CATERPILLAR POWER BARGE

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2.3 Classifications
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   2.4.2 Cathodic Protection
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B. TECHNICAL SPECIFICATIONS OF 115/13.8KV NORTH HARBOUR SWITCHYARD EQUIPMENT
2.0 CATERPILLAR POWER BARGE

2.1 PRINCIPAL PARTICULARS

A. American Bureau of Shipping (ABS) Registration Numbers

Power Barge No. IV

B. Dimension

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length O. A.</td>
<td>81.60 M</td>
</tr>
<tr>
<td>Breadth MLD</td>
<td>22.66 M</td>
</tr>
<tr>
<td>Depth MLD</td>
<td>4.88 M</td>
</tr>
<tr>
<td>Draft</td>
<td>2.20 M</td>
</tr>
<tr>
<td>Gross Tonnage</td>
<td>6,223 MT</td>
</tr>
</tbody>
</table>

2.2 DESCRIPTION OF THE BARGE

The barge is installed with 13 sets of deck mounted CATERPILLAR 3616 diesel engines each producing 4000 kW at the alternator end. The engines operate on heavy fuel oil.

Engine housing was erected to protect the engines and the auxiliary machinery from the weather. The housing is 68 meters in length, 16 meters in width and 12 meters in height. The engine housing was designed for unlimited wet tow and able to withstand a 60 m/s wind speed without a wave.

Deck houses were erected on the STBD side and forward of the barge to house the high tension switchboards, low voltage switchboards, control room, workshop, offices and crews, accommodation, etc.

Following facilities were provided below the main deck:-

- Two auxiliary machinery rooms which house the F.O. purifiers; F.O. transfer pumps, F.O. booster pumps, oily water separator, etc. Access to the Auxiliary Machinery space is by booby hatch.
- A sea water pump room which house the main sea water pumps and sea chest.

2.3 CLASSIFICATIONS

The deck cargo barge was designed and built to ABS “Rules for Building and Classing Steel Barges” with class notation “+A1 Barge”.
The power barge was designed and constructed in accordance with “Internationally Accepted Engineering Standards” e.g. IEEE, ANSI, IEC, etc. except the following system which have been designed and built to ABS standards:

1. CO₂ system,
2. Foam system,
3. Fire hydrant system,
4. All under deck steel reinforcement due to localize loading on the main deck.
5. All deck and bulkhead penetration that affect the watertight integrity of the barge.

2.4 PAINTING, CATHODIC PROTECTION AND QUARTER FURNISHINGS

2.4.1 PAINTING

The paints throughout the barge are marine type approved. All painting works were executed in accordance with good marine practice and paint manufacturers' recommendation.

All parts of spaces not specially specified in the painting scheme table were finished in conformance to surrounding or comparable spaces.

2.4.2 CATHODIC PROTECTION

The underwater hulls are fitted with cathodic protection by means of impressed current. The anodes designed for five (5) years operation were installed in accordance to manufacturer's recommendations and renewal every five (5) years.

2.4.3 QUARTER FURNISHINGS

1a. Change Room

The following were provided:

- 27 nos of double tier lockers. Lockers are sheet steel baked-on enamedled, approximately 18 inches deep by 15 inches wide, arranged as shown on General Arrangement, complete with hardware and fittings. Latches have eye for padlock.
- 10 double coat hooks were installed on clear bulkheads in Change Room.
- Wooden benches about 12 inches wide were provided as shown on General Arrangement.
- One waste basket.
- 3 toilets with accessories.
- 2 showers with accessories.
- 2 urinals.
- 2 wash basins.

2. Control Room

The following were provided:
- 2 office desks, 2 work desks
- 4 swivel arm chairs.
- 4 filling cabinets (4 tiers)
- 1 waste basket
- 1 white board
- 1 book shelf

3. Tea Room
- 1 lot of table and chair for 20 persons for Barge.
- 1 lot of table and chair for 16 persons for Barge.
- Refrigerator (216 litres).
- 1 hot water urn.
- 1 s/s wash basin.
- 1 water cooler

4. Plant Manager Office
- 1 office desk
- 1 mini refrigerator (3 cuft)
- 1 side board
- 2 filing cabinets (4 tiers)
- 1 work desk
- 1 swivel arm chair
- 2 side chairs
- 1 white board
- 1 dust bin

5. Admin Office
- 3 office desks
- 4 filling cabinets (4 tiers)
- 2 work desks
- 1 white board
- 3 arm chairs
- 3 side chairs
- 1 dust bin

6. Engineers Office
- 2 office desks
- 2 arm chairs
- 2 side chairs
- 4 filing cabinets (4 tiers)
2.5 TANKS

BARGE TANK CAPACITIES

<table>
<thead>
<tr>
<th>TANK NAME</th>
<th>BARGE (cu.m.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFO Storage Tank</td>
<td>330.750</td>
</tr>
<tr>
<td>HFO Settling Tank</td>
<td>165.370</td>
</tr>
<tr>
<td>HFO Settling Tank</td>
<td>165.370</td>
</tr>
<tr>
<td>HFO Day Tank</td>
<td>165.370</td>
</tr>
<tr>
<td>HFO Overflow Tank</td>
<td>165.370</td>
</tr>
<tr>
<td>LFO Day Tank</td>
<td>44.330</td>
</tr>
<tr>
<td>LFO Settling Tank</td>
<td>44.330</td>
</tr>
<tr>
<td>F.W Tank</td>
<td>44.30</td>
</tr>
<tr>
<td>Bilge Holding Tank</td>
<td>44.330</td>
</tr>
<tr>
<td>Sludge Tank</td>
<td>44.330</td>
</tr>
<tr>
<td>Dirty Oil Tank</td>
<td>10.00</td>
</tr>
</tbody>
</table>

2.6 MACHINERY

2.6.1 OPERATING SITE CONDITIONS

All machineries are rated for continuous tropical operation at given rating under the following site conditions:

- Ambient air temperature max.: 35°C
- Ambient air temperature min.: 25°C
- Ambient engine room temp. max.: 40°C
- Water temperature: 30°C
- Relative humidity: 85%

2.6.2 MAIN DIESEL GENERATING SETS

Thirteen units (13) Caterpillar Model 3616 Generator Set engines, four-stroke, direct-injected, turbocharged, aftercooled design, rated at 4000 ekw @ 900 rpm continuous duty.

