



Al Zour Refinery Area V/Section 10
Units 85-86-88-93-98
HANDBOOK

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MB/PH	BIK/IRA	AMH

KIPIC Mission & Vision

Mission:

To operate an integrated complex that manufactures refined petroleum and petrochemical products and supplies Liquefied Natural Gas (LNG) after regasification in a reliable, efficient, safe and environmentally responsible manner while maximizing profit, developing a professional and competent workforce and enabling Kuwaiti private sector's participation in the downstream petroleum industry.

Vision:

To be a leader in integrated refining, LNG and petrochemical operations that maximizes shareholder value, achieves operational excellence, commits to the development of our people and contributes to the development of the local economy.

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KIPIC HSE Golden Rules

1. Obtain work permit.
2. Control lifting activities & working at height risks.
3. Excavation risks shall be controlled.
4. Confined space works shall be authorized.
5. Conduct gas test when required.
6. Use required work related PPE.
7. All incidents shall be reported.
8. Know your role during emergency.
9. Enhance safe driving culture.
10. Mind all moving and energized equipment at your work vicinity.
11. Do not smoke outside designated smoking areas.
12. Implement waste management.

KIPIC Values

Integrity

Acting in a trustworthy manner with the highest standards of ethics, respect and honesty

Innovation

Developing and embracing new ideas, methods, and approaches to solving challenges that create value

Excellence

Encouraging strong performance, continuous improvement and a customer focus

One Team

Caring for the interests of KPC and ensuring alignment to achieve corporate and state goals

Partnership

Building and sustaining relationships that support growth and enhance operational excellence

Caring for People

Creating a culture where people develop and grow, and are positively motivated to contribute to the success of others

Commitment to HSE

Respecting the environment and ensuring safety, security and the promotion of a healthy workplace wherever KPC operates

Pride

Creating employee satisfaction on an individual level and promoting a sense of loyalty and belonging to KPC

Required P.P.E. for the site



Safety
Helmet



Eye
Protection



Protective
Gloves



High Visibility
Clothing



Laced Safety
Footwear



NO EXCUSES

1. Personnel H25 monitor to be worn whenever inside the unit
2. Selection of special PPE's based on activity

2. Al Zour Refinery Overview

Al Zour Refinery (ZOR) is an upcoming grass-root refinery located at Al Zour area. Al Zour Refinery will predominantly produce Low Sulfur Fuel Oil (LSFO) to replace High Sulfur Fuel Oil (HSFO) presently used in local power generation plants. ZOR is designed to process 615,000 BPSD of Kuwait Export Crude Oil or 535,000 BPSD of a mix of Kuwait Export and Heavy Crude Oils.

ZOR uses the latest technology to comply with stringent environmental regulations and produce ultra-low sulfur diesel fuel for international markets as well as jet fuel, kerosene, and naphtha feedstock for petrochemical plants.

ZOR was designed as three mini Refineries complex consisting of three Crude Distillation Units each designed to process

205.000 BPSD of KEC, or 210.000 BPSD of KHC, 120.000 BPSD of either Eocene or Lower Fars Crude Oil.

Six world-scale ARDS trains to produce the 225.000 BPD LSFO, and over 500 MMSCFD of Hydrogen. Other multiple trains e.g., Naphtha, Kerosene, and Diesel hydro-processing plants will further reduce sulfur to ultra-low levels of less than 10 ppm. Sulfur is removed and then produced molten sulfur is converted to its solid form for transportation and to be sold to world markets.

ZOR processing facilities are supported by utilities, Tank farm, Off-sites, Sulphur Pier and Sea Island.

3. Units Configuration & Capacities

3.1. Main Process Units

Unit Title	Unit No.	Capacity & No. of Units / Trains.
Crude Distillation Unit (CDU)	01/11/21	3 x 205.000 BPSD
Atm. Residue Desulfurization Unit (ARDS)	02/12/22	3 x 110.000 BPSD
Diesel Hydrotreater Unit (DHTU)	03/13/23	3 x 62.000 BPSD
Naphtha Hydrotreater Unit (NHTU)	04/14	2 x 18.200 BPSD
Kerosene Hydrotreater Unit (KHTU)	05/15	2 x 53.000 BPSD
Saturated Gas Unit (SGU)	34	9.300 BPSD LPG & Refinery FG
Heavy Oil Cooling Unit (HOC)	06	307.000 BPSD Atm. Residue

3.2 Process Supporting Units

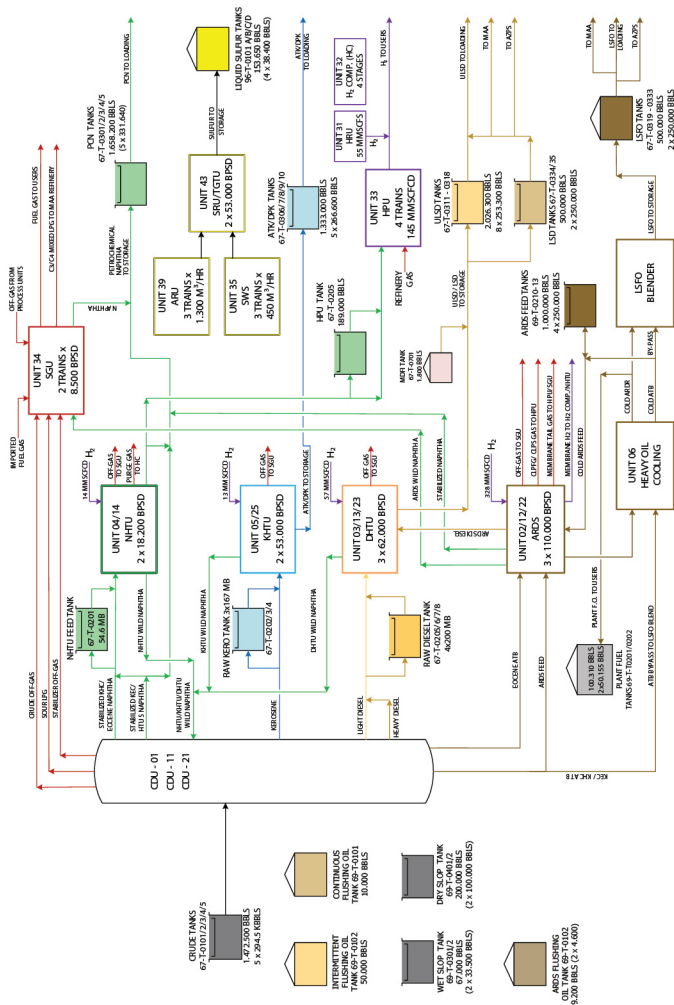
Unit Title	Unit No.	Capacity & No. of Units / Trains.
Hydrogen Compression Unit (HC)	32	741.4 KNM3/hr. (7 Comp)
Hydrogen Production Units (HPU)	33	4 x 145MM SCFD
Hydrogen Recovery Unit (HR)	31	61.44 KNM3/hr.
Sour Water Stripper Unit (SWSU)	35	3 x 450 M3/hr.
Amine Regeneration Units (ARU)	39	3 x 1,300 M3/hr.
Sulfur Recovery/Tail Gas Treating (SRU)	43	3 x 1,000 MTPD

Molten Sulfur Storage	96	4 X (10,500 MT)
Sulfur Granulation Unit	86	4 x 1200 MT/day
Hydrocarbon Flares (3x50%)	75	LP-788.4 MT/hr. & HP 492.5MT/hr.
Acid Gas Flare (AGF) - 2 Elevated Flare	92	72.6 MT/hr.

