Centrifugal **Duty:** 12.3 m^3/hr @ 12.0 bar ΔP **Motor:** 14.9 kW
P-103 A/B	**Turbine Fuel Pumps** **Type:** Vertical In-Line Centrifugal **Duty:** 15.0 m^3/hr @ 6.0 bar ΔP **Motor:** 7.5 kW
P-104 A/B	**Reflux Pumps** **Type:** Vertical In-Line Centrifugal **Duty:** 46.5 m^3/hr @ 13.0 bar ΔP **Motor:** 18.6 kW
P-105, P-106	**Inhibitor Pumps** **Type:** diaphragm **Duty:** 1.6 l/hr @ 20.6 bar ΔP **Motor:** 0.25 kW
P-107	**Demulsifier Pump** **Type:** diaphragm **Duty:** 1.6 l/hr @ 20.6 bar ΔP **Motor:** 0.25 kW
P-108 A/B (Optional)	**Desalter Water Pump** **Type:** centrifugal **Duty:** 2.1 m^3/hr @ 11.1 bar ΔP **Motor:** 2.2 kW
X-101 A/B	**Instrument Air Package** **Duty:** 128 NCMH @ 8.6 barg supply **Motor:** 11.2 kW

E. FLOW DIAGRAM

F. MATERIAL BALANCE

Hyprotech's Process Simulation HYSIM – Licensed to Petrofac LLC

Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Stream	P-101_DIS	CRUDE+E-102	CRUDE+E-103	CRUDE-E-103
Description	1	2	3	4
Vapour frac.	0.0000	0.0000	0.0000	0.0000
Temperature °C	32.5768	64.4615	117.3236	161.3825
Pressure kg/cm2	12.3037	11.2491	10.5460	9.4914
Molar Flow kgmole/h	120.2145	120.2145	120.2145	120.2145
Mass Flow kg/h	16419.9473	16419.9473	16419.9473	16419.9473
LiqVol Flow m3/h	21.0659	21.0659	21.0659	21.0659
Enthalpy kcal/h	-417705.2341	-160803.2262	307159.3986	737436.0266
Density kg/m3	767.4037	741.0085	694.5753	651.2234
Mole Wt.	136.5887	136.5887	136.5887	136.5887
Spec. Heat kcal/kg-C	0.4736	0.5095	0.5695	0.6213
Therm Cond kcal/m-hr-C	0.1088	0.1018	0.0892	0.0763
Viscosity cP	2.6075	1.5941	0.8485	0.5556
Z Factor	0.0845	0.0724	0.0626	0.0540
Sur Tension dyne/cm	21.5982	18.5932	13.8423	10.1663
Std Density kg/m3	779.9028	779.9028	779.9028	779.9028

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Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Stream	H-101_OUT	T-101_BTMS	T-101_OHV	REFLUX
Description	5	6	7	8
Vapour frac.	0.8832	0.0000	1.0000	0.0000
Temperature °C	243.3333	236.6203	113.3378	43.333
Pressure kg/cm2	1.4061	1.8069	1.6663	1.4554
Molar Flow kgmole/h	120.2145	26.6988	179.4470	110.3673
Mass Flow kg/h	16419.9473	6917.4658	15722.8027	9669.9541
LiqVol Flow m3/h	21.0659	8.0153	22.5494	13.8685
Enthalpy kcal/h	2.33247E+06	633031.0588	1.47260E+06	-205253.0741
Density kg/m3	5.1018	689.9076	4.6934	667.0587
Mole Wt.	136.5887	259.0921	87.6203	87.6203
Spec. Heat kcal/kg-C	0.6101	0.6596	0.4768	0.5165
Therm Cond kcal/m-hr-C	---	---	0.0169	0.0959
Viscosity cP	---	---	0.0078	0.5959
Z Factor	---	---	0.9493	0.0071
Sur Tension dyne/cm	---	---	---	16.8203
Std Density kg/m3	---	---	---	693.1212

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Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Stream	NAPHTHA	GAS	JET+E-102	JET-E-102
Description	9	10	11	12
Vapour frac.	0.0000	0.0000	0.0000	0.0000
Temperature °C	43.3333	43.3333	191.5735	82.2222
Pressure kg/cm2	1.4554	1.4554	6.6792	6.3979
Molar Flow kgmole/h	69.0797	0.0000	51.9566	51.9566
Mass Flow kg/h	6052.8491	0.0000	7337.7822	7337.7822
LiqVol Flow m3/h	8.6809	0.0000	9.2941	9.2941
Enthalpy kcal/h	-128469.3416	-0.0000	409373.4998	-58589.1329
Density kg/m3	667.0587	621.6101	638.6028	729.6127
Mole Wt.	87.6203	75.5973	141.2291	141.2291
Spec. Heat kcal/kg-C	0.5165	0.5437	0.6466	0.5213
Therm Cond kcal/m-hr-C	0.0959	0.0877	0.0849	0.1084
Viscosity cP	0.5959	0.3238	0.5301	1.2577
Z Factor	0.0071	0.0066	0.0375	0.0411
Sur Tension dyne/cm	16.8203	13.7857	11.1439	20.4939
Std Density kg/m3	693.1212	650.1137	778.0714	778.0714

Hyprotech's Process Simulation HYSIM – Licensed to Petrofac LLC

Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Stream	AC-102_IN	JET_RFLX	COOL_JET	RESID+E-101
Description	13	14	15	16
Vapour frac.	0.0000	0.0000	0.0000	0.0000
Temperature °C	82.2222	82.2222	43.3333	135.0000
Pressure kg/cm2	6.3979	6.3979	6.0464	6.6792
Molar Flow kgmole/h	24.4415	27.5151	51.9566	26.6988
Mass Flow kg/h	345108438	3885.9385	7337.7822	6917.4604
LiqVol Flow m3/h	4.3722	4.9220	9.2941	8.0153
Enthalpy kcal/h	-27561.5339	-31027.5990	-201179.8218	204501.4491
Density kg/m3	729.6127	729.6127	758.4432	768.6734
Mole Wt.	141.2291	141.2291	141.2291	259.0921
Spec. Heat kcal/kg-C	0.5213	0.5213	0.4777	0.5613
Therm Cond kcal/m-hr-C	0.1084	0.1084	0.1161	0.1113
Viscosity cP	1.2577	1.2577	1.9386	2.5528
Z Factor	0.0411	0.0411	0.0420	0.0651
Sur Tension dyne/cm	20.4939	20.4939	24.0468	20.0853
Std Density kg/m3	778.0714	778.0714	778.0714	850.7978

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Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Stream	RESID-E-101
Description	17
Vapour frac.	0.0000
Temperature °C	64.4444
Pressure kg/cm2	5.9761
Molar Flow kgmole/h	26.6988
Mass Flow kg/h	6917.4604
LiqVol Flow m3/h	8.0153
Enthalpy kcal/h	-52400.5616
Density kg/m3	818.0110
Mole Wt.	259.0921
Spec. Heat kcal/kg-C	0.4904
Therm Cond kcal/m-hr-C	0.1238
Viscosity cP	8.4695
Z Factor	0.0661
Sur Tension dyne/cm	25.4566
Std Density kg/m3	850.7978

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Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Column T-101

**** Stage Variables ****

Reflux Ratio	1.59768
Reflux Subcooled to	43.33 °C

Stg No	Pressure kg/cm2	Temp °C	Flow Rates (m3/h)				Duty kcal/h
			Liquid	Vapour	Feed	Draws	
1	1.5	43.3	13.9			0.0 V	-1.8E+06
						8.7 L	
2	1.7	113.3	16.6	22.5			
3	1.7	133.0	17.5	25.2			
4	1.7	141.2	17.7	26.1			
5	1.7	145.8	17.7	26.4			
6	1.7	149.2	17.7	26.4			
7	1.7	152.2	17.5	26.3			
8	1.7	155.4	17.2	26.2			
9	1.7	159.7	16.4	25.8	5.1 S		
10	1.7	165.2	0.0	19.9		14.4 S	
11	1.8	185.6	6.7	18.0	4.9 P		-2.4E+05
12	1.8	202.3	6.4	19.8			
13	1.8	210.9	6.2	19.5			
14	1.8	215.6	6.0	19.3			
15	1.8	219.0	5.5	19.0			
16	1.8	223.1	3.8	18.6			
17	1.8	236.6		16.9	21.1	8.0 L	
Side Stripper		1 draws	14.4	From stg 10 vapour return to stg 9			
18	1.7	176.3	15.5	5.1			
19	1.7	183.1	16.0	6.2		4.4 L	4.1E+-05
20	1.7	191.5		6.7		4.9 P	

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Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Column T-101

