



**Resalat Oil Field Development Project
Phase 1 (EPC-EPD)**



Contract
No.

Specification for Gas-Generator

Class

1

5365

Pr. Code	Area
LRSL	000

Disc.	Type
EL	SP

Seq.	Rev.
619	03

Seq.	Rev.
619	03

Seq.	Rev.
619	03

Seq.	Rev.
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Specification for Gas-Generator

					<i>S.S.</i>	<i>A.S.</i>	<i>M.A.</i>	
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REVISION RECORD SHEET

REV. NO.	PURPOSE	LIST OF UPDATED MODIFIED SECTIONS IF ANY
01	Change in Purpose of issue	-
02	Change in Purpose of issue	-
03	Change in Purpose of issue	-



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1. INTRODUCTION

1.1. Development Overview

The Resalat Field previously known as Rakhsh Field, is located in the Persian Gulf, some 80 km to the South of Lavan Island, in water depth of 65-75 meters. The facilities which were originally developed in 1968 have sustained some damage due to the Iran/Iraq war and adverse climate conditions thereafter.

To increase oil production capacity from this field (adding 12,000 stock barrels per day to current production), Iranian Offshore Oil Company (IOOC) has defined new project which includes Engineering, Drilling, Procurement, Construction for following items:

- New satellite Wellhead Platform (WHP1) with totally nine (9) conductor slots.
- Development and renovation of Existing offshore complex consist of new power generation, control system, HVAC, Electrical /control room, electrical panels(LV &MV),process & utility piping, and all necessary activities which shall be done for connection to existing facilities(Tie in requirements)
- Drilling of two new production wells in R1 and two wells in WHP1 platform and Re-entry and work-over of two existing well in R1 platform.
- One 10” productions submarine pipeline from WHP1 to PP and a single submarine cable (power and data) from SP to WHP1
- Inspection, Strengthening, Modification and Repair of existing R1 complex Jackets and topsides and replacement of boatlanding and Barge Bumpers.

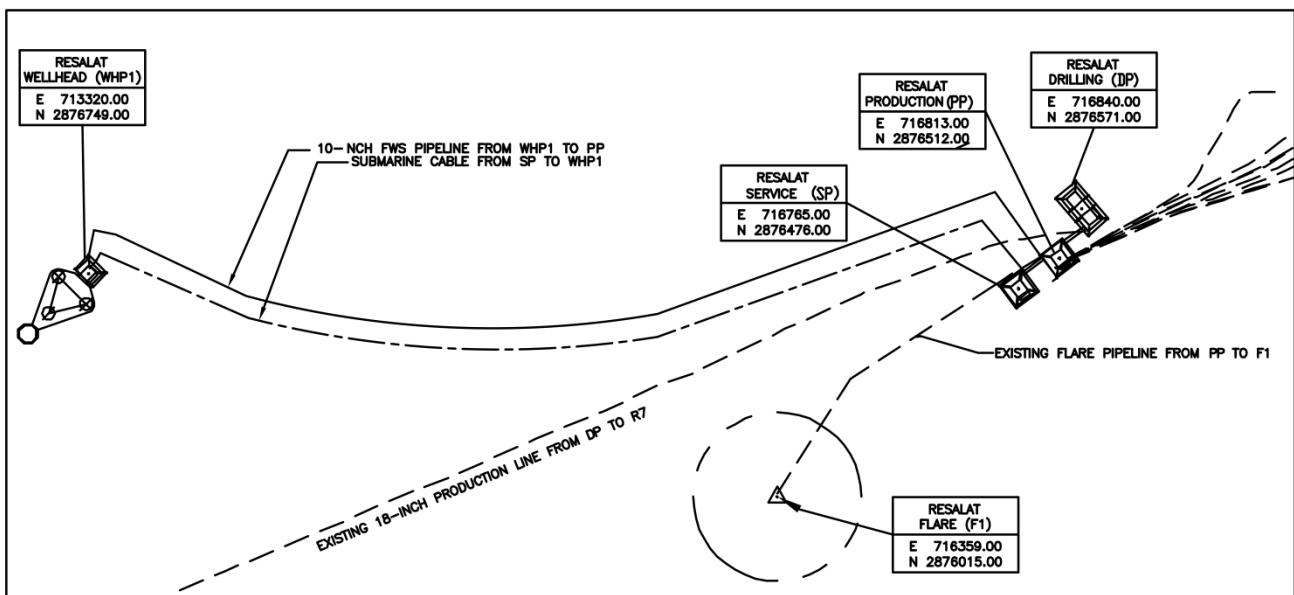


Figure 1: Resalat Development Field Layout (Datum ED 77, Zone 39, Cent. Meridian 51° East)



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1.2. Purpose of Scope

This specification covers the minimum requirements for design, manufacture, quality control, testing and finishing of industrial type Gas Engine Driven Generators.

