

MADURAI POWER CORPORATION PRIVATE LIMITED

106 MW Diesel Engine Power Plant, Paravai
Madurai – 625402. Tamil Nadu, India

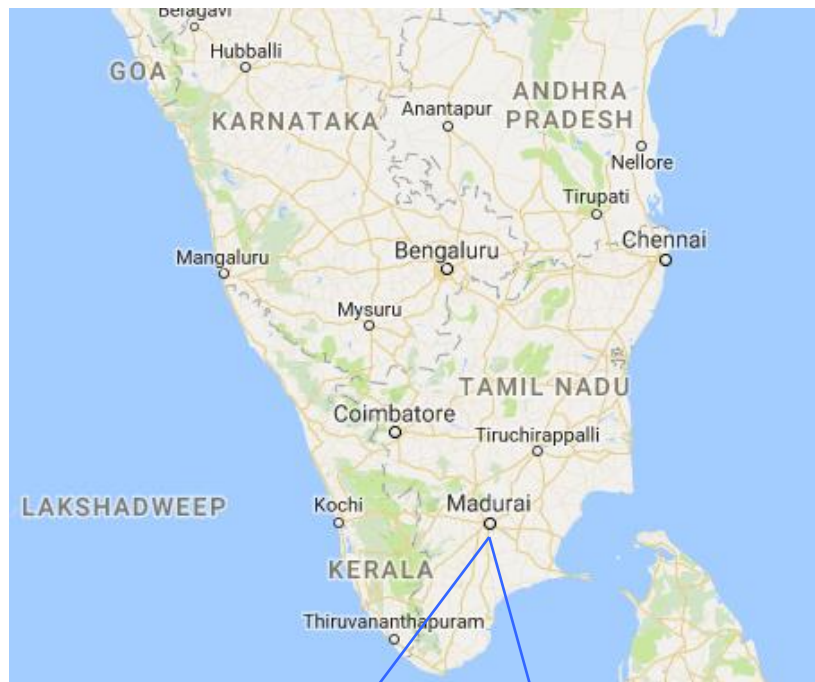


1. INTRODUCTION

The 106 MW diesel power plant is located at Samayanallur power board Complex, Paravai, Madurai District, Tamil Nadu in India. The plant consists of 7 nos. of Turbo charged Wartsila Diesel Engines each of 15.143 MW generating capacity and the total plant capacity is 106 MW. The EPC contractors for the plant were Wartsila NSD Corporation, Finland and Wartsila NSD India Limited.



2. PLANT LOCATION



The plant is located near to the Madurai to Dindigul Highway in Paravai, Madurai, Tamil Nadu, India which is approximately 12 kms from the Madurai city.



3. PLANT KEY DATA & MAJOR EQUIPMENTS – SUMMARY

3.1 Plant Key Data

1	Name of the Plant	Madurai Power Corporation P Ltd
2	Location/Address	Samayanallur Power Board Complex, Paravai, Madurai
3	Plant Capacity (gross)	7 X 15.143 MW
4	Plant Capacity (Site Rating)	106 MW
5	Designed Operation Philosophy (Base Load/Peaking)	Base Load & Peak Load
6	Power generation & evacuation voltage	11 KV/110 KV
7	Types of useable fuel & present fuel in use	LSHS/LSFO/HFO : LSHS
8	Plant Owner	Madurai Power Corporation P Ltd
9	O & M Contractor	Madurai Power Corporation P Ltd
10	Date of Commissioning/COD	22 nd September 2001
11	Date of termination of PPA (term 15 Year)	21 st September 2016

3.2 Plant Major Equipment Data

No	Equipment	Make/Model	Quantity	Capacity/Dimensions	Make
1	Prime Mover	Wartsila 18V46	7	17.... At 500 rpm (AT ISO condition)	Finland
2	Generator	ABB - AMG 1600SS12	7	20,000 KVA	Finland
3	Main Power Transformer	BHEL	4	40,000 KVA	India
4	Station Transformer	ABB	4	20,000 KVA	Finland
5	Black start Generator	Cummins VTA 28 G	1	500 KVA	Stamford, UK
6	Fuel Treatment Separator	Alfa Laval	4	8000 lit / hr	Italy
7	Lube Oil Purification	Alfa Laval	7	8000 lit / hr	Italy
8	Exhaust gas boiler	Aalborg	3	4270 kg / hr	Denmark
9	A. Auxiliary Boiler	Steamrator	1	3000 kg / hr	Finland
	B. Auxiliary Boiler	Thermax AMW 02	1	3000 kg / hr	India
10	A. Starting Air Compressor	Sperre HL2/160	2	3000 lit / 30 bar	Norway
	B. Starting Air Compressor	Ingersolrand	2	5000 lit / 30 bar	India
11	Plant Control System	WOIS / WISE	1		Wartsila, Finland

