13 x 12.1 MW Wartsila make Diesel Generator Sets:

3.1. DIESEL ENGINE GENERATOR SETS

Diesel Engine:
Weight: ~152 tone,
Size: 3.55m x 9.45m x 5.15m

Generator:
Weight: ~57 tones

The above illustration shows Wärtsilä V38 engine and generator arrangement with the engine flexibly mounted on the fixing rails or common base frame.

NOTE: Please see appendices 11.7 for operation hours of engines

3.1.1. ENGINE

13 Engines Wärtsilä 18V38

The engine is four strokes; direct injected, turbocharged and intercooler design.

Configuration: Vee form
Number of cylinders: 18
Cylinder bore: 380 mm

Diesel Engine Generator

3
Stroke: 475 mm
Speed: 600 rpm
Mean piston speed: 9.5 m/s
Compression ratio: 13:1
Brake mean effective pressure: 25, 1 bar
Swept volume per cylinder: 53.9dm3
Number of valves: 2 inlet valves, 2 outlet valves
Direction of rotation faced towards flywheel: Clockwise

Engine shaft output: "12150"kWm

Engine shaft output corresponds to 100% load of the engine at ISO 3046/I-1995(E) conditions.

The engine is designed for continuous heavy fuel duty and can be started and stopped on heavy fuel oil (HFO) provided that the fuel is heated to operating temperature. The system is designed for a fuel viscosity of 730 cSt/50 oC.

The Heavy Fuel Oil System (Fuel Oil No: 6) is the main fuel system. The engines can be started and stopped at heavy fuel, provided that operation temperature is maintained. However, it is necessary to use Light Fuel Oil for cold starts.

**Fuel Oil System**

The Wärtsilä V38B engine is designed for continuous and correct operation on heavy fuel oil (HFO) as well as light fuel oil (LFO). A preheated engine can be started directly on HFO provided that the external fuel system has the correct temperature and pressure. The engine can also be stopped on HFO although the external system has to stay in operation i.e. fuel must be circulated through the stopped engine continuously for heating purposes.

The internal fuel system mainly comprises but not limited to the following equipment:
- Low pressure pipes made of steel
- High pressure pipes, double wall with common leak alarm
- Injection pumps, individual for each cylinder
- Fuel injector in each cylinder
- Fuel oil pressure regulating valve

For one Engine Generator Set:

Required F. oil # 6 for 1 kwhr: 205,1 gr

(output is subject to new location)

205,1 x 11.075 x 24 hr / (1000 x 1000) = **54.5 ton /day**

Note: These figures are given for information purpose only and can not be used as guaranteed values.

**Technical Data for Operation Medias**

The engines are designed and developed for continues operation on operation media as described in appendices 11.11. Please, notice that those are extreme limits for Wärtsilä engines.
3.1.2. GENERATOR
13 Self-cooled 3-phase brushless, salient pole type, synchronous generator(s)
Nominal output 13843 kVA
Power factor 0.8
Voltage 15000 V, adjustment range ± 5%
Frequency 50Hz
Speed 600rpm
Runaway speed 720rpm
Efficiency at rated output
Voltage and p.f. 0.8: >97 %
Continuous short circuit
Current about 3 x In
Insulation
Class / temperature rise F/F
Enclosure IP21
Standard IEC34
F.oil# 6 amount for one day per engine at Power Plant: 5

3.2. FUEL OIL SYSTEM

3.2.1. LFO (DIESEL) SYSTEM
Unloading pump unit(s) 23 m³/hour
LFO Storage tank of 1.000 m³
Set of piping material for light fuel oil system
Flow meter for LFO system etc.

3.2.2. HEAVY FUEL OIL (HFO) SYSTEM
Unloading pump unit(s) 51.9 m³/hour
HFO Storage tank(s) of 7.500 m³
HFO Transfer pump unit(s)
HFO Buffer tank of 200 m³
Separator units 3 pcs
HFO Daily fuel tank(s) of 200 m³
HFO Booster unit(s) AMB 2 pcs
HFO Sludge Tank
3.3. PLANT LUBRICATING OIL SYSTEM
Storage tank(s) for fresh oil of 40 m³
Transfer pump unit(s) (stationary, for clean oil)
Storage tank for intermediate storage of oil during maintenance, 16 m³
Storage tank for used oil of 20 m³

3.4. COMpressed AIR SYSTEM
Starting air system 140 m³/h
Control and instrumentation air system 125 m³/h

3.5. COOLING SYSTEM

3.5.1. ENGINE COOLING SYSTEM
Open type expansion vessel(s) for HT cooling water circuit
6
Open type expansion vessel(s) for LT cooling water circuit
Radiator cooler package(s)

3.5.2. PLANT COOLING SYSTEM
Maintenance water tank with an electrical motor driven discharge pump
Storage tank for Glycol 40 m³

3.6. FIRE FIGHTING SYSTEM
2 fire pumps and hydrants with fire cabinets (one electric and one diesel engine driven)

3.7. FIRE FIGHTING & RAW WATER STORAGE TANK
Combined Capacity: 1,000 m³

3.8. EMERGENCY / BLACK START DIESEL GENERATOR
Capacity of one 500 kVA

3.9. MEDIUM VOLTAGE SWITCHGEAR

3.9.1. MEDIUM VOLTAGE PANELS
Busbar measuring cubicle
Station auxiliary transformer
Station low voltage switchgears
110 V Power Plant Control 150 Ahr
24 V DC System 75 Ahr

3.10. SWITCHYARD
It is excluded from the scope of supply except 3 nos step up transformers.

3.11. BOILERS

3.11.1 HEAT RECOVERY STEAM GENERATORS
4 nos of HRSG’s will be provided. It is strictly recommended to make proper modifications and overhaul for better efficiency to the existing HRSG’s.

3.11.2. PLANT AUXILIARY BOILER
For start-up period an Auxiliary Boiler (Oil Fired) will be supplied. Main characteristics of the boiler as follows;
• Steam flow: Max 5t/h, Min:3 t/h,
• 173C Saturated steam

11.7 Engine Operating Hours
Engine operating hours are as follows as of 20 June, 2007;
   i. DG#1-11.441hr
   ii. DG#2-10.986hr
   iii. DG#3-11.262hr
   iv. DG#4-10.825hr
   v. DG#5-10.864hr
   vi. DG#6-10.875hr
   vii. DG#7-16.447hr
   viii. DG#8-13.996hr
   ix. DG#9-14.284hr
   x. DG#10-9.976hr
   xi. DG#11-13.796hr
   xii. DG#12-11.796hr