1.3. Definitions





PROJECT	Resalat Oil Field Development – Phase 1
COMPANY	Iranian Offshore Oil Company (IOOC)
CONTRACTOR	Consortium of Iranian Offshore Engineering and Construction Company (IOEC) and Intelligent Solutions Inc. (ISI)
SUB-CONTRACTOR	Tehran Raymand Consulting Engineers (TRCE)
PURCHASER	Any firm who buy services, material and/or equipment for execution of the project within a dedicated contract.
SUPPLIER	Any vendor, manufacturer who supply any Service, Material or Equipment for the project
SHALL	Refer to a mandatory requirement
SHOULD	Refer to a recommendation
MAY	Refer to one acceptable course of action

2. CODES AND STANDARDS

LRSL-000-PM-LI-743	List of Applicable Codes and Standards
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3. REFERENCE DOCUMENTS

LRSL-000-EL-DB-603	List of Applicable Codes and Standards
LRSL-000-EL-SP-613	Specification for MV Switchgear
LRSL-000-EL-SP-622	Specification for PMS
LRSL-000-EL-SP-624	Specification for Electrical requirement for Package equipment

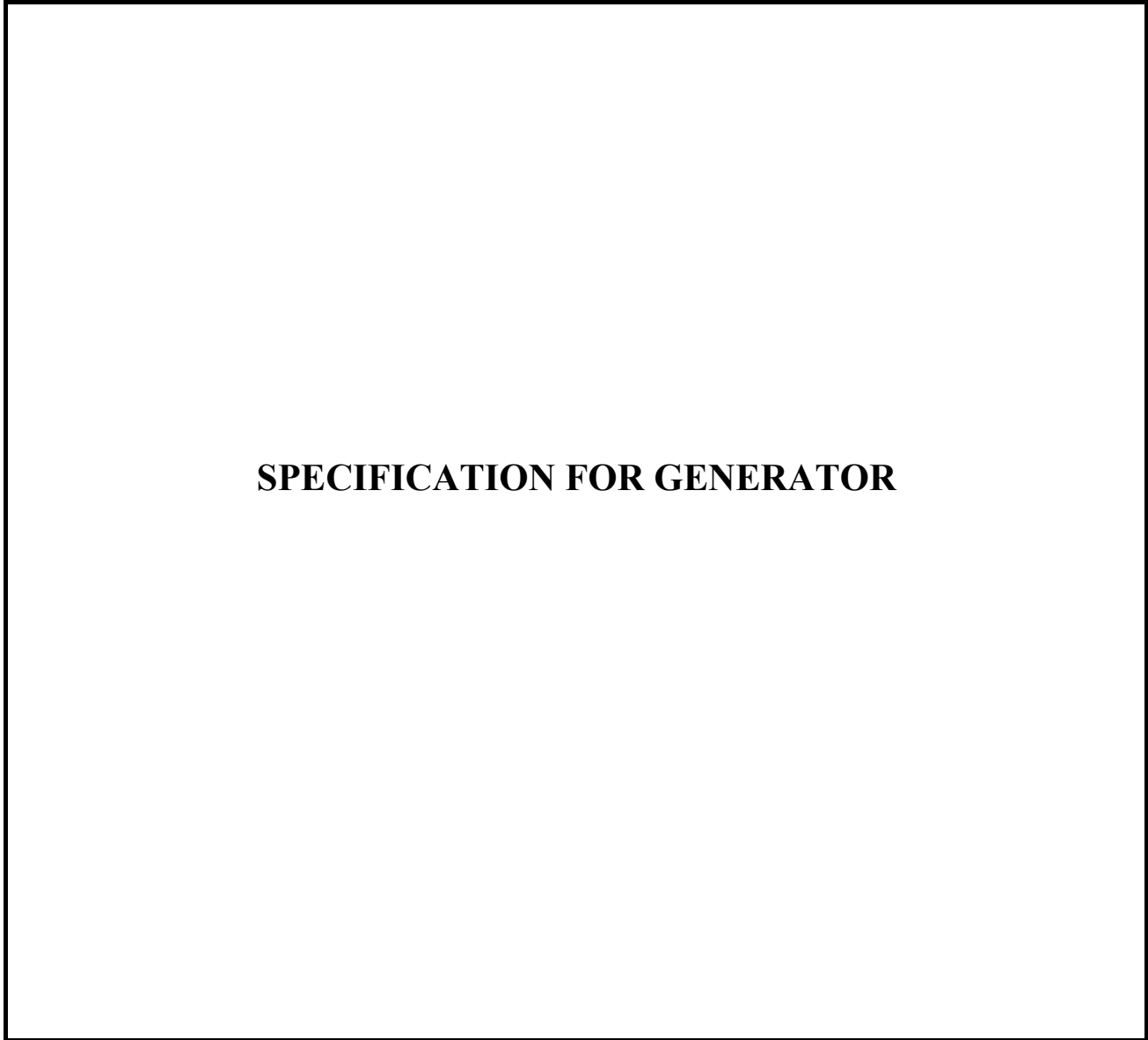
 	Resalat Oil Field Development Project Phase 1 (EPC-EPD)							
	Contract No.	Specification for Gas-Generator					Class	1
5365		Pr. Code LRSL	Area 000	Disc. EL	Type SP	Seq. 619	Rev. 03	Page 7 of 7

