

Technical specification

Project name: 2MVA HFO Container Type Power Plant

Project number: P130514

Power generation project

Product type: Stationary power plant

Engine configuration: 1×9L21/31

Date: MAY. 14, 2013

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1 General description

1.1 General

Power plant configuration	1 X ZGPT-9L21/31
Each diesel generating set standard	1881 kW
Total net output of power plant	≥2000 kVA
Generating sets voltage	0.4 kV
Frequency	50 HZ
PF	0.8
Speed	1000 rpm
Grid voltage	N/A
Main fuel	HFO/LFO

1.2 Design Condition and Performance Data

The equipment should be designed and manufactured according to the following operational conditions:

Design Conditions:

Ambient Air temperature :	45 °C
Total barometric pressure :	TBC
Cooling water temperature :	52 °C
Cooling system:	Cooling Equipment
Relative humidity:	Max.65%

1.3 Fuel oil for engine

(1) Heavy Fuel Oil

For a main fuel of the power plant, and this technical specification is based on 120 cSt at 50°C.

The specific gravity is based on 0.95 at 16.5°C, and fire point is higher than 56°C. The percentage (s) quantity is 3.5%.

The heavy fuel oil shall have the viscosity characteristics that the viscosity must be

within the range of 12 ~ 18 cSt with the heating lower than 150°C.

(2) Light diesel oil

For a start-up, stop and maintenance.

The viscosity of Diesel oil shall be of 2.0 ~ 14 cSt at Engine inlet under the power plant operating conditions.

1.4 Lubricating oil for engine

The lubrication oil of diesel should be selected from the recommended lubrication oil list to be of HD (heavy type) Grade API-CD and SAE 40.

1.5 Cooling Water

The normal fresh water with inclusion of preservative is designed and employed for design of cooling water system to prevent the rustiness and corrosion.

The water quality should conform to the following requirements:

Circulating Water of Engine

- pH value	7 ~ 9
- Total hardness (computed by CaCO ₃)	Maximum 75 ppm(mg/L)
- Chloride (computed by Cl ⁻)	Maximum 80 ppm(mg/L)
- Sulfate (computed by SO ₄ ²⁻)	Maximum 100 ppm(mg/L)
- Silicate (computed by SiO ₂)	Maximum 60 ppm(mg/L)
- Evaporation	Maximum 400 ppm(mg/L)

1.6 Standard

If there are no standards required to be described specially, all design, production and quality management as well as test should conform to relevant contents in the following international and national standards and manufacturer standards.

-GB Chinese Standard

-IEC International Electrotechnical Commission

-ISO International Organization for Standardization

-MAN Factory Standard

-ZG Factory Standard

1.7 Unit and Language

(1) Unit

The metric units should be employed for such contact documents as technical documents, sheet and drawings uniformly.

(2) Language

All documents, drawings, nameplates and contact correspondences between contractor and clients should be written in English.

1.8 Test and Inspection

(1) Factory Test

The diesel engine should be tested in the factory according to ISO3046 and manufacturer standard.

Load Test

Connect the diesel engine and the generator and employ the marine diesel as well as perform the test according to the following load and operating time.

Load	operating time
50%	30 mins
75%	30 mins
100%	60 mins

Other test items are as follows:

- Overspeed trip test
- Test of engine safety device

After factory test, a cylinder of engine should be selected to perform the following overhauling

- Piston and connecting rod
- Cylinder sleeve
- Main shaft bushing
- Intake/vent valve

(2) Field test

The customers should perform the starting and commissioning under the technical support of contractor. The following items should be inspected prior to commissioning and during commissioning:

- Installation inspection
- Connection and positioning inspection for engine and generator
- Test the interlocking, alarm and trip circuit to ensure the normal operating
- Inspection for safety devices

Site Performance Test

After the engine is started successfully, as long as the site condition is permitted, the customers should perform the following performance test under the technical assistance and guidance by supervisor.

Load	Time
50%	60 mins
75%	60 mins
100%	60 mins

The performance test procedure should be submitted to the customers.

1.9 Painting

All equipment should be painted according to the manufacturer standard, and the painting color should be notified to customers.

2 Technical specification

2.1 Engine particular

Type of Engine		Four stroke, single action, trunk piston diesel engine, with turbocharger and intercooler	
Model			9L21/31
Quantity of cylinder			9
Diameter of cylinder		mm	210
Stroke		mm	310
	Output *1)	kW	1980
MCR / rotating speed	Rotating speed	RPM	1000
	Maximal pressure	Bar	24.6
	Piston speed	m/s	10.3
Net weight of engine *2)		Ton	20.5
Cooling system	Cylinder sleeve	Fresh water	
	Piston	Lubrication oil	
	Air cooler	Fresh water	
Starting system		Compressed air	
<p>Note: *1) The output power refers to the engine power of fly wheel end under the condition of site design.</p> <p style="text-align: right;">*2) The net weight refers to the dry weight free of public base</p>			

2.2 Generator particular

Manufacturer	ABB/ AVK / LEROY SOMER or equal	
Rated output power	kW	1881
	kVA	2351.25
Rated voltage	kV	0.4
Rated current	A	3393.8
Rated frequency	Hz	50
Insulation degree	F	
Temperature rise	F	
Number of poles	Nos	6
Cooling mode	Air cooling	

Rated pressure regulating	%	±5
Full-load efficiency (zero tolerance)	%	95
Rated power factor	0.8	
Exciter type	Brushless excitation	

2.3 Fuel System

The design of fuel system for engine is used for combustion of reliable diesel oil.

- Fuel filter	Re-examination filter
- Fuel booster pump	Spiral, engine drive
- Fuel mixing tank	Cylindrical, with deaerator v/v
- Fuel supply pump	Spiral, engine drive
- Fuel oil daily tank	With water level
-Fuel oil pipeline and electric wire	Pipeline and electric cable in the inner of oil supply unit

2.4 Lubrication System

The engine is provided with the internal lubrication system of wet-type oil storage tank to provide the lubrication oil for all moving members and realize the lubrication and cooling.

- Fuel filter	Duplex type
- Lubrication oil pump	The engine driver is installed on the engine.
- Lubrication cooler	Plate-type installed on the engine
- Pregreasing pump	Engine drive

2.5 Compressed Air System

The starting air receiver has a capacity to allow for four (4) consecutive engine starts without recharging

- Starting air engine	: Compressed air , 30 bar
- Air compressor	: Electric driven, 30 bar
- Air storage tank	: Cylindrical, 30 bar
Control air receiver	: Cylindrical, 7 bar

2.6 Cooling Water System

The cooling water system of engine is composed of such two cooling water circuits as low-temperature circuit and high-temperature circuit. The heat for cooling water of engine is released to atmosphere from the cooling radiator.

Low temperature water circuit includes:

- Low temperature cooling water pump	Engine drive, installed on the engine
- Pressurized air cooler	Installed on the engine
- Lubrication oil cooler	Plate-type installed on the engine
- Cooling water expensive water tank	With liquid level meter
- Cooling radiator	Finned tube type

High-temperature water circuit covers:

- High-temperature cooling water pump	Engine attached
- Engine water jacket	Installed on the engine
- Thermostatic valve	Wax pattern, installed on the engine

2.7 Intake and Exhaust System

The engine is a kind of standard features, and a filter is provided on the turbocharger.

This filter belongs to the coarse strainer to prevent the larger particle entering into the turbocharger.

The allowable dust content of oxidizing air entering into the engine should not be higher than 0.5 mg/m³, therein, 90% dust content should be equal to or less than 5 μ m, and the rest content is less than 15 μ m.

