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THE FOLLOWINGBARGE MOUNTED POWER PLANT IS AVAILABLE FOR SALE WITH US WITH IMMEDIATE DELIVERY:

TECHNICAL SPECIFICATION OF THE 110 MW BARGE MOUNTED HFO/ GAS GENERATOR BASED POWER PLANT

1.1 BACKGROUND

Pic 1: Arial view of 110 MW power barge.

Introduction

The Power Plant is a 110 MW HFO/ GAS Generator based power plant, commenced commercial

operation in June 1999 and generates power through eight units of Wartsila Vaasa diesel engines which carries a capacity of 16.3MW each unit.

The Power Plant has been constructed on a floating barge.

Power Plant

The Power Barge entered commercial operation in June 1999 has a capacity of 130 MW with a PPA contracted output of 110MW. The power barge was constructed in China with 8 Units of dual fueled Wartsila Engine Generator Sets as prime movers, which fire on both Heavy Fuel Oil and as well Compressed Natural Gas ("CNG") to generate electricity through shaft connection to a ABB generator through 500 rpm speed.Electricity,15kV at 50Hz,generated by the 8 Units of Wartsila Engine, ABB Generator is delivered to 2 ABB Main Step-up Transformers on board of the barge.

Black Start Generator and UPS

The power barge is equipped with an emergency diesel generator to ensure power supply to all essential plant support system when the plant is isolated from the grid to facilitate the starting of the plant from cold without back feed from the grid. The black start generator is connected with the Black Start Bus BFA-900. The power required for necessary auxiliary equipment to start two engine generators, namely Unit #2 and Unit #7 on fuel oil from cold condition is supplied from the black start bus.The plant is provided with 110V and 24V battery system for power back up in case of blackout. The battery systems are redundant and connected to a redundant battery charger.

Fuel Handling

Heavy fuel oil is currently in used. The heavy fuel oil is delivered directly to the storage tanks on board the barge by tank vessels. The tank vessel, carrying the heavy fuel oil,is moored alongside the power barge on the river side. The barge is able to store all the heavy fuel oil utilizing its 5 fuel oil storage tanks, each with a capacity of 500MT.

Although the engine supports fuel gas firing as primary fuel for operation, fuel gas is not in used since 2010 because of the fuel gas supply instability. A purpose built fuel gas compressor station was installed on site for fuel gas handling.

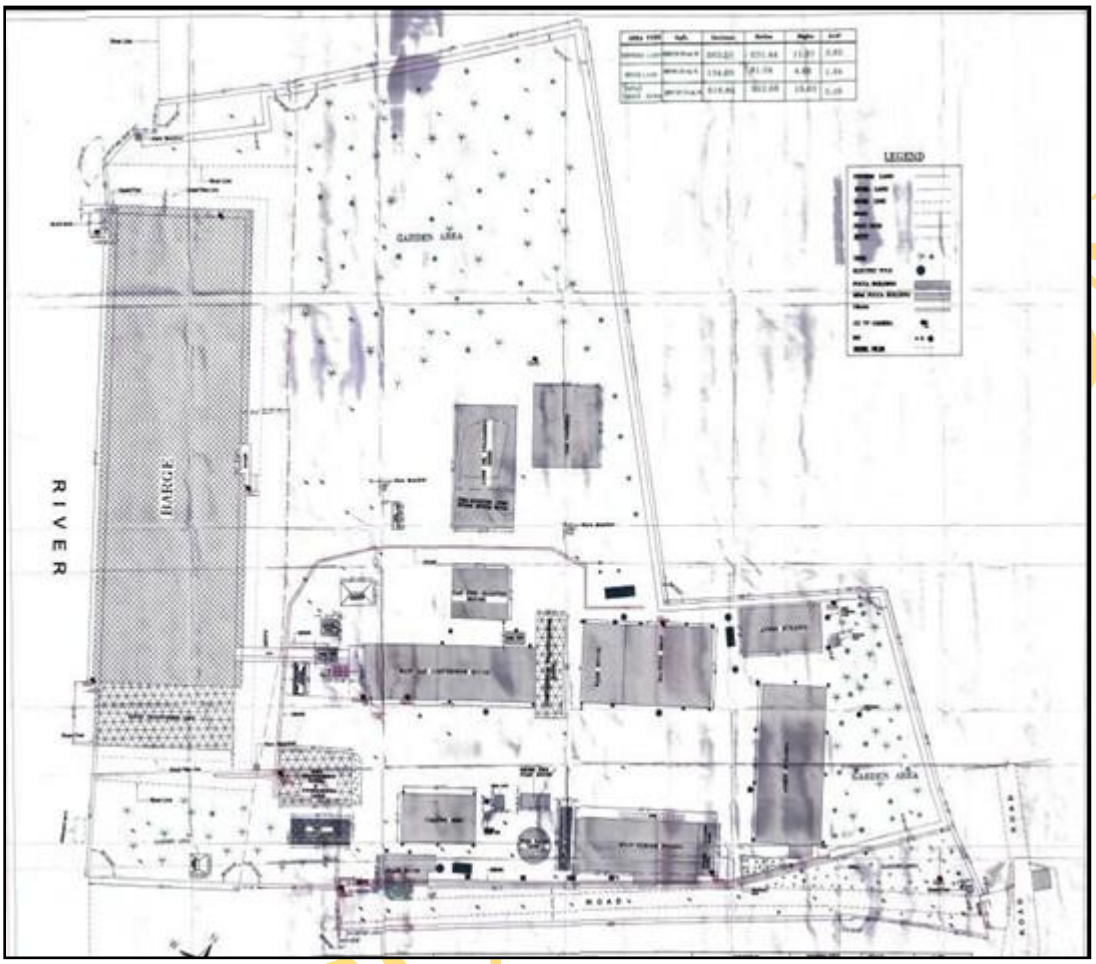
Layout and Construction

The power plant facility comprises of one floating power barge, gas compressor house / auxiliary equipment, office and storage buildings together with a comprehensive workshop.

Access to shore from the barge is enabled by gangways arranged to facilitate differences in sea water level. Power cables are arranged from one end of the power barge leading to an adjacent switch yard. Consequently, the power cables are not passing over the storage buildings inside the plant site. On the river side of the barge, there is a mooring arrangement and bunker station for the regular supply of fuel oil. The fuel oil pipes are arranged on the outside of the power barge and further distributed to the individual 5 storage tanks.

There is also a gas compressor station, where the natural gas is received via a pipe line from the LNG storage facility. This gas station compresses the natural gas pressure up to 360 bars before it is distributed through a single wall stainless pipe line before being consumed by the engine generators. The power plant is currently not operating on gas and has not been doing so since year 2010 due to shortage supply of gas.

The following provides the layout of the plant:



The layout of barge is conventional with the 2 main step-up transformers and a superstructure in one end containing control room, offices, storage and electrical equipment spaces and a covered machine hall stretching to the other end.