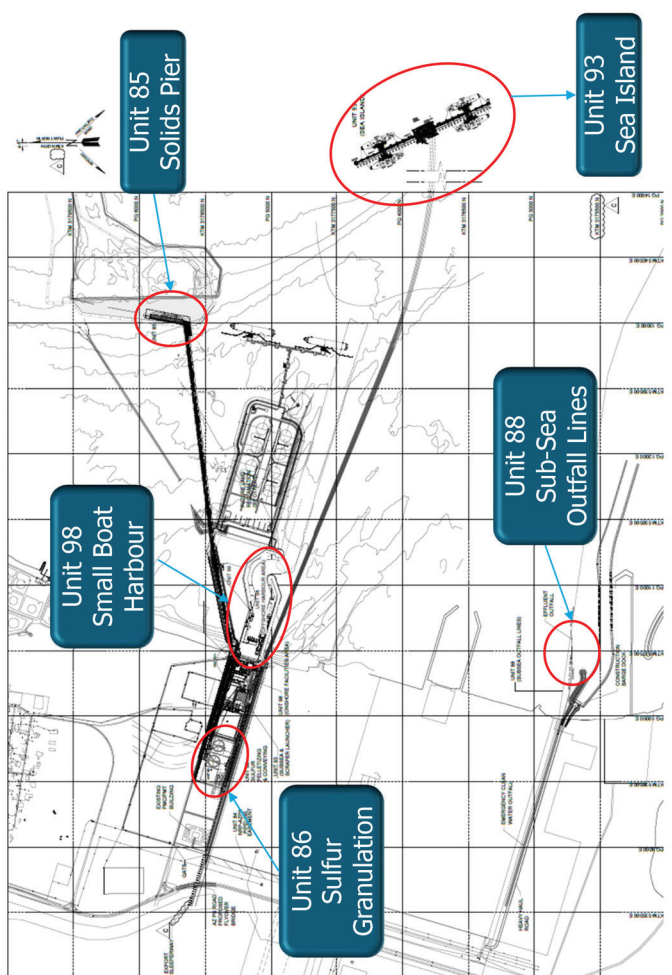
3.3 Utilities

Unit Title	Unit No.	Capacity & No. of Units / Trains.
Steam Generation	60	5 X 125 MT/hr.
Air & Inert Systems	61	Inst. Air - 15.304 NM ³ /hr.
		Plant Air - 6.000 Nm ³ /hr.
		Nitrogen - 5.628 Nm ³ /hr.
Water & Fire Water Systems	62	Desalination Water 1974 M ³ /hr.
		DM Water - 880 M ³ /hr.
		Polish water - 1860 M ³ /hr.
		Fresh Water - 643 M ³ /hr.
		Fire Water (4 x 25.272 M ³ Tank)
Cooling water	63	62.000 M ³ /hr (16 cell C.T)
Wastewater Treatment with ZLD	76	Primary t ₃ reatment 1000 M ³ /hr.
		Bio-Treatment 1525 M ³ /hr.
		ZLD - 1700 M ³ /hr.

3.4 Refinery Configuration Diagram



4. Units layout



5. Unit 93 Sea Island

5.1 Objectives of the Unit 93

The Unit 93 is designed for transfer and Loading of refined products of KIPIC into ships by means of onshore and onshore loading facilities.

The Unit 93 Sea Island offshore, consists of four loading berths: Berth 41, Berth 42, Berth 43, Berth 44 and Central Services Platform (CSP) for Utilities systems. Up to four products transport ships can be berthed simultaneously and any product can be loaded at any of the four berths. Multiple products can be loaded on a single ship, but same product cannot be loaded on multiple ships simultaneously during Stage I Operations.

ATK/DPK may be loaded simultaneously on two ships during Stage II Operations.

The function of Sea Island operations is surveillance of all Sea Island equipment and systems for proper operation.

These functions include continuous equipment observations, recording normal and abnormal plant conditions, and sampling if deemed necessary.

Facilities at Unit 93	
Scraper Launchers and Receivers	PCN Vapor Recovery Systems
Subsea transfer Pipelines	Firefighting systems
Products Export metering stations (Custody Meters)	Sewage System
Loading Arms	Process Utilities
Product Drain Systems	Electrical Power Generation System

5.2 General Design Capacity

Product	Design Loading Rate (Tonnes/hr)	Max Parcel Size (Tonnes)	Max Loading Time (Hrs)
ZOR TO SHIP – Export Products			
Liquids:			
PCN	3,114	100,000	36
ATK/DPK	3,677	120,000	36
ULSD	3,763	120,000	36
LSFO	2,422	80,000	36
Future Speciality Oil (unconverted gas oil)	1,283	40,000	36
Future ULSD Diesel Product (alternate grade)	3,108	100,000	36
Vapor:			
PCN Vapor (recovered during loading operations)	5,750 Am ³ /h	NA	36
Commodities:			
Bunker Fuel	628	5,000	8
MDO	573	300	0.52
SHIP TO ZOR – Import Products			
Ships Slops	124	800	8
Hydro Treated Naphtha (ZOR Refinery initial commissioning only)	86.6	60,000	480
Petrochemical Naphtha (ZOR Refinery initial commissioning only)	86.6	10,000	80

Aviation Turbine Kerosene (ZOR Refinery initial commissioning only)	95.8	30,000	240.1
Ultra Low Sulfur Diesel (ZOR Refinery initial commissioning only)	104.2	49,500	396
LSFO (provision)	722	-	-

5.3 Products Properties

Properties	PCN	ATK/DPK	SHIP SLOPS	ULSD / MDO	LSFO/ BFO
Operating Temperature (°C)	45	45	43	50	80
Specific Gravity @ 15°C	0.701	0.785	--	0.838	0.940
Specific Gravity @ 50°C	0.677 @ Op. temp.	0.766 @ Op. temp.	0.990 @ Op. temp.	0.818	0.915
Specific Gravity @ 80°C	--	--	--	0.804	0.897
Vapor Pressure, bar(abs) @ Operating Temperature	0.72	0.10	--	0.05	<< 0.1
Flash Point (°C)	<25	39/40	--	66	>100
Sulfur (wt%)	0.05	0.1/0.01	--	0.001 to 0.05	1.0
Viscosity @ 50°C, (cP)	0.41 @ Op. temp	0.85 @ Op. temp	0.62 @ Op. temp	2.26	85 - 210
Viscosity @ 80°C, (cP)	--	--	--	--	31 - 55
Viscosity @ 100°C, (cP)	--	--	--	0.48 @ 175°C	15 - 28

Pour Point (°C)	--	--	--	--	36
Wax appearance (°C)	N/A	N/A	N/A	N/A	40

5.4 Design Features

A free-standing Marine structure located approximately 17.5 KM from shore at a water depth of approx. 20 meters. Max. Tanker size: 120,000 DWT.

Four (4) multi-product liquid berths (Berths- 41/42/43/44) connected to a central service platform.

Estimated berth utilization cannot exceed 50%; Design target is 40%. 25 years life service.

Primary control, product metering, utility & power generation systems are accommodated at central platform

Sea Island is connected to shore via 5 sub-sea pipelines.

Vapor Recovery Unit for PCN loading: Adsorption Desorption Technology, minimum 99% recovery.

Bunker fuel will be available at all liquid product berths and loaded one ship at a time. Product loading and fueling may occur simultaneously.

5.5 Product Export Philosophy

The finished products are exported via the following subsea pipelines:

- Petrochemical Grade Naphtha (PCN) – 30”
 - Ultra-Low Sulfur Diesel (ULSD) – 30”
 - Low Sulfur Fuel Oil (LSFO) – 30”
 - Kerosene (ATK/DPK) – 30”
- And one subsea pipeline for:
- Ship slops unloading – 10”

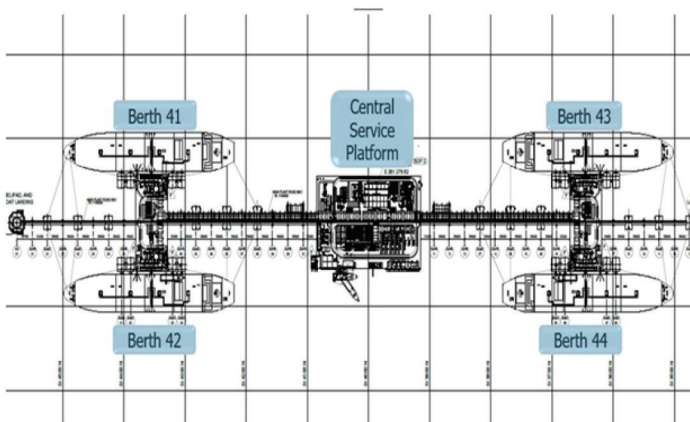
5.6 Product Import Philosophy

During initial commissioning of the Al Zour Refinery facilities, substantial quantities of several commodities will be required for system fill and start-up of the new production facilities. These products will be supplied from external sources and received through Sea Island to respective storage tanks in offsites:

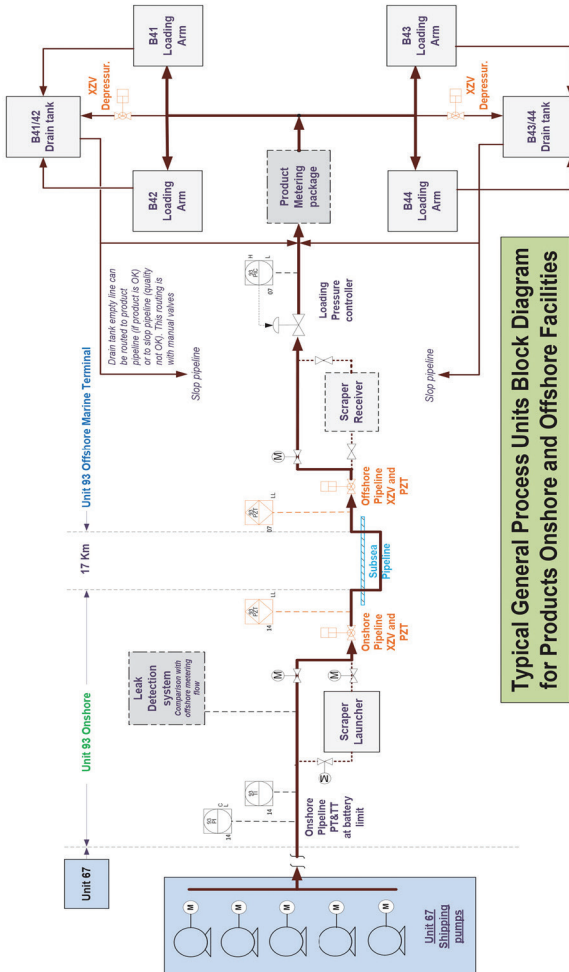
- Hydro Treated Naphtha via ships slops line
- Petro Chemical Naphtha via ships slops line
- Aviation Turbine Kerosene via ships slops line
- ULSD via ships slops line

Provisions are also provided for LSCO import (outside of initial commissioning of the Al Zour Refinery Facilities).

5.7 Sea Island Plan View



5.8 Typical General Process Units Block Diagram for Products Onshore and Offshore Facilities



Typical General Process Units Block Diagram for Products Onshore and Offshore Facilities

5.9 Scraper Launcher and Receiving System

The purpose of Scraper launchers and receivers are for the cleaning and inspection of pipelines from onshore to the sea island prior to initial operation and periodically thereafter as deemed necessary.

In-line cleaning and inspection tools are the devices that are inserted into the scraper. They travel through the pipeline driven by the pipeline product or a carrying fluid like water for surveying the pipeline wall integrity.

The purpose of internal inspections using intelligent scrapers is to detect the presence of anomalies and potential defects, in order to follow up with strategic integrity maintenance and rehabilitation programs.

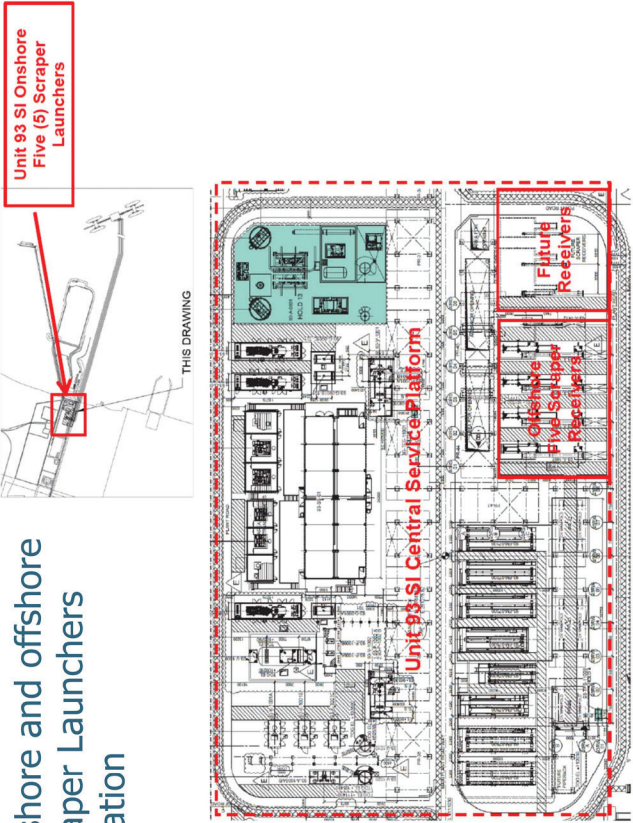
There are five scraper launchers and five scraper receivers provided for Sea Island.

SCRAPER LAUNCHERS/RECEIVERS				
Tag Number	Equipment Description	Capacity	Design P/T	
			barg	°C
93-A-1401	PCN Scraper Launcher	4,600	47.4	-3/85
93-A-1402	ATK/DPK Scraper Launcher	4,800	47.4	-3/85
93-A-1403	ULSD Scraper Launcher	4,600	47.4	-3/85
93-A-1404	LSFO Scraper Launcher	2,700	47.4	-3/85
93-A-1406	Ship Slops Scraper Launcher	125	47.4	-3/85

93-A-1407	PCN Scraper Receiver	4,600	47.4	-3/85
93-A-1408	ATK/DPK Scraper Receiver	4,800	47.4	-3/85
93-A-1409	ULSD/MDO Scraper Receiver	4,600	47.4	-3/85
93-A-1410	LSFO Scraper Receiver	2,700	47.4	-3/85
93-A-1412	Ship Slop Scraper Receiver	125	20	-3/85

5.10 Onshore and Offshore Scraper Launchers Location

Onshore and offshore Scraper Launchers Location



5.11 Custody Meters

Custody metering packages are provided to accurately measure and record the transfer of product from the refinery to the ocean, going tankers for accounting purposes.

The metering principle will be volume based, using the KROHNE Altosonic III uni-directional custody transfer ultrasonic flow meter which is connected to the redundant single stream flow computer. There are six custody meters located on the sea island.

The metering stations are skid mounted units with flow computers which totalize the flows from multiple meter runs. Each meter includes a sampler connection, density meters, filter, flow straightening device and multiple certified meter runs.

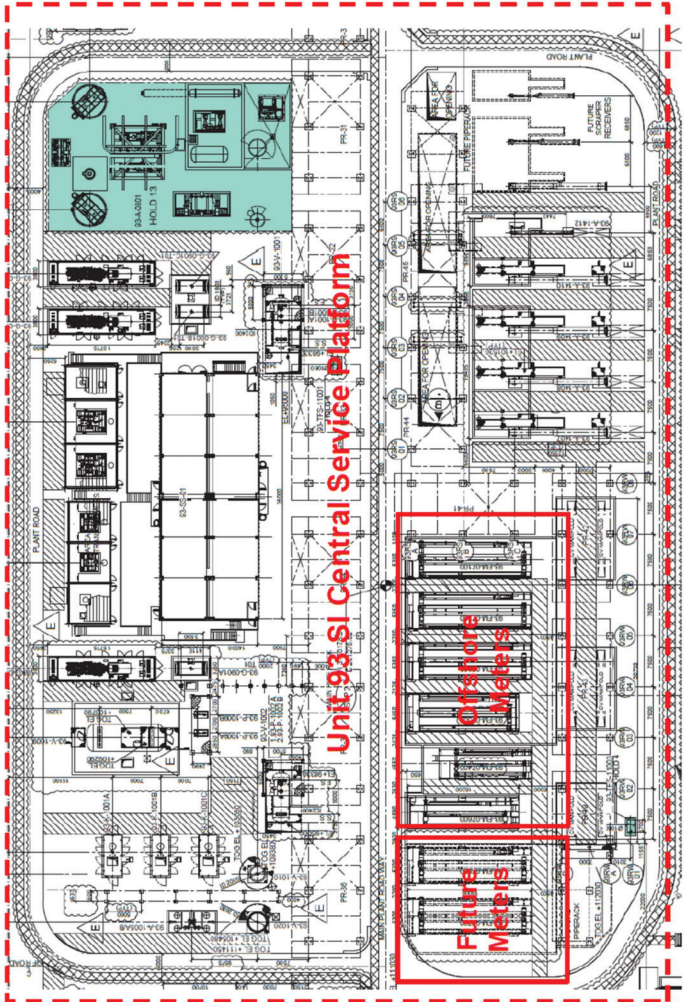
Each custody meter skid also includes a Bidirectional Pipe Prover which is capable of on-line proving of each individual meter run.