The total pressure loss inside the air intake system should be less than 200 mmWC. If the quality of inhaled air exceeds above-said allowable scope, the special air filter should be employed according to suggestion of ZG. The exhaust gas of engine is discharged into the chimney to enter into the atmosphere from the turbocharger via

the expansion joint and silencer.

- Total pressure loss inside the air intake system: maximal 300 mmWC
- Exhaust silencer: absorption and resonance type

2.8 Ventilation System

The ventilation system for container of main diesel generator includes the air inflow fan with conduit and ventilation tube of generator.

2.9 Installation

The diesel generator should be installed on the steel pedestal with damper.

Scope of Supply

No.	Description	Qty	Our Scope	Client Scope	Remark
1 Main Diesel Generator Set					
1.1 Engine and Generator					
	1) Engine and accessories (9L21/31)	1	O		
	2) Generator, with excitation system	1	O		
1.2 Container and Accessories					
	1) Container, with silencer	1	O		
	2) Lifting gear and sling chain used for maintenance	1	O		
	3) Ventilation system	1	O		
	4) Extinguisher (portable)	1	O		
	5) Others (door, lighting equipment)	1	O		
	6) Engine/generator control screen	1	O		
2 Fuel Supply Unit					
	1) Fuel pressurization module	1	O		
	2) Fuel flow meter	1	O		
	3) Fuel/diesel tee joint conversion valve (automatic)	1	O		
	4) Exhaust tank	1	O		
	5) Fuel oil pressurization pump	2	O		
	6) Viscosity controller(viscosity & temperature gross control)	1	O		
	7) Automatic fuel filter, with manual bypass filter	1	O		
	8) Fuel pressure control valve at the entrance of engine	1	O		
	9) Diesel tee joint conversion valve at the entrance of engine	1	O		
	10) Diesel tee-joint conversion valve at the vent of engine	1	O		
	11) Suction filter of diesel feeding pump	2	O		
	12) Diesel feeding pump	2	O		
	13) Diesel pressure control valve	1	O		
3 Air Compressor Unit					
	1) High-pressure air compressor unit	1	O		
	2) Air tank	1	O		
	3) Reducing valve unit	1	O		
	4) Air compressor unit	1	O		
4 Water Treatment Unit					
	1) Water Treatment unit, with water tank	1	O		
5 Remote Control and Monitoring System (RCMS)					
	1) Remote Control and Monitoring System	1	O		
6 Electrical Unit (ETU)					
	1) Electrical device box	1	O		
	2) Generator breaker panel	1	O		
	3) Output feeder (VCB)	1	O		
	4) Auxiliary transformer feeder (VCB)	1	O		
	5) Auxiliary transformer, with panel	1	O		
	6) Low-voltage input feeder (ACB)	1	O		
	7) Low-voltage power distribution disk	1	O		
	8) Storage battery and charger used for control	1lot	O		
	9) Neutral earthing resistance and circuit breaker screen	1	O		
7 Bulk Supply					

7.1 Fuel System					
	1) Suction strainer for HFO unloading pump	2	O		
	2) HFO unloading pump	2	O		
	3) HFO storage tank with accessories	2	O		
	4) Suction heater for storage tank	2	O		
	5) Steam control valve for suction heater				N/A
	6) Suction strainer for HFO transfer pump	2	O		
	7) HFO transfer pump	2	O		
	8) HFO settling tank with accessories	1	O		
	9) Heating coil for HFO settling tank	1	O		
	10) Steam control valve for settling tank				N/A
	11) HFO purifier unit	1	O		
	12) HFO service tank with accessories				N/A
	13) Heating coil for HFO service tank				N/A
	14) Steam control valve for service tank				N/A
	15) Suction strainer for HFO supply pump	1	O		
	16) HFO supply pump	1	O		
	17) Pressure control valve for HFO supply pump	2	O		
	18) FO drain tank unit	1	O		
	19) Heating coil for FO drain tank	1	O		
	20) FO drain pump	1	O		
	21) DO storage tank with accessories	1	O		
	22) Suction strainer for DO unloading pump	2	O		
	23) DO unloading pump	1	O		
	24) Suction strainer for DO supply pump	1	O		
	25) DO supply pump	1	O		
	26) DO pressure control valve	1	O		
7.2 Lubrication Oil System					
	1) Filling pump unit for lubrication oil (portable)	1	O		
	2) Lubrication oil used for first filling and commissioning	1	O		
7.3 Cooling Water System					
	1) Radiator, with expansion tank	1	O		
	2) Raw water tank, with pump	1	O		
	3) Chemical medicine for first filling	1	O		
7.4 Exhaust System					
	1) Exhaust silencer , with accessories	1	O		
	2) Exhaust chimney of main machine set	1	O		
7.5 Oily System					
	1) Oily filtering device	1	O		
	2) Sludge storage tank	1	O		
	3) Sludge oil unloading unit	1	O		
7.6 Electrical System					
	1) Black start diesel generator machine set	1	O		
	2) Site meter	1	O		
	3) Charge metering device	1	O		
	4) Power distribution requirement	1	O		
	5) Lighting system	1	O		
	6) Earthing and lightning system	1	O		
	7) Communication system	1	O		
	8) Deloading system				
7.7 Spare Parts and Tools					
	1) Standard spare parts of engine	1	O		

	2) Standard spare parts of generator	1	O		
	3) Maintenance tools of engine	1	O		
	4) Transport vehicle of machine set	1	O		
7.8 Bulk Materials					
	1) Mechanical bulk materials used for connection of equipment supplied by ZG within power plant area (pipeline, fittings, bracket of pipeline, valve)	1	O		
	2) Electrical bulk materials used for connection of equipment supplied by ZG within power plant area (cable, crane span structure, support)	1	O		
	3) Materials required outside of container-type power plant area	1	O		
	4) Fencing and sewage disposal materials	1	O		
	5) Earthing, lightning protection and lightning materials	1	O		
	6) Oil tank materials inside the power plant area	1	O		
	7) Final painting for pipeline, support and structures	1	O		
8 Services					
8.1 Project Design					
	1) Operation and maintenance manual	1	O		
	2) Preliminary design of power plant	1	O		
	3) Detailed design for power plant within the scope of zg	1	O		
	4) Detailed project design for civil works of power plant	1	O		
8.2 Training					
	1) Factory training	1	O		
	2) Site training	1	O		
8.3 Test and Commissioning					
	1) Installation of engine and generator	1	O		
8.4 Civil Works and Site Installation					
	1) Civil works and foundation	1	O		
	2) Fencing installation and draining work	1	O		
	3) Crane (25t) and forklift (5t)	1	O		
	4) Earthing, lightning protection and lightning installation as well as materials	1	O		
	5) Installation work for pipeline and electric wire	1	O		
	6) Installation of preset structure for exhaust chimney	1	O		
	7) Installation work of site bulk materials (pipeline, electric cable, chimney and insulation materials)	1	O		
	8) Final painting work for pipeline, pipe rack, support and structure	1	O		
	9) Installation work of preset oil tank inside the container-type area (diesel, sludge and raw water)	1	O		
8.5 Site Preparation, Transportation, Permission and Taxes					
	1) All applicable permission or approval for power plant by government	1		O	
	2) Land on site	1		O	
	3) Cement and concrete operation	1	O		
	4) Site clearing and leveling	1	O		
	5) Geology survey and piling operation	1	O		

6) Such equipment as electric power, water, air, office and telephone	1	O		
7) Accommodation for ZG and ZG subcontractor personnel	1	O		
8) Maritime transport from China port to site port	1	O		
9) Local hoisting and transportation (from port to site)	1	O		
10) Local taxes and tariffs	1	O		
11) Insurance	1	O		
12) Port Handling fees at the local port	1	O		
13) Customs clearance charge	1	O		

* Other items that are not described specifically within the supply scope should be provided by the buyer.