On the main engine hall of the barge, the 8 engine generators are arranged in parallel. Below main engine hall, there are segregated pump room spaces containing fuel and lube oil treatment plants, cooling water system and other ancillary systems together with storage/service tanks for fuel oil/lube oil and other service tanks.

The condition of the hull body is satisfactory and it is protected with a cathode hull protection systems. The most recent hull thickness measurement of Commodore I was conducted in October 2017with the report was stamped and acknowledged by a DNV surveyor. Annual certification of the hull is carried out.

Plant Control and Monitoring

Remote operation for start-up and shut down and normal operation is undertaken through a Distributed Control System (Wartsila Operator Information System ("WOIS")) which interfaces with the engine generator and other proprietary control systems for other equipment.

Operators inter face with the system via a number of control screens in the main control room, which provide higher solution graphics. Common alarms are shared between the screens. The control room

also contains a series of CCTV monitors which provide a realistic view of the plant from a number of remotely operated CCTV cameras.

The engine's main bearing temperatures are controlled and monitored in the control room by a non-line system of WOIS make. These systems are also provided with shutdown functions in the event the bearing temperatures will exceed the set value.The system is tested every 6 months. This system is only monitoring the main bearings and not the crank pin bearings.

Project Summary

Start Date Barge Construction	15 October 1998
Commercial Operations on HFO	29 June 1999
Commercial Operations on NG	03 October 2000
Technology	Reciprocating four stroke engines, dual fuel mode (Wartsila 18V46GD)
Number of Units	8 Diesel Engines coupled to 8 ABB Generators, 4 high pressure Main compressors, 1 high capacity Booster gas compressor
Manufacturer	Wartsila Finland and Ariel Corporation USA
Fuel	Natural Gas ("NG") and Heavy Fuel Oil ("HFO")
Net Saleable Capacity	120 MW HFO / 115 MW Natural Gas
Other Features	Barge Mounted Plant (300ft x 100ft), Radiator cooling, Onboard Fuel/Lube oil storage

Barge Details

The barge was built in accordance to the Det Norske Veritas (DNV) requirements. The following provides the detail information of the barge:

Built (year/location)	1998/China
Length	96.5m
Breadth	30.48m
Breadth moulded	29.4m
Draught (dwl)	3.70m
Gross Tonnage	4,957mt
Last docking	1998

The barge is built in accordance to Det Norske Veritas(DNV) regulations with the class notation Barge for Deck Cargo. The class is also maintained annually with regular annually class inspections carried out. The inspection for class certification is solely for the hull, internal storage tanks and the associated firefighting equipment installed. Machinery is not part of the inspection for the class certification survey. The latest inspection carried out was September2018.

The following are the class certificates held by the barge:

- Cargo Ship Safety Construction Certificate (1988Protocol)
- International Air Pollution Prevention Certificate
- Classification Certificate
- International Load Line Certificate
- International Oil Pollution Prevention Certificate
- International Sewage Pollution Prevention Certificate

- Non-Convention Cargo Ship Safety Construction Certificate

Total Generation

The total generation of each generator since the commercial operations date on 30 June 1999 until 31 December 2018 is as below:

Generator	Total Generation (GWh)
#1	1,147.94
#2	1,266.39
#3	1,200.00
#4	1,092.64
#5	1,108.51
#6	1,146.34
#7	1,184.08
#8	1,267.19
TOTAL	**9,413.09**

Note: Total Generation up to 28 February 2019

Engine Running Hours

The total running hours of each engine since the commercial operations date on 30 June 1999 until 12 March 2019 is as below:

Engine	Total Running Hours
#1	84,819
#2	94,637
#3	90,829
#4	81,544
#5	81,693
#6	85,171
#7	88,265
#8	91,899

Note: Running hours up to 12 March 2019

Historical Performance

Below are the historical performance data of the power barge for the last 5years.The availability in year 2017 and 2018 were affected by the Generator#6 and Generator#7 failure incidents. The plant has always achieved good availability in view that there are 8 diesel engines that require periodic maintenance and overhaul of the units yearly.

Year	2014	2015	2016	2017	2018
Annual Average Availability (%)	89.80%	93.71%	91.39%	87.88%	84.17%
Annual Average Heat Rate (kJ/kWh)	8,791	8,818	8,838	8,932	8,991

1.2 MAJOREQUIPMENT

Main engine prime mover

a. Main engine

Manufacturer	WARTSILA , Finland
Engine Type	18V46GD
Year Of Manufacturer	1997/1998
Output	16,290 KW
Rev. / Min.	500
Direction of Rotation	clockwise

b. Turning gear

Manufacturer	KATSA, Finland
Type	KV 250 - 370
RPS	25 R / sec.
Max. Torque	50 Nm

c. Turning gear motor

Manufacturer	ABB MOTORS LTD.
Type	QU 132 M6BT
Model	GS 971402

d. Turbo charger for Engine 2 to8

Manufacturer	NAPIER ALSTOM TURBOCHARGER
Type	557
Compressor	4H 250 F
Turbine	379 J
Max. speed	16250 RPM
Max. temp.	650ºC

Turbo charger for Engine 1 (retrofitted in February 2019)

Manufacturer	ABB
Type	VTR454D32

e. Charged air cooler

Manufacturer	VESTAAIR
Model	18V46 GD
Type	WT 163 / 163

f. Engine radiator unit

Manufacturer	FINCOIL
Model	FBX1GE-13-7-M3-H

Generator

a. Generator

Manufacturer	ABB
Type	AMG-1600 SR 12
Specification	KVA : 20000, P.f. : 0.80, V : 15000 Y, Hz : 50, RPM : 500, Amp : 770
Excitation	121 Volt , 11.1 Amp
Weight	53,200 Kg
Year of Manufacturing	1998

b. Bearing

Manufacturer	RENK HANNOVER
Type	SCZ CQ 36 - 325

c. Switchgears

Manufacturer	ABB

d. Black start generator

Manufacturer	MARATHON ELECTRIC
Model	574RSL4038
Engine	Perkins Engine (Shrewsbury Ltd.), England Model: 3000 Series

Transformer

a. Grid power transformer (Main Step Up Transformer)

Manufacturer	ABB
Type	KTRW145X80 ▪ Capacity:80MVA ▪ Connection: Ynd11 ▪ Standard: IEC76 ▪ Oil Volume:16,400kg

b. Station transformer

Manufacturer	ABB
Model	CTMP 18 HA 1600

Fire fighting System

a. Barge fire pump (motor driven)

Manufacturer	KSB
Pump	ETANORM-M 80-250-M-1
Motor	ZN3804-C37X52
Control panel	SISU PIIRN. NO.- B58877T

b. Barge fire pump (enginedriven)

