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Technical Proposal
For
Mini Refinery (Batch Distillation Unit)



0	03-May-2024	MRA	MRA	MRA	ISSUE FOR PROPOSAL
REV.	DATE	PRE,D	CHK,D	APP,D	DESCRIPTION

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1. Introduction

A mini-refinery typically is a small refinery that fractionates small amount of hydrocarbon & raw materials such as gas condensate, crude oil and other mixtures by atmospheric and vacuum distillation in one batch wise column. Remote or inhospitable inland locations will tend to provide favorable conditions for mini-refinery fuel production as distances and/or road conditions results in high transportation costs for imported fuels. This process is intended for separation of crude oil, gas condensate and their mixtures into:

- Naphtha fraction,
- Kerosene fraction,
- Diesel fraction,
- Heavy residual stock (black oil, fuel oil)

Block-modular mini oil refinery for processing of hydrocarbon raw materials consists of:

- Block of preparation;
- Block of distillation (processing plant);
- Feed & Product Tanks;
- Objects of production-auxiliaries such as:
 - Hot Oil Package
 - Cooling water system
 - Flare & Blowdown Package
 - Portable laboratory and control building

Benefits of a Mini refinery are listed below:

- Can be set up and in operation within two days after arrival at a site where the foundation and storage tanks are in place.
- A single operator may restart the plant from a cold start and have the plant in full operation in less than two hours.
- Plant can be completely automated and once an operator sets all the controlling points, all product temperatures and flows are controlled automatically.
- Easy support of plant.

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Some optional features may be needed for mini refineries; can be provided from MEHRAZ, are listed as:

- Special alloys may be included in the plant design.
- Desalter packages for removing salt from the crude.
- Naphtha, jet fuel, and diesel treaters (DMD)
- Gasoline stabilizers for reducing the Reid vapor pressure of motor fuels

MEHRAZ provides a turn-key or completely engineered refinery solutions package.

MEHRAZ performs development, manufacture and delivery of mini oil refineries.

Also Basic and Detail Design, Procurement, Construction and Commissioning of Mini Refinery Package scope of work would be divided, but not limited to following items:

Electrical	Power supply feeder, cabling, lighting, earthing, lightning, MCC, UPS.
Instrument	Cabling, DCS, PSVs, control valves, on-off valves, ESD.
Safety	Fire fighting, HAZOP, fire and gas detectors, blast protection, HSE.
Mechanic	Heat Exchangers, Reboiler, Pumps, packages, loading/unloading auxiliaries
Piping	All process and utility lines, valves, vent & drain system, insulation
Civil & Structure	Steel work, foundation, supports, control room, ditch, trench, road and paving

2. Scope of the Plant

The scope of the plant includes the main units but other components such as internal slop systems, feedstock /product tank farm, loading/unloading facilities, cooling water package, Hot oil Package, off sites such as flare & blowdown, and also laboratory, etc... can be included in the scope of the plant upon request.

3. Basis

Capacity	2000 bbl/day
No. of Batch/day	3

4. Feed Specifications

The main feed of this unit is Gas Condensate and Naphtha. The unit can be designed to fed with crude oil, Used Oil and Fuel Oil to produce light cut and vacuum gas oils.

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5. Product Specifications

As a result of processing of hydrocarbon raw materials following production are received:

- Straight-run petrol fraction - 180°C (Naphtha), which can be used as a component of motor fuel or as a raw material for pyrolysis.
- Kerosene fraction - 254°C.
- Diesel fraction - 380°C.
- Distillation residue, fraction > 380°C, is used as furnace fuel oil.
- The unit can be designed to fed with crude oil, Used Oil and Fuel Oil to produce light cut and vacuum gas oils.

6. Processes Description

At First, feed of the batch distillation plant (crude oil or gas condensate) will be analyzed in Laboratory for knowing its boiling range, and taking judgment of product withdrawal on its basis. The input feed will be broken down into naphtha, kerosene, diesel and fuel oil in the distillation column.

The feed will be charged in to batch kettle V-101 from feed storage tank (T-101A,B) through P-101A,B. Feed charged quantity can be calculated based on feed Tank level changes between start and end of reboiler charging or by installing flow meter.

When charging raw material, after liquid level in V-101 (reboiler) reaches about 80%, V-101 will be heated until bottom temperature of V-101 raise from room temperature and reach up to 45 °C.

First top product (naphtha) vapor will be given from the top of column C-101A,B and condensed in E-101 and cooled in E-102 and collected in to V-102. After some liquid level, total reflux will be started. When the column temperature profile set, one online sample will be taken and checked its property. Then the reflux can be reduced trough pump P-102A,B and started withdrawal top product in to V-103. When V-103 filled up, product will be transferred to naphtha storage tank (T-102) by P-103A,B. When the temperature of column top reach to 180 ° C, then withdrawal of second product to

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V-104 will be started and it is collected up to required level. The second product will be collected in the receiver and transferred through the pump P-104A,B to Kerosene storage tank (T-103).