4 Mechanical Assistance System

4.1 Lubricating Oil Supply System

The lubricating oil system is used for the whole power station, which provides clean lubricating oil required for the motor through lubricating oil replenishment pump from fuel reserve tank or daily oil tank. The waste oil tank provides temporary storage for used lubricating oil to facilitate further disposal and lubrication during maintenance period.

The oil sump pumps lubricating oil intermittently to the lubricating oil separator, separating the water in lubricating oil from the solid particle. If the lubricating oil is too cold, the lubricating oil heater shall be adopted to ensure good separating effect.

4.2 Water Supply System

The soft water in water softening plant shall be sent to the water supply tank and shall replenish water automatically based on water level. The condensate shall be returned to the water supply tank.

4.3 Fuel System

The main fuel is heavy fuel oil (HFO). Light fuel oil (LFO) is also used for start-up and shutdown.

The procedure of HFO supply: HFO is transferred to HFO storage tank (2×50m³) by HFO unloading pump. Then HFO is treated in the HFO Separator Unit, and then be transferred to the HFO Day tank (1×10 m³). Then part of the HFO is transferred to HFO Generator.

The procedure of LFO supply: LFO is transferred to LFO storage tank (50m³) by LFO unloading pump. Part of the LFO is transferred to HFO generator; the rest is transferred to other fuel oil units.

Each HFO generator consumes HFO for 0.38t/h, and then the fuel supply system is designed for meet the demand of one (1) set of HFO generator.

The volume of HFO storage tank is 2×50m³. The Volume will meet 14 days requirement of one set of diesel generator. For the convenient of fuel system operation, the system sets a HFO daily tank (10m³).

The HFO tank set heat tracing system.

5 Electrical System

5.1 Summary

The power equipment in the power station include station transformer, medium and low voltage distribution boxes, direct current, uninterruptible power supply and black start, etc. while the materials include power cables, control cables, protective tubes, cable trough, earthing equipment, central and local control panels, centralized control panels and console of generator set, etc.

5.2 System Voltage of Power Station

- Generator	AC 400 V 3Ph, 3W, Y Shape
- Dynamo	AC 230 V 3Ph, 3W
- Control	DC110 V, DC24 V and/or AC 230 V 1Ph 2W
- Output Voltage	0.4 kV 3Ph, 3W

5.3 Primary Diagram

The voltage at output end of generator set shall be 0.4KV with a frequency of 50Hz. All the diesel-electric generator sets shall be connected on the 0.4 KV bus. The 0.4KV power distribution system shall be connected with single bus, and 1 generator shall be a group and connected to the same bus.

5.4 Power Supply for Power Station

The power supply system of the power station shall be 400V/230V with neutral point direct earthing system.

5.5 Panels of Generator Breaker

The panels of generator breaker shall be metal-sealed switch equipment, independent type, with drawout breaker and suitable for indoor installation. This switch equipment shall be placed within the electrical units. The number of poles of breaker shall be 3, provided with appropriate rated continuous current and segmented current.

1) Type	metal sealing tyoe, indoor use
2) Rated Voltage	0.4KV, 3PH, 50 Hz
3) Working Voltage	0.4KV, 3PH, 50 H
4) Breaker	vacuum circuit breaker
- Type	drawout type
- Rated Current	4000A
- Rated Breaking Capacity	(25KA @ 0.4kV)
- Number of Poles	3

5) Synchronization

- Dual Voltmeter
- Dual Frequency Meter
- Synchroscope, with synchronous detection relays
- Manual Synchronization
- Autosynchronous

6) Generator Parameter Display

- V, A, F, PF, kW, KVAR, kWh, etc.

7) Electric Protection (multifunction relays, GPC)

- Low Voltage/Overvoltage Protection
- Low Frequency/Overfrequency Protection
- Over-current Protection
- Reversed Polarity Protection
- Excitation Loss
- Block Relay (independent type)

5.6 Control Panels of Motor/Generator

The control panels of motor/generator shall be metal-sealed control panels, independent type and suitable for indoor use, which shall be located within each main set and can execute the following control and monitoring work:

1) Control and Monitoring

- Annunciator
- Alarm Recording List
- Motor Pressure Display
 - Start Air Pressure
 - Fuel Pressure for Entering Machine
 - Lubricating Oil Pressure for Entering Machine
 - Air Pressure Boosted after Passing through Cooler
- Motor Temperature Display
 - Fuel Temperature for Entering Machine
 - Lubricating Oil Temperature for Entering Machine
 - Outlet Temperature of High Temperature Cooling Water
 - Exhaust Gas Temperature of Booster Inlet
- Generator Parameter Display
 - V, A, F, PF, kW, KVAR, kWh etc.
 - Coil and Bearing Temperature
- Sub-control and State monitoring
 - Oil absorption Valve Control and Monitoring of Lubricating Oil Oil
 - Outlet Valve Control and Monitoring of Lubricating Oil Local
 - Heater of Motor
 - Radiator Control

2) Protection Scheme for Generator Set

NO	Events	Generator Baeaker Open	Motor Shutdown	Remark
1	Low Voltage	O		
2	Overvoltage	O	O	
3	Low Frequency/Overfrequency	O		
4	Over-current	O		
5	Reverse Power	O		
6	Excitation Loss	O		
7	Emergency Stop	O	O	
8	Overspeed	O	O	
9	Low Voltage of Lubricating Oil	O	O	
10	High Temperature of Cooling Water	O	O	
11	Great Pressure Difference of Lubricating Oil	O	O	

5.7 Low Voltage Switch Devices

Overview

1) The low voltage switch cabinet shall be of metal sealing and independent type with fixed panels and electrical operation, drawer type air breaker suitable for indoor installation.

2) The air breaker shall be one that with 3 poles and 600V level (ACB) and provided with appropriate uninterruptible rated current and breaking capacity respectively.

3) The control center of motor shall be of single face and drawer type and the switchboard shall be of fixed type.

1) Type	Metal sealing type, indoor use
2) Working Voltage	230 V
3) Rated Voltage & Current of Bus	600 V 4000 A
4) Breaker	Air circuit breaker
- Type	Drawout type
- Rated Current	4000 A (ACB panels of incoming wire)

5.8 Space between Switchboards

The space of wall where the switchboards and electrical units are located shall be designed in accordance with ZG specifications.

5.9 Direct Current System

5.11.1 Battery	
- Rated Voltage	110V DC
- Type	Maintenance Free Lead-acid Storage Battery
- Number of Batteries	12
- Capacity	24 kVA
- Nominal Voltage	12 V/piece
- Backup Time	1 Hour
* The capacity shall be adjusted in the detailed design.	
5.11.2 Battery Charger	
- Type	Metal sealing type, indoor, float charger installed
- Quantity	1 Stand of 110V DC System
- Rated Output	110V DC, 40A
- Feeder Line	Molded Case Circuit Breaker
- Number of Poles	2

5.10 Cables

5.11.1 Low Voltage Feed Cables

1) Type	0.6/1.0KV XLPE, PVC Sheath
2) Number of Cores	Multi-core (2C, 3C or 4C) or single core (1C)
3) Conductor	Copper

5.11.2 Control Cables

1) Type	600V CVV(PVC/PVC)
2) Sheath	No
3) Number of Cores	Multi-core (2C-30C)
4) Conductor	Copper

5.11.3 Instrument Cables

1) Type	600V CVVS
2) Sheath	With Sheath
3) Number of Cores	1 pair and multiple pairs
4) Conductor	Copper

5.11 Pipeline and Cable Bridge

1) The cables can be installed on ground pipelines, cable-bridge, underground pipelines, or above cable trough or directly buried in the ground.