CUSTODY METERS		
Tag number	Equipment description	Design parameters
93-FM-07100	PCN custody meter	Design flow: 460 - 4,600 m ³ /h (3 x 50% meters)
93-FM-07100-P-01	Sampling pump – PCN custody meter	Capacity 10 m ³ /hr
93-FM-07200	ATK/DPK #1 custody meter	Design flow: 640 - 4,800 m ³ /h (3 x 50% meters)
93-FM-07200-P-01	Sampling pump – ATK/ DPK custody meter	Capacity 10 m ³ /hr
93-FM-07300	ULSD custody meter	Design flow: 614 - 4,600 m ³ /h (3 x 50% meters)

CUSTODY METERS

Tag number	Equipment description	Design parameters
93-FM-07300-P-01	Sampling pump – ULSD custody meter	Capacity 10 m3/hr
93-FM-07400	MDO Custody Meter	DESIGN FLOW: 614 - 700 m3/h (2 x 100%)
93-FM-07400-P-01	Sampling pump – MDO Custody meter	Capacity 10 m3/hr
93-FM-07500	LSFO Custody Meter	DESIGN FLOW: 363 - 2,700 m3/h (3 x 50% meters)
93-FM-07500-P-01	Sampling pump – LSFO Custody meter	Capacity 10 m3/hr
93-FM-07600	Bunker Fuel Oil Custody Meter	DESIGN FLOW: 363 - 700 m3/h (2 x 100%)
93-FM-07600-P-01	Sampling pump – BFO Custody meter	Capacity 10 m3/hr

5.12 Custody Meters Location in Central Service Platform



5.13 Loading Arms

Loading arms provide a flexible connection between the berth piping and the ship manifolds to safely load products from the Refinery Tankage through sub-sea pipelines onto product tankers and to transfer slops from these ships to appropriate onshore facilities.

There are 32 Loading Arms: Twenty-four product loading arms, four PCN vapor recovery arms, and four ship slops unloading arms.

Each loading/unloading/vapor recovery arm is a vendor supplied package with all parameters in the package PLC available in the DCS.

Four different product ships can be loaded simultaneously at four berths. Multiple products can be loaded on a single ship, but single product cannot be loaded on multiple ships simultaneously.

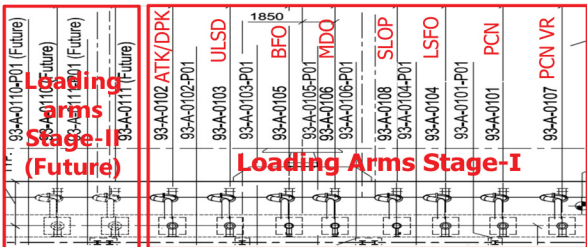
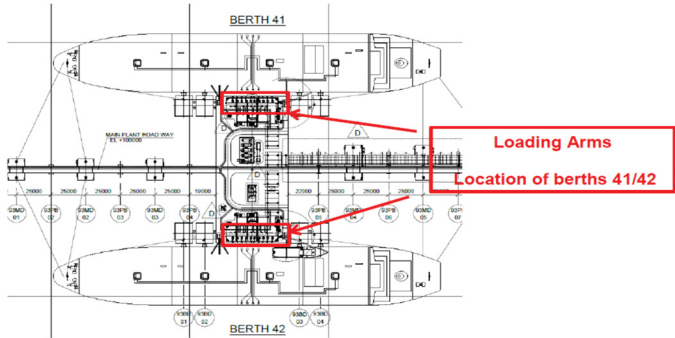
Drain Tanks & Pumps				
Tag Number	Equipment Description	Capacity	Design P. / T.	
			barg	°C
93-A-0101 – 0401	PCN Loading Arms	4,600	47.4	-3/85
93-A-0X01-P-01 X=1,2,3,4	Stripping Pump for PCN	10	13	-3/85
93-A-0102 – 0402	ATK/DPK Loading Arms	4,800	47.4	-3/85
93-A-0X02-P01 X=1,2,3,4	Stripping pump for ATK/DPK	10	13	-3/85

93-A-0103 – 0403	ULSD Loading Arms	4,600	47.4	-3/85
93-A-0X03-P01 X= 1,2,3,4	Stripping pump for ULSD	10	13	-3/85
93-A-0104 – 0404	LSFO Loading Arms	2,700	47.2	-3/90
93-A-0X04-P01 X= 1,2,3,4	Stripping pump for LSFO	10	13	-3/85

Equipment Details				
Tag Number	Equipment Description	Capacity	Design P. / T.	
			barg	°C
93-A-0X05-P01 X= 1,2,3,4	Stripping pump for BFO	10		
93-A-0105-0405	BFO Loading Arms	700	47.2	-3/90
93-A-0106-0406	MDO Loading Arms	700	47.4	-3/85
93-A-0X06-P01 X= 1,2,3,4	Stripping pump for MDO	10	13	-3/85
93-A-0107 – 0407	PCN Vapor Recovery Arms	5750	11	-3/85

93-A-0X09-S-01 X=1,2,3,4	Filter – VRU Safety Skid	5750		
93-A-0X09-S-02 X=1,2,3,4	Detonation Arrestor – VRU Safety Skid	5750		
93-A-0108 – 0408	Ship Slops Unloading Arms	125	15	-3/85
93-A-0107 – 0407	Vapor Recovery Safety Skid	5750		

5.14 Loading Arms distribution



5.15 Drain Tanks and Pumps

Product drain tanks are provided to collect liquid remaining in the loading arms when loading operation is completed. These drain tanks are mounted on the main Sea Island platform, under the elevated loading arm platforms.

There are eight individual tanks and each tank has a dedicated vertical submerged suction transfer pump(s) to return the collected liquid, on level control, to the appropriate pipeline upstream of the meter skids or to the ship slops pipeline. Five OHD drain tanks provided to receive drain from instrument, equipment, drip pans, curbed area & ship slop unloading arm.

Drain Tanks & Pumps				
Tag Number	Equipment Description	Capacity	Design P. / T.	
			barg	°C
93-V-0101 / 0301	PCN Drain Tank	21 m3	3.5	85
93-P-0101 / 0301	PCN Drain Tank Transfer Pump	20 m3/hr	9.8	85
93-V-0102 / 0302	ATK/DPK Drain Tank	21 m3	3.5	85
93-P-0102 / 0302	ATK/DPK Drain Tank Transfer Pump	20 m3/hr	9.8	85
93-V-0103 – 0403	ULSD/MDO Drain Tank	21 m3	3.5	85
93-P-0103 / 0303	ULSD/MDO Drain Tank Transfer Pump	20 m3/hr	10.7	85

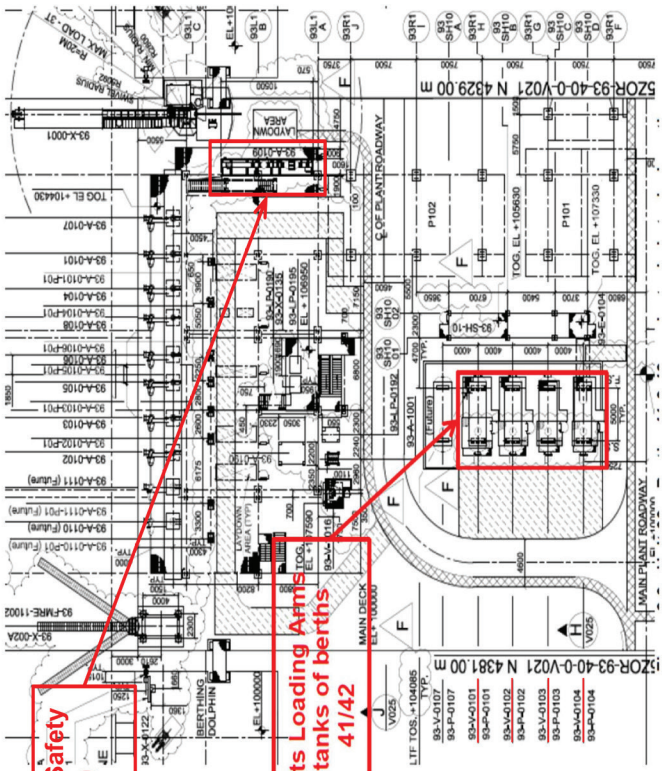
93-V-0104 – 0404	LSFO/Bunker Fuel Oil Drain Tank	21 m3	3.5	90
93-V-0104 / 0304	LSFO / BFO Drain Tank Transfer Pump	20 m3/hr	10.5	90
93-E-0104 – 0404	LSFO/Bunker Fuel Oil Drain Tank Heater	20 kw		90
93-V-1001 – 1005	OHD Drain Tank	30 m3	3.5	85
93-P-1001A/B–1005A/B	OHD Drain Tank Transfer Pump	35 m3/hr	10.3	85

5.16 PCN Vapor Recovery System (VRS)

Due to safety, environmental and occupational health concerns, the sea island marine terminal includes a PCN vapor recovery system (VRS) to reduce emission to atmosphere of volatile organic compounds displaced from the tankers holds during PCN loading operations.

**Vapor Recovery Safety
Skid (VRSS)
93-A-0109**

**Products Loading Arms
Drain tanks of berths
411/42**



- LTF TOS: +10085
TYP.
- 93-V-0107
 - 93-P-0107
 - 93-V-0101
 - 93-P-0101
 - 93-V-0102
 - 93-P-0102
 - 93-V-0103
 - 93-P-0103
 - 93-V-0104
 - 93-P-0104

5.17 Utilities

Plant & Instrument Air:

3 x 50% motor driven compressors

Plant air receiver, Instrument air dryer package, Instrument air receiver

Nitrogen:

Each berth has dedicated Cylinder bank & receiver.