4. GENERAL STATEMENT

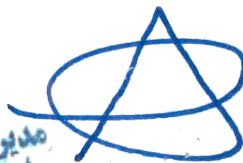
The attached SPECIFICATION FOR GENERATOR is confirmed as the Specification for Gas-Generator, except as added/modified/deleted herein, and renumbered/reissued as Specification for Gas-Generator (LRSL-000-EL-SP-619) for Resalat Oil Field Development Project, Phase 1.

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REV.	ISSUE DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED



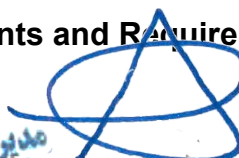
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1 SCOPE

This specification covers the minimum requirements for design, manufacture, quality control, testing and finishing of industrial type Gas Engine Driven Generators.

DEFINITION OF CONTRACTING PARTIES

Owner: Iranian Offshore Oil Company (IOOC)

Contractor:

Manufacturer: Whoever is responsible for the fabrication of equipment

Vendor: Whoever is responsible for the fabrication of a complete unit.



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2 CODES AND STANDARDS

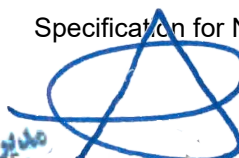
The design and fabrication of units shall conform to the latest International Electrotechnical Commission (IEC) standards.

IEC 60034	Rotating Electrical Machines
IEC 60038	IEC Standard Voltages
IEC 60044	Instrument Transformers
IEC 60050	International Electrotechnical Vocabulary
IEC 60051	Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories
IEC 60068	Environmental testing
IEC 60072	Dimensions and output series for rotating electrical machines
IEC 60085	Thermal evaluation and classification of electrical insulation
IEC 60152	Identification by hour numbers of the phase conductors of 3-phase electric systems
IEC 60186	Voltage transformers
IEC 60204	Electrical equipment of industrial machines
IEC 60228	Conductors of insulated cables
IEC 60230	Impulse tests on cables and their accessories
IEC 60255	Electrical relays
IEC 60446	Identification of conductors by colours or numerals
IEC 60742	Isolating transformers and safety isolating transformers

The above listing of standards and codes is not intended to be complete; however, it indicates main standards.

Project Specifications:

- Electrical Design Philosophy
- Hazardous Area Specification
- Specification for DC UPS
- Specification for MV Switchgear
- Specification for Power Management System
- Specification for Low Voltage Induction Motor
- Specification for Earthing System
- Specification for Neutral Earthing Resistor



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Specification for Medium Voltage Power Cables
 Specification for Low Voltage Power Cables
 Overall Single Line Diagram
 Data Sheet for Gas Engine Driven Generator
 Surface Preparation and Paint System Specification

DOCUMENT PRIORITY

In the event of any conflicts between this specification, datasheets, drawings, codes, and standards, the priority will be given in the following order:

- Purchase order
- Data sheet, and/or drawings
- This specification
- Codes and Standards.