2) The pipeline shall be rigid steel conduit.

3) The separate instrument cable bridge shall be provided to separate the instrument cables from the feed cables.

4) The cable bridge with different voltages shall be stacked up in descending order and the instrument cable bridge shall always be placed at the bottom.

5) The hot-dip galvanized steel shall be adopted for both bridges indoors and outdoors.

5.12 Black Start

The power station shall be equipped with one stand of 250kVA auxiliary engine, providing power for the black start of power station sets. The light oil shall be used for burning and the 24V storage battery for starting with a voltage of 0.4kV, frequency of 50Hz, power factor of 0.8pf and rotary speed of 1,500rpm. It shall be shifted to be the standby sets for emergency use under normal operation of the power station.

Technical parameters	
Model	ZCM200P
Dimension (L×W×H)	2454×945×1578
Weight (dry)	1750
Rated power	250/200
Standby power	263.75/211
Rated voltage V	400/230
Output frequency (Hz)	50
Rated power factor (cosØ)	0.8
Steady voltage regulation rate (%)	±1
Voltage waveform deviation rate (%)	≤0.5
Frequency fluctuation rate (%)	≤0.5
Frequency stable time s	≤3
Voltage stable time s	≤2.0
Waveform distortion rate THD	≤5%
Wire mode	3-phase 4-wire (neutral point
Control system	Micro-processor control system
Damping system	High-elasticity rubber damper
Noise (7meters) dB	
Engine	
Engine type	6LTAA8.9-G2
Power(Service/Standby) kW	220/245
Weight (dry)	710
Weight (wet)	740
Dimension (L×W×H)	1129×743×1095
Type	6L
Air intake type	Turbo-charge intercooler
Oil type	API CD 15W—40
Fuel type	0# diesel
Fuel consumption rate g/kWh	46
Oil consumption rate g/kWh	0.5% of fuel consumption
Starting system	DC 24V Electric start
Speed regulating mode	ADEC
Cooling method	Closed water circulation air
Speed rpm	1500
High pressure fuel oil pump	
Capacity of lub. Oil L	19
Capacity of cooling system L	11.1 (only engine)
Compression ratio	
Displacement L	8.9
Generator	
Model (single bearing)	MP-200-4
Dimension(L×W×H) mm	919×610×855
Weight kg	768
Power (service/standby) kW	200/211
Excitation system	Brushless self-excited

Shell protection	IP21
Insulation Class	H
Winding pitch	2/3
Steady voltage regulation rate %	≤1%
Recovery time s	≤1.0
Waveform distortion rate THD	≤5%
Control system	
Control module	170HC (automatic type)
Displayed contents	AC phase\line voltage, three-phase current, battery voltage, frequency, oil pressure, water temperature, operation time, displayed alarm malfunction, engine speed
Main functions	Under\over speed alarm, charge fail, emergency stop input, low oil pressure alarm, high water temperature alarm, start failure, three output settings, self-automatic start without power supply

5.13 Instruments & Control System

5.13.1 Overview

This section covers the technical requirements of instruments and control system

(ICS) which shall at least include but no limited to: complete set of instruments and power station control equipment.

5.13.2 Control and Monitoring System of Power Station

The main interface of operators shall be the operation station consisting of mouse, keyboard and color displayer.

a) Input & Output System Characteristics

- Simulated Signal : 4-20mA (if necessary)
- Digital Input : 24VDC
- Digital Output : Dry Contact of Relays

b) Operation Display

- Electric measurement (State of pumps, switch valves and packaged equipment)
- State of diesel-electric generator set (Red: running, green: stop, yellow: fault)
- Alarm status of electric & mechanical equipment

- Capacity status of fuel reserve tank (high and low)
- Trends (real time and historical)
- Alarm

c) Liquid Crystal Display/Keoboard Units

- One (1) engineer station, equipped with 19" color displayer and keyboard
- Two (2) operator stations, equipped with 19" color displayer and keyboard

d) Printing Units

- One (1) ink-jet printer to print paper documents (A4)
- One (1) dot printer to print alarm information (A4)
- One (1) laser printer print alarm information (A3 and A4)

5.13.3 Instruments

The necessary local instruments shall be provided for the oil tank and pipelines based on our standards to ensure the efficient and reliable operation of power station. The instruments are suitable for tropical climate to accommodate the environmental conditions of the power station. But when the oil tank is beyond the scope of supply of suppliers, the instruments of oil tank shall be provided by the oil tank supplier. If possible, the instruments applied in similar fields and with similar functions shall be of uniform type and provided by uniform manufacturer. However, the instruments installed by packaging shall subject to the standards and convention of manufacturers.

Each instrument shall pass authentication and labeled with tag number based on working standards. The engineering shall be used for unit local indicator and the international units shall be adopted to indicate the scale range of instruments.

All instruments shall be of industrial type and verified at site.

6 Civil Works Specifications

6.1 Overview

The section covers the overall requirements and conditions of civil work design and construction.

The civil works shall be responsibility of the owner, which shall include all relevant project design and construction works required for smooth completion of the project (relevant project having been described in the "scope of work"). All civil works shall conform to the requirements of technical specification. The civil works shall be designed based on required operational conditions and accord with national/international standards.

The supplier shall provide all design drawings, labor, materials and equipment

based on relevant specifications to complete civil works.

6.2 Scope of Work

The list of main structure/components is as follows:

1. Site roads within scope area
2. Site drainage system within scope area
3. Container power station base
4. Fuel tank subgrade with oil leakage protection embankment
5. Concrete subgrade of equipment
6. Piling work, site preparation, removal work, soil investigation work, passageways, and management floor with parking lot, reception office, rails and others.

6.3 Design Standards

6.3.1 Overview

This section covers all structures, including container power station, oil depot and etc.

Meanwhile, the following codes and standards shall be followed:

- Chinese Standards (GB)

6.3.2 Design Elements

All subgrade designs shall be based on the soil investigation report without considering the wind force and earthquake force simultaneously. Underground water level shall be fully considered for designs of all underground structures.

- Subgrade

The designs of mechanical bases shall all conform to relevant stipulation of latest national standards, international standards and manufacturer standards.

The types of subgrade system, i.e. piling foundation, independent footing shall be determined based on load and soil conditions and refer to detailed geotechnical report.

- The soil minimum allowable bearing capacity shall be 15 t/m².

6.3.3 Description of Miscellaneous Items

- Concrete Marking NO.

In addition to the above cases, the minimum concrete marking number shall be 250kg/cm² greater than compressive strength.

- The structural concrete of diesel generator subgrade piece: 300kg/cm² at minimum

- Lean concrete: 150kg/cm² at minimum

The scale of plain concrete under base plates or subgrade shall be 1:4:8 with a minimum thickness of 50mm.

The furnishing design shall be adopted for compact concrete in line with site reality, standards and engineering output.

6.3.4 Rainwater Drainage of Power Station

The rainwater drainage system shall take such factors as terrain, water system type and rainfall capacity of the place where power station is located into consideration. The rainwater shall be collected from roads, rigid parking lot and impervious area and discharged into the existing drainage pipeline and waterspout. The maximum and minimum flow velocity of drainage ditch shall accord with relevant local standards.

6.4 Others

The description of some main structures/components of power station is as follows:

- Facilities of fuel oil depot

The subgrade of fuel tank shall be made up of outer edge of compact concrete annular wall surrounding oil tank. All unsuitable materials inside the wall shall be removed and replaced with appropriate filling materials and completely compacted.

The filling materials can transfer the load of fuel tank; while the annular wall can fasten the compacted subgrade filling materials, therefore lower the possibility of local sedimentation to the maximum extent. The protection embankment shall be build surrounding the fuel depot area to prevent fuel oil from spreading upon leakage of fuel tank.