Required for PCN & ATK/DPK loading arm, PCN & ATF/DPK and OHD drain tanks.

Potable & Chilled water system:

Potable water supply is by KOC barge.

1 Tank (60 m³) for one week's requirement & 3 x 50% pumps

Carbon filter for potable water

Chilled water package for Eye wash & safety shower.

Service Water:

Sea water based, service water system for housekeeping / utility.

2 x 100% Motor driven pumps

Maintain Fire water header pressure as Jockey pumps.

Power Generation:

3 x 50% Diesel driven power generator of 3.125 MW Capacity.

Diesel Supply:

Tank for 1 week requirement for 2 Generators & 8 hrs. for 2 Fire water pumps.

2 x 100% diesel transfer pumps.

Utility Package Equipment

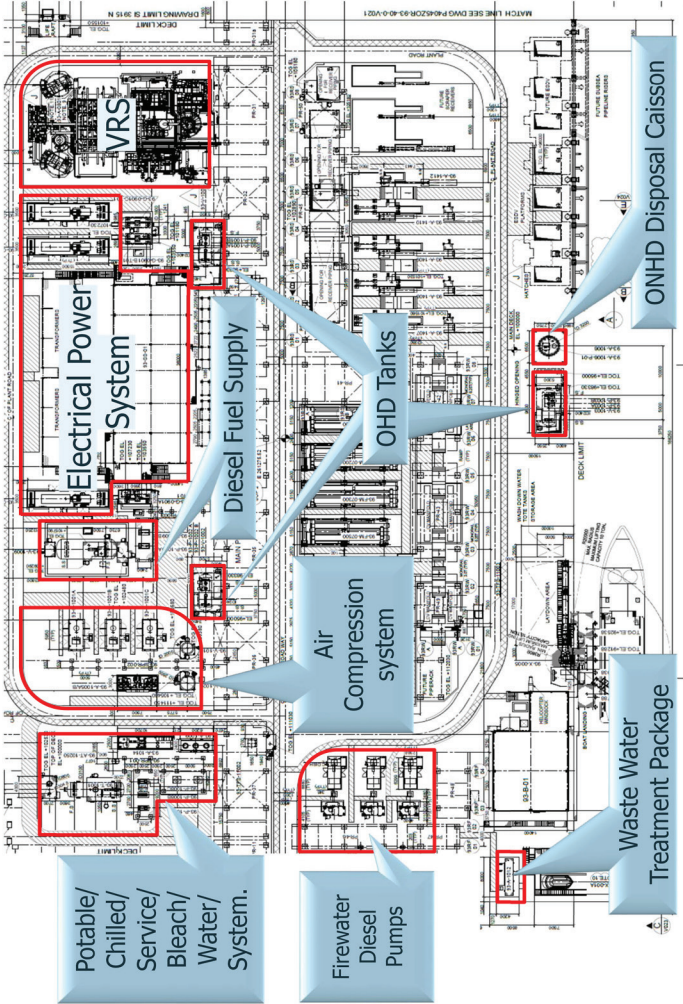
Tag Number	Equipment Description	Capacity	Design P. / T.	
			barg	°C
93-A-0801	Vapor Recovery Package	5750 m3/hr	11	85
93-A-1005A/B	Instrument Air Dryer Package	1171 Nm3/hr	10.5	85
93-A-1012	Sanitary Waste Water Package	30 people		85
93-A-1009	Chilled Water Package	49 m3/hr	14.5	85
93-A-1014	Bleach Package	1.4 m3/hr	20	85
93-K-0801-01A/B	Vapor Blower Package	5750 m3/hr	3.5	90
93-K-1001 A/B/C	Instrument and Plant Air Compressor Package	DESIGN: 1500 Nm3/hr (outlet flow) Suction Pressure: 0.0 barg		
93-G-0901 A/B/C	Power Generators	DESIGN: 3125 kVA, VOLTAGE: 6.6 kV, FREQUENCY: 50 Hz		

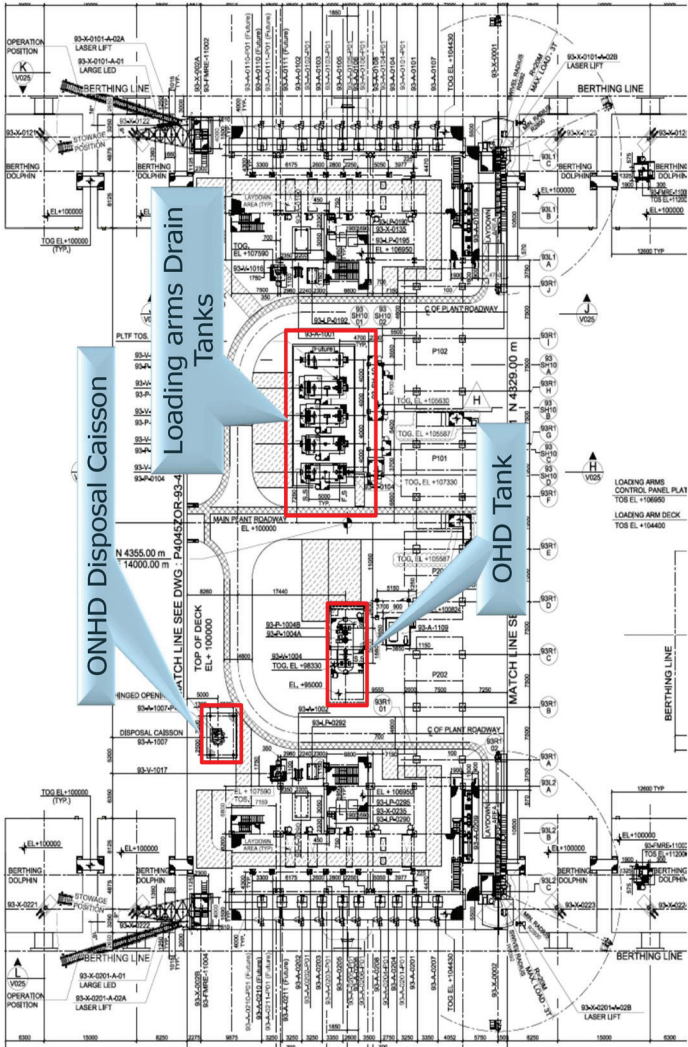
Utility Miscellaneous Equipment

Tag Number	Equipment Description	Capacity	Design P. / T. / Pow.		
			barg	°C	KW
93-P-1006 A/B	Service Water Pumps	144 m3/h	12.2	85	90

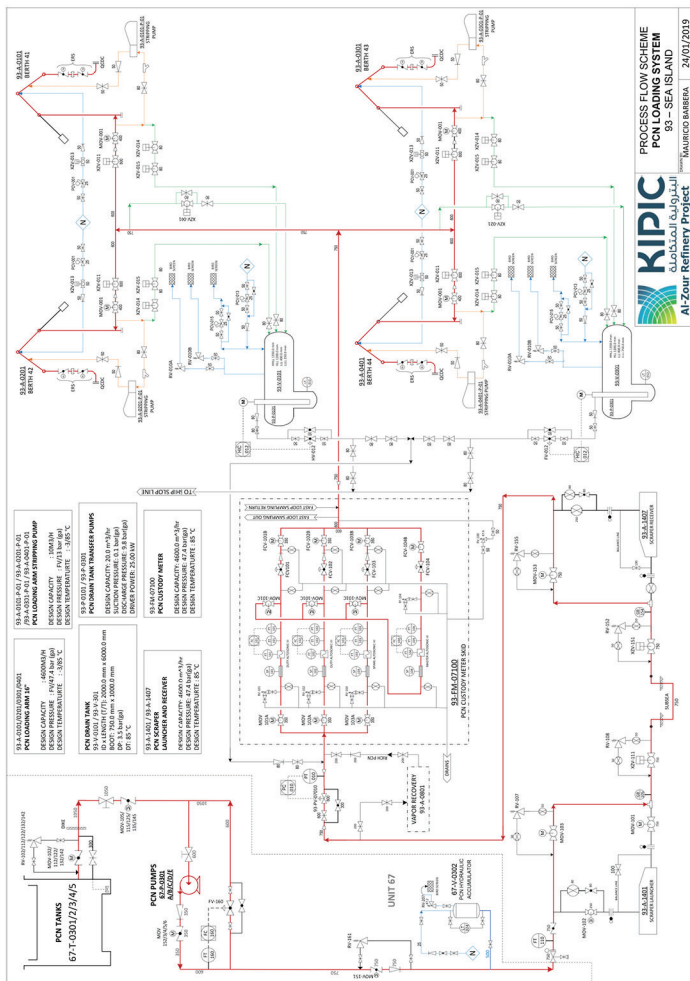
93-P-1009 A/B	Diesel Transfer Pumps	15 m3/h	3.5	85	0.84	
93-P-1008 A/B/C	Potable Water Pumps	24.5 m3/h	7.0	85	15	
93-P-1101 A/B/C	Firewater Pumps	515 m3/h	13.4	85	373	
		Capacity	Size (mm)			
93-T-1001	Potable Water Tank	80 m3	3100 x 9600	1	85	N/A
93-V-1009	Diesel Supply Tank	136 m3	4000 x 9500			N/A
93-V-1010	Plant Air Receiver	21 m3	2000 x 6000	10.5	85	N/A
93-V-1016 -1019	Nitrogen Receivers	8.8 m3	1500 x 4500	10.5	85	N/A
93-V-1020	Instrument Air Receiver	46 m3	2600 x 7800	10.5	85	N/A
93-E-0104	Electrical Heater for 93-V-0104 LSFO/FBO drain tank (41/42)	Design Duty: 20 kw				
93-E-0304	Electrical Heater for 93-V-0304 LSFO/FBO drain tank (43/44)	Design Duty: 20 kw				