General Specifications:
- Number of cylinders: 16
- Configuration: Vee
- Bore: 280 mm
- Stroke: 300 mm
- Displacement: 296 L
- Rated Speed: 900 rpm
- Mean Piston Velocity: 9.0 m/sec
- Low Idle Speed: 350 - 400 rpm
Cycle : 4-stroke
Compression Ratio : 13 : 1
Clearance Volume : 1.54 L
Peak Cylinder Pressure : 16,200 kpa
Rotation, Flywheel end : Counterclockwise
Heat Rejection to Atmosphere : 203 kw

<table>
<thead>
<tr>
<th>PB 4 ENGINE NO.</th>
<th>ENGINE SERIAL NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1PD00129</td>
</tr>
<tr>
<td>2</td>
<td>1PD00130</td>
</tr>
<tr>
<td>3</td>
<td>1PD00132</td>
</tr>
<tr>
<td>4</td>
<td>1PD00131</td>
</tr>
<tr>
<td>5</td>
<td>1PD00133</td>
</tr>
<tr>
<td>6</td>
<td>1PD00138</td>
</tr>
<tr>
<td>7</td>
<td>1PD00139</td>
</tr>
<tr>
<td>8</td>
<td>1PD00137</td>
</tr>
<tr>
<td>9</td>
<td>1PD00136</td>
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<tr>
<td>10</td>
<td>1PD00128</td>
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<tr>
<td>11</td>
<td>1PD00127</td>
</tr>
<tr>
<td>12</td>
<td>1PD00134</td>
</tr>
<tr>
<td>13</td>
<td>1PD00135</td>
</tr>
</tbody>
</table>

2.6.3 ELECTRICAL GENERATOR

Thirteen (13) units KATO type 8P12-4000 brushless revolving field generator with a direct connected rotating brushless exciter, in accordance with the following specifications:

General Specifications:
Duty : Continuous
Rotational Speed : 900 RPM
Electrical Rating : 4400KW, 5500KVA, 7967/13800 V, 60 Hertz 3 phase, 0.8 Power Factor
Efficiency : 96.6 % @ 100% load & 0.8 pf
Temperature Rise : 80 deg C over 45 deg C ambient
Over Speed Capability : 1125 rpm
Overload Capability : 10% for 1 hour every 12 hours
Insulation Class : F
Enclosure Design : IP23
Terminal Box Design : Top mounted, IP23
Terminals : 6 wires, Wye connection
Mounting : Two-bearing design. Sleeve bearings
Cool Air Exhaust : Air outlet is directed upwards, and is suitable for duct connection. Maximum duct backpressure is 0.6” H2O. Air flow is 12,000 cfm.

Alternator Heat Rejection : 140 kW
S. C. Ratio (by Calculation) : 1.2483
Reactance Data:

<table>
<thead>
<tr>
<th>Reactance Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xd(u)</td>
<td>108.0%</td>
</tr>
<tr>
<td>Xq(u)</td>
<td>63.0%</td>
</tr>
<tr>
<td>X’d</td>
<td>22.1%</td>
</tr>
<tr>
<td>X’q</td>
<td>63.0%</td>
</tr>
<tr>
<td>X”d</td>
<td>19.4%</td>
</tr>
<tr>
<td>X”q</td>
<td>17.0%</td>
</tr>
<tr>
<td>X2</td>
<td>18.2%</td>
</tr>
<tr>
<td>Xo</td>
<td>7.4%</td>
</tr>
<tr>
<td>T’d3</td>
<td>0.88</td>
</tr>
<tr>
<td>T’d0</td>
<td>4.274</td>
</tr>
<tr>
<td>TA</td>
<td>0.075</td>
</tr>
</tbody>
</table>

Generator:
Serial No:

<table>
<thead>
<tr>
<th>Barge</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>99485-15</td>
</tr>
<tr>
<td>No.2</td>
<td>99485-13</td>
</tr>
<tr>
<td>No.3</td>
<td>99485-16</td>
</tr>
<tr>
<td>No.4</td>
<td>99485-17</td>
</tr>
<tr>
<td>No.5</td>
<td>99485-03</td>
</tr>
<tr>
<td>No.6</td>
<td>99485-22</td>
</tr>
<tr>
<td>No.7</td>
<td>99485-26</td>
</tr>
<tr>
<td>No.8</td>
<td>99485-24</td>
</tr>
<tr>
<td>No.9</td>
<td>99485-23</td>
</tr>
<tr>
<td>No.10</td>
<td>99485-25</td>
</tr>
<tr>
<td>No.11</td>
<td>99485-14</td>
</tr>
<tr>
<td>No.12</td>
<td>99485-20</td>
</tr>
<tr>
<td>No.13</td>
<td>99485-21</td>
</tr>
</tbody>
</table>

2.7 MECHANICAL AUXILIARY SYSTEM

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

System consists of following:
- One day tank of 165 m$^3$ for 12 hour operations.
- Two settling tanks (cap: 165 m$^3$ each) of which each is designed for approx. 12 hour operation. While one tank is undergoing steady settling, the other tank is routed (by three-way valve) to separate suction and filled up when tank is approaching low level and change over to the other tank in every 12-hour continuous alternation and vice versa.
- Electrically driven transfer pumps (1 operating, 1 standby), strainers. Common steel base frame and interconnecting pipes, valves, seals, 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.