4. PLANT OVERALL PERFORMANCE EVALUATION

Operational Data as of 21st September 2016 (end of PPA term)

Machine Identification	DG 1	DG 2	DG 3	DG 4	DG 5	DG 6	DG 7
Running Hours	69042	54316	52432	64066	70952	55726	50751

Table

The Specific Fuel Consumption (SFC) and Specific Lube oil consumption (SLOC) calculated based on the Actual Energy injected into the grid.

Year	Availability (in %)	NET Specific Fuel Consumption (gm/kWh)	Specific Lube Oil Consumption (gm/KWh)	Plant Load Factor (in %)
COD - 2002	97.29	204.61	0.513	64.44
2002 - 2003	96.95	206.56	0.546	67.39
2003 - 2004	96.91	207.57	0.573	50.30
2004 - 2005	93.35	205.02	0.575	37.84
2005 - 2006	97.08	204.41	0.577	36.44
2006 - 2007	97.83	203.93	0.578	40.86
2007 - 2008	94.72	205.31	0.588	56.26
2008 - 2009	92.08	208.17	0.606	73.07
2009 - 2010	94.70	209.46	0.645	51.58
2010 - 2011	94.56	208.98	0.657	39.08
2011 - 2012	84.05	205.38	0.649	31.13
2012 - 2013	92.05	206.75	0.631	39.45
2013 - 2014	97.49	206.84	0.628	38.18
2014 - 2015	94.30	207.81	0.630	27.02
2015 - 2016	96.78	207.18	0.616	4.58
2016 - Sep 16	97.41	207.84	0.613	2.82

TECHNICAL INFORMATION FOR MAJOR EQUIPMENT

1. Prime Mover – 07 Nos. (Wartsila - Finland)

Type	Wartsila 18V46
Year of Manufacture	2000
Number & Arrangement of Cylinders	18, V type
Cylinder Bore Diameter	460 mm
Stroke Length	580 mm
Engine Speed	500 rpm
Mean Piston Speed	9.7 m/s
Swept volume per cylinder	96.4 l
Compression ration	16:01
Output	15611 Kw
Governor Manufacture	Woodward
Type	723- Electronic Governor
Governor actuator type	PG-EG 200
Wet sump capacity	16,000 liters
Cooling water volume of engine	2500 liters



Turbocharger (ABB – Switzerland)

Type	VTR 454-D32
Approx. Speed	16,000 rpm
Lubrication	Engine Driven

Engine Identification No.	DG 01	DG 02	DG 03	DG 04	DG 05	DG 06	DG 07
Serial No.	91333	91334	91335	91336	91337	91338	91339
Present Running hours	69042	54316	52432	64066	70952	55726	50731
SFC (g/kWh)	201.55						
SLOC (ml/kWh)	0.594						

2. Generator - 07 Nos.(ABB Oy - Helsinki, Finland)

Type	AMG 1600SS12
Year of Manufacture	2000
Rated apparent power	20000 kVA
Rated Power	15140 kW
Voltage	11,000 V
Current	1050 A
Frequency	50 Hz
No of Phase	3 Phase
Speed	500 rpm
No of poles	12
Connections	Y (Star)
Power Factor	0.8

Engine ID No	DG 01	DG 02	DG 03	DG 04	DG 05	DG 06	DG 07
Generator Sr No	4566247	4566248	4566249	4566250	4566251	4566252	4566253
AVR – BASLER ELECTRIC	DECS 125-15	DECS 125-15	DECS 125-15	DECS 125-15	DECS 125-15	DECS 125-15	DECS 125-15



[DG sets located in engine hall]

ELECTRICAL SYSTEMS

1. Main Power Transformer - 04 Units (BHEL)

Rated Power	40,000 kVA
Rated Frequency	50 Hz
Phases	3
Rated Voltage (HV/LV)	110,000/11,000 V
Rated Current (HV/LV)	210.194/2101.944 A
Connection Symbol	YNd1
Types of cooling	ONAF (ONAN 60%)
Type of Insulating oil	Mineral
No of Tap positions	21 Nos–On-load tap changer
Transportation weight	50000 kg
Oil Volume	20000 lts



[110 kV Switchyard & Main Transformers – 40 MVA]