5.18 Utilities Services Location





5.19 Sea Island Loading System Diagrams

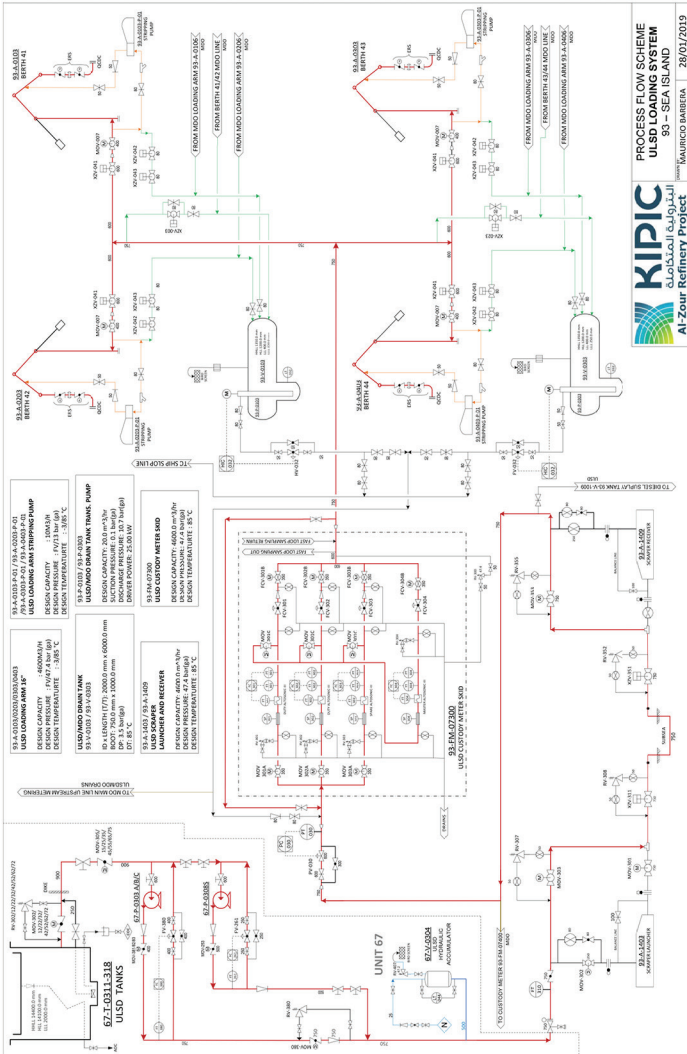


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PROCESS FLOW SCHEME
PCN LOADING SYSTEM
93 – SEA ISLAND

MAURICIO BARBERA 24/01/2019

Al-Zour Refinery Project



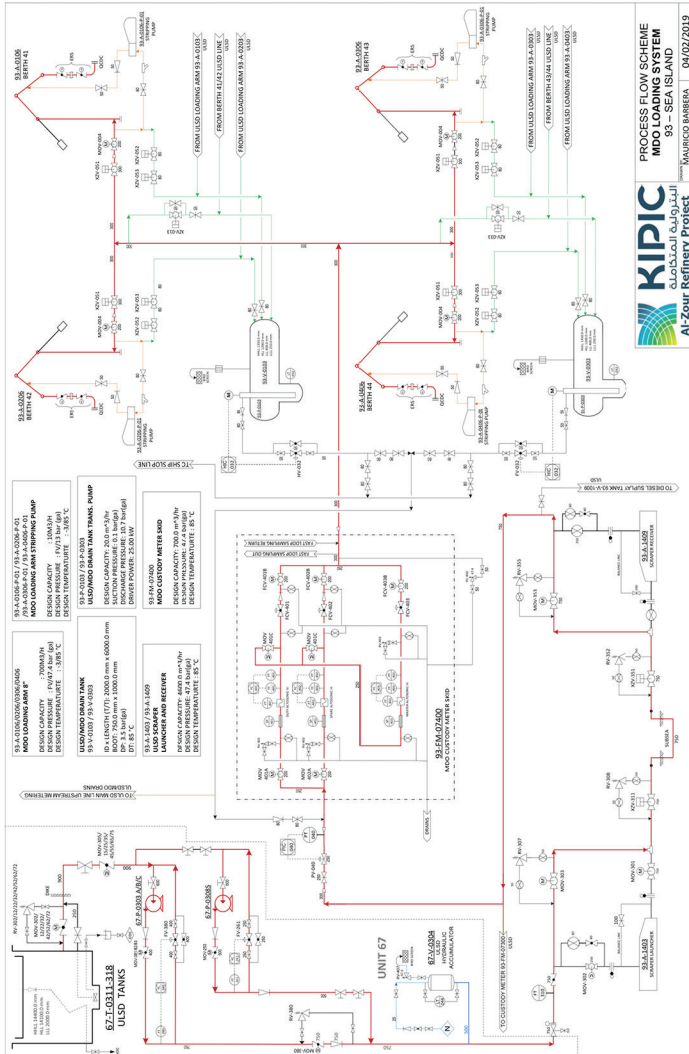
93-A-0203 / 93-A-0203-P-01
USLD LOADING ARM STRIPPING PUMP
 DESIGN CAPACITY: 4000000 L/H
 DESIGN PRESSURE: -1.585 bar(g)
 DESIGN TEMPERATURE: -3.055 °C

93-A-0202 / 93-A-0202-01
USLD MAIN TANK
 DESIGN CAPACITY: 4000000 L/H
 DESIGN PRESSURE: -1.585 bar(g)
 DESIGN TEMPERATURE: -3.055 °C

93-F4-0200
USLD CUSTOM METER SKID
 DESIGN CAPACITY: 4000000 L/H
 DESIGN PRESSURE: 0.1 bar(g)
 DESIGN TEMPERATURE: 15 °C

93-A-1007 / 93-A-1007
USLD RECEIVER
 DESIGN CAPACITY: 4000000 L/H
 DESIGN PRESSURE: 4.7 bar(g)
 DESIGN TEMPERATURE: 15 °C

93-IM-07300
USLD UTILITY SKID



PROCESS FLOW SCHEME
MDO LOADING SYSTEM
99 - SEA ISLAND
MAURICIO BARBERA 04/02/2019



6. Unit 86 Sulfur Granulation & Conveying

6.1 Objectives of the Unit 86

The main process objective of this unit is to receive liquid sulfur from Unit 96, Sulfur Storage, solidify it, and then convey the solid sulfur product to the covered circular stores.

Circular Stores are inventoried to provide 21 days of storage at 100% production rate, plus the 60,000 MT the largest parcel size to be shipped.