When temp of column top reaches to 254° C, then withdrawal of third product to V-105 will be started and it is collected up to required level. The third product will be collected in the receiver and transferred through the pump P-104A,B to Diesel storage tank (T-104). For heavy products such as gasoil, vacuum package X-101 should be come in to service. At the end of distillation, the heating process will be stopped and the remained distillation residue (fuel oil) in the reboiler will be cooled through E-103 in circulation mode. when the fuel oil temperature in the V-101 is reached to the desired temperature, the fuel oil will be transferred to the fuel oil storage tank (T-105) through P-105.

7. Main Process Equipment List

Item.	Service
E-101	Top product air cooler
E-102	Top product condenser
E-103	Bottom product air cooler
C-101A/B	Distillation column
V-101	Batch kettle (Reboiler)
V-102	Reflux drum
V-103	Product receiver (Naphtha)
V-104	Product receiver (Kerosene)
V-105	Product receiver (Diesel)
V-106	Vacuum receiver
X-101	Water ring vacuum pump
T-101A/B	Feed storage tank
T-102	Naphtha storage tank
T-103	kerosene storage tank
T-104	Diesel storage tank
P-101	Feed transfer pump
P-102	Reflux drum pump
P-103	Naphtha oil transfer pump
P-104	Kerosene/Gasoil transfer pump
P-105	Fuel oil transfer pump

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8. Engineering Documents

Basic & Detail engineering documents are as the following table 1 & 2:

Table 1: Basic Engineering Documents

Item No.	Item
1.	Process
1.1	Process Design Basis*
1.2	Process Design Criteria (Based on NIOEC Spec.)
1.3	Process Flow Diagrams (PFD)
1.4	Process Description
1.5	Heat and Material Balances-H&MB
1.6	Utilities Consumption Summary
1.7	Chemical & Effluent Summary
1.8	Utility Distribution Diagram (UDDs)
1.9	Piping and Instrumentation Diagram (P&IDs)
1.10	Material Selection Diagram (MSDs)
1.11	Process Equipment List
1.12	Line List
1.13	Process Electrical Load List
1.14	Alarm and Trip Set Point List
1.15	Flare Relief Load Summary
1.16	Process Data Sheet for Distillation Column
1.17	Process Data Sheet for Fire Heater
1.18	Process Data Sheet for Pumps
1.19	Process Data Sheet for Heat Exchangers (Air Cooled and Shell & Tube)
1.20	Process Data Sheet for Separators
1.21	Process Data Sheet for Filters
1.22	Duty Specification for process Packages
1.23	Laboratory analysis schedule and methods
1.24	Operating Manual
2.	Instrument
2.1	Process Instrument Datasheets for Control Valves
2.2	Process Instrument Datasheets for Safety Valves
2.3	Process Instrument Datasheets for ON/OFF Valves
2.4	Process Instrument Datasheets for RO
2.5	Process Instrument Datasheets for Temperature
2.6	Process Instrument Datasheets for Pressure
2.7	Process Instrument Datasheets for Flow
2.8	Process Instrument Datasheets for Level
2.9	Process Instrument List
2.10	Cause and Effect Diagram
3.	Electrical
3.1	Electrical load Summary
4.	Piping
4.1	Piping Design Criteria
4.2	Piping Material Specification (PMS)
4.3	Preliminary Plot plan for process unit

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Table 2: Detail Engineering Documents

Row	Discipline	Description
1	Instrument	Instrument Index
2	Instrument	I/O list
3	Instrument	Data sheet for PT
4	Instrument	Data sheet for FT
5	Instrument	Data sheet for FE
6	Instrument	Data sheet for TT
7	Instrument	Datasheet for On-Off Valve
8	Instrument	Datasheet for Control Valve and regulators
9	Instrument	Data sheet for PSV / TSV
10	Instrument	Data sheet for PG
11	Instrument	Data sheet for PDT
12	Instrument	Data sheet for TG
13	Instrument	Data sheet for LG
14	Instrument	Data sheet for Differential Pressure LT
15	Instrument	Data sheet for Radar type LT
16	Instrument	Data sheet for Displacer type LT
17	Instrument	Datasheet for Magneto structive type LT
18	Instrument	Instrument Cable Route Plan
19	Instrument	Instrument Junction Box Termination Diagram
20	Instrument	Instrument Loop Wiring Diagram
21	Instrument	Hook-up Diagram & Piping Assembly
22	Instrument	Instrument and Junction Box Location Layout
23	Instrument	Instrument Air Consumption Calculation
24	Instrument	Instrument Power Consumption Calculation
25	Instrument	Control Valve Sizing Calculation
26	Instrument	Orifice Sizing Calculation
27	Instrument	PSV Sizing Calculation
28	Instrument	MTO for Instrument Cable
29	Instrument	MTO for Instrument Bulk Material
30	Mechanical	Engineering Drawing for HXS
31	Mechanical	Mechanical Data Sheet for PUMPS
32	Mechanical	Engineering Drawing for VESSELS
33	Mechanical	Engineering Drawing for TOWERS
34	Piping	PMS
35	Piping	3D Model Review
36	Piping	Plot Plan
37	Piping	Piping Isometric Drawing
38	Piping	MTO for Piping Bulk Material
39	Piping	MTO for Paint & Insulation
40	Piping	Support List

