DESCRIPTION OF THE BARGE

The floating power plant has been designed for base load application, intended for parallel operation with a public supply system. The power generation part consists of a DG-set using six (6) units of Wartsila Vasa 18V32 and six (6) units of Wartsila Vasa 12V32 as a prime mover driving the generator generating the electrical power.

The operation of the diesel generating sets is carried out from the control room. The operation method is manual with automatic synchronizing, based on the operator's push button order. Auxiliary equipment is controlled from panels mounted close to the equipment.

The main cooling system utilized seawater through an intake water barge.

MAIN DIESEL GENERATING SETS

All diesel engines are of four stroke, direct injected, turbocharged, intercooled design.

Make	:	Wartsila Vasa
Configuration	:	Vee
Number of Engines	:	Twelve
Engine Type	:	6 x 18V32 6 x 12V32
Number of Cylinders	:	18 (18V32) 12 (12V32)
Cylinder Bore	:	320 mm
Stroke	:	350 mm
Speed	:	720 rpm
Mean piston speed	:	8.4 m/s
Mean effective pressure	:	21.9 bar
Swept volume per cylinder	:	28.15 m^3
Compression ratio	:	12:1
Direction rotation	:	Clockwise (Facing towards flywheel)
Rated Output	:	6600 kW (18V32)

ENGINE AND GENERATOR SERIAL NUMBER

ENGINE NO.	ENGINE SERIAL NO.	MANUFACTURING DATE
1	6217	1993
2	6219	1993
3	6218	1993
4	6255	1993
5	6254	1993
6	6214	1993
7	6220	1993
8	6221	1993
9	6310	1993
10	6253	1993
11	6252	1993
12	6251	1993

ELECTRICAL GENERATOR

Directly coupled to Diesel Engine (12V32)

Generator Type	:	Self-cooled brushless synchronous
Electrical Generator Model No.		
Duty	:	Continuous
Rotational Speed	:	720 RPM
Electrical Rating	:	7125 kVA, 13800 V, 60 Hertz 3 phase, 0.8 Pf
Efficiency	:	96.50 % @ rated load
Over Speed Capability	:	864 rpm

Directly coupled to Diesel Engine (18V32)

Generator Type	:	Self-cooled brushless synchronous
Electrical Generator Model No.		
Duty	:	Continuous
Rotational Speed	:	720 RPM
Electrical Rating	:	7125 kVA, 13800 V, 60 Hertz 3 phase, 0.8 Pf
Efficiency	:	96.50 % @ rated load
Over Speed Capability	:	864 rpm

Generator:

Serial No:

No.1	-
No.2	-
No.3	-
No.4	-
No.5	-
No.6	-
No.7	-
No.8	-
No. 9	-
No. 10	-
No. 11	-

BARGE TANK CAPACITIES

TANK NAME	DURA 3 (cu.m.)
HFO Settling Tank	300
HFO Day Tank	300
Diesel Oil Buffer Tank	40
Diesel Oil Day Tank	40
Lube Oil Storage Tank	40
Sludge Tank	75
Oily Water Tank	40
Lube Oil Waste Tank	40
Distilled Water Tank	20
Raw Water Tank	20

Fire Pump Day Tank	200 L
Auxiliary Boiler Day Tank	500 L
Hydrophore Tank For Distilled water	1000 L
Hydrophore Tank For Potable water	1000 L
Feed Water Condensate Tank	500 L
Expansion Tank	200 L
Sludge Collecting Tank	200 L
Maintenance Tank	500 L

MECHANICAL AUXILIARY SYSTEM

HEAVY FUEL OIL SYSTEM

The heavy fuel oil is transferred from the storage tank to the settling tank by the transfer pump unit and from the settling tank by the separator pumps to the separator where the fuel is purified. From the separator unit the fuel is transferred to the day tank. The feeder pump unit then transfers fuel from the day tank to the booster unit where the fuel is finally heated, filtered and pressurised before engine entry.

System consists of following :

- Transfer pump including two electrically driven transfer pumps (1 operating, 1 standby), strainers. Common steel base frame and interconnecting pipes, valves, seals, and flanges are included.
- Separator units including strainers, separator delivery pumps, steam heaters for fuel, sludge tank with pump and heater, control panel for automatic/hand operation and interconnecting pipes, valves, seals, flanges are included.
- Booster units with each unit serving up to four engines. Each unit is installed with two electrically driven fuel feeder pumps (one operating, 1 standby). Air venting vessel, steam heaters for heavy fuel oil, electrically controlled automatic filter with bypass filter, temperature control, viscometer, control panel for automatic/hand operation and interconnecting pipes, valves, seals, flanges are included.
- Fuel feed pump and filter unit for each engine including duplex fine filter, common base frame of steel and interconnecting pipes, valves, seals, flanges are included.