Equipment	Operating Capacity	Design Capacity
Sulfur Granulation Units (3 + 1 no's)	1200 MT/day each	700-1200 MT/day
No:1 Product Sulfur Granule Conveyor	125 MT/hr	150 MT/hr
Circular Stores (2 no's)	65,000 MT	65,000 MT

6.2 Feed and Product Properties

LIQUID SULFUR PROPERTIES	
Temperature	1300C-1550C
Specific Gravity	1.8@1380C
Composition (wt%)	
Sulphur	99.5-99.8
Organics	Nil

Ash	0.5
Carbon	Nil
Acidity	Nil
Moisture	Nil
H2S	10 ppm max (normal) 30 ppm max (upset)
Viscosity	8 cP (8-11 cP)

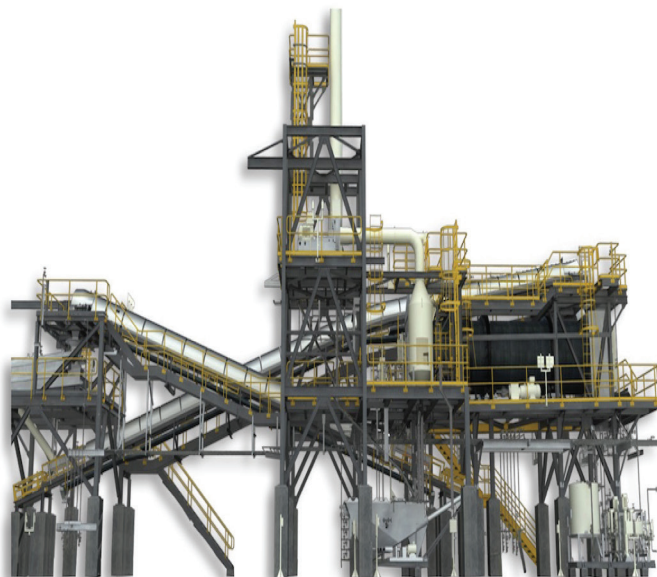
SOLID SULFUR SPECIFICATIONS	
Angle of Repose Average Size Distribution	>25°C
Average Size Distribution	2-6 mm
Shape	Spherical
Average Size	2 – 6 mm
Bulk Density	>1040 Kg/m ³
Moisture Content	<0.5 wt%
Purity (dry basis)	99.5 wt%
Color	'Texas' Bright Yellow

6.3 Sulfur Granulators

Four Sulfur granulators units with one available as a spare. Granulation process uses a size enlargement process to transform molten Sulphur into dense spherical solid granules.

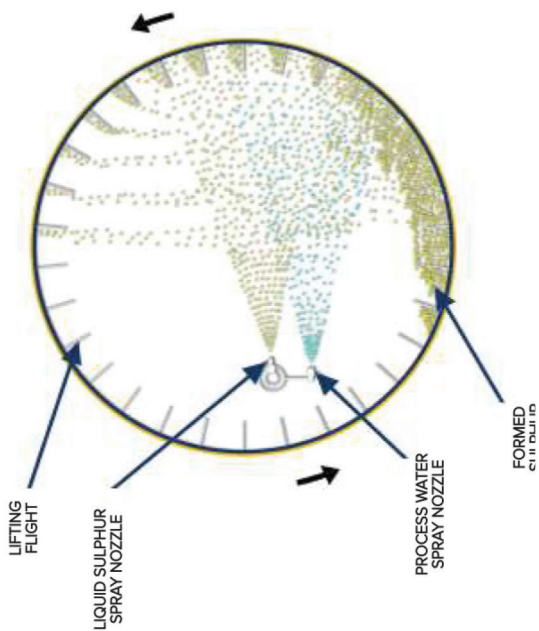
Small particles of Sulphur (seed) are sprayed and coated with molten Sulphur as the product moves through a rotating drum. Each applied layer is cooled to solidification before another coat of molten Sulphur is applied. With repeated application, bonding and then cooling of successive coats, the seeds increase in volume and weight until they reach the desired granule size, between 2 to 6 mm in diameter.

6.4 Sulfur Granulation Unit



6.5 Sulfur Granulation Process

GX™ Drum Cross-Section



6.6 Solid Sulfur Conveying

To transport the product sulfur granules from the outlets of the sulfur granulators to the two circular store stockpiles within Al-Zour Refinery.

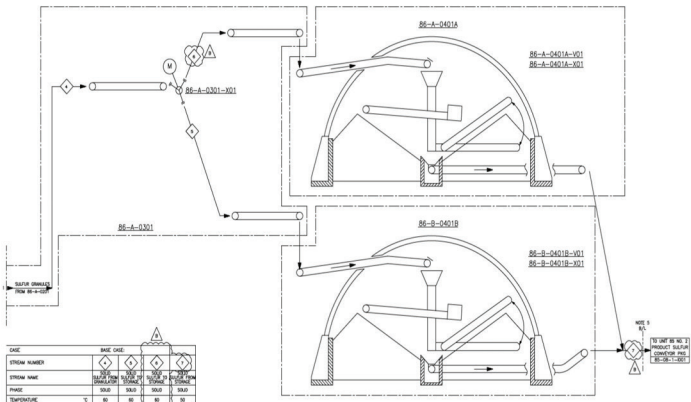
Consists of a series of belt conveyor sections, a diverter gate, and transfer towers.

Product sulfur from the sulfur granulators enters this conveyor in the first section and is transported to one or both circular stores at a rate of up to 125 ton/hr. This conveyor services each of the circular stores through parallel conveyor legs.

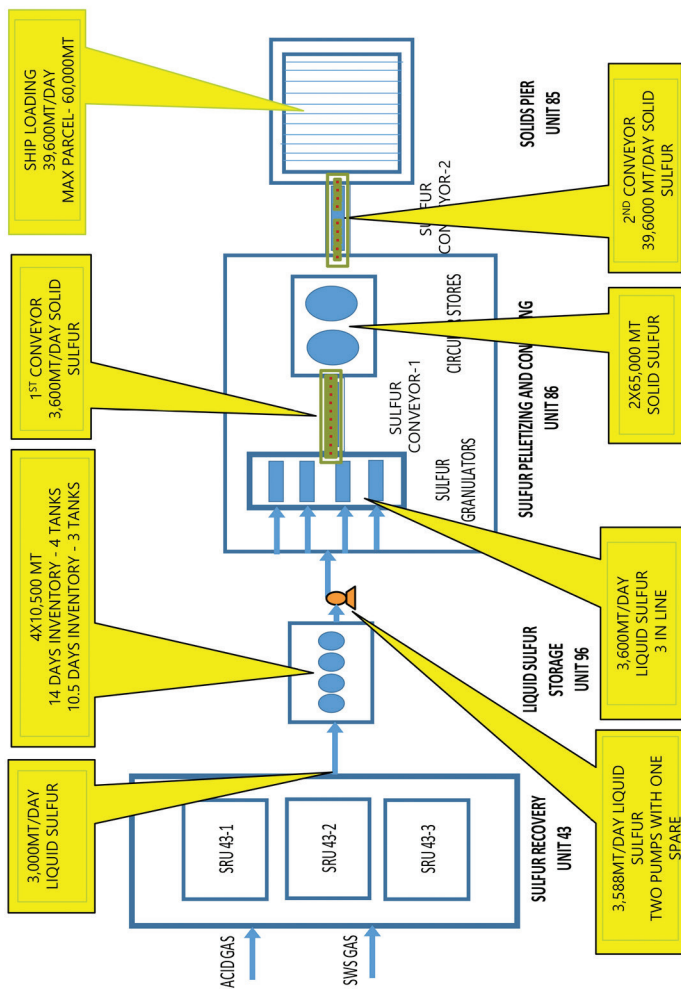
6.7 Solid Sulfur Storage

Covered stockpiles (circular stores) are utilized for storage of sulfur granules produced by the sulfur granulator.

Two parallel units, 86-A-0401A/B, are employed, each of 65,000 tons capacity. Together, the two circular stores provide storage of one shipping parcel (60,000 tons) and 21 days sulfur production at full rate.



6.8 Sulfur Handling



6.9 Utilities

Water System:

Demineralized water is introduced in to the granulation drum which provides the required cooling in the system.

Steam (Electric Steam generator, (2 X 5 t/h):

IP steam produced at 10 barg is let down to 4.0 barg and used for steam jacketing/ tracing of piping and equipment, Utility Stations. Also supplies steam to Unit 98.

Potable Water (1 X 100% Temperature Control package):

Used for safety shower and eyewash; Cooled from 36° C. to 25° C. Also has heating facility (electric heater).

Nitrogen Tube Trailer:

(four trailers, 3700 Nm³ each from 131 barg to 11 barg): Used for purging etc.

Instrument Air and Plant Air:

Used for purging etc; Supplied from Unit 98

7. Unit 85 Solid Pier

7.1 Objectives of the Unit 85

The Solids Pier (Unit 85) is a shore-connected marine structure that shall facilitate safe and reliable berthing and mooring of ocean-going bulk carriers for loading of solid sulphur product. This facility shall provide space and support for ship loading equipment, conveyors, auxiliary equipment, utilities, equipment for control of loading and shipping operations, and access to these same facilities.