**HFO Separator**
- No. of Units : 3 units
- Type : FOPX - 613 TFD - 24-60
- Specification
- Capacity : 14400 liters per hour.
- KW : 15 kw
- Rpm : 1765 rpm
- Make : Alfa - Laval

**HFO/LFO Booster Module**
- No. of Units : 4 units
- Type : CE94
- Specification
- Capacity : 7.2 Cu. M per Hour
- Working Press. : 16 bars
- Power : 6.4 kw at 480 V/60 hertz
- Make : ALFA-LAVAL

**2.7.2 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, flanges are included.

### 2.7.3 LUBRICATING OIL SYSTEM

The lubricating oil is pumped from the oil sump by the main lube oil pump. 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 includes 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 and 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 Separator**

- **No. of Units**: 13 unit per barge / 1 unit per engine
- **Type**: MMPX304SGP11-06
- **Specification**
  - **Capacity**: 14.2 l/min.
  - **KW**: 3 kw
  - **Rpm**: 3430 rpm
  - **Make**: Alfa - Laval

### 2.7.4 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 unit
Type : 15T2
Specification
Capacity : 63 m3/hr @ 30 bar
Power : 20 HP
Speed : 1755 RPM
Make : INGERSOLL-RAND

Air Receiver
No. of Units : 4 units
Specification
Pressure : 30 bar
Capacity : 1000 liters
Make : WILH SIEBEL

2.7.5 COOLING SYSTEM

Each diesel engine is cooled by own individual cooling system for cooling cylinder heads and cylinder liners and low temperature circuit (LT) for cooling the charge air and lubricating oil. Each circuit is 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. A central sea water cooling system consisting of six sea water cooling pumps (five running, one standby) and filter is installed to serve individual engine fresh water cooling circuit.

Injector Tip Cooling Module
No. of Units : 4 units
Type : ACG052N5.IVBP
Specification
Capacity : 5.5 kw (two per module)
Max Work Press : 10bar
Make : Alfa - Laval

Sea Water Cooling Pumps
No. of Units : 6 units
Specification
Pump Capacity : 813 cubic meters per hour
Type : MU250.400L
Motor Power : 200 HP
Total Head : 45m
Rpm : 1750 rpm
Voltage : 460/3ph/60Hz
Make : Pompe Garbarino
An anti-fouling tank is connected to the sea water line in the pump room. It reduces / eliminates marine growth and reduce corrosion rate in the sea water line. It consists of 7 (marine growth) copper anodes and 3 (trap corrosion) aluminum anodes.

2.7.6 EXHAUST GAS SYSTEM

The system includes exhaust gas silencers, expansion bellows and the exhaust gas stack.

2.7.7 CHARGE AIR SYSTEM

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

2.7.8 HEAT RECOVERY SYSTEM

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

Steam Generation System

a. Exhaust Gas Boiler
   No. of Units : 3 units
   Type : EOG - 4 Spiral wound layer steel boiler tubes
   Specification :
   Steam Capacity : 2 tons per hour, saturated steam
   Steam Operating Pressure : 5 to 8 bars
   Make : Clayton

b. Oil Fired Boiler
   No. of Units : 1 units
   Type : EO - 100 Spiral wound layer steel boiler tubes
   Specification :
   Steam Capacity : 1.5 tons per hour
   Steam Operating Pressure : 8 bar
   Fuel : Light Fuel Oil (LFO)
   Make : Clayton

2.7.10 OVERHEAD CRANE
One unit of 2.5 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 travel the full length of the engine room stopping at the control room.

<table>
<thead>
<tr>
<th>Overhead Crane</th>
<th>Capacity</th>
<th>Model</th>
<th>Hoist Winch</th>
<th>Winch Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 units (one per barge)</td>
<td>2.5 Tons, 4-fall, single speed hoist, Blooma</td>
<td>410L</td>
<td>Morris</td>
<td>460V, 3ph, 60 Hz</td>
</tr>
</tbody>
</table>

2.8 AUXILIARY SYSTEM

2.8.1 SEWAGE TREATMENT SYSTEM

One (1) 30 men sewage treatment plant is installed.

<table>
<thead>
<tr>
<th>Sewage Treatment Plant</th>
<th>Maker/Model</th>
<th>Size</th>
<th>Max Hydraulic Flow</th>
<th>Motor Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 unit</td>
<td>Hamworthy Model STO/ST1A-ST13A</td>
<td>ST3A</td>
<td>2.3 m³/day</td>
<td>2.4 kw, 440V, 3ph, 60 Hz</td>
</tr>
</tbody>
</table>

2.8.2 FIRE SYSTEM

One (1) electrical motor driven fire pumps of capacity 270 m³/hr at 70m is provided for each barge. Fire pump is at main deck to take suction from the sea directly during transit and to take water from the sea water supply line at mooring site.

Delivery pipes are led along the deck/bhd, machinery space and other compartments so that an adequate supply of water is ensured for fire fighting.

The fire main system is developed so that reaching it will be possible and fight a fire in any area of the barge. The system incorporate sufficient branch lines, with isolation valves, so that a single failure shall not put the entire system out of commission.

Fire hose, all-purpose nozzles, hose racks, hydrants, etc. are provided. Every fire stations are complete with a hydrant, hose rack, hose, nozzle, spanner.