The most recent document as of the date of project issuance shall be used.

All documents, drawings, data, etc. shall be in English.

SI metric system of measurement shall be used except for pipe and pipe fittings, which may be in inches.

3 ENVIRONMENTAL CONDITIONS

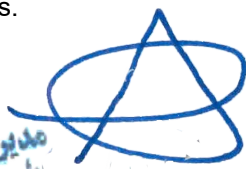
Site environmental conditions are given in Project Specification for Climate, Utilities and Units of Measure.

The rating of the equipment shall take into account the environmental conditions specified. All heat sources within the enclosure shall be accounted for.

The Gas Engine Driven Generators shall be mounted outdoors in a vendor supplied enclosure.

OTHER ENVIRONMENTAL CONDITIONS

- Relative humidity may be as high as 100% outdoors but not less than 50%.
- Condensation as a result of high humidity shall be taken into account.
- Rapid changes of air temperature and pressure shall be taken into account.
- Equipment will be placed in saline and corrosive atmosphere.
- The air can be laden with dust.
- Cables and equipment exposed to direct sunlight shall be provided with suitable shades.



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4 GENERAL REQUIREMENTS

The Gas Engine, gearbox, generator, and termination panels shall be skid mounted.

Electrical equipment supplied on the skid shall meet the requirements of Class I, Zone 1 hazardous area.

5 SCOPE OF SUPPLY

Components to be supplied are:

- generator and exciter
- automatic voltage regulator
- local control, excitation and protection panels
- enclosure, air intakes, discharge gas outlet

Unless otherwise specified in the requisition, the scope of work shall include:

- Supply of generator and exciter.
- Supply of automatic voltage regulator.
- Supply of protection relays, CTs, VTs and surge protection devices.
- Supply of local control, excitation and protection panels.
- Supply of battery charger.
- Supply of common synchronization panel (by chosen generator supplier).
- Supply of neutral earthing resistor.
- Supply of fire and gas detection equipment
- Supply of dummy shaft(s) to allow removal of rotor from stator.
- All special tools for installation and maintenance (a list of special tools, individually priced shall be provided with quotation).

This scope of work shall be read in conjunction with Gas Engine scope of work to form a complete, working gas engine driven generator set.

Some works are:

- Location at site, levelling and alignment.
- Fuel gas supply and piping.
- Installation of cable and wire for power and control from switchgear and Gas Engine Unit Control Panel to skid mounted terminal boxes.
- Commissioning and acceptance tests.



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6 SYNCHRONOUS ALTERNATING GENERATOR

6.1 General Design

The generator shall be a completely operational on skid package. The design shall include revolving field, air cooled, open drip proof, brushless rotating exciter, permanent magnet, Class F and temperature rise B, and two-bearing synchronous generator. Generator is constructed to NEMA and IEC standards. Generator phase rotation shall be as per data sheet. The generator shall have an independent provision for lifting. The generator shall be fan ventilated; screen protected with air intake filters.

Generators shall meet IEC 61000 requirements regarding emission of radio frequencies.

6.2 Performance Specification

Each unit shall be compatible with running synchronously and sharing the load in this operation.

The generator, exciter and regulator system shall provide steady state voltage adjustable $\pm 10\%$ and regulation to 0.5% of steady state voltage for any power level from 0 to full load regardless of power factor.

Generator site rating to be as per data sheet. Overload capability of 150% of output rating for one minute and/or 110% of rating for two hours in any period of 24 hours without exceeding 110°C stator temperature or 105°C rotor temperature at maximum ambient temperature.

Short circuit capability of alternator and excitation system to be minimum of 300% of full load rating for 3 second duration under 3 phases symmetrical short-circuit conditions.

Unbalanced Loads: Cylindrical rotor machines shall be capable of operating continuously on an unbalanced system. With none of the phase currents exceeding the rated current, the negative sequence current may be up to 10% of the rated current. When operating under maximum unbalance conditions, specified maximum temperature rise may be exceeded by not more than 5°C.

Wave Form: When tested on open circuit and at rated speed and voltage, the waveform of the line-to-line voltage shall be sinusoidal with a relative harmonic content not exceeding 1.5%. The same limits shall apply for the telephone harmonic factor (THF).