HFO SEPARATOR

Manufacturer	:	Alfa Laval
Model	:	FOPX 613 BTFD
Capacity	:	7000 l/h
Speed of motor shaft	:	1,800 rpm
Frequency	:	60 Hz
Power Consumption	:	8 kW
Bowl Speed	:	rpm

Separator Sludge Pump

Manufacturer	:	ALLWEILLER
Type	:	Horizontal rotary self priming single stage ecc. Screw Pump
Model	:	SEP 550.1 A11 P01 - 122PP
Capacity	:	50m3/hr
Pump weight	:	130 kgs. Approx.
Speed	:	700 rpm
Power Cons.	:	11.5 kW
NPSHR	:	2.0 m
Bearings	:	Radial/axial bearing greased lub.
Materials Casing	:	Cast Iron
Rotor	:	S.W. resistance steel
Stator	:	Perbunan
Motor Type	:	E80 -160 - 4 Gear
Speed	:	700 rpm
Power Output	:	14 kW
Protection	:	IP55
Ph / Voltage / Freq.	:	3 / 460 / 60
Insulation Class	:	F
Starting Method	:	D.O.L.

FUEL BOOSTER MODULE SKID

No. of units	:	2 unit for 6 18V32
Manufacturer	:	AURAMARIN ENGINEERING OY
Type	:	AMB-C26 MWSS
Capacity	:	10.56 L / hr
Serial no	:	2669, 2670
No. of units	:	2 unit for 6 12V32
Manufacturer	:	AURAMARIN ENGINEERING OY
Type	:	AMB-C26 MWSS
Capacity	:	7.0 L / hr
Serial no.	:	

Pump and Filter unit

Manufacturer	:	Boll & Kirch Filterbau
Type	:	Fully Automatic Backflushing
Capacity	:	3.8 m3 / hr 2.4 m3 / hr

HFO Transfer Pump

No. of Units	:	2 Units
Manufacturer	:	KVAERNER Singapore
Type	:	Vertical/Horizontal gear pump w/ relief valve
Model	:	R95 / 100 FL - Z DB - GLRD (U) – SO
Capacity	:	100 m3/hr
Speed	:	1750 rpm
Power Cons.	:	32.3 kW for 300 cSt

Discharge Pressure	:	3 bar
Viscosity	:	300 cSt
Shaft Seal	:	Mechanical Seal
Materials Casing	:	Cast Iron, GG25
Gear / Shaft	:	Nitrated Steel seal in FPM (VITON)
Motor Manufacturer	:	MEZ or equal
Type	:	TEFC
Model	:	F225S04
Speed	:	1750 rpm
Power Output	:	37 kW
Protection	:	IP55
Ph/Voltage/Freq	:	3 / 460 / 60
Insulation Class	:	F
Starting Method	:	Star Delta

LIGHT FUEL OIL SYSTEM

The light fuel oil is transferred from the storage tank by the transfer pump unit to the day tank and from the day tank the system is connected via a change-over valve to the heavy fuel oil system. System consists of one transfer pump unit. Strainers, common base frame of steel, control panel for automatic/hand operation and interconnecting pipes, valves, seals, and flanges are included.

Diesel Oil Auxiliary Pump

Manufacturer	:	Rickmieir GmBH
Type	:	Vertical / Horizontal gear pump w/ internal relief valve
Model	:	R45 / 160 FL - Z DB - GLRD (U) – SO
Capacity	:	15 m3 / hr
Speed	:	1750 rpm
Power Cons.	:	3.5 kW for 75 cSt
Discharge pressure	:	3 bar
Viscosity	:	75 cSt
Shaft Seal	:	Mechanical seal
Materials Casing	:	Cast iron, GG25
Gear/Shaft	:	Nitrated Steel seal in FPM (VITON)
Motor Manufacturer	:	MEZ
Type	:	TEFC
Model	:	4AP112M-4
Speed	:	1740 rpm
Power Output	:	4 kW
Protection	:	IP55
Ph/Voltage/Freq.	:	3/460/60
Insulation Class	:	F
Starting Method	:	D.O.L.