Manufacturer	KSB
Pump	ETANORM-M 80-315 M1
Engine	SISU Type: VALMET 320 DSPK
Control panel	SISU 320 DSPK

c. Barge jockey pump

Manufacturer	KSB
Pump	MOVICHROM, N-G3-12-PN25G1
Motor	2Z3C/6205

Control panel	SISU PIIRN. NO.- B58877T

d. Fixed CO2system

Manufacturer	Kidde
Model	WK-283428-000

Fuel Oil System

a. HFO transfer pump

Manufacturer	IMO AB
Model	ACG 052 N6 ITBP
Motor	ABB MOTORS LTD. M2AA112M 3 Phase Motor Cl. F , IP 55, IEC 34 - 1 Weight : 27 Kg.

b. HFO feeder pump

Manufacturer	IMO AB
Model	ACG 052 N6 ITBP
Motor	MEZ MOTORS LTD. CZECH REPUBLIC 7BA132S02 3 Phase Motor Insl. F, IP 55, IM V5 , Weight : 63 Kg

c. HFO fuel booster pump

Manufacturer	IMO AB
Model	ACG 070 N6 NTBP
Motor	MEZ MOTORS LTD. CZECH REPUBLIC 7BA160 M02 3 Phase Motor, Insl. F, IP 55, IM V5 , Weight :107 Kg

d. Fuel oil unit feed pump

Manufacturer	IMO AB
Model	ACG 045 K6 NTBP
Motor	ABB MOTORS LTD. M2AA132SA 3 Phase Motor, Insl. Cl. F, IP 55, IEC 34-1, Weight : 3 Kgs

e. Fuel oil unit return pump

Manufacturer	IMO AB
Model	ACE 025N2 NTBP
Motor	ABB MOTORS LTD. M2AA 090S 3 Phase Motor, Insl. Cl.F, IP 55, IEC 34

Lube Oil System

a. Clean lube oil transfer pump

Manufacturer	IMO AB
Model	ACE 038 N1 IVBO

Motor	ABB MOTORS LTD. M2AA090L 3 Phase Motor, Insl. Cl. F, IP 55, IEC 34

b. New lube oil transfer pump(shore)

Manufacturer	IMO AB
Model	ACE 032 N1 IVBO
Motor	ABB MOTORS LTD. M2AA090S 3 Phase Motor, Insl. Cl. F, IP 55, IEC 34

c. Used lube oil transfer pump

Manufacturer	IMO AB
Model	ACE 038 N1 IVBO
Motor	ABB MOTORS LTD. M2AA100L 3 Phase Motor, Insl. Cl. F, IP 55, IEC 34

d. Used lube oil unloading pump

Manufacturer	IMO AB
Model	ACE 038 N1 IVBO
Motor	ABB MOTORS LTD. M2AA 100L 3 Phase Motor, Insl. Cl. F, IP 55, IEC 34

e. Lube oil automatic filter

Manufacturer	BOLL & KIRCH
Model	6.61.07.DN.200
Specification	Filter : 34 micron Max. allw. Working Pressure : 10 bar Max. allw. Working Temperature : 80 deg C

f. Engine lube oil cooler

Manufacturer	ALFA LAVAL
Model	M 15 - BFM8
Specification	Max Working Pressure : 8 bar Max. Working Temperature : 110 deg C Test Pressure : 12 barg Volume : 379.8 liter

g. High pressure sealing oil pump

Manufacturer	Brueninghaus Hydromatic
Model	A4 VSO 40 DR PPB13N00
Motor	ABB MOTORS LTD. M2AA225SMB6 3PhaseMotor Insul. Cl.F, IP55, IEC34-1

Fuel Gas Compressor System

a. Gas compressor

Manufacturer	ARIEL CORPORATION
Model	JGK/4
Specification	Stroke : 139.7 mm Max/min Rated Speed : 1200/600 rpm Max. Total Rod Load : 329166.852 N Normal LO Pressure : 345 kPa Max. LO Temperature : 88 deg C Ist Stage Cylinder Specification : Bore : 149.225 mm, Stroke : 139.7 mm, Class K Max Allowable Working Pressure : 141.379 barg Piston End Clearance (mm) HE:2/3 CE : 1/3 Min. Volume Clearance % HE : 21.8 CE : 26.5 2nd Stage Cylinder Specification: Bore : 98.425 mm, Stroke : 139.7 mm, Class K-FS- TR Max. Allowable Working Pressure : 462.069 barg Piston End Clearance (mm) HE:2/3 CE :1/3 Min. Volume Clearance % HE:42.5 CE :42.5

b. Gas compressor motor

Manufacturer	ABB INDUSTRY FINLAND
Model	HXR 500 LP6
Specification	3 Phase Motor, Duty SI, IC 411, IM 1001, IP 55, IEC 34-1

c. Booster gas compressor

Manufacturer	ARIEL CORPORATION
Model	JGC/4
Motor	Stroke : 165 mm Max/min Rated Speed : 1000/500 rpm Max. Total Rod Load : 114000 N Normal LO Pressure : 345 kPa Max. LO Temperature : 88 deg C Year of Mfg. : Nov 1999 Cylinder Specification Bore : 318 mm, Stroke : 165 mm, Class C Max Allowable Working Pressure : 800 barg Piston End Clearance(mm) HE : 2.03-3.56 CE :1.02 Min. Volume Clearance % HE:15.6 CE :16.8 Cylinder Serial No.:

d. Booster gas compressor motor

Manufacturer	ABB INDUSTRIE AG
Model	AMB 560L6A BAEB
Specification	Squirrel Cage Induction Motor 3 phase Motor, IC 611, IM 1001, IP 54, Insl. Cl. F, IA/IN 5.5

Compressed Air System

a. Starting air compressor motor

Manufacturer	ABB MOTORS LTD.
Model	M2AA200MLB 4
Motor	3 Phase Motor, Insl. Cl F, IP 55, IEC 34-1, Wt. 205 Kg

b. Barge instrument & service air compressor unit/motor

Manufacturer	TAMROTOR OY
Model	Fx-15-7 EAA
Specification	Capacity : 2.15 m3/min Max. Working Pressure : 7 barg Speed : 9220 rpm Weight : 285 kg Motor : 15 kW, Elect. Supply : 415, Hz : 50

c. Barge Instrument Air Dryer/Motor

Manufacturer	HANKISON INTERNATIONAL
Model	HIT 75 CE
Specification	Ps : 40 barg HP Ps : 12 barg LP Volt : 230, kW : 1.04, Amp : 5.5, Hz : 50, IP 20