<table>
<thead>
<tr>
<th>Fire Main System</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 units</td>
<td></td>
</tr>
</tbody>
</table>
Main Fire Pumps
Description : Electrical-driven centrifugal pump distribution header arranged in a ring manner with isolation valve.
Make : Pompe Grabarino
Type : MU150.400A
Capacity : 270 m³/hr
Head : 76 M
Speed : 1750 RPM
Power : 125 HP
Rating : 460V, 3ph, 60Hz

2.8.3 FEED WATER SYSTEM

Fresh water supply needed for boiler feed water and sanitary & potable water is shore supplied from existing thermal plant on a daily basis. Two electric motor driven feed water pumps of capacity 5 m³/hr at 25m is provided for each barge.

A fresh water maker of 15T/day is installed to cater for each barge machinery and personnel consumption.

Fresh Water Maker
No. of Units : 1 units
Type : SP-26-C80
Specification :
Capacity : 15 cubic meters per day
Make : Alfa - Laval

2.8.4 SANITARY & POTABLE WATER SYSTEM

One (1) sanitary/potable water gravity tank with supply water from feed water system and to provide flushing for toilets.

2.8.5 WATER TREATMENT SYSTEM

Water treatment system for sea water cooling line is provided with a sea water pump package located in separate pump room situated outside the mooring site.

2.8.6 VENTILATION AND AIR CONDITIONING
Mechanical forced ventilation system is provided for main generator room, machinery room, switchgear room, MCC room, battery room, workshop, stores and toilet.

Air conditioning is provided for control room, mess room, office.

### Air Condenser Unit

<table>
<thead>
<tr>
<th>No. of Units</th>
<th>Location</th>
<th>Type</th>
<th>Specification</th>
<th>Capacity</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 units per barge</td>
<td>Control Room</td>
<td>38HD-024-70125</td>
<td></td>
<td>24000 BTU/hr</td>
<td>Carrier</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Units</th>
<th>Location</th>
<th>Type</th>
<th>Specification</th>
<th>Capacity</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 unit</td>
<td>Engineer’s Office</td>
<td>38AT-018-70125</td>
<td></td>
<td>18000 BTU/hr</td>
<td>Carrier</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Units</th>
<th>Location</th>
<th>Type</th>
<th>Specification</th>
<th>Capacity</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 unit</td>
<td>Administration Office</td>
<td>38HD-024-70125</td>
<td></td>
<td>24000 BTU/hr</td>
<td>Carrier</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Units</th>
<th>Location</th>
<th>Type</th>
<th>Specification</th>
<th>Capacity</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 unit</td>
<td>Plant Manager Office</td>
<td>38AT-018-S-70125</td>
<td></td>
<td>18000 BTU/hr</td>
<td>Carrier</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Units</th>
<th>Location</th>
<th>Type</th>
<th>Specification</th>
<th>Capacity</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 unit</td>
<td>Tea Room</td>
<td>38MS-238-71125</td>
<td></td>
<td>38000 BTU/hr</td>
<td>Carrier</td>
</tr>
</tbody>
</table>

### Fan Coil Unit

<table>
<thead>
<tr>
<th>No. of Units</th>
<th>Location</th>
<th>Type</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 units per barge</td>
<td>Control Room</td>
<td>42JM024</td>
<td></td>
</tr>
</tbody>
</table>
Rating : 220-240V/1ph/50Hz
Make : Carrier

No. of Units : 1 unit
Location : Engineer’s Office
Type : 42JM018
Specification :
Rating :
Make : Carrier

No. of Units : 1 unit
Location : Administration Office
Type : 42JM024
Specification :
Rating :
Make : Carrier

No. of Units : 1 unit
Location : Plant Manager Office
Type : 42JM024
Specification :
Rating :
Make : Carrier

No. of Units : 1 unit
Location : Tea Room
Type : 42JM018
Specification :
Rating :
Make : Carrier

2.8.7 WORKSHOP EQUIPMENT

Welding Machine
No. of Units : 1 unit per barge
Type : EXCEL-ARC 500 CC
Specification :
Rating Output :
Type :
Volts : 36
Amps : 400
Duty CY% : 60
Max. OCC : 58
Line Volts : 200/230/460/575 V
Line Amps : 76/66/33/26 A
Make : Hobart

Grinding Machine
No. of Units : 1 unit per barge  
Type : GT 21 205mm Bench Grinder  
Specification :  
Rating : 230V, 1ph, 50/60Hz  
Speed : 3000/3600 RPM  
Wheel : 205 x 19 x 15.88mm (2320/min)  
Make : Hitachi Koki

Drill Press  
No. of Units : 1 unit per barge  
Type : SM-25GF  
Specification :  
Capacity : 25mm  
Motor : 1HP, 240V, 60 Hz  
Make : Taisun

Pipe Threading Machine  
No. of Units : 1 unit per barge  
Type : 300 COMPACT  
Specification :  
Capacity : 3mm to 50mm ; 62mm to 100mm  
Volts : 230V, 1ph, 60Hz  
Amp : 8.0A  
Make : Ridgid

Lathe Machine  
No. of Units : 1 unit (Barge V)  
Type : C6246/1000  
Specification :  
Motor : 7.5 kw  
Full Load Current : 18A  
Rating : 440V, 3phase, 60 Hz  
Make : East Machinery

2.8.8 BILGE SYSTEM/OILY WATER SEPARATION SYSTEM

The bilge system is arranged to take suction at void tanks by means of a portable hand pump. Bilge hats or wells are provided at the engine coaming area. A bilge pump is also installed in the pump room and discharge overboard.

Suction is taken from the bilge holding tank and sludge tank through a pump strainer with the slow-revolving positive displacement pump. The oily water goes through 2 stages of separation and discharges water overboard and / or back to the tank of origin.