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Table 2: Detail Engineering Documents

Row	Discipline	Description
41	Electrical	Lighting Installation Details & Notes
42	Electrical	Earthing & Lightning Protection Installation Details & Notes
43	Electrical	Power Installation Details & Notes
44	Electrical	Electrical Load List
45	Electrical	Calculation Notes for Cable Sizing & Voltage Drop
46	Electrical	Calculation Notes for AC UPS, DC Charger & Batteries
47	Electrical	Calculation Notes for Earthing & Lightning Protection
48	Electrical	Calculation Notes for Lighting System of Buildings
49	Electrical	Calculation Notes for Lighting System of Outdoor Area & Shelters
50	Electrical	Data Sheet for Power Transformers
51	Electrical	Data Sheet for Diesel Generator
52	Electrical	Data Sheet for LV Switchgear & Capacitor Bank
53	Electrical	Data sheet for Lighting & Distribution Panels
54	Electrical	Data Sheet For Local Control station
55	Electrical	Data Sheet for AC UPS, DC Charger & Batteries
56	Electrical	Data Sheet for Power & Control Cables
57	Electrical	Data Sheet for Lighting Materials
58	Electrical	Data Sheet for LV Induction Motors
59	Electrical	Data Sheet for LV Bus Duct
60	Electrical	Single Line Diagram for MV Switchgear
61	Electrical	Single Line Diagram for LV Switchgear & Capacitor Bank
62	Electrical	Single Line Diagram for Lighting & Distribution Panels
63	Electrical	Single Line Diagram for AC UPS & DC Charger
64	Electrical	Power & Control Cable Schedule
65	Electrical	Electrical Equipment Arrangement Layout for Substation Building
66	Electrical	Lighting & Smal Power Layout for Outdoor Area & Shelters
67	Electrical	Lighting & Smal Power Layout for Buildings
68	Electrical	Earthing & Lightning Protection Layout for Outdoor Area & Shelters
69	Electrical	Earthing & Lightning Protection Layout for Buildings
70	Electrical	Main Cable Route Layout & Sections
71	Electrical	Cable Route Layout & Arrangement in Substation Cable Gallery
72	Electrical	MTO for Main Electrical Items
73	Electrical	MTO for Power & Control Cables
74	Electrical	MTO for Lighting Materials
75	Electrical	MTO for Earthing & Lightning Protection Materials
76	Electrical	MTO for Bulk Materials
77	Structure	Foundation & Structural Calculation for VESSEL
78	Structure	Foundation & Structural Drawing for VESSEL
79	Structure	Foundation & Structural Calculation for TOWER
80	Structure	Foundation & Structural Drawing for TOWER

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Table 2: Detail Engineering Documents

Row	Discipline	Description
81	Structure	Foundation & Structural Calculation for Heat Exchanger
82	Structure	Foundation & Structural Drawing for Heat Exchanger
83	Structure	Foundation Drawing for PUMP
84	Structure	Calculation Book for Pipe Rack & Bridge
85	Structure	Pipe Rack & Bridge Foundation Drawing
86	Structure	Pipe Rack & Bridge Structural Drawing
87	Structure	Foundation & Structural Calculation for Main Structure and Platforms
88	Structure	Foundation & Structural Drawing for Main Structure and Platforms
89	Civil	UG composite Drawing & Detail
90	Civil	Surface Water Drawing
91	Control Project	Time Schedule
92	Control Project	Work Break Down Structure (WBS)
93	Control Project	Master Document Register (MDR)

Notes:

1. This MDL has been prepared based on minimum executive & procurement requirements.
2. It is assumed, documents such as "Relay Coordination & Setting Tables", "Schematic & Termination Diagrams", "Metering & Protection Diagrams" to be prepared by Switchgear Manufacturer.
3. It is assumed that all engineering documents related to work packages such as "Cathodic Protection System" & "Heat Tracing System" (if needed) to be provided by Vendor.
4. Procurement Engineering & Vendor's evaluation (documents such as MR & TBE) are not taken into account.
5. It is assumed that Specification of all equipment to be referred to the last revision of National Iranian Oil Company Specification (NIOEC Specs).

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9. Utilities Specification

8.1. Cooling Water

Supply Temperature	:	30 °C
Return Temperature	:	40 °C
Supply Pressure	:	4.0 barg

8.2. Hot Oil

Supply Temperature	:	300 °C
Return Temperature	:	260 °C

10. Capital Cost Estimation

The total EPC capital cost for battery limit is estimated to be **4 Million Dollars**. The cost of following items is excluded from CAPEX:

- Storage tanks
- Cooling water system
- Flare & Blowdown Package
- Portable laboratory

Also Total **EP** capital cost for battery limit is estimated to be **3.4 Million Dollars**.

11. Work Breakdown Structure

The estimated Work Breakdown Structure of the EPC project is as table 3:

Table 3: Work Breakdown Structure (WBS)

12	11	10	9	8	7	6	5	4	3	2	1		N0.
												Basic Engineering	1
												Detail Engineering	2
												procurement	3
												Construction	4
												Pre-Commissioning	5
												Startup	6

12. Process Flowsheet