LFO (D.O.) TRANSFER PUMP

No. of Units	:	2 units

Manufacturer	:	Rickmieir GmBH
Type	:	Vertical / Horizontal gear pump w/ internal relief valve
Model	:	R95/800 FL - Z - DB - GLRD (U) – SO
Capacity	:	75 m3/hr
Speed	:	1750 rpm
Power Consumption	:	25.5 kW for 300 cSt
Discharge pressure	:	3 bar
Viscosity	:	300 cSt
Shaft seal	:	Mechanical Seal
Materials Casing	:	Cast Iron, GG25
Gear / Shaft	:	Nitrated Steel Seal in FPM (VITON)
Motor Manufacturer	:	MEZ or equal
Type	:	TEFC
Model	:	F200L04
Speed	:	1765 rpm
Power Output	:	30 kW
Protection	:	IP55
Ph/Voltage/Freq	:	3 / 460 / 60
Insulation Class	:	F
Starting Method	:	Star Delta

LUBRICATING OIL SYSTEM

The main lube oil pump pumps the lubricating oil from the oil sump. The total lube oil flow is cleaned in the fine filter and the centrifugal oil filter. Lube oil is cooled by the lube oil heat exchanger cooled by the LT cooling water and the temperature of the lube oil is to be regulated by three way thermostatic. From the lube oil sump the lube oil is circulated via the separator built-in pump. Water and solids are separated in the separator unit and the cleaned lube oil is pumped back into the lube oil sump.

Lube oil system consist of:

- Lube oil separator unit for each engine with steam heaters for lube oil.
- Sludge tank with pump, common base frame of steel, control panel for automatic/hand operation.
- Interconnecting pipes, valves, seals, flanges.
- Lube oil coolers, pre-lubricating oil pumps, thermostatic three way valves, automatic filter units, filter units and lube oil transfer pump units.

Lube Oil Treatment Skid

L.O. Separator

No. of Units	:	6 units for 12V32
	:	6 units for 18V32
Manufacturer	:	Alfa Laval
Model	:	LOPX 707SFD 34-60

Capacity	:	1.6 L / hr (12V32) 2.0 L / hr (18V32)
Power Consumption	:	8 kW
Sep. Speed	:	1800 rpm
Supply Water Pressure:	:	200 - 600 kpa

L.O Sludge Pump

Manufacturer	:	ALLWEILLER
Type	:	Horizontal rotary self priming single stage ecc. Screw Pump.
Model	:	SEP 550.1 A11 PO1 - 122PP
Capacity	:	50 m3/hr
Pump Weight	:	130 Kgs. Approx.
Speed	:	700 rpm
Power Cons.	:	11.5 kW
NPSHR	:	2.0 m
Bearings	:	Radial/Axial bearing greased Lub.
Materials Casing	:	Cast Iron
Rotor	:	1.4301 S.W. Resistance Steel
Stator	:	Perbunan
Motor Type	:	E80-160-4 gear
Speed	:	700 Rpm
Power Output	:	14 kW
Protection	:	IP55
Ph / Voltage / Freq.	:	3 / 460 / 60
Insulation Class	:	F
Starting Method	:	D. O. L.

Lube Oil Transfer Pump

No. of Units	:	1 unit
Manufacturer	:	Rickmieir GmBH
Type	:	Vertical / Horizontal gear pump w/ internal relief valve
Model	:	R95 / 400 FL - Z - DB - GLRD (U) –SO
Capacity	:	40 m3/hr
Speed	:	1750 rpm
Power Consumption	:	9.6 kW for 120 cSt
Discharge Pressure	:	3 bar
Viscosity	:	120 cSt
Shaft Seal	:	Mechanical Seal
Materials Casing	:	Cast Iron, GG25
Gear/Shaft	:	Nitrated Steel seal in FPM (VITON)
Motor Manufacturer	:	MEZ or equal
Type	:	TEFC
Model	:	FC160M04
Speed	:	1745 rpm
Power Output	:	11 kW
Protection	:	IP55
Ph / Voltage / Freq.	:	3 / 460 / 60

Insulation Class	:	F
Starting Method	:	Star / Delta

Pre-Lube Oil Pump

No. of Units	:	6 Units for 12V32 6 Units for 18V32
Manufacturer	:	Wartsila Finland
Type	:	Screw Pump
Capacity	:	21 m3 / hr (12V32) 32 m3 / hr (18V32)

STARTING AIR SYSTEM

Compressed starting air is delivered by the air compressor and is supplied from the starting air unit to the air bottles. Control and working air outlet is connected to the compressed air supply via a pressure regulator. The system includes two (2) electrically driven starting air compressors, pressure switches for starting and stopping air compressor, alarm switch for low starting air pressure to engine, oil and water separator, control panel for automatic/hand operation, pressure reduction valve for control and working air, four air bottles, each engine equipped with all necessary accessories and common base frames of steel and interconnecting pipes, valves, seals, flanges to be included. An air dryer is also provided for the control air system.