Oily Water Separator  
No. of Units : 1 units  
Make : Victor
\[
\begin{array}{|c|c|}
\hline
\text{Capacity} & 3 \text{ m}^3/\text{hr} \\
\text{Working Pressure} & 3.45 \text{ bar} \\
\text{Power} & 1.1 \text{ kw} \\
\text{Speed} & 477 \text{ RPM} \\
\text{Rating} & 460\text{V, 3ph, 60Hz} \\
\hline
\end{array}
\]

\subsection{VENT AND SOUND SYSTEM}

All independent storage tanks are fitted with sounding and vent pipe. Void tanks have only sounding pipes. Striking plates are fitted at bottom of each sounding pipe.

All vent pipes terminating on deck with goose-neck vents. Air pipes for loose tanks are terminated on top of the respective tanks.

\subsection{FIXED FIRE EXTINGUISHING SYSTEM}

The control room, LV/HT rooms are protected by fixed CO$_2$ fire extinguishing system and all other area such as engine room, auxiliary machinery room, switchgear room, etc. are protected by portable fire extinguishers.

High pressure CO$_2$ system

Comprises 10 x 100 lbs CO$_2$ bottle located at the entrance of the barge. The system can operate manually at the CO$_2$ bottle area by opening respective valves. On remote, activation panel are located at the entrance of the covered area. Upon activation, 30 sec +/- 5 sec is allowed before CO$_2$ activation. System has a flooding factor of 0.56 m$^3$/kg.

\begin{table}[h]
\begin{tabular}{|c|c|c|}
\hline
\text{Area Covered} & \text{Volume} & \text{No. of CO$_2$ Bottle} \\
\hline
LV Room & 296 cu. m. & 5 \\
Control Room & 323 cu. m. & 6 \\
HT Room & 587 cu. m. & 10 \\
\hline
\end{tabular}
\end{table}

Hot Foam System

Comprises 1000 liters concentrated foam tank, 14 foam generator spaced out evenly in engine house with capacity of 165 cu. m. / min, and fire pump of flow rate of 270 m$^3$/hr. system are activated manually. Foam mixes with seawater at 2 % ratio and floods engine house in less than 3 minutes at filling time of 2 m/min.

Foam/Water Hydrant Station
Comprises 6 stations located in the engine house, 3 % inductor, 2 x 25 liters pail of foam and nozzle jet spray @ 450 li/min for each station.

2.8.11 TANK HEATING

Heavy fuel settling and day tank, sludge tank are provided with steam heating coils. For heavy fuel storage tanks, appropriate length of heating coils are provided near suction pipe area.

2.9 ELECTRICAL (ON BOARD)

2.9.1 13.8KV GENERATOR SWITCHGEAR

The medium voltage switchgear includes the following items:

a) Generator Incomer Circuit Breakers - 13 units

Cubicle : Unilib’s Standard Cubicle
Size : 2100 (H) x 800 (W) x 1800 (D) MM

Circuit Breaker
1 - SF6 Circuit Breaker 24 kV, 1250A, 3 pole 40KA at 24 KV Drawout Version

Protection
3 - Nondirectional Over current relay (51), Basler
1 - Reverse Power Relay (32), Basler
1 - Gen. Loss of excitation relay (40), Basler
1 - Under/Over Voltage Relay (27/59), Basler
1 - Differential Relay (87), Basler
1 - Negative sequence Protection Relay (46), Basler

b) Network Feeder Circuit Breakers - 2 units

Cubicle : Unilib’s Standard Cubicle
Size : 2500 (H) x 1150 (W) x 2300 (D) MM

Circuit Breaker
1 - SF6 Circuit Breaker 24 kV, 2500A, Merlin Gerin
3 pole 40KA at 24 KV Drawout Version

Protection
2 - Overcurrent Relay, Basler
1 - Earth fault relay, Basler
1 - Test Lamp, Izumi
1 - Alarm Stop, Izumi
2 - Reset, Izumi

c) Station Transformer Feeder Circuit Breakers - 2 units

Cubicle : Unilib’s Standard Cubicle
Size : 2500 (H) x 900 (W) x 2300 (D) MM

Circuit Breaker
1 - SF6 Circuit Breaker 24 kV, 1250A Merlin Gerin, 3 pole 40KA at 24 KV Drawout Version

Protection
2 - Overcurrent Relay, Basler
1 - Earth fault relay, Basler

d) Neutral Grounding System - 1 unit
The neutral grounding system consists of the following equipment:

i) Neutral Contactor Panel
Cubicle :
Size : 2000 (H) x 1000 (W) x 1000 (D) MM
Frame : L50 x 50 x 50 MM Angle Iron
Doors : 2.5 MM Thick Zinc Coated Sheet Steel
Finishing: Grey Epoxy Powder Paint

Protection Relay
1 - Non Directional Earth Fault Relay (51N) Basler

ii) Neutral Grounding Resistor
2 - Neutral grounding resistor, 80 ohm, 10 second, to limit the earth fault current to approximately 100 amps.

The resistor will be of the dry type, and will be installed in a ventilated floor standing enclosure.

2.9.2 STATION TRANSFORMER

1800 KVA 13.8 KV / 0.48 KV, 3 PHASE, 60 HZ EACH
Qty : 2 units/barge

Type : Onan
Capacity : 1800 KVA
Voltage : Pri : 13.8 kV, +/- 5%, 3 Phase
Sec : 480V, 3 Phase
Frequency : 60 Hz
Vector : YnD 11 or YnD 1
Hermetically sealed, complete with oil temp protection and sudden gas pressure protection.