**** Stage Variables ****

Reflux Ratio 1.59768

Reflux Subcooled to 43.33 °C

Stg No	Pressure kg/cm2	Temp °C	Flow Rates (kg/h)				Duty kcal/h
			Liquid	Vapour	Feed	Draws	
1	1.5	43.3	9670.4			0.0 V	-1.8E+06
						6052.8 L	
2	1.7	113.3	12235.4	15723.2			
3	1.7	133.0	13115.6	18288.2			
4	1.7	141.2	13396.3	19168.4			
5	1.7	145.8	13468.6	19449.1			
6	1.7	149.2	13456.9	19521.4			
7	1.7	152.2	13374.4	19509.7			
8	1.7	155.4	13167.4	19427.1			
9	1.7	159.7	12628.9	19220.2	3901.0 S		
10	1.7	165.2	0.0	14780.6		11236.8 S	
11	1.8	185.6	5359.3	13388.6	3886.1 P		-2.4E+05
12	1.8	202.3	5199.7	14861.8			
13	1.8	210.9	5060.6	14702.2			
14	1.8	215.6	4872.5	14563.1			
15	1.8	219.0	4538.0	14375.0			
16	1.8	223.1	3164.7	14040.5			
17	1.8	236.6		12667.2	16419.9	6917.5 L	
Side Stripper		1 draws	11236.8	From stg 10 vapour return to stg 9			
18	1.7	176.3	12121.0	3901.0			
19	1.7	183.1	12542.0	4785.2		3449.7 L	4.1E+-05
20	1.7	191.5		5206.2		3886.1 P	

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Date 1999/02/16 Version STD | C2.70 Case Name CPCDTUX2.SIM

Column T-101

**** Stage Variables ****

Reflux Ratio 1.59768

Reflux Subcooled to 43.33 °C

Stg No	Pressure kg/cm2	Temp °C	Flow Rates (kgmole/h)				Duty kcal/h
			Liquid	Vapour	Feed	Draws	
1	1.5	43.3	110.4			0.0 V	-1.8E+06
						69.1 L	
2	1.7	113.3	118.4	179.4			
3	1.7	133.0	119.3	187.5			
4	1.7	141.2	118.4	188.4			
5	1.7	145.8	116.7	187.4			
6	1.7	149.2	114.8	185.8			
7	1.7	152.2	112.4	183.9			
8	1.7	155.4	108.7	181.5			
9	1.7	159.7	101.3	177.8	33.0 S		
10	1.7	165.2	0.0	137.4		85.0 S	
11	1.8	185.6	34.9	121.0	27.5 P		-2.4E+05
12	1.8	202.3	31.2	128.4			
13	1.8	210.9	29.1	124.7			
14	1.8	215.6	27.3	122.6			
15	1.8	219.0	24.8	120.8			
16	1.8	223.1	16.5	118.3			
17	1.8	236.6		110.1	120.2	26.7 L	
Side Stripper		1 draws	85.0	From stg 10 vapour return to stg 9			
18	1.7	176.3	90.5	33.0			
19	1.7	183.1	92.2	38.6		24.4 L	4.1E+-05
20	1.7	191.5		40.3		27.5 P	

III. PROJECT SUPPLY

III. PROJECT SUPPLY

A. SCOPE OF PROJECT

Contractor will provide the engineering, shop fabrication, and field services summarized below for the Crude Topping Unit. Detailed definition of equipment and services provided are found throughout the proposal.

1. ENGINEERING

Contractor has used in-house expertise in the design of the Crude Topping Unit and no third party licenses and/or fees are applicable. All work will be accomplished at our Tyler, Texas office.

The project deliverables are as follows:

a. Quality Plan
b. Project Design Manual
c. Process Flow Diagrams
d. Utility Flow Diagrams
e. Piping and Instrumentation Diagrams
f. Plot Plan
g. Vessel Assembly and Detail Drawings
h. Structural Drawings
i. Foundation Loadings
j. Piping Plans and Elevation Drawings
k. Cable and Conduit Schedules/Drawings
l. Electrical One-Line Drawings
m. Marshalling and PLC Layout/Detail Drawings
n. Junction Box Details/Drawings
o. Instrument Piping Plan Drawings
p. Instrument Location Plan Drawings
q. Equipment and Instrument Specification Sheets
r. Operating and Maintenance Manual
s. Spare Parts list for two years worth of operation
t. PLC configuration programming

Contractor has a complete set of engineering specifications and details which will be used on this project. This information allows Contractor to initiate work more readily with extreme accuracy. These details are followed and understood by all appropriate personnel and have been utilized on numerous jobs.

2. SHOP FABRICATION

Contractor will furnish materials, construction equipment, labor and supervision to shop fabricate equipment and modules and make it ready for shipment. In general, the shop fabrication of the unit will consist of the following:

a. Construct vessels and modules.
b. Install equipment, instrumentation, piping and electrical equipment on modules.
c. Fabricate platforms and ladders as required.
d. Install control and instrumentation wiring, and tubing on modules from users to module junction boxes.
e. Pressure test piping and vessels.
f. Calibrate and check controls, instruments and safety devices to extent possible.
g. Prime and finish coat on furnished equipment and modules.
h. Prepare modules and equipment for shipment.
i. Provide insulation and winterization protection as required.
j. Provide module lighting with related conduit and wire to module junction boxes.
k. Provide MCC.
l. Provide Allen Bradley PLC-5 with RS View Control software.
m. Provide Allen Bradley PLC-5 based ESD System.
n. Provide SCADA interface with control system.

Fabrication of equipment and modules will be done by Contractor in JSC "Dzerzhinskchemmash" shop and Petrofac shop in Tyler, Texas, USA.

3. SHIPPING AND TRANSPORTING TO SITE

a. Delivery of parts and materials supplied by Petrofac CIF Russian Port is included. In land transportation of the above items to JSC "Dzerzhinskchemmash" shop is not included.
b. Transportation of the complete modules from JSC "Dzerzhinskchemmash" shop to the job site will be done by the Customer.

4. FIELD SERVICES

Petrofac will provide adequate personnel for commissioning and start-up assistance on a rate sheet basis.

5. START-UP SPARE PARTS

Start-up spare parts will be provided by Petrofac and are included in the sales price.

B. GENERAL MECHANICAL DESCRIPTION

1. INSTRUMENT SUMMARY

Local control loops will be pneumatic; instrumentation for remote signals will be electronic and controlled by control panels as defined by client specifications. Provisions will be made to allow remote hook up for client provided control panels. The instruments Petrofac LLC proposes to supply are listed below.

The unit will be so instrumented as to facilitate automatic operation and will be supplied with all instrumentation necessary to control the unit as shown on the project P&ID's.

Petrofac LLC will define and procure, all required controls and instrumentation within the battery limits for the safe, stable, reliable, and economic operation of the process. Petrofac LLC will prepare specifications and installation drawings and perform necessary calculations for the design, procurement and installation of the skid's limit instrumentation.

Petrofac LLC will supply all necessary electronic transmission equipment including locally mounted instrumentation (I/P transducers and transmitters) necessary for interface with the Process Control Room. On modules where more than three (3) instruments with compatible output signals are located Petrofac LLC will install conduit and wiring from those instruments to module junction boxes. On modules with three (3) or fewer instruments, conduit only will be installed and routed to the module edge for field installation of wiring by others.

Local instrument tubing that may be required to run between the modules that are being furnished will be brought to a bulkhead panel at the edge of each module. There shall be a separate junction box for each signal level. Carbon steel tubing, plastic tubing, and plastic raceways will not be used. Instrumentation tubing will be stainless steel for tubing handling process fluids. Tubing in other areas will also be stainless steel.

Tubing containing liquid or gases that can condense moisture will be sloped to permit draining and will be piped at the instrument to remove entrapped air or gas.

An instrument air header will be furnished with each module. This header size will be a minimum of one inch. Each low pressure pneumatic instrument will have its own filter regulator near the instrument. Each high pressure instrument will use a filter only. Each air supply connection will have a shut-off valve and be identified.

1. **INSTRUMENT SUMMARY - continued -**

Local controllers will be mounted at convenient locations for maintenance.

Flow, pressure, temperature and level transmitters that are required to bring signals from the instrumentation to the control room will be electronic.

Instruments including pressure indicators, local controllers, and sample connections, etc. will have process block and bleed valves. Valves will be 1/2" inch barstock needle valves or globe valves. Either will be furnished with threaded ends. If required, the tubing block and bleed valve will be furnished at the instrument when it is not close to the pipe or vessel process connection.

Locally mounted thermometers will be adjustable angle bimetallic type with five (5) inch dial and SS well and will cover the complete operating temperature range. Thermowells will be provided for all temperature indicators.

Instruments will be purchased in manufacturer standard enclosures rated for weather proof conditions.

Transmitters will be provided by Petrofac LLC for electronic transmission of signals from remotely controlled instrumentation provided in the Unit to the control room or controlling PLC. I/P transducers will be provided by Petrofac LLC for electronic signals from the control room or controlling PLC to the control valves. Transducers and transmitters will be wired to a junction box at the edge of the modules.