2. Station Transformer - 04 Unit (ABB Transmit Oy, – VAASA, Finland)

Rated Power	2000 kVA
Rated frequency	50 Hz
No of Phases	3
Rated Voltage (HV/LV)	11,000/433 V
Rated Current (HV/LV)	104.9/2667 A
Connection Symbol	Dyn 11
Types of cooling	ONAN
Approx. Masses (Total)	4700 kg
No of Tap positions	5



[Aux Transformer – 1.1 MVA]

3. Medium Voltage Switchgear System (ABB Transmit Oy)

Type	MH12C 31.5
Operating Voltage	11,000V
Rated Voltage	12,000V
Rated Current	2,500A
Frequency	50Hz
No of phases	3

Generator Cubicles

07 Units

Breaker Type	HPA12/1231C MH
Specifications	12kV, 1250 A, SF ₆

Station Transformer Cubicle

04 Units

Breaker Type	HPA12/631C MH
Specifications	12kV, 630 A, SF ₆

Outgoing Cubicle

04 Units

Breaker Type	HPA12/2531 C MH
Specifications	12kV, 2500 A, SF ₆

4. Low Voltage Switchgear System (ELKAMO, KKBU Switchgear)

Type	KKB
Rated Voltage	≤ 690 V
Rated Current	
-horizontal bus bars	400 A...4000 A
-vertical bus bars	400 A...2000 A
Frequency	50Hz
No of phases	3

Main Breakers- Q1 & Q2 (Merlin Gerin)

Type	M32H1 (Masterpact)-Air Circuit Breaker
Specifications	690V, 3200A

Main Breakers- Q3 & Q4 (Merlin Gerin)

Type	M32H1 (Masterpact)-Air Circuit Breaker
Specifications	690V, 3200A



[Medium voltage & Low voltage switchgear]

5. High Voltage Switchgear System (ABB Power Technology, Sweden)

Rated Voltage	110kV
Main Breakers	27 Units
Type	SF ₆ Circuit Breaker; LTB 145 D/B
Rated Voltage	110 kV
Rated Normal Current	3150 A
Rated Frequency	50/60 Hz

Isolator Switch of Two Feeders**Two Column Rotary Disconnecter with Earthing Switch – GR Power Switch Gear**

Type	DB
Specifications	145 kV, 1250 A

Zinc Oxide Surge Arresters- (Elpro International Limited)

Type	9L12BNU048
Specifications	48 kV

6. DC System-02 Units (EFORE Oyj, Finland)

Type	EIPS 110-1800.3-D1
Rated Voltage	110 VDC

MECHANICAL SYSTEMS

1. Lube oil Purification System

LO Separator – 07 Units (one per Engine) -Alfa Laval

Model	LOPX-710 SFD 34
Max. density of feed	1100 kg/Cu.mt
Max. density of sediment	1350 kg/Cu.mt
Max. density of oper. Liquid	1000 kg/Cu.mt
Bowl speed	5175 rpm

Separator EL. Motor

Capacity	11.5 kW
Model	ABB M2AA-160m-4

Feeder Pump

EL. Motor

Capacity	1.5 Kw
Model	ABB M2AA90S

Pump

Model	IMO ACP 032 N1 NVBP
Capacity	8500 lph



[Alfa Laval – Lube oil Separator]

2. Fuel Purification System

HFO Separator– 04 Units Alfa Laval

Model	FOPX 614 TFD 24
Maximum Density of feed	1.100 Kg/M ³
Maximum Density of Operating liquid	1.000 Kg/ M ³
Bowl speed	4140 rpm

Separator EL. Motor

Capacity	15.5 kW
Type	ABB M2AA160L-4

Feeder Pump

EL. Motor

Capacity	2.5 kW
Type	ABB M2AA 90 LB

Pump

Type	IMO ACP 038N1 NVBP
Capacity	8500 lph



[Alfa Laval – HFO Separators]

3. Fuel Unloading Units (3 Units)

HFO Unloading Units – 3 Units Onkilahden Metalli OY Finland

Unloading Pump	06 Nos	
Model		IMO AB STOCKHOLM, SWEDEN
Type		ACF 090-N4 IRBP
Capacity		28.6m ³ /h each @ 4 bar
Make		IMO

Motor	06 Nos	
Type		M2AA180L8
Capacity		11 kW
Make		ABB



3.a. Fuel Transfer Units (1 Unit)**HFO Transfer Unit**

Transfer Pump

02 Nos

Type

IMO ACF 080 K4 IRBO

Capacity

32.6m³/h @ 4 bar

Make

IMO

El. Motor

02 Nos

Type

MEZ Czech Republic

Capacity

15 kW

Make

MEZ Czech Republic



[HFO transfer system]