Air compressor

No. of Units	:	2 units
Manufacturer	:	SPERRE
Type	:	HL2 / 140 reciprocating
Capacity	:	88 m3 / hr
Pressure	:	30 bar
Motor Manufacturer	:	ABB
Power Output	:	23 kW
Frequency	:	60 Hz
Voltage	:	480 V
Ampere	:	40 A
Speed	:	1170 rpm

COOLING SYSTEM

The diesel engines are cooled by two separate circuits consisting of high temperature (HT) circuit for cooling cylinder heads and cylinder liners and low temperature circuit (LT) for cooling the charge air and lubricating oil. Both circuits are connected to a heat exchanger which is cooled by the sea water. The system includes heat exchanger, thermostatic three way valves, expansion vessels of cooling water including level switches. A separate preheating unit is provided to serve the cooling system for all engines. Sea water pumps for the cooling water system are shore based.

Central Cooling (Sea Water Cooling)

No. of Units	:	3 units
Unit Assignment	:	
Manufacturer	:	KVAERNER SING.
Model	:	C22BA12 - 16V48 AAN

Type	:	Double suction, one stage, axially split vertical centrifugal pump
Capacity	:	1360 m3/hr
Speed	:	1190 rpm
Power Consumption	:	237 kW
Min driver rating	:	249 kW
Pump Total Head	:	50 mlc
Outlet Total Head	:	50 mlc
NPSHR	:	3.8 m
Shaft seal	:	Mechanical seal w/ barrier fluid
Bearing	:	Grease Lubricated ball bearing
Materials Casing	:	Ni - Al – bronze
Impeller	:	Ni - Al – bronze
Shaft	:	Stainless Steel (AISI 329)
Coating	:	Vernyl top coat, Blue - RAL 5015
Motor Manufacturer	:	ABB
Model	:	M2CA 355 MB6 - V1
Type	:	TEFC
Speed	:	1190 rpm
Power Output	:	300 kW
Power Supply	:	3 Ph / 480 V / 60 Hz
Rated Current	:	474 Amp.
Starting Current	:	3270 Amp.

By-pass (Quenching) Pump

No. of Units	:	3 units
Unit Assignment	:	
Manufacturer	:	KVAERNER SING.
Model	:	C22BA12 - 16V48 AAN
Type	:	Double suction, one stage, axially split vertical centrifugal pump
Capacity	:	1360 m3/hr
Speed	:	1190 rpm
Power Consumption	:	237 kW
Min driver rating	:	249 kW
Pump Total Head	:	50 mlc
Outlet Total Head	:	50 mlc
NPSHR	:	3.5 m
Shaft seal	:	Mechanical seal w/ barrier fluid
Bearing	:	Grease Lubricated ball bearing
Materials Casing	:	Ni - Al – bronze
Impeller	:	Ni - Al – bronze
Shaft	:	Stainless Steel (AISI 329)
Coating	:	Vernyl top coat, Blue - RAL 5015
Motor Manufacturer	:	ABB
Model	:	M2CA 355 MB6 - V1
Type	:	TEFC
Speed	:	1190 rpm
Power Output	:	300 kW

Power Supply	:	3 Ph / 480 V / 60 Hz
Rated Current	:	474 Amp.
Starting Current	:	3270 Amp.

Rotary Band Screen

No. of Units	:	2 units
Manufacturer	:	E. Braudrey & CIE
Flow rate	:	1.5 m3 / sec
Mesh Aperture	:	1.4 X 1.4 mm
Speed	:	7 - 14 rpm
Spray water Flowrate	:	25 m3 / hr
Power Supply	:	460 V / 60 Hz / 3 phase
Drum Diameter	:	2.8 m

Sump Pump

Manufacturer	:	POMPE GARBARINO
Type	:	P80
Flowrate	:	18 m3/hr
Speed	:	225 rpm

CHARGE AIR SYSTEM

System includes dry type intake filters, expansion bellows for intake air pipes and intake air silencers, pipes, etc.

Air Intake Filter

Manufacturer	:	AMER FILTER INDUSTRIES
Type	:	Fiber Filter element Amerkool / Amerklen

HEAT RECOVERY SYSTEM

The steam for fuel heating requirements is supplied by the three (3) waste heat recovery boilers and one auxiliary boiler (fired by diesel oil).