Steam System

a. Steam generator

Manufacturer	STEAMRATOR
Model	STEAM2250
Specification	Output : 1.5 mW Max Operating Pressure : 13 Mpa Max Operating Temperature : 195 deg C Minimum Operating Temperature : 0 deg C Volume : 0.6 m3

b. Steam generator burner

Manufacturer	OILON LTD. FINLAND
Model	KP-140H
Specification	Oil Volume : (47-200) Kg/hr Oil Quality : (4-12) mm2 / sec + 20 deg C 415 Volt, 3-50 Hz, 5.5 Kw

c. Steam generator burner motor

Manufacturer	LONNE, NORWAY
Model	4 AP112M-2
Specification	3 Phase Motor, Insl. Cl. F, IP 55, IEC 34, B5

d. Exhaust Gas Boiler

Manufacturer	AALBORG
Model	Type: AV-6N

1.3 CONDITION OF ENGINE ANDGENERATORS

Engine Major Overhaul

The engines underwent periodic maintenance at the interval specified by the OEM, Wartsila. The maintenance regime for the Engine and main scope of work are listed as below:

- Every 1,000 hr – Preventive maintenance including oil change and filter replacement
- Every 6,000 hrs – Additional inspections and condition tests
- Every 12,000 hrs – Additional turbo charger overhaul and maintenance of auxiliary equipment
- Every 16,000 hrs – Additional cylinder head overhaul and inspection of all moving components clearance.
- Every60,000 hrs–Additionalmovingcomponentreplacementsuchasconrod,bearing,camshaft bushing and auxiliary equipment overhaul.

The generator for each unit is subject to an OEM recommended 60,000 hrs rotor pull out overhaul and thorough inspection along with a yearly inspection.

The transformer is subject to a six monthly inspection and electrical test. Both transformers have had their HV bushing replaced in January 2018 and comprehensive electrical tests were carried out by ABB in 2016. Oil was also replaced in 2016 during the maintenance carried out by ABB.

Vibration Monitoring – Condition monitoring of the plant's equipment has been established. Vibration monitoring using manual hand held vibration measurement device to record on all rotating equipment in the plant on a quarterly basis.

Lubrication Oil Sampling – The lubrication oil for the engine is sampled and sent to the US based Sigma Laboratories on a monthly basis. The plant chemist also carried out lubrication oil analysis and samples are taken on a weekly basis for TBN, water content, etc.

Fuel Oil Sampling–At every delivery of a new fuel oil,samples are taken and senttoViswa,Singapore for analysis. On a 6 monthly basis, oil samples before and after, the lubrication oil purifier are taken and sent for analysis. This allows the plant to determine the efficiency of the oil purifiers.

Transformer Oil Sampling–Insulation oil samples are taken and it is to be carried out on a six monthly basis. The extensive oil analysis includes testing for both corrosive sulphur and furfural related compounds. The oil samples are sent to third party laboratories on a yearly basis for analysis. The in house laboratory is used for regular analysis of oil for moisture content and dielectric strength monthly. The transformers are not installed with online DGA monitoring.

Thermographic Analysis – Thermographic inspections are undertaken on the engine exhaust manifold, 15kV and 32kV connections on a routine two yearly basis by third party specialist.

The tables below show the major maintenance that was carried out on the main components of the engines.

Engine#1

			Inspection & Maintenance Carried Out										
Date	**Accumulate d RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
22.09.03	16,427	16K overhaul	√	√	√				√			√	
09.10.04	22,091	8K overhaul						√					
05.10.06	33,996	16K overhaul	√	√					√			√	
12.08.09	53,031	16K overhaul	√	√	√				√		√	√	√
04.11.12	67,932	60K overhaul	√	√	√	√	√	√	√	√	√	√	√
12.12.18	84,810	16K overhaul	√	√		√	√	√	√	√		√	√

Engine#2

			Inspection & Maintenance Carried Out										
Date	**Accumulate d RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
24.01.02	12,037	16K overhaul	√	√									
13.06.04	24,445	8K overhaul	√	√								√	
11.12.06	41,254	16K overhaul	√									√	
12.02.07	42,402	Preventive	√						√			√	
25.06.09	59,319	16K overhaul	√	√								√	
06.11.09	61,035	60K overhaul	√	√	√	√	√	√	√	√	√	√	√
28.01.11	66,409	Preventive										√	
06.08.14	83,648	16K overhaul	√	√		√				√		√	√
15.09.17	92,289	Overhaul	√				√	√					

Engine#3

			Inspection & Maintenance Carried Out										
Date	**Accumulate d RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
09.03.02	12,707	16K overhaul	√	√									
14.02.04	21,342	8K overhaul	√								√	√	
15.12.06	38,439	16K overhaul	√	√	√				√		√	√	
02.06.10	54,943	16K overhaul	√	√					√			√	√
13.10.14	79,920	16K overhaul	√	√		√				√	√	√	√

Engine#4

			Inspection & Maintenance Carried Out										
Date	**Accumulated RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
25.05.03	15,633	16K overhaul	√	√	√							√	
07.09.04	22,401	8K overhaul											
06.04.06	32,218	16K overhaul	√	√					√			√	
27.12.08	50,601	16K overhaul	√	√	√				√		√	√	
06.04.11	60,899	60K overhaul	√	√	√	√	√	√	√	√	√	√	√
24.01.17	78,525	16K overhaul and Generator Cryogenic cleaning	√	√		√	√	√	√	√	√	√	√

Engine#5

			Inspection & Maintenance Carried Out										
Date	**Accumulated RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
10.12.03	15,929	16K overhaul	√	√	√				√	√		√	
21.03.05	23,154	8K overhaul						√				√	
05.07.06	31,167	16K overhaul	√	√	√				√			√	
21.05.09	49,755	16K overhaul	√	√					√			√	√
20.09.13	68,089	Big end bearing failure	√	√		√	√	√	√	√		√	
06.10.13	68,089	60K overhaul	√	√	√	√	√	√	√	√	√	√	√

Engine#6

			Inspection & Maintenance Carried Out										
Date	**Accumulated RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
05.05.02	12,378	16K overhaul	√	√							√		
15.04.05	28,887	16K overhaul	√	√	√				√			√	
14.01.08	48,239	16K overhaul	√	√					√			√	
10.09.10	62,086	Preventive										√	

05.11.10	63,117	60K overhaul	√	√	√	√	√	√	√	√	√	√	√
28.10.13	73,439	8K overhaul	√			√		√				√	
20.12.15	81,158	16K overhaul	√	√		√	√	√	√	√		√	
08.05.16	82,094	16K overhaul	√	√		√	√	√	√	√		√	

Engine#7

			Inspection & Maintenance Carried Out										
Date	**Accumulate d RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
25.08.02	13,510	Overhaul	√	√	√				√		√		
22.08.04	22,996	8K overhaul						√					
17.12.05	28,281	16K overhaul	√	√					√			√	
10.10.08	48,057	16K overhaul	√	√	√				√			√	
14.01.11	60,521	Engine Reconstruction	√	√	√	√	√	√	√	√	√	√	√
24.08.15	79,998	16K overhaul	√	√	√	√	√	√	√	√		√	√
07.07.17	86,255	Preventive	√										