Relief valves will be direct spring loaded full nozzle type except large valves (3" x 4" or larger) may be pilot operated. All relief valves will have carbon steel body with SS trim or material of construction appropriate for the media in contact.

The relief valve vent header will be sized to limit built-up back pressure at the discharge of the safety relief valves connected to the header to ten percent (10%) of the set pressure when the safety relief valve is flowing and to limit the superimposed back pressure at the discharge of the safety relief valve to five percent (5%) of the set pressure when the safety relief valve is not flowing.

1. **INSTRUMENT SUMMARY - continued -**

The instrument, control valve, and safety relief valve types that will be supplied by Petrofac LLC are listed below:

ITEM NO.	DESCRIPTION
Relief Valves	CROSBY (Conventional Type) carbon steel body, RF flange inlet and outlet, (except NPT for inlet size ¾"), 316 stainless steel trim, stainless steel spring.
Control Valves (Globe)	Fisher carbon steel body, type CP, RF flange connections, stainless steel trim, diaphragm actuator, 3582 positioner, 846 I/P.
Control Valves (Ball)	WKM floating ball valve, carbon steel body, stainless steel ball, Rotork pneumatic piston spring return actuator with Westlock limit switch.
Pressure Regulator	Fisher carbon steel body, stainless steel trim.
Electronic Flow Transmitters	Rosemount Model 1151DP*S52B3M1, SMART, carbon steel body, 316 SS diaphragm, 4-20 Ma output.
Electronic Pressure Transmitters	Rosemount Model 1151GP*S52B3M1, SMART, carbon steel body, 316 SS diaphragm, 4-20 Ma output.
Electronic Temp. Transmitters	Rosemount Model 3144D1E5B4M5, SMART, programmable input, 4-20 Ma output.
I/P Transducer	Fisher Model 846, 4-20 Ma input, 3-15 PSIg output, 2" pipe mounting.
Pneumatic Level Transmitter (Throttling)	Fisher Model 2500-249B, carbon steel cage, stainless steel displacer, 3-15 psig output.
Electronic Level Transmitter (Throttling)	Fisher Model 2390-249B, carbon steel cage, stainless steel displacer, 4-20 ma output.

1. INSTRUMENT SUMMARY - continued -

The instrument, control valve, and safety relief valve types that will be supplied by Petrofac LLC are listed below:

ITEM NO.	DESCRIPTION
Solenoid Valve	Asco model 8320G200, SS body, NEMA 4X coil enclosure.
Level Gauge	K-TEK Series KM26S, stainless steel chamber.
Level Switch	Magnetrol, steel head, stainless steel float, hermetically sealed snap switch, NEMA 7 enclosure.
Pressure Gauge	Ashcroft 1279SS or equal, 4-1/2" dial, phenolic case, stainless steel tube and socket.
Temperature Indicator	Ashcroft 50EI60E or equal, 5" dial, adjustable angle, stainless steel well, 3/4" NPT or 1 1/2" RF Flange, process connection, as required.
Pressure Switch	NEO-DYN model 132P5*CC6G, stainless steel welded diaphragm, DPDT hermetically sealed switch.
Flow Indicators	Orange Research model 1516DG, 316 SS body, 4.5" dial.

Instrument Vendor selections indicated in this proposal are preliminary. PetroFac reserves the right to substitute equipment of equal or better quality for either technical or commercial reasons with client approval.

2. CONTROL SYSTEMS

a. Overview

The Control System for each Crude Topping Plant shall consist of a redundant Emergency Shut Down (ESD) Programmable Logic Controller (PLC) and a simplex Control PLC. A redundant ControlNet Communication Link shall interconnect the PLC, I/O, and Workstations. The ESD and Control Communication Network shall be separate. The Human-Machine Interface (HMI) shall consist of two (2) Industrial Workstations running Windows NT based RSView software. Development tools shall be available on one (1) of the workstations and runtime (operator tools) shall be available on both workstations. The PLC's and HMI Software shall be manufactured by Rockwell / Allen-Bradley. Each of the ESD PLC's shall have an Ethernet Connection to interface with the redundant SCADA Ethernet Connection specified. Reference drawing "System Network Overview" for a graphical representation of the system.

b. General

1) All analog and digital signals for the control system shall be 24Vdc.

2) Input power to all AC devices in control system shall be 220Vac.

c. ESD PLC System

1) The PLC, Power Supply, and Communication shall be dual redundant. This scope of supply **DOES NOT** include redundant I/O Modules or the detection of hardware failures on I/O Modules.

2) Allen-Bradley PLC5/40C shall be used since it is a redundant system (SLC's and PLC5/20s can not be redundant).

3) I/O Modules shall be Flex I/O. Flex I/O has many advantages over PLC 5 I/O Modules, such as size, cost, and the ability to replace modules while the system is powered.

4) Communication between I/O, Control PLC, and the Workstations shall be redundant ControlNet. It is strongly recommended that the network cabling to field control panels be in rigid conduit. Two separate paths should be taken to each panel. As per section 2.3.3 and 2.3.4 of Attachment "C" of the RFQ, the conduit and network cable is to be supplied, installed, and engineered by purchaser. Petrofac LLC shall recommend the network cable type to be used by purchaser.

2. CONTROL SYSTEMS - controls -

5) The ESD PLC System shall have a dedicated control network (Control Net) to the Flex I/O and the Workstations.

6) External Watchdog Timers shall be provided to "Watch" ESD PLC System.

7) The ESD PLC shall be located in the Main Control Panel.

8) The ESD System shall be designed to perform the following functions in a safe and timely manner:

- Stop All Motors
- Close the Crude Feed Valve
- Close the Diesel Product Valve
- Close the Resid Product Valve
- Block and Bleed Fuel Line
- Sound Audible Alarm and Start Rotation Beacon
- The Shutdown Sequence shall include Time Delays to allow heater cooling.

d. Control PLC System

1) The Control PLC shall be simplex (non-redundant).

2) Allen-Bradley PLC5/40C shall be used to keep spare parts to a minimum.

3) I/O Modules shall be Flex I/O. Flex I/O has many advantages over PLC 5 I/O Modules, such as size, cost, and the ability to replace modules while the system is powered.

4) All Proportional Integral Derivative (PID) Control shall be performed by the Control PLC. All sequence control for the heater and instrument air system shall be performed by the Control PLC. All indication and alarm logic shall be performed by the Control PLC.

e. Workstations

1) Two (2) Industrial Workstations shall be provided for the Human-Machine Interface (HMI). One station shall be for Engineering / Operation and the other for Operation only. The operator shall be able to control and monitor the plant from either Workstation. Engineering and Development (graphics building, database modifications, PLC programming, etc.) shall be available on only one Workstation.

2. CONTROL SYSTEMS - controls -

2) Rockwell (owners of Allen-Bradley) Software shall supply the HMI package RSView. A 300 point runtime license shall be provided for each workstation.

3) Each Workstation shall have the following minimum specifications:

- 20" Color Monitor
- Pentium II 400MHz Processor
- 64 MB RAM
- 4 GB Hard Drive
- 1.44MB Floppy
- CDROM
- Zip Drive
- Windows NT 4.0 Operating System
- Redundant ControlNet PC Card

f. Main Control Panel

1) The Main Control Panel (MCP) shall be located in the Local Control Center Building.

2) The ESD and Control PLC shall be located in the MCP.

3) ESD and Control Signals shall be segregated in the MCP.

4) Bypass key switches for shutdown signals shall be provided and mounted on the MCP.

5) A Plant ESD Pushbutton, an ESD Reset Pushbutton, and a ESD Reset Lamp shall be on the MCP.

6) The Control Panel shall be NEMA 12.

2. CONTROL SYSTEMS - controls -

g. **Heater Control Panel**

1) The Heater Control Panel (HCP) shall be NEMA 4.

2) ESD and Control Signals shall be segragated in the HCP.

3) The HCP shall be located near the process heater in the field.

4) All the pushbuttons and pilot lights necessary for local start up and control shall be provided on the HCP. A first in – first out alarm sequence shall be provided with shutdown alarm indications, with an alarm acknowledge and reset pushbutton.

5) The HCP shall have a power on/off switch accessible from the front of panel.

6) The HCP shall be designed for a Class 1 Division 2, Group D environment.

7) The HCP shall be designed for an outside ambient temperature of – 37°C.

h. **Instrument Air Control Panel**

1) The Instrument Air Control Panel (IACP) shall be NEMA 4.

2) All the pushbuttons and pilot lights necessary for local start up and control shall be provided on the IACP.

3) The IACP shall be located near the Instrument Air Compressors in the field.

4) The IACP shall have a power on/off switch accessible from the front of panel.