The generator sub-transient reactance shall be at least 10% without negative tolerance.

Rotor (revolving field) to be dynamically balanced complete with cooling air fans, layer wound field coils cemented in place with high strength insulating compounds. The complete revolving element shall be dynamically balanced through the full speed range up to 125% of synchronous speed. Rotor shall be electrically and mechanically balanced through 0 to 110% of full-load rating.

The combined efficiency of the generator, exciter and regulator at full load shall be greater than 97%. The Packager is to provide the overall guaranteed efficiency at bid.

6.3 Stator Winding

Six ends of the stator windings shall be brought out to a common terminal box and star connected with tinned copper links. Provision shall be made for external connection of the neutral point to the plant grounding system.

The insulation material for the stator winding shall be of approved type and class F according to IEC 60085 with temperature rise limited to the temperature of Class B insulation.



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The windings shall be securely braced, impregnated and baked for a tropical environment, and shall be finished with hard setting oil and moisture resistant varnish.

6.4 Rotor

The shaft shall be precision machined high quality steel, and shall carry the generator rotating field, the AC exciter rotor, the rotary 3 phase full wave rectifier assembly and cooling fan.

The complete rotor assembly shall be securely braced and dynamically balanced. The rotor shall be salient pole construction with heavy-duty interconnected copper damper winding.

Rotor shall be designed in order to withstand:

- The maximum torque variations under all operating (short circuit, emergency shut down, etc....)
- The maximum over-speed which may be reached after a full load rejection or manual governing action

6.5 Generator Excitation

The excitation system shall be brushless type directly coupled to the generator shaft. The excitation system shall consist of a permanent magnet generator on the generator shaft, revolving excitation generator, stationary exciter field, electronic solid-state voltage regulator complete with crosscurrent compensation circuit, and generator output voltage potential transformer. The system shall be designed to control the output voltage at a constant level for all load conditions. Excitation system shall be capable of providing the field current necessary to meet all the requirements of the generator performance specified. The voltage regulator shall be of the droop-type crosscurrent compensated for parallel operation. Voltage regulator shall be compatible, with accessories for remote automatic synchronizing. This function will be driven by a PLC logic monitoring and control system.

A slow-speed protection device 96% of normal speed shall be provided to ensure that no harm can be done to the diodes or exciter windings due to "field forcing" (over excitation) during rapid load changes.

Excitation shall be sufficient to ensure that generator can deliver momentarily, at rated voltage and at nominal power factor, 1.25 times the rated current.

6.6 Voltage Regulation

The steady state voltage regulation shall be maintained within plus and minus 5 volt of nominal voltage from no load at 0.8 to 1 power factor and at a speed droop of approximately 3%. A voltage adjusting rheostat shall be provided on the control panel for adjusting the voltage for a range of plus and minus 10% of the nominal voltage.

The automatic voltage regulator shall be suitable for connection to generator CT's and shall be designed to meet the following requirements:

- Constant voltage operation with generator voltage set between 90% and 110% of rated value
- Voltage droop operation, with voltage droops to proportionate the reactive component of generator current.

The voltage regulators shall be supplied complete with devices suitable for limiting under-excited operations to safe values.



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The A.V.R supply system shall allow short circuit sustained operation and/or generator voltage restoration after line short circuit clearing.

The A.V.R shall be fast efficient thyristor type (solid state) and avoiding pumping oscillations.

6.7 Machine Protection and Protective Relaying

Integral protection will be over temperature, vibration and winding differential protection. Platinum RTD temperature detectors shall be placed in each of bearing housing and two numbers in each of the three generator stator windings. Instrumentation with RTDs shall have adjustable set points for alarm and shutdown functions as well as readout facilities showing temperature in Celsius. Generator winding leads (6 minimum) shall be housed in a terminal box of sufficient size to enclose four donut type current transformers, insulated load terminals and high voltage cable stress relief terminations for load and neutral connections for a total of four connections requiring stress relief. Other protective devices will be contained in the generator set control console and/or the generator output switchgear.

Vibration monitoring pickup shall be provided in each bearing housing complete with instrumentation for detection, alarm point selection, alarm and shutdown output.

Anti-condensation heaters, thermostatically controlled, shall be installed within the stator housing and connected to a separate terminal box.

Vibration monitoring pickup shall be provided in each bearing housing complete with instrumentation for detection, alarm point selection, alarm and shutdown output.