Engine#8

			Inspection & Maintenance Carried Out										
Date	**Accumulate d RH of Engine**	**Maintenance Type**	**Big End Bearing**	**Main Bearing**	**Thrust Bearing**	**Piston Crown**	**Con Rod & Bush**	**Gudgeon Pin**	**Valve Mechanism**	**Cam Shaft Piece & P**	**Lube oil Cooler**	**Liner 'O' Ring**	**Crankcase relief**
07.07.02	13,590	16K overhaul	√	√	√						√		
03.09.05	30,724	16K overhaul	√	√	√				√			√	
06.07.08	50,216	16K overhaul	√	√	√				√		√	√	
06.12.10	60,145	Preventive										√	√
18.04.12	72,050	60K overhaul	√	√	√	√	√	√	√	√	√	√	√
02.04.15	86,349	A7B7 big end bearing damaged	√	√	√	√	√	√			√	√	√
22.02.16	85,876	16K overhaul	√	√		√	√	√	√	√		√	√

RH = Running Hours

Engine Maintenance History and CurrentStatus

Engine #1:

a. The total running hour of the engine is 84,819 till date. The engine underwent 16,000 run-hour interval minor overhaul in December 2018 and 60,000 run-hour major overhaul in November 2012.

b. The engine was converted to 100% HFO from the gas diesel ("GD") injection system in year2016.
c. Currently, the engine has 3 cylinder heads that were repaired with metal stitching method and the remaining 15 are new cylinder heads that were purchased between year 2016 and2018.
d. During the last 16,000 run-hour minor overhaul, the two Napier 557 turbochargers were replaced with ABB VTR454D32 turbochargers in February 2019 under the retrofit program.
e. The ABB Generator coupled to the engine underwent stator windings partial discharge ("PD") burn repair job along with full re-wedging. Additionally, 6 numbers of rotor poles out of twelve were rewound between December 2018 and February2019.

Engine #2:

a. The total running hour of the engine is 94,639 till date. The engine underwent 16,000 run-hour minor overhaul in September 2014 and 60,000 run-hour major overhaul in November2009.
b. Due to the big-end bearing shells failure, the crankpin of unit A2B2, A4B4, A7B7 and A9B9 underwent machining to 5.0 mm undersize, 2.0 mm undersize, 7.0 mm undersize and 8.0 mm undersize respectively.
c. The engine was converted to 100 % HFO from the GD injection system in year2018.
d. Currently, the engine has 12 cylinder heads that were repaired with metal stitching method and the remaining 6 are new cylinder heads which were purchased between year 2013 and2017.

Engine #3:

a. The total running hour of the engine is 90,835 till date. The engine underwent 16,000 run-hour minor overhaul in November2014.
b. Due to the catastrophic damage from the connecting rod, the engine block was replaced by EPC Contractor Wartsila with a new one in year 2007 along with performing other reconstruction work on the engine.
c. The engine was converted to 100 % HFO from the GD injection system in year 2017
d. Currently, the engine has 11 cylinder heads that were repaired with metal stitching method and the remaining 7 are new cylinder heads which were purchased between year 2014 and2017.

Engine #4:

a. The total running hour of the engine is 81,546 till date. The engine underwent 16,000 run-hour minor overhaul in February2017.
b. Due to the catastrophic damage from the connecting rod, the engine block was replaced by Goltens Singapore PTE Ltd. with a used one in year 2011 along with performing other reconstruction work on the engine.
c. The engine was converted to 100 % HFO from the GD injection system in year2016
d. Currently, the engine has 2 cylinder heads that were repaired with metal stitching method and the remaining 16 are new cylinder heads which were purchased in year2016.

Engine #5:

a. The total running hour of the engine is 81,698 till date. The engine underwent 60,000 run-hour major overhaul in November2013.
b. Due to the big-end bearing shells failure in 13, the crankpin of unit A7B7 underwent machining to 10.0 mm undersize.
c. The engine was converted to 100 % HFO from the GD injection system in year 2016
d. Currently, the engine has 10 cylinder heads that were repaired with metal stitching method and the remaining 8 are new cylinder heads which were purchased between year 2015 to2017.

Engine #6:

a. The total running hour of the engine is 85,172 till date. The engine underwent 16,000 run-hour minor overhaul in May 2016 and 60,000 run-hour interval major overhaul in November2010.
b. Due to the big-end bearing shells failure in 2016, the crankpins of unit A2B2 and also the unit A8B8 underwent machining to 5.0 mm undersize.

c. Currently, the engine has 16 cylinder heads that were repaired with metal stitching method and the remaining 2 are new cylinder heads which were purchased between year in year2017.
d. The engine was converted to 100 % HFO from the GD injection system in year2018
e. Due to electrical failure in mid of 2017, the stator windings of the generator underwent full rewinding in year 2018. All the twelve numbers of rotor poles also underwent rewinding due to the earth fault and inter-turn shorts.

Engine #7:

a. The total running hour of the engine is 88,275 till date. The engine underwent 16,000 run-hour minor overhaul in September2015.
b. Due to the catastrophic damage from connecting rod, the engine block was replaced by EPC contractor Wartsila with a new one in year 2011 along with performing other reconstruction work on the engine.
c. The engine was converted to 100 % HFO from the GD injection system in year2016
d. Currently, the engine has 7 cylinder heads that were repaired with metal stitching method, 2 were repaired by a local workshop,1 was repaired by an overseas company,1 was original from the OEM Wartsila and the remaining 7 are new cylinder heads which were purchased between year 2015 and2017.
e. Due to electrical failure in end of 2017, the stator windings of the generator underwent partial discharge ("PD") burn repair and full re-wedging and in addition to the rewinding of all the 12 numbers of rotor poles in year2018.

Engine #8:

a. The total running hour of the engine is 91,900 till date. The engine underwent 16,000 run-hour minor overhaul in March 2016 and 60,000 run-hour interval major overhaul in April 2012.
b. Due to the big-end bearing shells failure in 2015, the crankpins of unit A7B7 underwent machining to 10.0 mm undersize.
c. The engine was converted to 100 % HFO from the GD injection system in year2017
d. Currently, the engine has 5 cylinder heads that were repaired with metal stitching method, 2 were repaired by a local workshop, 2 were original from the OEM Wartsila and the remaining 9 are new cylinder heads which were purchased between year 2015 and2017.

Generator Inspection

In 2017, Generator #6 (July 2017) and #7 (November 2017) suffered electrical failures and the rotor and stator bar shave to be repaired and rewound. The generator restoration works were completed and both the generators were commissioned on 9 July 2018 and 9 June 2019 for Generator #6 and #7 respectively to full load operation (i.e. Generator #6: 14.5 MW and Generator #7: 14MW).