4. Fuel Feeder Unit

HFO Feeder

Feed Pump	02 Nos	
	Type	ACG 060N6 ITBP
	Capacity	32m ³ /h
	Make	IMO
El. Motor	02 Nos	
	Type	EN60034
	Capacity	11kW
	Make	MEZ Czech Republic

LFO Feeder

Transfer Pump	01 Nos	
	Type	ACG 060N6 IVBP
	Capacity	30 m ³ /h
	Make	IMO
El. Motor	01 Nos	
	Type	A-EF 132SB-D
	Capacity	7.5 kW
	Make	Brook Crompton



[HFO and LFO feeder unit]

5. Fuel Booster Unit (2 units) (AURA MARINE Ltd.)

Feeder booster type	ABM-L 60 SS
Total Power max...	52650 kW
HFO Viscosity	380 cSt/50 °C
Fuel consumption maximum	13m ³ /h
Viscosity set point minimum	16 cSt
Injection temperature maximum	130 °C
Fuel pres. At unit maximum	10bar
HFO day tank temperature	90 °C

Booster Pump (02 Nos)	Type	ACG 070N6 NTBP
	Capacity	49.7 m ³ /h
	Make	IMO
El. Motor	Type	7BA 160M -02
	Capacity	15 kW/ 2920 rpm
Steam Heater (02 Sets)	Type	MX25L T16L1500
	Capacity	400 kW
	Make	VESTA™
Automatic Filter (02 Nos)	Type	6.61.07 DN 100
	Make	BOLL & KIRCH FILTERBAU GMBH
Viscosity Meter (02 Nos)	Type	0379-0106
	Make	VAF Instruments



[HFO Feeder Booster Unit]

6. Engine Fuel Feeder Unit – One unit for each machine

Fuel filter	Type	2.06 5.4 265 500-DN80
	Make	Boll & Kirch
Engine Fuel Feeder Pump (01 No)	Type	ACG 045K6 NTBP
	Capacity	10.3 L/min
	Make	IMO
El. Motor	Type	M2AA 132 SA
	Capacity	5.5kW
	Make	ABB
Return Fuel Pump (01 No)	Type	ACE 025 N3 NTBP
	Capacity	9 L/min
	Make	IMO
El. Motor	Type	M2AA 905 3GAA
	Capacity	1.1 kW
	Make	ABB



[HFO Fuel Feeder Unit]

7. HT/LT Cooling Water Radiators (FINCOIL)

Casing Material	Hot dip galvanizing steel
Finned Coil	Cu/Al
Internal Volume	550 liters

Electrical Motors

No of Motors	140 Nos
Capacity	7.5 kW/3 Phase, 380 -420 Delta/660-720 Star (5 rows for 1 engine)
Type	WU-DA160LV
Make	Invensys Brook Crompton, Huddersfield, UK



[HT/LT Cooling Water Radiator Unit]

8. Engine Pipe Module**LO Cooler**

Manufacturer
Type

APV
A/S A085

Lube Oil Filter

Auto Filter
Safety filter

Boll & KIRCH
Boll & KIRCH Metal Mesh

6.61.07 DN 200
Fineness 34µm
Fineness 60µm

Pre-lube Pump – Pre lubricating of Engine

Type ACF 110N 4 IRBO
Make IMO
Capacity 882 lph

El. Motor

Capacity 30 kW/ 1465 rpm/ 3 Phase/ 415 V 50 Hz
Type WU - DF200LNXD
Make Brook Hansen

Preheating Pump- Preheat HT water system of engine at stop condition

Type AL-1053/2X 326 9860003
Make KOLMEKS
Capacity 14 m³/h at 0.8 bar

El. Motor

Capacity 1.3 kW
Type OKN-871D F15
Make KOLMEKS



[Alfa Laval – Lube Oil Cooler]



[LO Filters]

9. Compressed Air System

Starting Air System - SPERRE

Compressors	02 nos
Type	HL2/160
Make	SPERRE
Capacity	140 m ³ /h

Starting Air System - Ingersol Rand – 2 Sets

Compressors	04 nos
Type	15T2
Make	Ingersol Rand
Capacity	54 m ³ /h

Starting air vessel capacity 3000L *4



Ingersol Rand



SPERRE

[Starting Air Compressors]