7 Technical Data and Drawings of Products

7.1 General Requirements

7.1.1 The seller shall provide complete drawing data based on technical specification of equipment, scope of supply and guarantee conditions.

7.1.2 The drawings provided by the seller shall be distinct and the data shall be of clear organization structure and logicity. The content of data shall be correct, accurate, uniform, clear and complete, which can meet the project requirements.

7.1.3 For other documents and data silent on the contract technical data list while required by the project, the seller shall also provide for free upon discovery. The seller shall provide new technical data timely for free when improvement on sets (equipment) is made.

7.2.1 Technical Documents as Project Design Data and Drawings

The seller shall provide data and drawings required for project design and those that required for project installation, debugging and commissioning and operational maintenance.

The details are listed in the following table:

No.	Name of Submitted Data	Remarks
1	Appearance Diagram of Sets	
2	Installation Diagram of Sets	
3	Overhaul Dimension Diagram of Main Components and Parts	
4	Diagram of Moter System	
5	List of Sensor Used for Sets	
6	Table of Motor Heat Balance	
7	Calculation Sheet for Set Torsional Vibration	
8	Diagram of Motor Appearance	
9	Dimensions of Motor Axis	
10	Schematic Diagram of Electrical System	
11	Dimension Diagram and Installation Diagram for Assembly and Connection of External Auxiliary Equipment	

7.2.2 Hand over Such Technical Documents as Data and Drawings Provided with Equipment

The seller shall timely provide data and drawings required for satisfying project installation, debugging and commissioning, performance acceptance and operational maintenance (not limited to the following documents):

NO.	Name of Data Submitted	Submitted Qty	Submittal Date	Comment
1	Dimension Diagram & Installation Diagram for Assembly and Connection of Set Outline External Auxiliary Equipment	3 Sets	Handover with Equipment	
2	Diagram of Set Control System			
3	Diagram of External Auxiliary Equipment Control System			
4	Schematic Diagram of Electrical System			
5	Instruction for Installation and Use			
6	Instruction for Use and Maintenance			
7	List of Spare Parts and Consumable Goods Used for Operational Maintenance			
8	Equipment Encasement List			
9	Ex-factory Certificate			

8 Delivery

8.1 Transportation Requirements

The seller shall be responsible for inland transportation costs, insurance expenses and sea transportation fees for equipment dispatching to the appointed harbor.

8.2 Packaging Requirements

The seller shall be responsible for package of equipment and the packaging fees shall be included in the equipment total price. The package and transportation of equipment shall conform to stipulation of indication signs for packaging, storage and transportation "GB191-73" and the packing list shall be included.

8.3 Delivery Site

The delivery site shall be at the place where the project is located.

8.4 In case the equipment is damaged or lost during the course of transportation,

the seller shall negotiate with the department undertaken transportation and transact claim indemnity.

9 Service Assurance Range

9.1 Warranty Period

The warranty period shall be one year.

9.2 Site Service Assurance

The seller can provide more timely and comprehensive service assurance within warranty period. The after-sale service assurance work and training on site operators shall be conducted for the whole course by medium to high dynamic dispatching site service engineers, the accommodation of who shall be provided by the buyer.

9.3 Technical Training Providing Training on Operator for Users For Free

The seller shall provide factory training for 10 persons lasting for 5 days for the buyer and arrange their accommodation for free.

9.4 Site Guidance for Installation and Debugging

The seller shall be responsible for guidance for installation and debugging of supplied equipment while assisting rightful cooperation requirements of site service staff on the seller side shall be responsibility of the buyer, so as to ensure the work go on smoothly.

9.5 Commitment

9.5.1 The site service staff on the seller side shall possess the following qualifications:

- a. Obey laws and disciplines and observe various regulations and systems at site.
- b. with strong sense of responsibility and enterprising spirit, in place on time
- c. Understand the design of contract equipment and be familiar with its structure. Have identical or similar sets site working experience and can carry out site guidance correctly.
- d. In good health and adaptable to site working conditions

9.5.2 Responsibilities of Site Service Staff on Seller Side

- a. The tasks of site service staff on the seller side mainly include treatment of equipment quality problem, installation and debugging guidance, participating in commissioning and performance acceptance test.
- b. Before installation and debugging, the technical service staff on the seller side shall conduct technical disclosure to the buyer, explain and demonstrate procedures and methods to be conducted.
- c. The site service staff on the seller side shall reserve the rights to be given a free hand to handle all technical and business problems occur at site. If the quality problem is found at site, it shall be resolved by the site service staff on the seller side within the time specified by the buyer. If the seller entrusts the buyer to dispose, the site service staff on the seller side shall issue the power of attorney and assume corresponding economic responsibility.
- d. The normal coming and going and replacement of the site service staff on the seller side shall negotiate with the buyer in advance.

9.5.3 Obligations of Buyer

The buyer should cooperate with work of the site service staff on the seller side and provide convenience for their living, traffic and communication.

The evaluation on reasonable suggestions of site service engineers shall be made by the buyer and confirmed in writing. The result due to no acceptance or no execution of the buyer shall be responsibility of the buyer.

10 Design Liaison

The plan, time, place and content requirements related to design liaison shall be decided through consultation by both parties during contract execution phase.

Notes: referring to the attachment for the followings

1. Genset three view drawings about 2MVA power plant
2. Fuel oil system diagram for 2MVA power plant
3. Lubricant oil system diagram for 2MVA power plant
4. Cooling water system diagram for 2MVA power plant
5. Start-up air controlling system diagram for 2MVA power plant

Annex 1 Technical Parameter Table of Machine Set

Technical parameter for Generator Set	
Type	9L21/31
Brand	Zg-MAN
Dimension /L×W×H (mm)	7779×1750×3289
Weight (T)	30.9
MCR (kW)	1881
Voltage Rating (V)	400
PF	50
Rated Speed (rpm)	1000
Voltage Regulation (%)	±1
Voltage fluctuation rate (%)	≤0.5
Frequency fluctuation rate (%)	≤0.5
Load mutation frequency settling time (S)	≤3
Mutation load voltage stabilization time (S)	≤2
Terminal connection	3phase 3wire
Fuel type	Diesel oil ; HFO up to 700cSt at 50°C
Engine	
Type	9L21/31
Make	ZG
Weight (T)	20.5
MCR (kW)	1980 ,according to ISO3046
Cylinders	9L
Spec. fuel oil consumption (g/kWh)	189+5%,according to ISO3046
Spec. lub oil consumption (g/kWh)	0.4-0.8+20%, according to ISO3046
Starting system	Compressed Air
Cooling system	Water cooling
Rated Speed (rpm)	1000
Idle speed (rpm)	600
Mean effective pressure(MEP) (bar)	24.6
Piston speed (m/s)	10.3
Displacement /cylinder (L)	10.7
Governor style	Hydraulic governor
Exhaust gas temperature (after TC) (°C)	330
Exhaust back pressure(Max) (mbar)	25
Compression ratio	15.5
Stroke (mm)	310
Cylinder Bore (mm)	210
Alternator	
Brand	ABB/ AVK / LEROY SOMER or equal
MCR (kW)	1881
Voltage Rating (V)	400
Rated Frequency (Hz)	50
PF	0.8(Lag)
Field System	Brushless, self-excited
Coolant method	Self-fan coolant
Insulation Grade	F
Grade of Protection	IP23
rated speed (rpm)	1000
Temperature Rise Stator / Rotor	F/F
Efficiency	95%