2.9.3 GENERATOR/ENGINE CONTROL PANEL

Qty. – 13 units)

Cubicle :
Size : 2100 (H) x 1000 (W) x 800 (D) MM
Frame : L50 x 50 x 50 MM Angle Iron
Doors : 2.5 MM Thick Zinc Coated Sheet Steel
Finishing: Grey Epoxy Powder Paint

Complete with metering, control switch, programmable logic controller, controllers, control relays, transducers, alarm indication window, etc.

Metering
1 - Generator voltmeter 0-20 kV, PT 14.4 kV/120V, Toyo Keiki
1 - Generator ammeter 0-300 A, CT 300/5A, Toyo Keiki
3 - Frequency meter 55-65 Hz 120 V, Toyo Keiki
1 - MVAR + - 4 MVAR, Toyo Keiki
1 - KW Mtr 0-5 MW, PT 3 x 14.4kV/120V, CT 3 x 300/5A, Toyo Keiki
1 - P.F. meter PT 14.4 kV/120V, CT 3 x 300/5A, Toyo Keiki
1 - DCA Excitation Ammeter, Toyo Keiki
1 - DCV Excitation Voltmeter, Toyo Keiki
1 - KWH Meter, PT 14.4kV/120V, CT 3 x 300/5A, Osaki
1 - Engine tachometer

Controller/Control Relays
1 - Engine speed control governor 2301A, Woodward
1 - Digital synchronising & load control (DSLC), Woodward
1 - AVR, Kato
1 - Voltage sensing relay (84), Izumi
1 - Frequency sensing relay (81), Dold
1 - Circuit Breaker blocking relay (94), Izumi
1 - Circuit breaker closing aux relay (3x), Izumi
1 - Circuit breaker tripping aux relay (3Y), Izumi
1 - Synchronising aux relay 43 SX/Sy, Izumi
1 - Circuit breaker closing aux relay 52 GZ, Izumi
1 - Engine cool down module CDM, Izumi
1 - Engine start-stop relay 5X, Izumi

Alarm Indication Window
Alarms and shutdowns for electrical and mechanical parameters are displayed on the Generator Control Panel. Engine shut down parameters are derived from volt free contacts hard wired from the engine protection system, whereas alarm set points are derived in the master PLC, from analogue signals communicated from engine mounted sensors. 4 - 20mA or PT100 sensors are provided.

The following alarm / shutdown parameters are annunciated

1 - 24V DC Control source on light
1 - Engine fail to start light (S/D)
1 - Emergency stop light (S/D)
1 - Engine overspeed light (S/D)
1 - Engine high crankcase press (S/D)
1 - Engine high water temp (S/D)
1 - Engine high oil temp (S/D)
1 - Low water jacket level
1 - Low oil pressure (S/D)
1 - Under voltage / H2 fault
1 - Differential fault (S/D)
1 - Generator overcurrent
1 - Earth fault (S/D)
1 - Under / over voltage (S/D)
1 - Negative sequence current (S/D)
1 - Reverse power (S/D)
1 - Loss of Excitation (S/D)
1 - High winding temp (AL)
1 - High bearing temp (AL)
1 - High water temp (AL)
1 - High oil temp (AL)
1 - Low oil press (AL)
1 - Low injector coolant press (AL)
1 - High exhaust stack temp (AL)
1 - High / low fuel temp (AL)
1 - High manifold air temp (AL)
1 - Low water level (AL)
1 - Low oil level (AL)
1 - High exhaust temp differential (AL)
1 - High AC / OC inlet temp (AL)
1 - Low sea water pressure (AL)
1 - Low coolant temp (AL)
1 - Governor failure (AL)
1 - Oil pan metal particle detector (S/D)
1 - PLC failure (S/D)
1 - Engine panel not in remote (AL)
1 - Low load operation (AL)
1 - Engine de-rate activated (AL)
1 - High lube oil differential pressure (S/D)
1 - Lube oil treatment plant fault (AL)
2.9.4 COMPUTER BASED MONITORING SYSTEM

Computer
IBM PC Pentium Computer
256 KB External Cache
4 MB RAM Memory expandable to 32 MB
2 serial, 1 parallel
At IDE Bus Controller
1.2 MB, 1.44 MB Floppy
170 MB Harddisk
200 MW Power Supply
101 Keys keyboard
14” Super VGR Monitor
Microsoft mouse
Dot Matrix Printer 24 Pin type
1 - UPS system for 3 computers

The PC package is a color graphics operator interface software designed for the monitoring of multiple programmable logic controllers connected on a network system.

The system comes complete with properly configured graphics, giving windows for:

1) Lube oil system
2) Cooling system
3) Fuel oil system
4) Diesel generator sets
5) Electrical single line & load distribution

The system also provides: trends, reports, history, and alarm list (indicating date and time).

Additional inputs will be provided for the process signals:
10 Channels 4-20 mA analogue inputs
Channels digital (volt free) inputs

2.9.5 MASTER CONTROL SYNCHRONIZING PANEL

Integrated with the generator control panels to form one control panel suite.

Cubicle:
Size: 2100 (H) x 1000 (W) x 800 (D) MM
Frame: L50 x 50 x 50 MM Angle Iron
Doors: 2.5 MM Thick Zinc Coated Sheet Steel
Finishing: Grey Epoxy Powder Paint
**Metering**
2 - Voltmeter 0-20 kV, PT 14.4 kV/120V, Toyo Keiki
2 - Frequency meter 55-65 Hz 120V, Toyo Keiki
1 - Synchroscope 2 x 120 V AC, Toyo Keiki
3 - Syn lamp, Izumi
2 - kW meter total, Toyo Keiki
1 - System mimic panel, Unilib
2 - Var Meter Total, Toyo Keiki
1 - Square D Power Logic - Bus A
1 - Square D Power Logic - Bus B

**Control / Control Relays**
1 - Start/stop control & indication (for seawater pump)
1 - Under/over Hz relay (Bus A & B)
1 - Under/over Volts relay (Bus A & B)