5) The IACP shall be designed for a Class 1 Division 2, Group D environment

6) The HCP shall be designed for an outside ambient temperature of – 37°C.

2. CONTROL SYSTEMS - controls -

i. MCC Interface Panel

1) The MCC Interface Panel (MIP) shall be NEMA 12.

2) The MIP shall be located near the MCC equipment in the MCC Building.

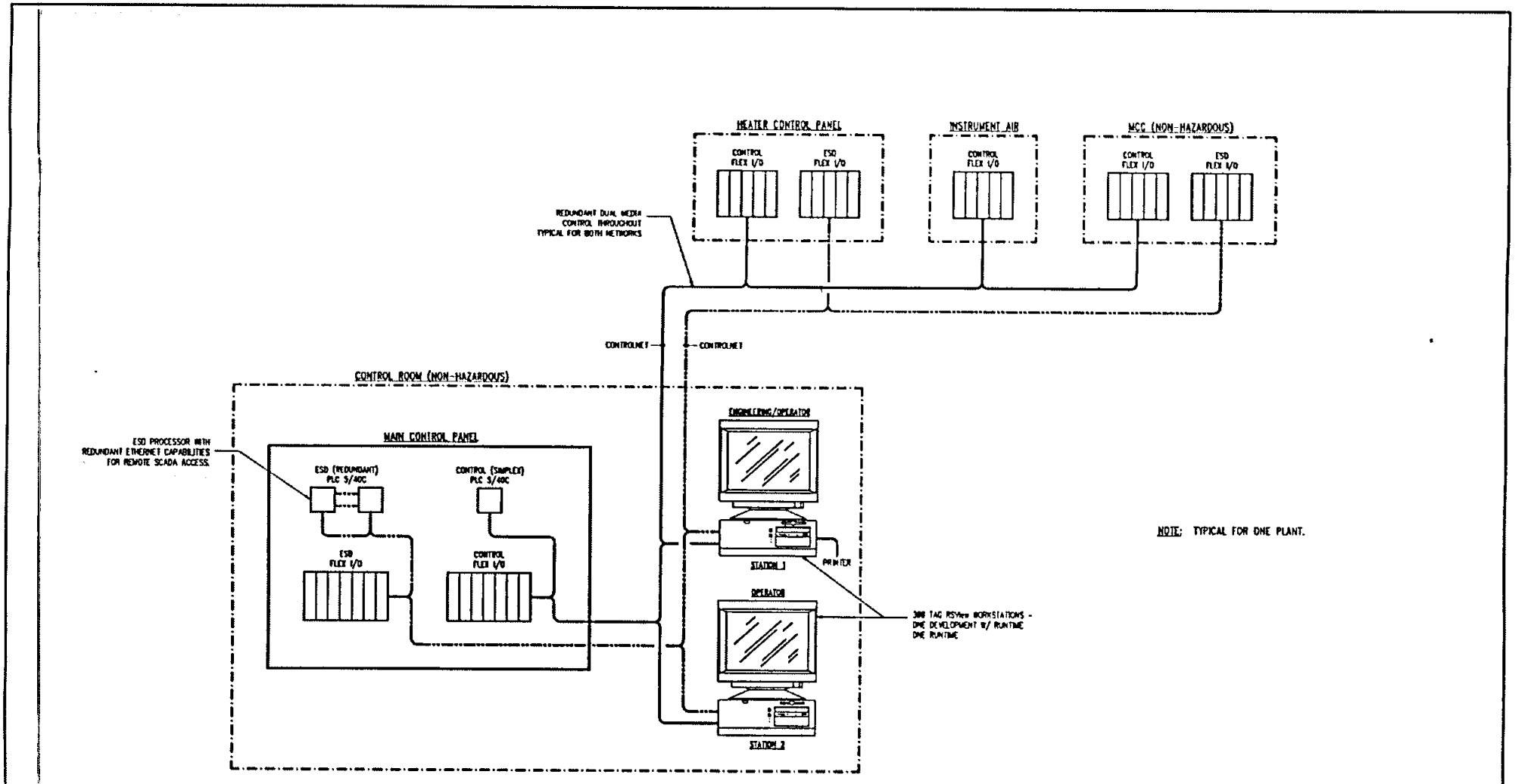
3) The MIP shall have a power on/off switch accessible from the front of panel.

4) Motor Statuses shall interface with the Control Flex I/O Digital Input module(s) and the Motor Shutdown signals shall interface with the ESD Flex I/O Digital Output module(s) contained within this panel.

j. Documentation

1) The following documentation shall be supplied with the Control System:

- Control System Layout (Overview)
- Control Panel Layouts (for each panel)
- Schematics
- Interconnection Diagrams
- Logic Diagrams
- Function Diagrams



NOTE: TYPICAL FOR ONE PLANT.

NOTES

DRAWING ISSUED
- ☐ PRELIMINARY
- ☐ FOR ENGINEERING
- ☐ FOR DESIGN
- ☐ FOR CONSTRUCTION
- ☐ FOR APPROVAL
- ■ FOR INFORMATION
- ☐ REVISED DESTROY ALL PREVIOUS COPIES OF THIS REVIEW THIS ISSUE FOR CHANGES

NO.	REVISION	CK'D	APP'D	APP'D	DATE
A	ISSUED FOR INFORMATION				

DESIGNER: JDA PLOTDATE: 1-11-99 DWG. INCHES

PETROFAC

CONTROL SYSTEMS: LAYOUT

SYSTEM NETWORK OVERVIEW

3. PIPING AND VALVES

Piping and valves will be designed and fabricated in accordance with the applicable sections of Petrofac Engineering Standards and with all applicable GOST and standards.

PIPING

Piping will be designed and fabricated in accordance with the applicable sections of the following codes, latest edition and addenda:

ASME Power Boiler Code, Section I
ANSI Power Piping B31.1
ANSI Chemical Plant and Petroleum Refinery Piping B31.3, 1993.

Process piping welds will be a minimum of ten percent (10%) spot radiographed.

Equipment spacing will be as close as is practical to allow accessibility and yet minimize hydraulic and heat losses and the lengths of off-module piping that must be field erected.

Piping for modular equipment will be installed between pieces of equipment and/or from equipment to module edge. Termination at module edge will be with a standard pipe fitting or butt weld bevel in accordance with the piping specifications. Some module piping and equipment may be dismantled for shipping because of height limitations; however, this will be minimized.

Interconnecting piping (except threaded piping and socket weld piping 2" and smaller) between modules, and other off-module equipment will be supplied prefabricated (to the greatest extent possible). Some field welds will be required to ensure proper fitting. Interconnecting threaded and socket weld piping 2" and smaller will be supplied as straight lengths of pipe along with loose fittings for fabrication and installation in the field.

Piping on modules will be adequately supported with provisions made in the design for expansion and contraction. Piping connections will be designed to withstand loads imposed on them by connecting piping and insulation.

VALVES

Valves for on-module piping will be supplied and installed in accordance with the specifications referenced above. Valves for interconnecting piping within the battery limits or off-module items within the battery limits furnished by Petrofac will be supplied in accordance with the specifications referenced above.

Bolts and gaskets along with construction spares for piping will be furnished. Safety relief valves will be piped so as to be free draining back to the source.

Manual control and operating valves will be readily accessible for operators from the operating area. Handles and chain wheels may be used.

Contractor will furnish material certification papers and certified vendor prints for valves falling within the jurisdiction of the ASME Power Boiler Code and provide proper ASME Stamping for the piping. Petrofac has the appropriate stamps (Section 1 and 8) to do all shop piping work as coded work.

C. PROJECT SCHEDULE

4. ELECTRICAL

Petrofac will provide electrical design, equipment, and materials within the module limits.

All electrical equipment and systems will be designed and provided in accordance with the latest editions of applicable standards from the National Electrical Code (NEC), American Petroleum Institute (API) Standards RP-500 and RP-540, the National Electrical Manufacturers Association (NEMA), and Petrofac LLC Engineering Standards. The requirements of the Russian Standards referenced in the GENERAL REQUIREMENTS document will be met as a minimum.

Petrofac will provide and install electrical materials on the modules as follows.

a. Junction boxes for connection of instrument signals; on each module, there will be a separate junction box for each instrument type, analog, digital, thermocouple, and RTD; modules that do not have a particular type of instrument will not include a junction box for that type of instrument; where any number of instruments of a particular type are on a module, a junction box will be provided;

b. Conduit and wire from the instrumentation junction boxes to individual instruments;

c. Conduit and wire from motor connection boxes to module edge for field-routed cable;

d. Conduit and wire from motor control stations to module edge for field-routed cable;

e. Tray from instrumentation junction boxes to module edge;

f. Lighting junction boxes and 70 watt high pressure sodium light fixtures;

g. Conduit and wire from lighting junction boxes to light fixture locations;

h. Motor control stations for module-mounted motors.

i. Cable tray to be heavy duty hot dipped galvanized ladder type.