Annex 2 List of Tools

Standard Tools List					
NO.	Description	Qty	Plate	Item	Remark
Cylinder head					
1	Valve spring tightening device	1	52000	014	
2	Lifting tool for cylinder unit	1	52000	038	
3	Grinding tool for cylinder head/liner	1	52000	087	
4	Max. pressure indicator	1	52000	134	
5	Handle for indicator valve	1	52000	146	
Piston, connecting rod and cylinder liner					
6	Removing device for flame ring	1	52000	021	
7	Guide bush for piston	1	52000	045	
8	Fit and removal device for connecting rod bearing	1	52000	069	
9	Lifting device for cylinder liner	1	52000	082	
10	Lifting device for piston and connecting rod	1	52000	104	
11	Testing mandrel for piston ring grooves, 6.43 mm	1	52000	153	
12	Testing mandrel for piston ring grooves, 5.43 mm	1	52000	165	
13	Piston ring opener	1	52000	190	
14	Supporting device for connecting rod and piston in the cylinder liner (2 pieces), incl. fork	1	52000	212	
	Fork	52000	221		
15	Honing brush	1	52000	224	
Operating gear for inlet and exhaust valves					
16	Feeler gauge	1	52000	010	
Crankshaft and main bearings					
17	Dismantling tool for main beating upper shell	1	52000	035	
18	Balancing weight installing tool	1	52000	060	
Turbocharger System					
19	Eye screw for lifting	1	52000	036	
20	Container complete for water washing of compressor side	1	51205	318	
21	Blowgun for dry cleaning of turbocharger	1	51210	136	
Fuel oil system and injection equipment					
22	Cleaning tool for fuel injection	1	52000	013	
23	Extractor device for injector valve	1	52000	407	
24	Grinding device for nozzle seat, incl. plier for piston pin lock ring	1	52000	074	
25	Pressure testing tool	1	52000	050	
Lubricating oil system					
26	Fitting device for lube. Oil cooler	1	52000	044	
27	Eye screw for lifting	1	52000	032	
Hydraulic tools					
28	Hydraulic tools box 1, incl. pressure pump consisting of:	1	52000	633	
	Pressure pump complete		52000	011	
	Hose with unions		52000	202	
	Force-off device		52000	424	
	Storage tank		52000	520	
	Set of spare parts		52000	532	
29	Hydraulic tools box 2, consisting of:	1	52000	554	
	Hydraulic tightening cylinder M33 x 2		52000	275	
	Pressure part M33 x 2		52000	371	
	Set of spare parts		52000	238	
	Hydraulic tightening cylinder M30 x 2		52000	287	
	Pressure part, short M22 x 2			383	
	Pressure part, long M22 x 2			096	
	Tension screw M22 x 2			131	

	Set of spare parts			251	
	Turn pin			556	
	Turn pin			568	
	Turn pin			334	
	Angle piece			358	
	Measuring device			448	
30	Hydraulic tools box 3, consisting of:			581	
	Hydraulic tightening cylinder M30 x 2		52000	263	
	Pressure part, short M30 x 2		52000	072	
	Pressure part, long M30 x 2		52000	059	
	Tension screw		52000	118	
	Set of spare parts		52000	226	
	Turn pin		52000	593	
	Turn pin		52000	603	
	Turn pin		52000	334	
31	Resetting device for hydraulic cylinder	1	52000	436	
32	Broad chisel	1	52000	473	
33	Broad chisel	1	52000	485	

Tools for Reconditioning

NO.	Description	Qty	Plate	Item	Remark
1	Fit and removal device for main bearing cap	1	52001	036	
2	Fit and removal device for connecting rod bearing	1	52001	073	
3	Turning device for cylinder unit	1	52001	107	
4	Grinding machine for valve seat rings	1	52001	119	
5	Fit and removal device for valve guides	1	52001	120	
6	Touching bow for inlet valve	1	52001	132	
7	Fitting device for valve seat rings	1	52001	156	
8	Plate	1	52001	168	
9	Extractor for valve seat rings	1	52001	181	
10	Fit and removal device for fuel injection pump	1	52001	203	
11	Setting device for fuel injection pump	1	52001	215	
12	Fit and removal device for cooler insert	1	52001	239	
13	Micrometer screw	1	52001	252	

Annex 3 Standard spare parts

Standard spare parts					
NO.	Description	Qty	Plate	Item	Remark
Cylinder head					
1	Valve spindle, inlet	2	50502	274	
2	Valve spindle, exhaust	2	50502	274	
3	Spring	4	50502	201	
4	Valve seat ring, inlet	2	50501	123	
5	Valve seat ring, exhaust	2	50502	184	
6	Valve rotators	4	50502	191	
7	Kit for cylinder unit consisting of following items	1	50500	021	
7-1	O-ring		50501	064	
7-2	O-ring		50501	135	
7-3	O-ring		50501	72	
7-4	O-ring		50501	196	
7-5	O-ring		50501	231	
7-6	O-ring		50501	243	
7-7	O-ring		50501	363	
7-8	Circlip		50502	095	
7-9	Conical ring 2/2		50502	178	
7-10	O-ring		50502	237	
7-11	O-ring		50502	250	
7-12	O-ring		50502	536	
7-13	O-ring		50502	014	
7-14	Piston ring		50601	093	
7-15	Piston ring		50601	103	
7-16	Oil scraper ring		50601	127	
7-17	Sealing ring		50610	031	
7-18	O-ring		50610	055	
7-19	O-ring		51230	027	
7-20	O-ring		51402	033	
7-21	O-ring		51402	104	
7-22	O-ring		51404	022	
7-23	O-ring		51401	046	
7-24	Seal ring		51630	033	
Piston and Connecting Rod, Cylinder Liner					
8	Screw for connecting rod	2	50601	152	
9	Screw for connecting rod	4	50601	211	
10	Bush for connecting rod	1	50601	056	
11	Piston pin	1	50601	019	
12	Retaining ring	2	50601	032	
13	Connecting rod bearing 2/2	1	50601	139	
Engine Frame and Base Frame					
14	Main bearing shells	1	51101	241	
15	Stud	2	51101	216	
16	Nut	2	51101	228	
Turbocharger System					
17	Gasket	1	51202	024	
Fuel Oil System and Injection Equipment					
18	Fuel oil injector	5	51402	116	
19	Fuel oil injection pump	1	51401	565	
20	Fuel oil high-pressure pipe in cylinder head				
20-1	Pressure pipe, complete	1	51404	117	
22	Delivery socket, complete	1	51404	129	

Annex 4 Maintenance schedule

Maintenance schedule (1/2) (during the operation of fixed power station)													
Note: ● = overhauling ■ = performance check	Intervals of the inspection/ repairing of components	Intervals of overhaul											Work card number
		50	200	2000	8000	16000	32000	daily	weekly	monthly	seasonally	observation	
Operation of the diesel engine Parameter measurement of diesel engine and generator, refer to operating Parameter of the Diesel, 502-1.....Oil leakage check...		■							■				502-01.00502-05.00
Cooling water: requirements for water quality Cooling water system: samples, refer to chapter 504...									■				505-01.15
Cylinder cover Intake valve and exhaust valve: check and adjust air valve clearance..... Check the lubrication of the transmission mechanism of air valve..... Check the rotation of rotary valve in running diesel engine.....				■		■							505-01.15
Controlling and safety system, automatic device and gauge Safety, alarm and monitoring apparatus..... Lambda controller: adjusting lambda Level check in speed											■ ■ ■		509-01.00 509-10.00 chapter 509

<p>controller, refer to chapter 509.....</p>													
<p>Pressurizer system Air filter cleaning, at compressor side..... Turbine cleaning, dry cleaning..... Compressor side, washing.... Expansion joint on exhaust pipe... Re-fastening of all the bolts and adapting pieces.</p>			●						■			●	<p>512-35.00 512-10.00 512-05.00 512-01.10 512-30.00</p>