**Alarm / Indication Window**
1 - 24V DC Control light source
1 - Feeder #1 Tripped
1 - Feeder #2 Tripped
1 - Bus A Under / over Hz
1 - Bus B Under / over Hz
1 - Bus A Under / over Volts
1 - Bus B Under / over Volts
1 - Booster Module #1 failure Hz
1 - Booster Module #2 failure Hz
1 - Booster Module #3 failure Hz
1 - Booster Module #4 failure Hz
1 - HFO treatment plant failure
1 - Boiler failure
1 - Low 24 V DC Battery Voltage
1 - Low 110 V DC Battery Voltage
1 - Tip cooler module #1 failure
1 - Tip cooler module #2 failure
1 - Tip cooler module #3 failure
1 - Tip cooler module #4 failure
1 - Freshwater generator failure
1 - Start air compressor low oil level
1 - Lamp test push button
1 - Alarm accept push button
1 - Alarm reset push button
1 - Lot of control relays 24V DC
2.9.6 **DC SYSTEM**

The DC Power Supply comprises the 24VDC and 110VDC Battery and Battery Chargers for the complete control of engine, switchboard and safety system.

**24 VDC BATTERY PANEL** - 1 Unit

- **Cubicle**: 1 Unit
  - **Size**: 2100 (H) x 1000 (W) x 800 (D) MM
  - **Frame**: L50 x 50 x 50 MM Angle Iron
  - **Doors**: 2.5 MM Thick Zinc Coated Sheet Steel
  - **Finishing**: Grey Epoxy Powder Paint

- **Circuit Breaker**
  1 - 50A 2P MCB for battery / charger, Merlin Gerin
  2 - 20A 2P MCB for battery charger, Merlin Gerin
  45 - 10A 2P MCB for feeder (24V), Merlin Gerin

- **Metering**
  2 - Ammeter -100-0-100A DC, Toyo Keiki
  1 - Voltmeter 0-50V DC, Toyo Keiki

- **Controller**
  2 - 24V DC Battery bank 100 AH, Unilib
  2 - 24V DC Battery charger 100A, Unilib

**110 VDC BATTERY PANEL** - 1 Unit

- **Cubicle**: 1 Unit
  - **Size**: 2100 (H) x 1600 (W) x 800 (D) MM
  - **Frame**: L50 x 50 x 50 MM Angle Iron
  - **Doors**: 2.5 MM Thick Zinc Coated Sheet Steel
  - **Finishing**: Grey Epoxy Powder Paint

- **Circuit Breaker**
  3 - 10A 3P MCB, Merlin Gerin
  3 - 50A 2P MCB for battery / charger output, Merlin Gerin
  2 - 10A 3P MCB for battery charger, Merlin Gerin
  24 - 10A 1P MCB for feeder, Merlin Gerin

- **Metering**
  1 - Ammeter -50-0+50A DC, Toyo Keiki
  1 - Voltmeter 0-150V DC, Toyo Keiki

- **Controller**
  1 - 110V DC Battery bank 65 AH, Unilib
  4V DC Battery charger 30A, Unilib
2.9.7 LV SWITCHGEAR

LV STATION DISTRIBUTION - 1 UNIT

Cubicle:
Size: 2100 (H) x 1000 (W) x 800 (D) MM
Frame: L50 x 50 x 50 MM Angle Iron
Doors: 2.5 MM Thick Zinc Coated Sheet Steel
Finishing: Grey Epoxy Powder Paint

Circuit Breakers
Incoming Circuit Breakers
1 - 2500ACV 500V 3 Pole 75 KA, draw out version, Merlin Gerin
Bus tie circuit breaker
1 - 2500ACV 500V 3 Pole 75 KA, draw out version, Merlin Gerin
Shore Supply Incomer Circuit Breaker
1 - 800A MCCB 500V 3 Pole, Merlin Gerin

Protection
1 - Overload / short-circuit unit (thermal & magnetic)
Load Distribution Feeders / Starters
Load distribution is split into Bus A and Bus B, on either side of the bus tie. The main sections of the LV distribution system provide feeders and /or starters for the auxiliary loads. A 230 volt three phase section is also included in each of the bus sections, to provide 230 volt distribution to the auxiliary loads. 480 V power supply to the LV distribution system is from the Caterpillar supplied station transformers, whereas the 230 volt three phase supply is from the 230 volt switchboard.

2.9.8 FIRE DETECTION AND ALARM SYSTEM

A Fire Detection and Alarm System are installed on the barge to detect a possible fire hazard and provide alarm in the control room. Automatic heat and smoke detectors, fire alarm bells, horn and/or rotating beacon lights are installed.

Fire Detection System
The fire detection system in PB IV and V consist of:
a) Smoke Detectors
b) Heat Detectors
c) Flame (UV) detectors
They are capable of monitoring all working spaces for incipient fire conditions alerting duty personnel by audio and visual alarm to the existence and location of such condition. In the control room, the audio and visual alarms are de-activated once they are acknowledged. The panel also indicates the zone where the fire condition is detected.

Fire Alarm Zones
Zone 1 - Engine room (FR 1 to FR 11)
Zone 2 - Engine room (FR 11 to FR 21)
Zone 3 - Engine room (FR 21 to FR 29)
Zone 4 - L.V. Switchboard room
Zone 5 - Station Transformer
Zone 6 - H.T. Switchboard room
Zone 7 - S.T Room /Engr. Office/Tea Room
Zone 8 - Workshop/Store
Zone 9 - Control Room
Zone 10- Plant Mgr/Admin office/Change Room
Zone 11- S.W. Pump room
Zone 12- Aux. Machinery room

2.9.9 LIGHTNING SYSTEM

Lightning arrestor is installed on the highest structure on the barge and grounded to the main hull structure to protect the barge from the effects of lightning.