Instrument cable shall be as follows:
Stranded copper, minimum 16 AWG, 600V, non-armored, low temperature insulation and jacket material.

Instrument wire shall be as follows:
Stranded copper, minimum 16 AWG, 600V, low temperature insulation.

ESD cable shall be as follows:
Stranded copper, minimum 16 AWG, 600V, non-armored, type 'FR" cable in accordance with UL VW-1, IEEE-383 and ICEA-210,000 BTU/hour test.

4. ELECTRICAL - continued -

Power/Control cable shall be as follows:
Stranded copper, 600V, non armored, low temperature insulation and jacket material.

Power/Control wire shall be as follows:
Stranded copper, 600V, non-armored, low temperature insulation.

Before shipment, Petrofac will test insulation on wiring by using a mega-ohm meter, and will test wiring continuity with either an ohm meter or by impressing a voltage on the circuit and verifying that it functions properly.

Petrofac will provide materials for installation by others off of modules as follows:

a. Light fixtures for equipment installed on modules; (in order to avoid shipping damage, light fixtures will be shipped loose for installation in the field; the wiring will be installed by Petrofac on the modules, but will not have to be terminated in the field when the light fixtures are installed).

b. Motor control stations for motors that are not installed on modules.

c. Power and control cables from motor control center to motors and control stations

d. Motor Control Center

e. *Main - Tie – Main switch gear.

f. *2 each - 300 kVA, 10 kV-380/220v, 3ph substation transformer with close coupled non-load break primary isolation switch.

g. *One prefabricated electrical building complete with the above motor control center and associated electrical equipment;

NOTE: The items marked with an * may be included as an option at an additional cost.

Contractor is not providing:

a. Off module area lighting materials.

PETROFAC LLC

JOB/PROPOSAL NO.: P-98070	SCOPE OF SUPPLY ELECTRICAL, SHEET 1 OF 3	PROVIDED BY: PETROFAC (P) PETROFAC SUBCONTRACT (S) OTHERS (O) NOT APPLICABLE (-)
CLIENT:	DATE JANUARY 1999 REV. # A	

ITEM DESCRIPTION	MODULE			FIELD			REMARKS
	ENGR/ DESIGN	MAT'L	LABOR	ENGR/ DESIGN	MAT'L	LABOR	
* MCC Building	P	P	P	-	-	-	OPTIONAL EQUIPMENT
Control Room Building	-	-	-	-	-	-	
* Building HVAC/Pressurization	P	P	P	-	-	-	OPTIONAL EQUIPMENT
Electrical Generator	-	-	-	-	-	-	
* Substation Transformer	P	P	P	-	-	-	OPTIONAL EQUIPMENT
HV Switchgear	-	-	-	-	-	-	
MV Switchgear	-	-	-	-	-	-	
LV Switchgear	-	-	-	-	-	-	
Motor Starters in MCC	P	P	P	-	-	-	
Motor Starters in Switchrack	-	-	-	-	-	-	
Lighting Contactors	P	P	P	-	-	-	
Lighting and Distribution Transformers	P	P	P	-	-	-	
Lighting and Distribution Panelboards	P	P	P	-	-	-	
UPS and Panelboards for Instruments	-	-	-	-	-	-	
Panelboards for Emergency Lighting	P	P	P	-	-	-	
Motor Control Stations	P	P	P	-	-	-	
Welding Receptacles	-	-	-	-	-	-	
Convenience Receptacles	-	-	-	-	-	-	
Light Fixtures	P	P	P	-	-	-	
Flood Light Fixtures	-	-	-	-	-	-	
Electric Heat Tracing	P	P	P	-	-	-	

PETROFAC LLC

JOB/PROPOSAL NO.: P-98070	SCOPE OF SUPPLY ELECTRICAL, SHEET 2 OF 3	PROVIDED BY: PETROFAC (P) PETROFAC SUBCONTRACT (S) OTHERS (O) NOT APPLICABLE (-)
CLIENT:	DATE JANUARY 1999 REV. # A	

ITEM DESCRIPTION	MODULE			FIELD			REMARKS
	ENGR/ DESIGN	MAT'L	LABOR	ENGR/ DESIGN	MAT'L	LABOR	
Instrumentation Junction Boxes	P	P	P	-	-	-	
Lighting Junction Boxes	P	P	P	-	-	-	
Motor Junction Boxes at Module-edge	P	P	P	-	-	-	
Control Station Junction Boxes at Module-edge	P	P	P	-	-	-	
Cable Tray	-	-	-	-	-	-	
Power Wiring to HV and/or MV Switchgear	-	-	-	-	-	-	
Power Wiring to Substation Transformer Primary	-	-	-	-	-	-	
Power Cables to LV Switchgear	-	-	-	-	-	-	
Bus Duct to LV Switchgear	-	-	-	-	-	-	
Power Cables to MCC	-	-	-	P	P	O	
Bus Duct to MCC	-	-	-	-	-	-	
Conduit to Motors	P	P	P	-	-	-	
Conduit to Control Stations	P	P	P	-	-	-	
Conduit from J-Boxes to Instrumentation	P	P	P	-	-	-	
Conduit from J-Boxes to Light Fixtures	P	P	P	-	-	-	
Conduit from J-Boxes to Flood Light Fixtures	-	-	-	-	-	-	
Wire/Cable to Motors	-	-	-	P	P	O	
Wire/Cable to Control Stations	-	-	-	P	P	O	
Wire/Cable from J-Box to Instrumentation	P	P	P	-	-	-	
Wire/Cable from J-Box to Light Fixtures	P	P	P	-	-	-	
Wire/Cable from J-Box to Flood Light Fixtures	-	-	-	-	-	-	
Cable from Panelboard to Lighting J-Boxes	-	-	-	P	P	O	
Cable from Control Room to Instrumentation J-Boxes	-	-	-	O	O	O	

PETROFAC LLC

JOB/PROPOSAL NO.: P-98070	SCOPE OF SUPPLY ELECTRICAL, SHEET 3 OF 3	PROVIDED BY: PETROFAC (P) PETROFAC SUBCONTRACT (S) OTHERS (O) NOT APPLICABLE (-)
CLIENT:	DATE JANUARY 1999 REV. # A	

ITEM DESCRIPTION	MODULE			FIELD			REMARKS
	ENGR/ DESIGN	MAT'L	LABOR	ENGR/ DESIGN	MAT'L	LABOR	
Grounding – Underground	-	-	-	P	P	O	
Grounding - Above Ground	P	P	P	-	-	-	
Power Wiring Terminations	-	-	-	P	P	O	
Control Wiring Terminations	-	-	-	P	P	O	
Instrument Wiring Terminations	P	P	P	O	O	O	
Lighting Wiring Terminations	P	P	P	P	P	O	
Intrinsically Safe Wiring	-	-	-	-	-	-	
Wiring Continuity Testing	P	P	P	O	O	O	
Megohm Testing	P	P	P	O	O	O	
Equipment/Device Functional Testing	P	P	P	O	O	O	

INCOMING VOLTAGE: 10kV 3 Phase 50 Hz

UTILIZATION VOLTAGE: MV Motors: N/A LV Motors: 380V Fractional Motors: 220V

Motor Control: 220VAC Lighting: 220VAC UPS: (BY OTHERS) 380/220V

Digital Instruments: 220VAC Analog Instruments: 24VDC

AREA CLASSIFICATION

PROCESS AREAS: Indoor: Class N/A Div. N/A Groups N/A
Outdoor: Class 1 Div. 2 Groups D

NON-PROCESS AREAS: Indoor: Class NH Div. NH Groups NH
Outdoor: Class NH Div. NH Groups NH

ABBREVIATIONS: N/A - Not Applicable; NH - Non-Hazardous

NOTES: _____

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5. CIVIL AND STRUCTURAL

STRUCTURAL

Structural steel provided by Contractor will be designed and fabricated in accordance with AISC and Petrofac Engineering Standard ES-401.

Wind design for Structural will be in accordance with ASCE 7-93 "Minimum Design Loads for Buildings and Other Structures". Seismic design will be in accordance with UBC '94. The basic wind speed used will be 46 m/s.

We will provide structural steel required for the furnished modules, pipe racks, ladders, platforms, miscellaneous steel, and instrument and electrical racks. The metallurgy will be A572-G50 or other equivalent steel with similar properties.

Any required field erected steel will be prefabricated in Dzerzhinskchemmash's shop and pieces will be clearly marked for erection by others in accordance with drawings that will be provided by Petrofac.

We will provide, as deemed necessary, access in the form of ladders and platforms to manholes, safety valves, manual valves, control valves, instrumentation, motors, burners, fill connections, and sample tapes to facilitate the ease of operation and maintenance.