Following the Generator #6 and #7 failure incidents in 2017, inspections on all the remaining generators were carried out in July 2017. The result of the inspection is as below:

Gen	Condition	Findings	Recommendations	Action Taken
1	Fair	- L1 phase partial discharge ("PD") pattern show advanced stage slot PD mainly due to eroded corona coating and probably also due to lose winding in the slot. - L2 and L3 phases PD patterns show internal discharges in the main insulation due to delamination of insulation layers and surface discharges in the end winding area.	- Remove the rotor to perform cryogenic cleaning of the stator winding & hand cleaning of the rotor winding. - Insertion of graphite loaded conductive side slot packers to fill void between stator core and stator oil. - Repair all the PD activity locations by standard method. - Perform off line PD, tan delta and capacitance mapping test on the stator after repairs.	- In December 2018, Generator #1 was opened up for the partial discharge repair works. on six (6) of the rotor poles in addition to the planned repair works on the generator rotor and stator. The repair works of Generator #1 was completed on 28 February 2019 and the generator is currently in healthy condition.
2	Excellent	- L1 phase PD patterns show internal discharges in the main insulation due to delamination of insulation layers and surface discharges in the end winding area of low level with low repetition rate. - L2 and L3 phases PD patterns indicate mainly end winding discharges. Possible cause is the weakened end winding voltage suppression system. Discharge magnitudes are of low levels.	- Hand cleaning of end winding to remove all the dry dust wherever accumulated to the best possible extent. - Hand clean field winding. - Repeat the PD test after a period of 12months.	- Hand cleaning of end winding, overhang area, rotor and field winding completed. - In-situ Cryogenic cleaning of stator completed with dry ice.
Gen	**Condition**	**Findings**	**Recommendations**	**Action Taken**

3	Excellent	- L1 and L2 phases PD patterns indicate mainly end winding discharges. Possible cause is the weakened end winding voltage suppression system. Winding is contaminated by dry dust all over which also gives rise to the end winding surface discharges over a period of time. Discharge magnitudes are of very low levels. - L3 phase PD patterns indicate low level internal discharges. These discharges generally occur due to delamination of mica layers in the main ground wall insulation. Patterns show discharges arein initial state.	- Hand cleaning of end winding to remove all the dry dust wherever accumulated to the best possible extent. - Hand clean field winding. - Repeat the PD test after a period of 12months.	- Hand cleaning of end winding, overhang area, rotor and field winding completed. - In-situ Cryogenic cleaning of stator completed with dry ice.
4	Good	- L1, L2 and L3 phases PD patterns show internal discharges in the main insulation due to delamination of insulation layers and surface discharges in the end winding area. - It has been observed that around 35 PD site areactive and have moderately affected the outermost insulation layers of the ground wall insulation of the slot area of the coils. - Damages created by PD to the insulation system cannot be fully repaired without a full rewind with new stator coils. However, by mini mising the root causes and reapplying the weakened corona protection wherever accessible, the ramp up rate of the PD activity and its damages can be controlled and slower down by	- Remove the rotor to perform cryogenic cleaning of the stator winding & hand cleaning of the rotor winding. - Insertion of graphite loaded conductive side slot packers to fill void between stator core and stator oil. - Repair all the PD activity locations by standard method. - Perform off line PD, tan delta and capacitance mapping test on the stator after repairs. -	- For the time being hand cleaning of end winding, overhang area, rotor and field winding completed. - In-situ Cryogenic cleaning of stator completed

		considerably.		
5	Excellent	- L1 phase PD patterns indicate mainly end winding discharges of low level with low repetition rate.	- Cryogenic cleaning of the winding to remove all the greasy substance to the best possible extent.	- For the time being hand cleaning of end winding, overhang area, rotor and Field winding completed.

Gen	Condition	Findings	Recommendations	Action Taken
		- L2 phase PD patterns indicate mainly end winding discharges of low level with low repetition rate. Spark PD patterns observed mainly due to contamination due to conductive remnants all over the winding especially on Drive end. - L3 phase PD patterns indicate defect due to the detachment of main insulation from the conductors. Discharge magnitudes are of low levels and with low repetition rate indicate discharge in its initial stage.	- Hand clean field winding. - Repeat the PD test after a period of 12months.	- In-situ Cryogenic cleaning of stator completed
6		- On 9 July 2017, Generator #6 suffered flashover damage on the stator and rotor winding.	-	- The stator windings underwent full rewinding at site while all the 12 rotor poles were sent to Quartzelec workshop in India for rewinding. - After the rewinding works, electrical tests (insulation resistance, polarization index, tan delta, partial discharge measurement, capacitance test, ELCID test) were carried out and the results were good. - Pictures of the repair isin **Appendix 2.**

7		- 22 November 2017, generator #7 suffered electrical fault on the stator and rotor windings.	-	- The stator windings underwent partial discharge ("PD") burn repair and full re- wedging while all the 12 rotor poles were set to Quartzelec workshop in India for rewinding. - After the rewinding works, electrical tests (insulation resistance, polarization index, tan delta, partial discharge measurement, capacitance test, ELCID test) were carried out and the results were good. - Pictures of the repair isin **Appendix 3.**
8	Good	- L1 phase PD patterns show internal discharges in the main insulation due to	- Cryogenic cleaning of the winding to remove all the	- For the time being hand cleaning of end winding,

Gen	Condition	Findings	Recommendations	Action Taken
		delamination of insulation layers and surface discharges in the end winding area of low level with low repetition rate. - L2 phase PD patterns indicate mainly internal discharges happening within the main ground wall insulation with magnitudes of low levels. - L3 phase PD patterns indicate low level internal discharges, end winding discharges, and slot discharges. Discharge magnitudes are of low levels with low repetition rate.	greasy substance to the best possible extent. - Hand clean field winding. - Repairs to the distorted end turns on 3 poles and addition of POLYGLASS resin bands on all 12 poles – 4 corner seach. - Repeat the PD test after a period of 12months.	Overhang area, rotor and field winding completed. - In-situ Cryogenic cleaning of stator completed

Note: The generator condition rating is as per the report and is based on the Global Evaluation Table as per IEC 60270.

1.4 MAJOR PLANT UPGRADES

The following major upgrades have been carried out in the last five (5) years as per the table below.