2.9.10 INTERNAL TELEPHONE/P.A. SYSTEM

A page/party communication system is provided for internal communication and public address purposes. The system consists of the following:
Wall mounted Central Exchange Unit for 24 Stations
Desk mounted telephone station for the following:
  Control Room
  Plant Manager Office
  Admin. Office
  Engineer Office
Wall mounted telephone station for the following:
  Workshop
  Tea Room
  Pump Room
  HT Room
  LV Room
  Aux. Machinery Room
Wall mounted telephone station for fuel barge and on-shore installation like switchyard, guard office, on shore warehouse, etc.

2.9.11 LIGHTING SYSTEM

There are two numbers of 90 KVA 480V/230V service transformers. Power and lighting distribution panels are installed for small power and lighting system. Emergency lighting fixtures c/w built-in battery are also provided. Power barges are lighted by means of fluorescent lamps and floodlight with a minimum lux as per IEC requirement or equivalent. All fluorescent fixtures are equipped with approved type high power factor ballast designed to give hum-free operation. Floodlights are high pressure sodium vapor type. A minimum number of emergency lights c/w built-in battery as required by the regulation bodies are installed.
230V Lighting and Power Transformer

No. of Units : 4 units
Unit Assignment : 2 unit per barge
Specification :
  Capacity : 90 KVA, 3ph, 60Hz
  Voltage : 480V/230V
  Type : Dry type natural air cool
  Connection : Delta/Wye
  Make : Chye Sin Electric Co.

II. SWITCHYARD COMPONENT

3.0 BRIEF DESCRIPTION OF 115/13.8KV NORTH HARBOURSWITCHYARD

The 115 kV/13.8 kV outdoor switchyard is a single bus design, with two (2) incoming transformer bays and one (1) outgoing bay. The transformer receives power from the barge at 13.8 KV and steps up the voltage to 115 KV and connected to a 5 km. transmission line Utility’s substation.

One transformer bay consists of:
- one (1) 63.5 MVA, 13.8 KV/115 KV, 3 phase, 60 Hz Power Transformer
- one (1) circuit breaker
- one (1) disconnect switch
- one (1) set current transformer
- one (1) set surge arrester

The outgoing bay consists of:
- one (1) circuit breaker
- two (2) disconnect switch
- one (1) set capacitor voltage transformer
- one (1) set current transformer
- one (1) set surge arrester

An air-conditioned control room is provided for the control, supervision and operation of the switchyard. It contains all the necessary control and relay panels as well as the auxiliary power system with two battery chargers and one 220 VDC regulated supply, two dry-type transformers for 230 VAC supply, a battery room with battery rack containing 19, 12V maintenance-free battery.

The power transformers are equipped with an off-load tap changer enabling voltage ratio adjustment. Protection of transformer and bus is provided by the use of the overcurrent, differential, earth fault relays. The transmission line protection is by pilot wire differential protection scheme.

The switchyard is provided with remote control, supervision and annunciation system.
TECHNICAL SPECIFICATIONS OF 13.8 / 115 KV NORTHHARBOUR SWITCHYARD EQUIPMENT

(1) 3 x 115 kV Circuit Breaker type SIEMENS 3 AQI EG. 1 x 115 kV SIEMENS Circuit Breaker 60 Hz. 31.5KA/3UC

(2) 3 sets capacitive voltage transformer (EMER) 115 KV / 110 / / 3 complete with line trap and line matching unit type trench electrical TEHM115 a.

(3) 9 x Current Transformer 115 kV rated (SIEMENS)

(4) 9 x 115 kV Surge Arresters (SIEMENS)

(5) 4 x Disconnecting Switches (SIEMENS)

(6) 1 x Container housing the following protection equipment:
   (A) 2 x Transformer Panel each comprising of Transformer Protection
       (a) Duo-Bias Protection REYROUE
       (b) Overcurrent and Earth Fault Protection ABB
       (c) Breaker Fail
       (d) Busbar Zone Protection
       (e) Restricted Earth Fault Relay
   (B) 2 x Metering Panel comprising of ammeters and voltmeters and MW, MVAR meters and annunciators
   (C) 2 x AC 480V Panels.
   (D) 3 x Battery Chargers
   (E) 1 x DC 125V DC Supply Panel
   (F) 1 x Storage Batteries
   (G) 2 x 480V/230V AC Transformers
   (H) 1 x Line Protection Equipment consisting of:
       (a) Distance Protection - GEC LFZP model 111 c/w DEF Blocking Scheme.
       (b) Breaker Fail Protection
       (c) Busbar Zone Relay
       (d) Overcurrent and Earth Fault
       (e) Remote End Protection

(7) 1 complete microwave communication system ABB NERA Type Model NL-187, antenna and waveguide EW64 quadlink of channel band - Telco and Andrew Parabolic.

(8) 1 x Perimeter Chainlink Fence

(9) 1 x Substation Earthing System.

(10) 1 x Stainless Steel Metering Panel

(11) 3 x Stainless Steel Marshalling Box on Switchyard

(12) 1 x Annunciator Panel

(13) (A) 2 x Transformer receive gantry structures.
     (B) 1 x Take-off structure.
     (C) 2 x Busbar gantry structures

(14) 2 sets of 3 double circuits 660mm2 AAC overhead conductors / insulators from barge to switchyard.
     1 lot single circuit 660mm2 AAC within switchyard.

(15) 1 lot of control cabling within switchyard.
     1 lot of 480V AC 7 cabling from barge to yard.
     2 x 63.5MVA 13.8/115kV transformers, MEIDENSHA made.