Module-mounted plant sections are designed for four (4) point lift of the module assembly. Some type of spreader bar will be required for the lift. This spreader bar assembly is by others unless specified. Module designs will be free of unnecessary overhead and vertical structural steel members with diagonal bracing which limits personnel access to equipment. Module layout will provide required room to remove bundles on heat exchangers for maintenance and cleaning.

Module layout will provide access to manually operated valves by arranging them either on the perimeter of the module or providing an access aisle to them on the module.

Modules will be designed to set on footing or mat foundations. Grade level skids will be decked with ¼" checkered floor plate. Elevated skids or platforms will be provided with 11/4" x 3/16" Serrated Galvanized grating or Russian equivalent.

No fireproofing is provided on any structural materials.

CIVIL

Petrofac will provide a foundation loading diagram for the equipment and modules provided. Foundation design, material procurement, and installation of the foundations will be by Purchaser.

All other civil work will be accomplished by the Purchaser.

6. CATALYST, CHEMICALS AND OPERATING SUPPLIES

No chemicals, additives and lubricants will be supplied by us. We acknowledge the need of and recommend that neutralizing and filming amines be used in the overhead of T-101 tower. The recommended dosage should be made on the advice of client's chemical supplier. A demulsifier may also be required for addition to the crude oil. Again, the advice of the client's chemical supplier is required for dosages.

No catalyst is required in this process.

7. INSULATION, WINTERIZATION AND PAINT

INSULATION

Insulation will be specified for equipment and piping as required for heat conservation and personnel protection in accordance with Petrofac Engineering Standards. Generally, pipe insulation provided by Petrofac will be calcium silicate.

External insulation as required for on-module and off-module equipment will be supplied and installed by Contractor.

Surfaces that are hot enough to cause auto ignition of liquids that are present in the area will be insulated to prevent this from occurring. This will include man-ways, flanges and valves. Petrofac will provide insulation materials only for such items that are part of off-module piping; off-module piping insulation must be installed in the field.

Insulation for personnel protection will be provided when temperatures are above 60°C.

Weather proofing will consist of aluminum jacketing with factory applied vapor barrier.

All tracing will be electrical, designed with a -36°C minimum ambient temperature.

PAINTING

Paint and surface preparation for modules, piping, structural steel, and equipment will be supplied in accordance with Petrofac Engineering Standards with the following clarifications.

- Platforms, platform ladders, ladders and cages, stair treads, and stair stringers will be painted. Surfaces that are galvanized or stainless steel will not be painted.

- Other uninsulated carbon and low alloy steel equipment, modules, structural steel, and uninsulated carbon and low alloy steel piping will be sandblast cleaned in accordance with Petrofac Engineering Standards.

- Exposed surfaces will be painted with a prime and finish coat. Any surfaces that are stainless steel, aluminum, brass, or copper will not be painted.

- Surfaces to be painted will be free of dirt, grease or oil before painting. Surfaces that are to be painted will be sandblast cleaned to meet the Petrofac Engineering Specifications. Surfaces which are sandblast cleaned will be prime coat painted the same day.

- Pumps, motors, compressors, instruments, and other "off the shelf" equipment which are purchased will utilize the manufacturer's standard machinery finish.

8. CLEANING, TESTING AND SHIPMENT PREPARATION

Pressure vessels will be individually pressure tested in accordance with the specific requirements of Russian Standards and Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code for them prior to their being subjected to the piping system pressure test.

Items falling under the jurisdiction of Section I of the ASME Boiler and Pressure Vessel Code will be tested accordingly.

The piping system will be pressure tested in accordance with the requirements of ANSI B31.3 or ANSI B31.1 (when applicable). Loose piping shall be field tested.

The pressure testing procedure for the piping system will be in accordance with the requirements of the Russian standards.

Water will be used to hydrostatically pressure test those lines which will handle only water, steam, condensate or other waterborne fluids during operation.

Dry, oil-free air or nitrogen gas will be used to pneumatically pressure test those lines which will handle any other fluids (such as air etc.) during operation.

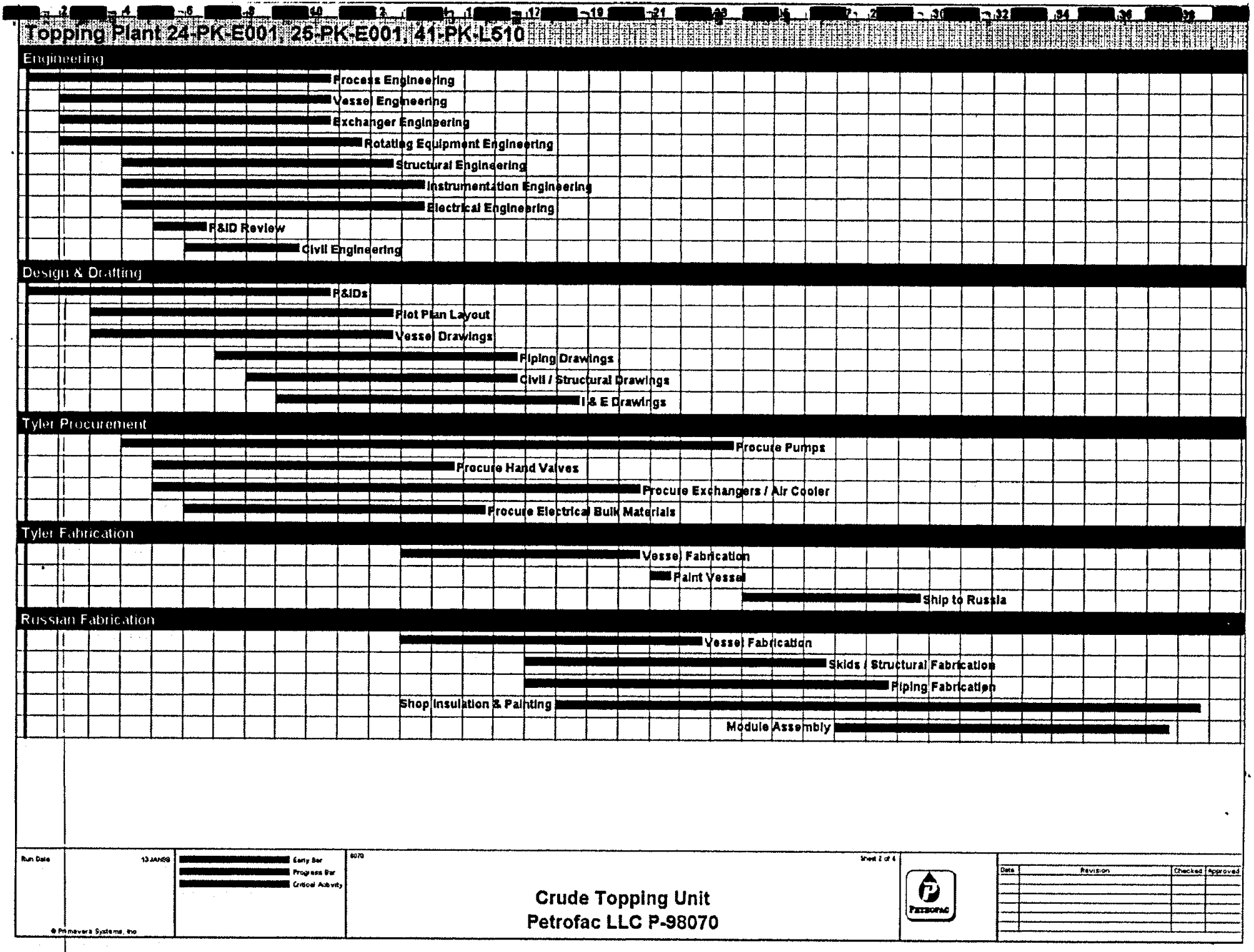
All openings will be suitably covered and sealed to prevent the entrance of dirt or other foreign material during shipment.