Instrument Air Unit

Type	ES 15 - 7EANA
Make	TAMROTER INSTRUMENT AIR COMPRESSOR
Capacity	2.11 m ³ /h

PLANT AUXILIARY SYSTEMS**10. Ventilation System**

Ventilation Fans	7 Nos
Capacity	26 kW
Make	Fan Woods
RPM	1440
Ventilation Fans	2 Nos
Capacity	30 kW
Make	Bharat Bijilee
RPM	1460
Auxiliary Fans	21 Nos
Capacity	4.4 kW
Make	Fan Woods
RPM	1440

11. Machine shop Equipments

- Padestal Drilling M/c
- Padestal drilling M/c Motor
- Light duty Lathe Machine (400x1000)
- Heavy Duty Lathe Machine (600x2000)
- Milling Machine
- Spindle Drive Motor
- Work bed drive Motor
- Power Hacksaw machine
- Power Hacksaw Motor
- Radial Drilling Machine
- Vertical Movement Motor
- Drill spindle Drive Motor
- Coolant pump Motor
- Valve Spindle grinding M/c
- Grinding wheel Drive motor
- Feed motor
- Industrial Washing machine
- Pump 1 Motor
- Pump 2 Motor
- VIBRA CLEANING Machine
- Pedestal Grinding machine 1
- Pedestal Grinding machine 2
- Pedestal Grinding machine 3
- High pressure water pump (LFO Unloading)
- High pressure water pump (Boiler tube cleaning)

MATERIAL HANDLING EQUIPMENT

- Workshop Crane (2 Ton)
- Fuel Treatment House Crane (500 Kgs)
- Fuel workshop crane (500 Kgs)
- Forklift (3000 kgs)



11. a Laboratory Equipments



12. Exhaust gas boilers

Exhaust gas boiler RCC 902/903/904.

Type

Smoke tube boiler – H307

Manufacturer

Aalborg Industries, Denmark

Design pressure

10 bar

Working pressure

7 bar

Design

Horizontal

Steam production

4270 kg/h

Exhaust gas flow

31.5 kg/s

Exhaust gas temperature max

400° C



[Exhaust Gas Boiler Unit]

13. Additional Start up Boiler 1

Type	3 pass wet back smoke tube boiler – SM30DL
Make	Thermax –Shellmax boilers
Design pressure	10.54 bar
Working pressure	7 bar
Design	Horizontal
Steam production	3000 kg/h



[Additional Startup Boiler Unit]

13. (a) Additional Start up Boiler 2

Type	3000 kg/h, Output 2 MW
Make	Steamrator Finland
Design pressure	13 bar
Working pressure	10 bar
Design	Horizontal
Steam production	3000 kg/h

14. Waste Fuel Management System

Sludge Treatment Unit– Fully Automated System

Manufacture	JOWA AB
Type	STU/S-32
Capacity (Maximum)	32 m ³ /24h
Chemical	JOWA M-87

Sludge Transfer Unit

Sludge Transfer Pump	01 No Pneumatic pump
Capacity	6-8m ³ /h
Type	Jabsco/impeller 52200
El. Motor	1.2-1.5 kw
Type	VAD 90L



[Water treatment unit & JOWA Sludge Treatment Unit]

15. Water treatment unit

Fully Automated System

Manufacture	Watman
Permeate water Flow	2.1 m ³ /h
Flow	2.06 m ³ /h
Chemicals	Sulphiuric , Anti scalent

Booster pump 02 nos

Pressure Gauge	3.5-4.5 bar
Pressure Switch	3-4 bar
Voltage current	400v/2.6A
Over heat protection	2.6 A
RO high pressure pump 02 nos	

Voltage /current	405/9.25
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Over heat protection	10.5
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Out let pressure	11.2
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Pressure Switch	6 bar
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Bag filters 02 nos

Cartridge filter 02 nos

RO Membrane

Type	Filmtec BW 30
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Reject pressure	10.6bar
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[Water treatment unit]

16. Black Start Generator Unit

Generator	STAMFORD , VE
Engine	Cummins India Ltd ,VTA-28G
Rated Power Continuous	500 kVA
Active Power	400 kW
Power factor	0.8
Voltage	400/230 V
Frequency	50 Hz
Speed	1,500 rpm



[Black Start Generator]