The approach trestle departs offshore through the Small Boat Harbour (Unit 98) via the northern breakwater and travels out into the Arabian Gulf to a point east-north-east on the 10-meter depth contour. The required water depth at the Solids Loading Berth is 15 meters.

The Solids Loading Berth is a piled supported structure for berthing of a single vessel and is connected to shore via a piled approach trestle. The approach trestle will carry the conveyor, roadway, utilities and other infrastructure required for transfer and loading operations.

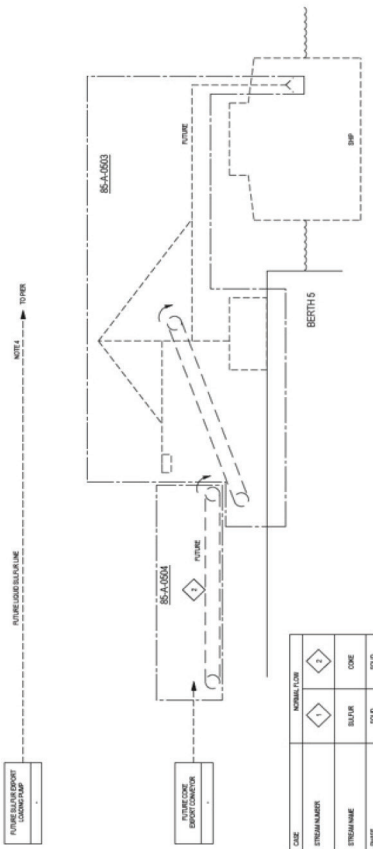
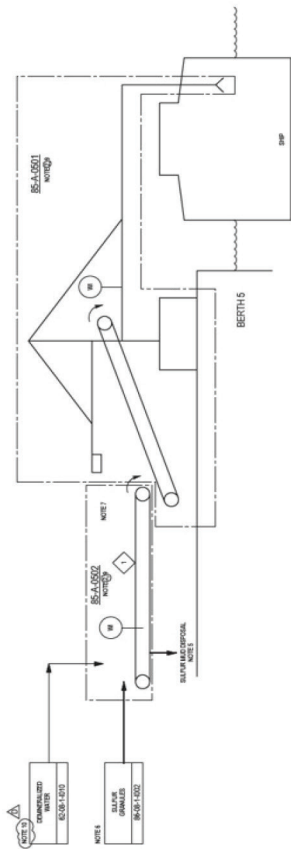
7.2 Design Features

Sulfur product from Sulfur granulation unit (U-86) will be transferred to Product Conveyor package.

Conveyer rated capacity: 1650 MT/Hr. (Working 1500 T/Hr.)
From Conveyor it is transferred to traveling Ship Loader Vessel
Capacities: 15000 to 60000 DWT

Expected Loading Operation: approx. 100 days in a year with berth occupancy less than 30%

Max. Loading time: 40 hrs. Parcels per year (at max size): 20



CODE	STREAM NAME	STREAM NAME	STREAM NAME
	1	BALUR	WPA 15
	2	CORE	WPA 16

0.0000

7.3 Facilities / Utilities

Sulfur Conveyor:

transfers Sulfur granules from U-86, 1650 T/Hr.

Traveling Ship Loader:

package for transfer to Ship.

Plant & Instrument Air:

2 x 100% Motor driven rotary screw compressors, plant air receiver, Inst. Air dryer package, Inst. Air receiver.

Potable / Chilled water:

Supply from ZOR for SS/EW and sanitary facilities.

Chlorinator package:

For Sea water pumps to prevent marine growth in the seawater pumps and intake metal work, a chlorinator package 85-A-2002 is provided. A branch from service water pump discharge provides the motive force at an ejector for suction of chlorine gas through the chlorinator rotameter. The service water containing dissolved chlorine/hypochlorous acid is sent to the service water pumps and the fire water pumps. The gaseous chlorine is supplied from the vapor part of the connected chlorine cylinder while a spare cylinder is kept as a spare.

Sanitary Waste Water Treatment:

Electric incinerating toilets

Fire Water system:

2 x 100% capacity diesel engine driven pumps (stand-by mode), Diesel make up is by truck.

8. Unit 98 Small Boat Harbour

8.1 Objectives of the Unit 98

The Small Boat Harbour consists of a harbour with a sheltered approach, berthing areas for support craft (tugs, mooring line boats, etc.), fuelling depot and other infrastructure as required for operation of this facility.

Landward of the harbour is the Marine Operations Building Complex that consists of office buildings, maintenance shops, warehouse, harbour master control tower and other buildings required to support maritime operations.

8.2 Facilities of Unit 98

- MDO bunkering system for tug boats and small crafts.
- Utility system such as air, water and LP steam.
- Sanitary waste water system.
- Oil water system.

8.4 Diesel Fuel Supply System

The diesel supply system includes the receiving facility, filtering, storage and distribution to the consumers.

The Diesel Supply system is composed of one MDO Storage Drum 98-V-0101 and two MDO supply pumps 98-P-0101AB.

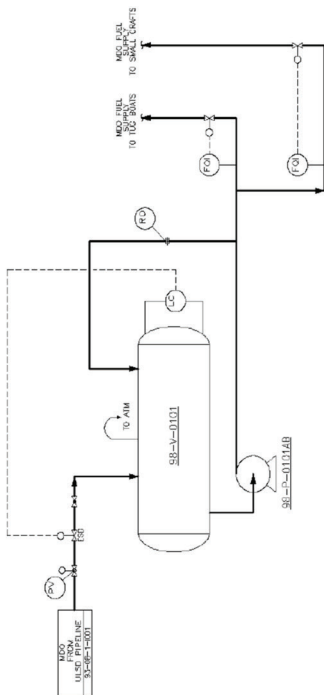
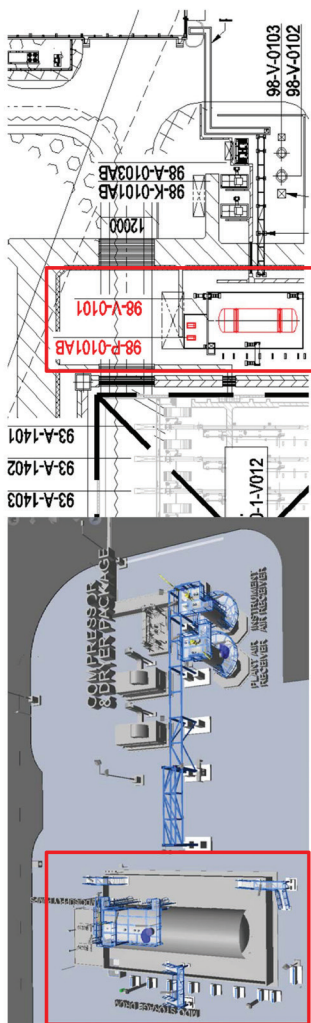
The working capacity of the drum is 234 m³ designed to meet one time loading of 188 ton for the largest tug boat with 70 TBP, and the approximate time of is estimated to be 4 hours at the filling rate of 57.7 m³/h.

The pumps supply MDO at the flow rate of min. 4.0 m³/h and max. 34 m³/h.

The min. flow to protect the MDO supply pumps will be kept by a continuous spill back through a restriction orifice.

Provision is made for a facility to provide fuel for 2 mooring boats, 1 crane work boat, 3 crane pilot boats and 9 tug boats, respectively.

8.5 Diesel Fuel Supply System diagram



8.6 Utilities

Instrument Air and Plant Air:

Two air compressors (2 x 1206 m³/h).

Water System:

Provided from unit 62.

LP Steam System:

LP Steam is provided from Unit 86.

Oily Water System:

Oily water in PHA shall be gravity routed to Common AOC Sump, 98-T-0103 or Oily Water Sump 98-T-0102 to be located in Small Boat Harbor and will be pumped to Unit 76 WWTP.

Sanitary Waste Water System:

Two lift stations, one for buildings and other for Harbor. Pumped to Unit 76 Waste Water Treatment.

9. Unit 88 Sub-sea Outfall Line

9.1 Objectives of the Unit 88

Subsea outfall line is part of the Plant Water System and provides an outlet into the Gulf. It includes:

- HDPE pipeline: 750m (onshore 90m, offshore 660m).
- Air release/Inspection Box: reinforced steel concrete structure Air release valve and Ball valve in air release/inspection Box Diffuser check valve: 4 EA.
- Diffuser dome: the protection concrete structure for diffuser check valves.
- Marker post with solar powered navigation warning light.
- Normally, no flow will go to the gulf. When zero liquid discharge (ZLD) facility is out of service or during extended period of heavy rainfall, water will be routed to the gulf.

9.2 Unit 88 General Arrangement