No	Date of Modification	Description	Reason for Upgrade	Cost (USD)
1	Feb 2019	Eng. #1 both bank existing Turbocharger (NAPIER 557) replaced by ABB Turbocharger Type: VTR454D32.	- NAPIER 557 Turbocharger has become obsolete. Parts are not easily available. - ABB Turbocharger VTR454D32 is abundantly used presently and has good reliability. - The 2 units of Napier TC components that were taken out can be cannibalized for spare parts for the others 7engines.	330K
2	Dec 2018 & Jan 2019	SF6 breaker tulip contacts replaced with new one.	Due to aging, all the tulip contacts were tested to have contact resistance above the limit set by the OEM. High contact resistance can cause heating and subsequently flashover. To ensure reliability, all the tulip contacts were Replaced.	160K

3	Dec 2018 & Jan 2019	Generator 3 & 5 obsolete HPA series SF6 breaker replaced with newer version HD4 breakers	HPA series breakers have breaker obsolete and spring charging mechanism is malfunctioning and cannot be serviced. The breakers were replaced with newer versions to ensure plant reliability.	120K
No	**Date of Modification**	**Description**	**Reason for Upgrade**	**Cost (USD)**
4	Nov 2017 & Jul 2018	Generators AVR DEC 125 replaced upgraded version DECS 250.	AVR DEC 125 has become obsolete and not functioning correctly.	160K
5	Mar 2016 & Nov 2018	Conversion of GD injector to pure HFO injector of all engines.	As the plant is contracted to run only on HFO. The HFO injectors	250K
6	Jan 2014	Installation of Engine High Temp cooling water system thermostatic Proportional, Integral, Derivative ("PID") valve in all engines	To avoid thermal shock in the engine during starting, PID valve was installed in all the engines.	40K

1.5 MAINTENANCE & SERVICEAGREEMENT

The maintenance team includes a dedicated group of maintenance engineers and workshop fabricators. The whole maintenance team consists of 30 staffs. The maintenance department is organised along conventional functional disciplines, which includes a Mechanical Section, an Electrical and C&I Section, Machine Shop Section and as well a Maintenance Planner & QAQC Engineer.

The site team undertakes condition monitoring as well as routine maintenance, preventative and defectmaintenance.Themajorityofthestaffhasbeenemployedatthepowerplantformanyyears since COD and are considered to be very familiar with the plant equipment.

There is no Long Term Service Agreement ("LTSA"). All parts and services are procured from the Original Equipment Manufacturer ("OEM") or other third party supplier through the company's procurement process. Wartsila, the OEM of the engines provide all the necessary parts and services for the main engines. Other reputable vendors and suppliers that are also supplying parts and services to NEPC includes:

- Marine power International,UAE
- GST, Singapore
- Alphastar, Singapore
- Sperre, Norway
- Napier, UK
- ABB.
- Gentech.
- Marine Motor Services, Germany

The plant maintenance management system runs on maintenance software call Data Stream MP2. The system has been specifically configured and structured to manage and track a variety of maintenance tasks as required by the plant. Specific plant identification tags are used in the registry for identification of plant equipment/components. Among the facilities built into the maintenance

management system include generation and tracking of:

- Fault notifications
- Work orders, including links to maintenance procedures
- Preventive maintenance schedules
- Conditioning monitoring program schedules
- Spares inventory (including re-order triggering)

The MP2 computerised maintenance planning system has been developed and configured to help support and monitor the plant maintenance activities. The MP2 computerised system contains the preventative maintenance programs based on the relevant OEM recommendations. The computerised system includes condition monitoring requirements, routine operational testing, and plant maintenance history.

1.6 PLANT PROTECTION FACILITIES

Fire Protection Systems

Generally, the fire protection system for the plant is divided in to barge and land facilities. Barge Fire protection system are divided into 8 zones, installed with circa 97 smoke/heat detectors. These covers crucial protected fire prone areas such as engine hall, switch gear room, central control room, cable tunnels and engine room. No fix fire protection system is installed in the engine hall. The land facilities are divided I n9 zones, installed with circa119smoke/heat detectors. The areas covered are mainly the buildings such as the administration building, annex building, warehouse, lube oil unloading shed, booster compressor spare motor room and machine shop.

All detectors are connected to a central fire panel located in the central control room with mimic displays to identify the location of the alarm activated easily. Activation of the detectors will automatically trip the engine generator and shut the ventilation system.

Fire Panel System – The firefighting system for barge are divided into 3 levels, Level 100, 200 & 300. The fire panel for the barge is located in the central control room i n the barge which is of Esmi make of Mini 2000 model. The land facilities fire panel, which is made by Photain Control, is also located in the central control room in the barge; a repeater is also installed at the security guardhouse.

Fire Water System – The barge is equipped with a single set of diesel and electric driven fire water pump delivering 180 m3/hr of fire water, sourced from the river. The fire water is fed into a single firering main line where17 fire hydrants were connected. A jockey pump is installed to maintain the fire water pressure at 8bar.

The land facilities are equipped, as well, a single set of diesel and electric driven fire water pump which delivers as well, 180m3/hr of firewater, sourced from a 250m3 fire water storage tank. Water in the storage tank is supplied from an underground well. The fire water pump supplies water to a single3”ring fire main connected to 11 fire hydrants. A jockey pump is installed to maintain the fire water pressure at 8bar.

Both barge and land facilities fire ring main line are inter connected through a single manual valve to provide fire water support to each other when ever required.

Hydrants and Hose Reels – Hydrants are provided in all yard areas of this site. Hydrants are of the above ground type and feature two connections plus a below ground isolation valve. Hose-reels are provided on all floors in all areas and are located to minimise travel distance in a fire situation.

Fire Extinguishers – Hand held and wheeled extinguishers are provided throughout the site. The barge has 81 pcs of hand held fire extinguishers of all types, A, B and C types along with 26 pcs of wheeled dry powder and CO2 extinguishers and 4 wheeled foam extinguishers. The land facilities are provided with 53pcs of CO2 and dry chemical hand held fire extinguishers and 6 wheeled dry powder and CO2 fire extinguisher. All locations of the fire extinguishers, along with its type are clearly listed and shown in the fire plan which can be seen all around the site.

Gaseous Flooding Systems – The barge is mainly protected by conventional automatic fixed CO2 gaseous flooding systems. A total of 20 pcs of 45 kg CO2 bottles are installed to provide fire protection in the following areas.

- Switch gear room
- Cable tray compartment
- Separator compartment

CO2 for the gaseous flooding systems are supplied from two 6 tons refrigerated CO2 tanks dedicated for each Gas Turbine Generator Enclosure whilst the rest are supplied by CO2cylinders.

On the land facilities, automatic fixed CO2 gaseous flooding of 4 pcs of 45 kgs CO2 bottles are installed to provide protection for the booster gas compressor control room and the main gas compressor control room.

Foam Injection – There is no fixed foam tank fire extinguishing installed on the barge. However, 3 tanks of fixed foam tank fire extinguishing are installed separately for the oil pit area, lube oil/chemical area and barge transformer area (through 3 units of foam monitors on the jetty). Total amount of foam combined for all 3 tanks is circa 4000 liters. In addition to the 400 liters of foam in each tank, the warehouse stores another 4,000 liters of spare foam.

Gas Detection System – The barge is installed with 22 gas detectors spreading around within the barge to detect any gas leakage. Besides that, on the land facilities, the main gas compressor house is installed with eight gas detectors while another four gas detectors are installed on the booster gas compressor house. The alarms from all the gas detectors are connected and transferred to the central alarm station in the central control room in the barge while the compressor room sensors are connected at the gas compressor switch gear room.