17. Overhead Crane Details – 2 Nos

Manufacture
Load

SWIFT Consolidated Hoists Pvt Ltd
10 ton



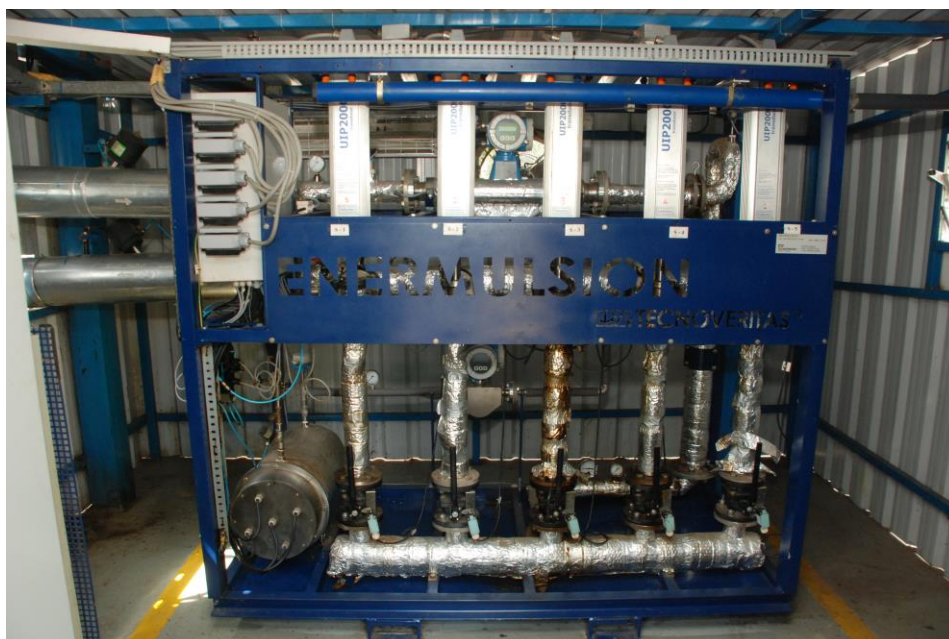
[Overhead Crane 10.0 t]

18. ENERMULSION – Fuel Emulsification System

(The unit blends about 10% of water and 90% of HFO. When this blended fuel is used, fuel savings upto about 5% is possible. This keeps the combustion chamber cleaner resulting in increased running hours between overhauls.)

Manufacturer
Capacity
Nominal emulsion capacity

TECNOVERITAS
70 Tons/Day
3000 L/hr



[Enermulsion unit]

19. Hot Water generator

(for maintaining engine temperature during non-generation period)

Make	Thermax
Type	AMW-02
Heat output	2,00,000 K.Cal/hr (Oil fired)



[Hot water generator unit]

20. DG HALL

The Diesel Generator hall accommodates the following:

1. Diesel Generator Sets
2. Pipe Modules for Lube Oil and Cooling Water
3. Lube Separator Modules
4. Ventilation System
5. Hot Water Generator for engines temperature control
6. MV Panel & LV Panel Rooms (Air Conditioned)
7. Main Control Room (Air Conditioned)
8. Electrical / Mechanical Workshops
9. Laboratory (Air Conditioned)
10. Warehouse (Air Conditioned)
11. Tool Room

12. Fuel Service Room (Air Conditioned)
13. Office for Managers & Engineers (Air Conditioned)
14. Conference Room (Air Conditioned)
15. Controls for fire / emission monitoring.

The complete DG hall is constructed by structures, insulated panels and insulated roof. The insulated panels control the sound emission by about 50 decibals. (DG hall at full load at about 110 decibals; Outside DG hall at about 60 decibals).

The DG hall structures and panels can be dismantled for erection at a different location. All the structures and insulated panels were imported from Europe and installed by WARTSILA, Finland.

The machinery space is well ventilated by blowers installed at the DG hall walls. Other areas are either Air Conditioned or equipped with Air Circulation.



21. Vapour Absorption Machine – 2 units

Make:	THERMAX LTD, Chinchwad, Pune
Machine Model:	E51 2S S.no: 9
Year of Manufacturing:	2004
Operating Weight:	27.3 Ton
Cooling capacity:	1845.9 kw
Heating capacity:	2030.5 kw
Heat source type:	Hot water
Inlet pressure:	5.0 bar(g)
Power supply:	415 V Frequency: 50Hz
Capacity:	550 TR each



22. Safety Equipments

- Main Fire pump
- Main Fire pump Motor
- Jockey pump
- Jockey pump motor
- Emergency Fire pump Engine
- Emergency Fire pump
- Fire pump House MCC Panel
- Fire fighting panel
- Fire alarm control Panel
- Different portable fire extinguishers