9. ESTIMATED WEIGHTS AND DIMENSIONS

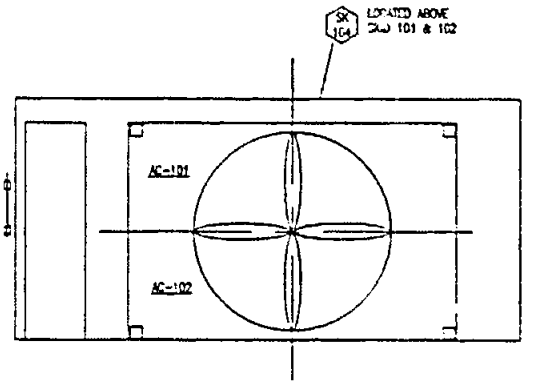
ITEM	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)	WEIGHT (kg)
SKID 101	12,192	3,048	3,657	19,200
SKID 102	12,192	3,353	3,657	21,200
SKID 103	12,192	3,048	3,657	19,200
SKID 104	6,401	3,048	---	10,000
SKID 105	3,962	2,438	---	5,425
SKID 106	2,286	1,219	---	1,250
H-101				22,000
T-101 *	19,812	2,438	2,438	11,400
T-102 *	8,534	1,829	1,829	3,650

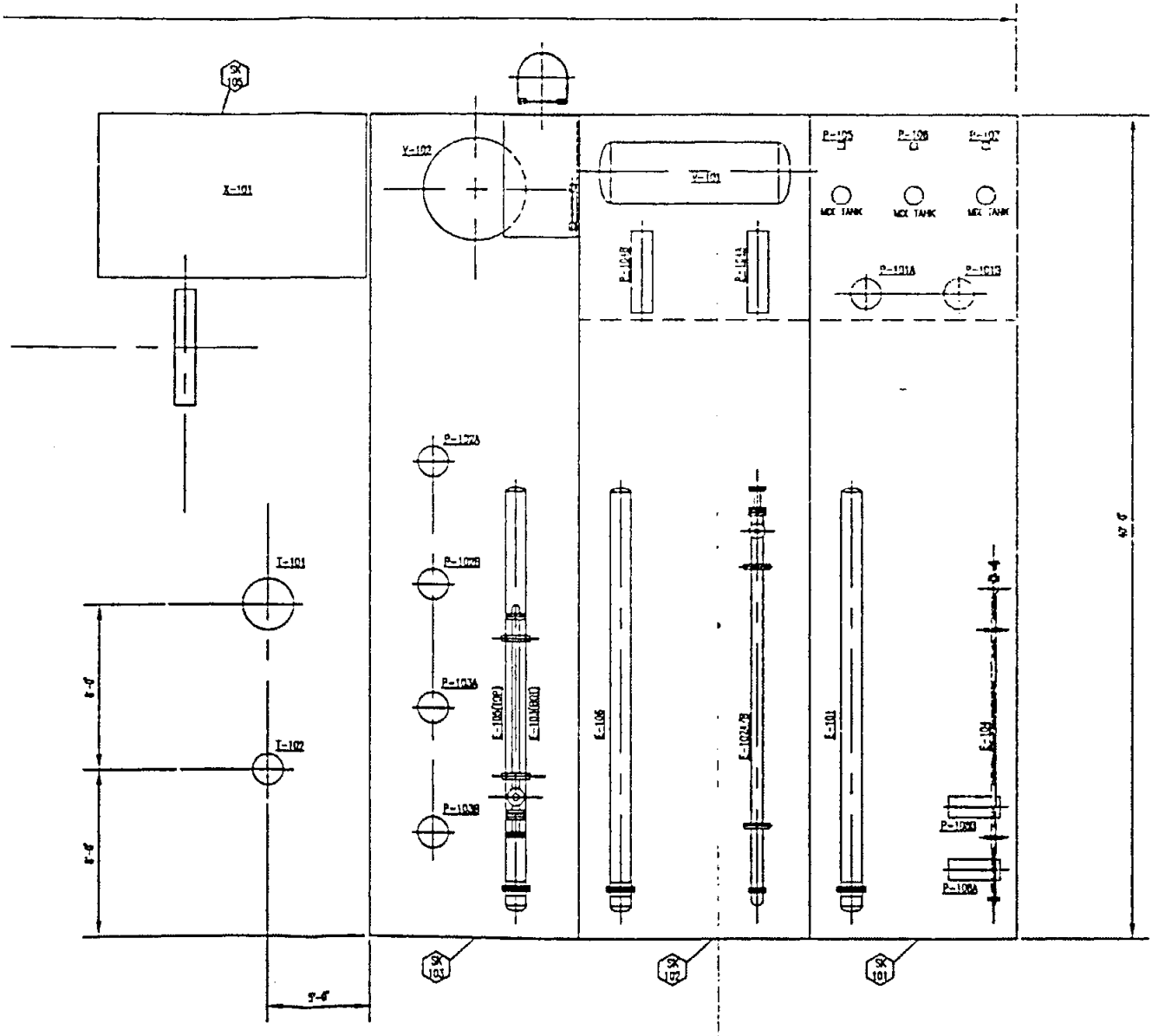
NOTE: The above weights and dimensions are **preliminary** estimates only.

* **Shipping Dimensions**


Topping Plant 24-PK-E001, 25-PK-E001, 41-PK-L510
Engineering
Process Engineering
Vessel Engineering
Exchanger Engineering
Rotating Equipment Engineering
Structural Engineering
Instrumentation Engineering
Electrical Engineering
P&ID Review
Civil Engineering
Design & Drafting
P&IDs
Plot Plan Layout
Vessel Drawings
Piping Drawings
Civil / Structural Drawings
I & E Drawings
Tyler Procurement
Procure Pumps
Procure Hand Valves
Procure Exchangers / Air Cooler
Procure Electrical Bulk Materials
Tyler Fabrication
Vessel Fabrication
Paint Vessel
Ship to Russia
Russian Fabrication
Vessel Fabrication
Skids / Structural Fabrication
Piping Fabrication
Shop Insulation & Painting
Module Assembly
Run Date
13JAN99
Early Bar
Progress Bar
Critical Activity
© Primavera Systems, Inc
6070
Sheet 2 of 4
Crude Topping Unit
Petrofac LLC P-98070
Petrofac
Date
Revision
Checked
Approved

D. PLOT PLAN





PLOT DATE: 1-13-99

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REVISION			CK'D	APP'D	APP'D	DATE
CK'D	APP'D	DATE 01-99	SCALE 1/4"=1'-0"			

PETROFAC LLC
TYLER, TEXAS

PLOT PLAN

CRUDE TOPPING PLANT

105 NCM/D DIESEL PRODUCT

CLIENT:

DWG. P-98070-D-201-1 REV. A

IV. TECHNICAL CLARIFICATIONS

IV. TECHNICAL CLARIFICATIONS

A. CPC-70001 page 9 item 2.2 DESIGN SUMMARY B. REDUNDANCY/ RELIABILITY REQUIREMENTS states: "Equipment and software design criteria shall be such that no single failure can cause deficient operation." Redundancy of instruments not included in Petrofac's design.

B. CPC-70001 page 11 item 2.4 PHYSICAL REQUIREMENTS A. states "Electronic and pneumatic instruments, control valves, and pneumatic-electric transducer located outdoors must be rated for operability at temperature –40°C through +44°C." Analog readouts will be provided as LCD readouts would require instrument enclosures which we have not included in our price. (See Clarification "F")

C. CPC-70001 page 23 item 3.1.5 states "A checkpoint measurement shall be provided for all panel-mounted temperature controllers. When the controller primary element is a thermocouple, the checkpoint may be by means of a duplex thermocouple and two (2) pairs of extension lead wires." The checkpoint will be the local temperature indicator.

D. CPC-70001 page 30 item F.3 states "Transparent thru-vision type gauge glasses ... They shall be equipped with illuminators for all services." Petrofac will provide magnetic type level gauges with color magnetic flags. CPC-70001 page 30 item F.5 states "Magnetic float liquid level indicators with color magnetic flags are preferable."

E. CPC-70001 page 47 item H.1 states "Valve actuators shall be electric or electro-hydraulic." RFQ#0876010-4-0701-RQ dated November 20, 1998 item 2.2.13 states "Instrument air supply is not available at the site, therefore the supplier shall provide a reliable stand alone instrument air package or instruments/devices with alternative energizing power source." Petrofac will provide pneumatic actuation and an instrument air package for instrument air and H-101 liquid fuel atomizing air.

F. CPC-70007, Page 17 states "Electronic instruments, control valves, electrical drives located outdoors must be rated for operability of –28°C through +39°C." This is different than CPC-70001 page 11 item 2.4.A Physical Requirements.

G. CPC-70950 page 12 item J.1 states "Safety relief valves shall be bench set and leak tested. Safety relief valves shall be tested according to API Standard RP527." This is listed as a JOB SITE CHECKOUT AND CALIBRATION. Factory testing, certification and sealing are standard. The testing and certification facilities for Safety Relief Valves, at the job site are not included.

H. CPC-59101 page 3 states " The process skids will be enclosed, insulated, heated and ventilated." Petrofac's design does not include removable panels for enclosing, insulating or heating the process skids. Process building can be supplied at Customer's request. The unit is designed for operation outside in local climate conditions/ This includes cold climate steel, tracing, and insulation for severe winter conditions. Shelters can be provided for operation comfort similar to units we have designed which are currently operational in similar or worse conditions in the CIS. We consider enclosing skids with insulated panels to be too restrictive to operation and maintenance activities and possibly dangerous. If full enclosure and heating is required we suggest a building over the process unit.