The alarm level set for gas detection alarm to activate is 20% of natural gas (“NG”) lower explosive limit (“LEL”) while shut down trip is 40% of NG LEL.

Testing of Fire Protection System – The plant is required to carry out a weekly functional test of the fire water pumps, typically on a Friday. Hand held and wheeled fire extinguishers are monthly checked along together the fire flaps and other fire related equipment. Regular servicing of the fire extinguishers and related equipment is carried out by a third party contractor.

The CO2 automatic fixed fire extinguishing systems are serviced every 5 yearly. The service includes cylinder pressure test, system loop check and air blowing of pipes, level gauging and complete system functional test.

The foam, for sampling, in the fixed foam tank fire fighting system and in the warehouse is regularly taken and tested by the UK based Kerr Fire.

The fire detection system on the barge and land facilities is periodically carried out on a 6 monthly basis. Fire hoses are pressure tested and inspected.

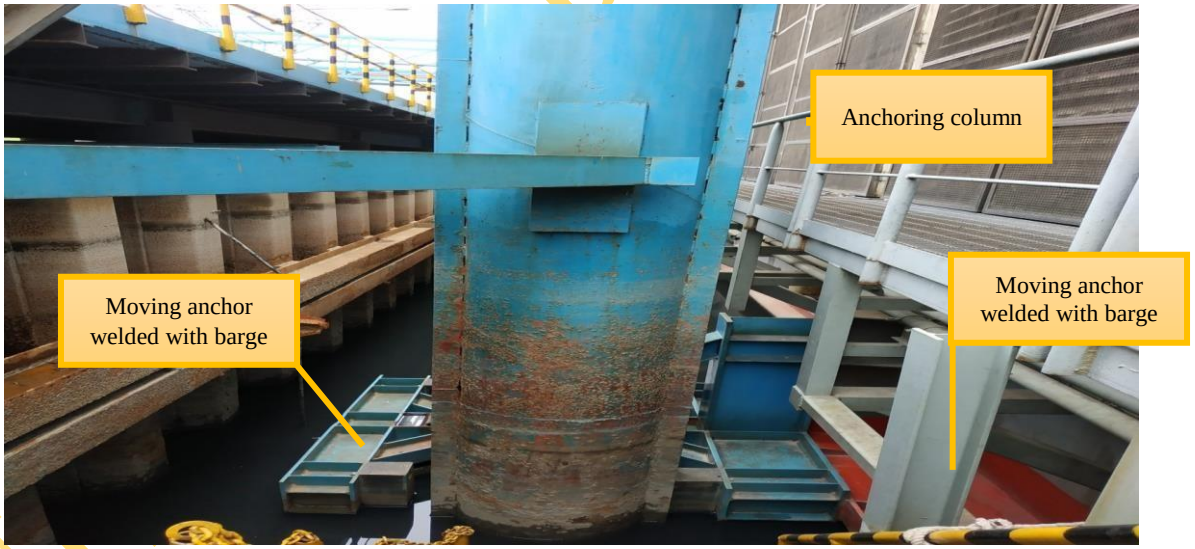
Fireproofing

The admin and equipment buildings are constructed of predominantly non combustible materials. The layout and spacing of the engine generators is adequately spaced with in the vastly spaced engine hall. The spacing is considered to be good with adequate spatial separation between the plant and equipment.

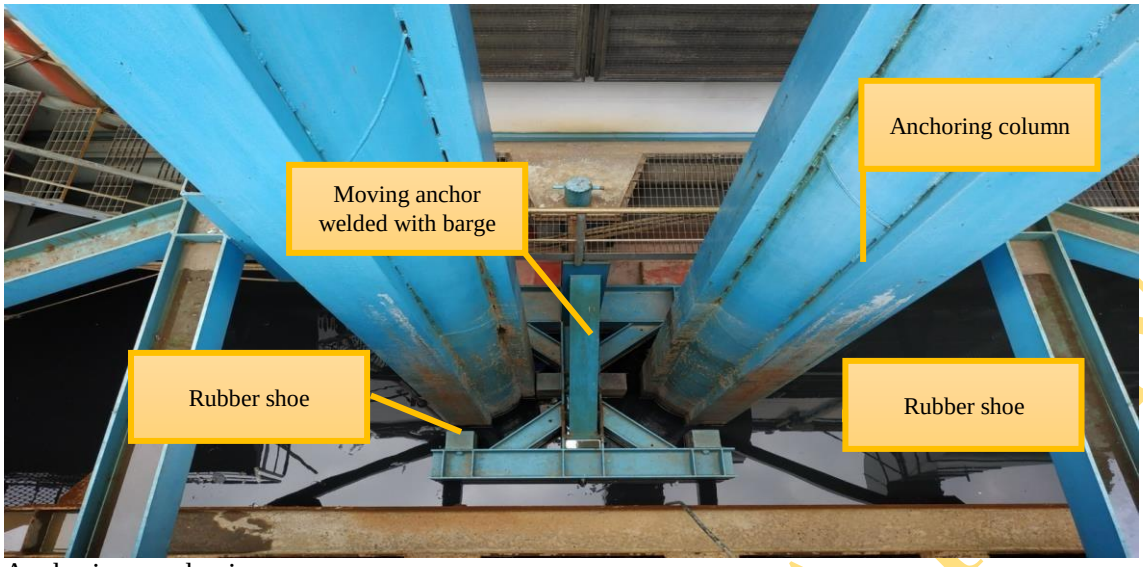
The main plant transformers are located externally on the barge with transformers separated from the adjacent buildings with substantial spacing and blast wall.

1.7 REMOVAL OF THE POWERBARGE

The power barge is moored to the jetty with seven (7) self-adjusting fender arrangements tied to vertical column directly anchored to the river. This system allows the barges to adjust with the rise and fall in the river water level without any requirement for measures from the staff.



Anchoring column



Anchoring mechanism

The distance between the bottom of the barge and the sea bottom is minimum 1.5 meters. Normally the river may rise about 3 meters, particularly during the monsoon season. The tide is reported to be about 0.5 meters. Regular dredging is carried out every 3 years by a hired contractor company and the previous dredging of the muddy bottom was done in2016.

To move the power barge,the anchoring column shave to be dismantled. There is no engine to drive the barge and would require a tug boat to pull the power barge out of the jetty and to any location that is the final destination.

The gross tonnage of the barge is 4957 tonnes and the length of the barge is 96.561 metres. The barge requires a draft of [m]for sailing. The tub boat with sufficient pulling capacity will be required.

Removal of the power barge shall be the responsibility of the buyer.

1.8 SPARES

Sufficient spares are kept at warehouse to ensure the plant operates safety and reliably. The list of spares and inventory currently kept at the ware house shall be given later**.**