Steam Generation System

No. of Units	:	1 unit Oil fired Boiler
Manufacturer	:	PARAT - ANDERS HALVORSEN
Type	:	Double suction, one stage, axially split vertical centri. Pump
Steam Pressure	:	8.0 bars (a)
Steam Flow	:	1560 kg / hr
Steam Temp.	:	170 °C
No. of Units	:	3 units Exhaust Gas Boiler
Manufacturer	:	PARAT - ANDERS HALVORSEN
Steam Pressure	:	8.0 bars (a)
Steam Flow	:	750 kg / hr/unit
Steam Temp.	:	170 °C
No. of Units	:	4 units EGB Feed Pump
Manufacturer	:	Grundfos

Type	:	CR2 - 70A - F - A BUBE
Model	:	C4053006 7P 19401
Speed	:	3500 rpm
Flow rate	:	150 m3 / hr
Head	:	67.7 m

BLACK START DIESEL GENERATING SET

The emergency generating set is installed to provide power to the essential equipment during blackout condition due to failure of the main diesel generating sets or main bus bar. It is also to provide power for the starting of the power plant at cold condition.

Black Start Engines

No. of Units	:	1 unit
Type	:	Engine Drive Synchronous
Specification	:	
Capacity	:	400 kW
No. of cylinders	:	
Rpm	:	
Make	:	Perkins Diesel

OVERHEAD CRANE

One unit of 2.5 ton & 5.0 ton top running electric overhead travelling cranes is installed in the engine room for the maintenance of the DG sets. The span covers the full length of the engine-generator at minimum and travels the full length of the engine room stopping at the control room.

Overhead Crane	:	2 units
Capacity	:	5.0 Tons
Manufacturer	:	Legion Hoist Singapore
Type	:	LG4 2012 H3
Capacity	:	5.0 Tons
Manufacturer	:	GEMAG
Type	:	Self breaking motor

MAIN TRANSFORMER

Power Transformer #1

Brand	:	General Electric
KVA Capacity	:	19200/25600/32000
Voltage Rating	:	115,000 GRD. Y/66,397 volts
Connection	:	Wye – Delta
Cycles/Second	:	60 Hz
Impedance	:	5.76 %
Oil Quantity	:	4830 gals.
Total Weight	:	125700 lbs.
Serial Number	:	D590553

Power Transformer #2

Brand	:	Delta Star
KVA Capacity	:	30,000 – 37,500

Voltage Rating	:	115,000 GRD. Y/66,400 13,800 GRD. Y/79700V		
Connection	:	Wye – Delta		
High Voltage BIL	:	550 kV		
Low Voltage BIL	:	30 kV		
Cycles/Second	:	60 Hz		
Serial Number	:	E78870396		
Insulating Fluid	:	Mineral Oil		
Total Weight	:	139600 lbs.		
Wdg. Temp. Rise	:	65 C		
Number of Phases	:	Three		

Station Transformer #1

Brand	:	ABB Stromberg Power		
Phase	:	3-Phase		
Frequency	:	60Hz		
Type	:	KTMU 18HC 1600		
Serial No.	:	5200335		
Year Manufacture	:	1994		
KVA Rating	:	1600		
Standard	:	IEC 76		
Primary Voltage	:	13800 +/- 2 x 2.5 %	A =	66.94 A
Secondary Voltage	:	480	A=	1925 A
Connection	:	Dyn 11		
Insulation Level	:	L1 95 AC 38/A68		
Cooling	:	ONAN		
Zk	:	10676		
Po	:	2184		
Total Wt.	:	3,760kg.		
Wt. of Oil	:	720 kg		
Temp. Rise	:	50/55 C		

Station Transformer #2

Brand	:	ABB Stromberg Power		
Phase	:	3-Phase		
Frequency	:	60Hz		
Type	:	KTMU 18HC 1600		
Serial No.	:	5200336		
Year Manufacture	:	1994		
KVA Rating	:	1600		
Standard	:	IEC 76		
Primary Voltage	:	13800 +/- 2 x 2.5 %	A =	66.94 A
Secondary Voltage	:	480	A=	1925 A
Connection	:	Dyn 11		
Insulation Level	:	L1 95 AC 38/A68		
Cooling	:	ONAN		
Zk	:	10676		
Po	:	2184		
Total Wt.	:	3,760 kg.		

Wt. of Oil	:	720 kg
Temp. Rise	:	50/55 C