I. CPC-59101 page 8 item 3.0 Control Systems states "An electronic control system is to be provided. There shall be no pneumatic instrumentation. Field/module instrumentation shall be "smart" in order to take advantage of the on-board diagnostic capabilities of these types of sensors. All the control loops mounted on the module are mounted and tested by the manufacturer." Not all instrumentation is available as "smart". PETROFAC LLC will mount and test control loops on module(s). Refer to Section III.B.1 "Instrument Summary" of this Technical Appendix for clarification.

J. No fireproofing is provided on modules or equipment due to the rigors of transport to the sites. If required, the Buyer must procure and install on site.

K. No provisions have been made for firewater systems, deluge systems, or for fire detection/alarm systems for the process area.

L. Structural steel has been provided that is adequate for -37°C. Metallurgy for fabricated equipment such as towers, vessels and piping has not been designed for this low temperature and design pressures. It will be necessary that a strict warm-up procedure be followed strictly any time a coded pressure vessel, tower or piping is put in service when the temperature is below -29°C. The equipment must be warmed above -29°C before it is significantly pressurized. This is an acceptable procedure according to industrial standards.

M. Specification CPC-70502

Section 3.3: Petrofac LLC recommends using the PLC rack and modules purchased for ESD PLC System to test SCADA Interface. Purchasing separate equipment for the portable system would be costly and is not necessary. **No additional equipment for a "Portable System for Integrated Testing of SCADA/PLC" shall be provided in this scope of supply.** Testing of the proposed interface requires only the redundant ESD PLC's. The HMI Software does not have anything to do with the SCADA Interface. The advantage of having the SCADA interface directly with the PLC is that if the HMI is down, the SCADA can still control and monitor the plant. Also the Software Driver for Allen-Bradley PLC5 Ethernet is very common. Most SCADA Vendors should have this driver. **SCADA driver software is not in Petrofac LLC scope of supply.**

N. Specification CPC-70004

Section 6.2: The proposed system for the ESD is a redundant (hot-standby) PLC5/40C Allen-Bradley PLC. The PLC, Power Supply, and Communications are redundant. The I/O modules are not redundant. **Petrofac LLC takes full exception to this section.** Without a very detailed description of "Components" and a detailed description of the specific redundancy required, Petrofac LLC can not guarantee compliance. If full redundancy (I/O Modules included) is a major issue to the Purchaser, Petrofac LLC could offer a Fail-Safe Control System as an alternative. Please contact our sales department if interested.

Section 6.3: **Petrofac LLC takes full exception to this section.** Not clear on what a "Multiple Contingency fault" is, need more detail.

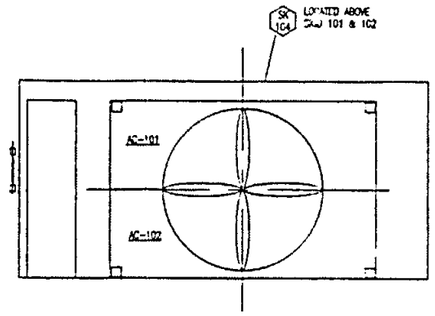
Section 10.3 Intrinsic Barriers are not included in this scope of supply. **Petrofac LLC takes full exception to this section and sections 10.4, 10.5, 10.6, & 10.7.**

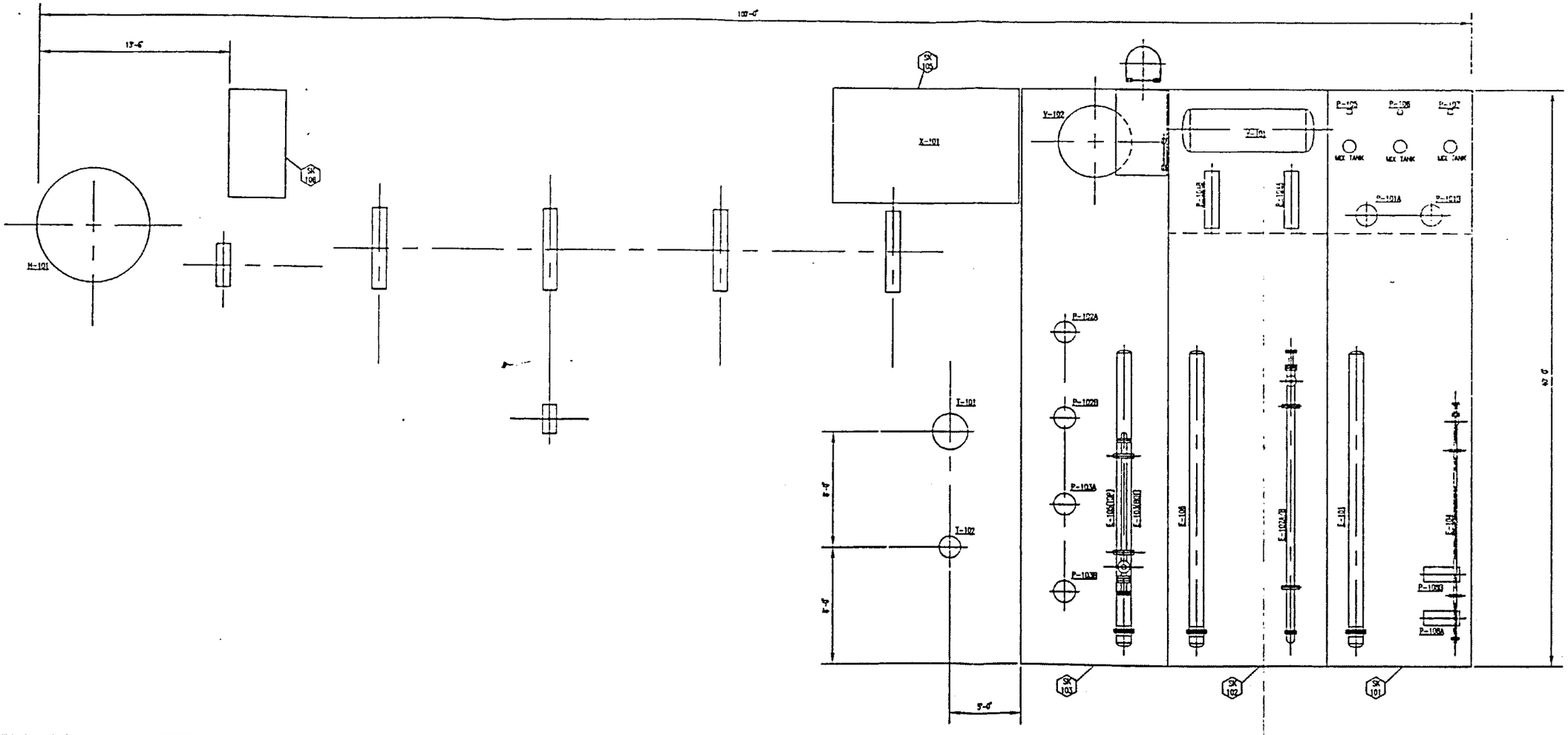
O. **General:**

- A Fire & Gas System, including sensors, is not included in this scope of supply.

EP. NO.	EQUIPMENT DESCRIPTION
101	CRUDE TOWER OVERHEAD CONDENSER
C-102	DIESEL PRODUCT COOLER
E-101	CRUDE FEED / COLD RESID EXCHANGER
102A/B	DIESEL / CRUDE EXCHANGERS
103	HOT RESID /CRUDE EXCHANGER
104	DESALTER WATER EXCHANGER
E-105	DIESEL STRIPPER REBOILER EXCHANGER
106	INTERMEDIATE RESID / CRUDE EXCHANGER
101	CRUDE FEED HEATER
101A/B	CRUDE CHARGE PUMPS
P-102A/B	RESIDUE PUMPS
103A/B	DIESEL PUMPS
104A/B	CRUDE TOWER REFLUX PUMPS
105	NEUTRALIZING AMINE PUMP
P-106	FILMING AMINE PUMP
P-107	DEMULSIFIER PUMP
108A/B	DESALTER WATER PUMPS
101	CRUDE TOWER
102	DIESEL STRIPPER
V-101	CRUDE TOWER OVERHEAD ACCUMULATOR
X-102	DESALTER
101	INSTRUMENT AIR PACKAGE

MODULE NO.	MODULE SIZE
SK-101	10'-0" x 40'-0"
SK-102	11'-0" x 40'-0"
SK-103	10'-0" x 40'-0"
SK-104	10'-0" x 21'-0"
SK-105	8'-0" x 13'-0"
SK-106	4'-0" x 7'-6"





PLOT DATE: 1-13-99

NOTES

DRAWING ISSUED
- ■ PRELIMINARY
- ☐ FOR CONSTRUCTION
- ☐ FOR ENGINEERING
- ☐ FOR APPROVAL
- ☐ FOR DESIGN
- ■ FOR INFORMATION
- ☐ REVISED DESTROY ALL PREVIOUS COPIES OF DWG. REVIEW THIS ISSUE FOR CHANGES

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