Maintenance schedule (2/2)
(during the operation of fixed power station)

Note: ● = overhauling ■ = performance check	Intervals of the inspection/ repairing of components	Intervals of overhaul										Work card number			
		50	200	2000	8000	16000	32000	monthly	weekly	daily	seasonally		observation		
Air compression system Function test: main starting valve and emergency starting valve.....Air filter, discharge through discharge cup.....Air compression system: check(when pressure drop surpasses 0.7bar, replace the filter element).....															513-01.40 513-01.21 513-01.90
Fuel system and fuel injection device Fuel system: check..... Fuel: take a sample at each refueling, refer to chapter 504.. Fuel injector: adjust injection starting pressure.....															514-01.90 chapter 504

<p>Plunger, connecting rod and cylinder cover Plunger check..... Piston ring and scraper ring..... Check the space between piston pin and connecting rod bushing..... Measure inner diameter of big end of connecting rod..... Check bearing bush on the big end of connecting rod..... Re-fastening connecting rod..... Cleaning, boning and measuring of cylinder jacket.....</p>	200				■	■ ● ■ ■ ■								<p>506-01.10 506-01.10 506-01.15 506-01.15 506-01.16 506-01.25 506-01.35</p>
<p>Camshaft and camshaft drive Check the wheel gear, bolts and joints on the camshaft..... Check the space between bearing on the camshaft..... Adjustment state examination of the camshaft..... Lubrication examination of bearing on the camshaft.....</p>	200					■ ■ ■ ■								<p>507-01.00 507-01.05 507-01.20 507-01.00</p>

**Maintenance schedule for the overhauling and checking of fixed power station
(2/3)**

Note: ● = overhauling ■ = performance check	Intervals of the inspection/ repairing of components	Intervals of overhaul											Work card number	
		50	200	2000	6000	12000	24000	daily	weekly	monthly	seasonally	observation		
Transmission mechanism of intake valve and exhaust valve Check the guide set of the tappet roller on the air valve..... Examination of valve bridge, valve spring and valve follower..... Lubrication examination of the transmission mechanism..						■								508-01.00 508-01.10 508-01.00
Crankshaft and main bearing Check the main bearing..... Check the thrust bearing..... Viscous damper, refer to work card..... Balancing weight: re-fasten, refer to 500.40..... Main bearing and thrust bearing cap: refasten.....	200 200				■		■	■						510-01.05 510-01.05 510-04.00 510-01.05
Body and base of diesel engine Refasten bolts connecting the body and base of diesel engine, refer to 500.40....	200				■									
Pressurization system Air cooler: cleaning and check..... Re-fasten all bolts and joints... Pressurizer, refer to Instructions.....	200				■								■	512-01.00 512-30.00
Air compressing system Air starter: dismount and check.....													■	513-01.30

Annex 5 Company introduction

Introduction to MAN

MAN Diesel boast more than 110 years of experience in the manufacture and operation of Diesel engines. It was at MAN in Augsburg that, between 1893 and 1897, Rudolf Diesel's epoch-making idea, the Diesel engine, was developed to the point where it was ready to go into service. MAN Diesel built the world's first large scale Diesel Power Station in Kiev 1904 and the first ocean going vessel powered by a Diesel engine 1912. MAN Diesel SE has installed approx. 26,000 medium speed engines with a power of more than 53,500 MW all over the world.

References

References of engines from the actual programme:

Customer	Country	No. x Engine	Total Power
VOESTALPINE Stahl	Austria	2 x 12V32/40DF	9.6 MW
National Electricity Corporation	Sudan	2 x 18V28/32S	8.5 MW
EDA, Electricidade dos Acores	Portugal	1 x 7L32/40	3.5 MW
CARIBBEAN UTILITIES	Cayman Is.	1 x 14V48/60	14.7 MW
UNE Cuba Energoimport	Cuba	11 x 9L28/32H	20.8 MW
UNE Cuba Energoimport	Cuba	1 x 18V28/32S	4.1 MW
UNE Cuba Energoimport	Cuba	7 x 18V28/32S	28.4 MW
UNE Cuba Energoimport	Cuba	7 x 18V28/32S	28.4 MW
UNE Cuba Energoimport	Cuba	12 x 18V28/32S	48.6 MW
BEC Cat Island	Bahamas	2 x 9L28/32H	3.8 MW
BEC Hatchet Bay	Bahamas	4 x 18V28/32S	16.2 MW
PPC - Grece Islands	Greece	1 x 12V32/40	6.0 MW
Grønlands Energiforsyning	Greenland	1 x 18V28/32S	4.2 MW
Grand Bahama Power	Bahamas	1 x 18V48/60	18.9 MW
EDF - Port Est, La Reunion	France	9x18V48/60	170.1 MW
EDA, Electricidade dos Acores	Portugal	2x5L21/31	2.0 MW
EDF - Bellefontaine, Martinique	France	6x18V48/60	113.4 MW
Grønlands Energiforsyning	Greenland	1x18V28/32S	4.2 MW
Geoterm	El Salvador	4 x 18V48/60	75.6 MW
Electrawinds, Brugge	Belgium	2 x 18V48/60	37.8 MW
Belco	Bahamas	4 x 12V48/60	50.4 MW
Energetica Camacari Muricy	Brazil	8 x 18V48/60	151.2 MW
Atlas Power	Pakistan	11 x 18V48/60	213.6 MW
BEC Bimini	Bahamas	2 x 9L32/40	9.0 MW
BEC Cat Island	Bahamas	2 x 9L32/40	9.0 MW

Tortola	Brit. Virgin Island	4 x 18V32/40	36.0 MW
BLM-Suez	Panama	10 x 18V32/40	90.0 MW
Barcelona Airport	Spain	5 x 18V32/40DF	36.0 MW
IGI Termoindustriale	Italy	1 x 18V32/40	9.0 MW
OXON Termoindustriale	Italy	1 x 18V32/40	9.0 MW
Isolux	Ecuador	2 x 12V32/40	12.0 MW
Milos	Greece	2 x 12V32/40	12.0 MW
PAMPA Energia S.A.	Argentina	2 x 18V32/40	16.2 MW
ADANAC Ruby Creek	USA	4 x 18V32/40	36.0 MW
Ingemas	Senegal	4 x 18V32/40	36.0 MW
Surimane Phase 3 N.V.Energiebedrijven Suriname	Suriname	1 x 18V32/40	9.0 MW
VINLEC Extension	St. Vincent	2 x 9L32/40	9.0 MW
Guadeloupe	France	9 x 18V48/60	170.1 MW
Breitener Gas Conversion	Brazil	1 x 18V51/60DF	17.5 MW
Stelco IV	Maldives	2 x 18V32/40	18.0 MW
Yanbu Cement Extension	Saudi Arabia	6 x 12V48/60	75.6 MW
Komsilga	Burkina-Faso	1 x 18V48/60	18.9 MW
Extension Owen Springs	Australia	1 x 12V51/60DF	11.7 MW
Karadeniz Power Ship #1	Turkey	6 x 18V51/60DF 3 x 14V48/60	149.4 MW
EDF Extension	Martinique	6 x 18V48/60	113.4 MW
AL TAKAMOL	Egypt	5 x 18V32/40CD	45.0 MW
PLC MEZHREGIONENERGO	Russia	1x 18V32/40PGI	8.1 MW
ENDESA GENERACION	Spain	1 x 12V48/60	12.6 MW
HUB POWER	Pakistan	11 x 18V48/60	207.9 MW
ELECTRAWINDS	Belgium	2 x 18V32/40	18.0 MW
Endesa	Spain	1 x 9L21/31	1.9 MW
CENTRAIS ELETRICAS	Brazil	2 x 9L32/40	9.0 MW
CENTRAIS ELETRICAS	Brazil	38x 18V32/40	342.0 MW
OKINAWA Electric	Japan	1 x 18V48/60	18.9 MW
Asian Colour Coated Ispat Ltd.	India	2 x 16V28/32S	7.5 MW
Honda Siel Cars	India	1 x 8L27/38	2.6 MW
Asian Colour Coated Ispat Ltd.	India	1 x 18V28/32S	4.2 MW
Grasim Industries	India	1 x 8L27/38	2.6 MW
POWER AND WATER	Australia	2 x 12V51/60DF	24.0 MW
Ambatovy	Madagascar	3 x 7L27/38	6.7 MW
STX Dalian	South Korea	2 x 6L27/38	4.0 MW
STX Dalian	South Korea	2 x 8L27/38	5.3 MW
Electric Power Develop. Co Ltd	Japan	3 x 18PA 6	15.9 MW
Ceuta ENDESA	Spain	3 x 12V48/60	37.8 MW
Mosoblenergogas	Russian Federation	2 x 18V32/40PGI	16.0 MW
Melilla ENDESA	Spain	3 x 12V48/60	37.8 MW
Arabian Cement Co. Ltd.	Saudi Arabia	3 x 18V48/60	56.7 MW
INCA Santo Domingo	Dominican Republic	2 x 9L32/40	9.0 MW
UNE 2 Energoimport de la Habana	Cuba	7 x 18V48/60	132.2 MW
UNE 3 Energoimport de la Habana	Cuba	1 x 18V32/40DF	6.9 MW
SONABEL La Soc. Nat. d'Electricité	Burkina Faso	1 x 18V48/60	18.9 MW
Chekka Holcim Leban S.A.L.	Lebanon	1 x 18V48/60	18.9 MW
Sepcol Southern Electric Power Co.Ltd.	Pakista	1 x 18V48/60 5 x 18PC4.2	128MW
Ibiza ENDESA for Gas y Electricidad S.A.	Spain	4 x 18V48/60	75.6 MW

Sharourah Al-Saleem / Saudi Electric Comp.	Saudi Arabia	3 x 12V48/60 2 x 12V48/60	63.0 MW
Fortune Electric, Taipei Taiwan Power Co.	Taiwan	4 x 9L32/40	18.0 MW
NATCO Public Electric Comp.	Yemen	1 x 16V32/40 1 x 12V32/40	20.0 MW
Surimane N.V.Energiebedrijven Suriname	Suriname	2 x 18V32/40	17.2 MW
Shuaiba ABB / Public Authority for Industry	Kuwait	1 x 9L48/60	9.4 MW
GECSA Genedora Electrica S.A.	Guatemala	2 x 18V32/40	19.0 MW
White Nil Petroleum Operating Company	Sudan	5 x 18V32/40	54.0 MW
Choloma I-III Energia Renovables S.A.	Honduras	14 x 18V48/60	265 MW
Los Guinchos, Las Palmas ENDESA for UNELCO	Spain	4 x 12V48/60	50.4 MW
Las Salinas, Fuerteventura ENDESA for UNELCO	Spain	3 x 18V48/60	56.7 MW
Punta Grande, Lanzarote ENDESA for UNELCO	Spain	5 x 18V48/60	94.5 MW
Weipa Comalco Aluminium Ltd.	Australia	6 x 9L32/40	27.0 MW
Pico / Belo Jardim Electricidade dos Acores	Portugal	1 x 7L32/40 2 x 12V48/60 4 x 9L40/54	58.5 MW
Grand Bahama Grand Bahama Power Comp.	Grand Bahama	1 x 18V48/60	18.9 MW
Caracol Knits Ingemas, Gijon	Honduras	1 x 12V48/60	12.6 MW
St. Vincent Vinlec	St. Vincent	2 x 9L32/40	9.0 MW
Pembroke /Bermuda Bermuda Electric Light Comp. Ltd.	Bermuda	2 x 14V48/60	29.4 MW
Benue Cement Company (BCC)	Nigeria	5 x 18V32/40	45.0 MW
Comp. des Pétroles	Libya	2 x 18V32/40	17.0 MW
Pedregal Power Company	Panama	3 x 18V48/60	56.7 MW
Caribbean Utilities Comp. Ltd. Grand Cayman	Cayman Islands	2 x 14V48/60 1 x 12V48/60	38.0 MW
Aqualectra, Curacao	Netherlands Antilles	4 x 18V32/40	34.5 MW
China National Offshore Oil Corp.(CNOOC)	China PR	5 x 16V32/40 5 x 16V32/40	76.8 MW
Poplar Bluff / Mississippi	USA	3 x 18V32/40DF	21.0 MW
Consortio Breitener for Forteleza Power Station	Brasil	8 x 18V48/60 2 x 16V32/40	167 MW
Peng Hu TATUNG Co.	Taiwan	8 x 9L58/64 4 x 12RK270	125 MW
Habas Kasimpasa	Turkey	3 x 18V48/60	57.0 MW
Esemboga Ankara Enerji Uretim A.S.	Turkey	7 x 16V32/40	53.8 MW
Mineracao Rio Do Norte S.A.	Brasil	5 x 9L48/60	47.0 MW
Dohuk, Erbil, Sulaimaniyah UNDP for Local Electricity Authority,	Iraq	3 plants with 4 x 16V32/40	92.0 MW
Union Fenosa S.A	Dominican	5 x 18V48/60	94.5 MW
Power Barge Esperanza Puerto Quetzal Power Ltd.	Guatemala	7 x 18V48/60	132 MW
Nouakchott SONELEC	Mauretania	2 x 9L48/60 4 x 52/55B	54.0 MW

Stationary Engine

Programme 2010

MAN Diesel power plants are located in all regions of the world - in deserts, on pack-ice, at low altitude or in high mountain regions. Whether located in an area with a climate of dry heat, tropical air humidity, permanent frost or extreme temperature fluctuations, our power plants always provide reliable energy.

Our power plants are able to be operated on various kinds of fuels with highest flexibility and economy.

Powering the World

Brochure with general information about the MAN AG Group of companies and specially MAN Diesel SE, its history, product portfolio and worldwide services. MAN Diesel, the "birthplace of the Diesel engine", is one of the world's leading suppliers of large-bore Diesel engines for marine application, energy production, railways and heavy duty vehicles. In addition, MAN Diesel also build turnkey power stations and complete propulsion systems for ships.

Power Plants

Energy wherever you need it.

MAN Diesel is one of the world's leading suppliers of land-based and floating power plants based on Diesel and gas engines. Over the last century we have built thousands of Diesel power plants worldwide. The experience we have gained and the technology we have developed over that time enables our specialists to tailor power plants to the individual needs of customers all over the world.

L+V32/40

Four stroke Diesel Engine

Brief description of the MAN Diesel engine type L+V32/40 with technology information and technical details as well as engine dimensions.

With a power output range of 2,300 to 10,000 kW, the engine type it is ideal for small and medium sized applications. The tried and tested 32-bore four-stroke classic.

NR/S

The Economical

MAN Diesel has more than 60 years unprecedented experience of producing turbochargers with plain bearings and uncooled hot gas casings.

This turbo charger features a radial turbine and a radial compressor. By the comparably simple design of the cast radial turbine, the NR series becomes the most economical choice for Diesel, Dual-Fuel and Gas engines of this power range.

Courses 2010

MAN PrimeServ Academies

Customised training programmes from basic Diesel engine maintenance to complete power plant operation. We offer training modules for your Plant Managers, Maintenance Personnel, Operators and Control & Instrumentation staff.

In-factory and at-site courses for increased productivity and enhanced quality.

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