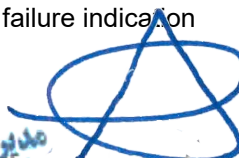
Anti-condensation heaters, thermostatically controlled, shall be installed within the stator housing and connected to a separate terminal box. Vibration monitoring pickup shall be provided in each bearing housing complete with instrumentation for detection, alarm point selection, alarm and shutdown output.

Anti-condensation heaters, thermostatically controlled, shall be installed within the stator housing and connected to a separate terminal box.

The vendor shall supply a generator protection relay panel, which will be mounted in an air-conditioned room.

The following relays are anticipated, although the vendor shall make his own recommendation:

- Stator ground faults 51N
- Differential protection 87
- Overload protection 49
- Over current (voltage restrained) 51V
- Overvoltage / Undervoltage protection 59/27
- Unbalanced loading 46
- Overexcitation / underexcitation 51/37
- Loss of excitation 40
- Reverse power 32
- Excitation low speed protection
- iode failure indication



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- Over and under frequency relay
- Rotor earth fault relay
- Vibration detection relay (alarm and trip)
- Bearing temperature (alarm and trip)

All relays shall have manual reset devices and visual indication of trip. The panel shall be wired with a common trip for remote action and a common signal for alarm in the engine generator main control panel.

6.8 Neutral Earthing Resistor

A dry type earthing resistor shall be provided for each machine, to limit earth fault current from each machine. The earthing resistors shall be as per standard.

6.9 Current Transformers

Current transformers, generally as a minimum, shall have the following accuracies in accordance with the latest edition of IEC 60044.

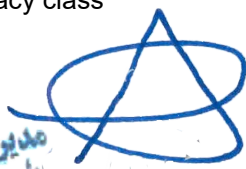
CT's used for protection	:	5 P 10 and class X for differential protection
CT's used for metering	:	Class 1
Auxiliary CT's used for remote current indication	:	Class 1

One number CT must be provided on the neutral to earth connection for earth fault protection of the generator.

Three number CT's must be provided on the mains of the generator to feed the control panel (for measurements, protections, controls, etc.)

Name plate of current transformers as a minimum shall have the following information:

- Current ratio
- Power V.A
- Manufacturer
- Model number
- Ordering number
- Accuracy class



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6.10 Lubrication

Pressure lube oil system for bearing lubrication and complete with startup pump, lube oil storage tank, storage tank heater, and air cooler. This lube system may be common to the Engine lube system. Drip pans shall be included for collection of any leakage. Lube oil pump shall be AC with separate DC backup.

6.11 Terminations

Power, control and instrumentation cables shall be brought out to edge of skid mounted junction boxes and terminal strips. Exposed junction boxes at the edge of the skid shall be IP66 and the assembly shall be suitable for the specified zone.

6.12 Electrical Controls and Instrumentation

The package shall include PLC control, indicating instruments, data recording, event recording, and real world control interface facilities for the engine and generator. Controls shall initiate a start sequence, running supervisory control, automatic synchronizing, load sharing, running protection, stopping, and emergency shutdown. Controls and instrumentation shall include as a minimum the devices and controls as indicated in datasheets. Note that this specification includes the devices contained within the Gas Engine generator unit control panel with facilities to multiplex, via a data communication link, the status and operation functions to a remote location.

The control system shall be designed to include all the requirements of the PMS, Engine/ Generator controls, parallel operating Engine driven generators and supervisory control from operators and/or an upstream power plant.

6.13 Bearings

Radial bearings shall be of the tilting pad type with steel backed babbit pads. These shall be accessible from outside the generator.

Resistance Temperature Detectors (RTDs) shall be provided in the bearing pads in the numbers and positions specified in the Data Sheets. The RTDs shall be embedded in the bearing metal.

Non-contact vibration pick-ups shall be installed at all hydrodynamic bearings in the numbers and positions specified in the Data Sheets.

The shaft surface shall be marked by a once-per-turn reference to provide a phase marker. One (1) key phasor shall be provided.

The manufacturer shall be fully responsible for the adequacy and correctness of the bearing & lubrication system and the bearings shall be electrically isolated from the frame to prevent shaft currents.

6.14 Cooling System

The generator shall be fan ventilated; screen protected with air intake filters.

For gas Engine cooling requirements, see Mechanical Specification for gas engine.

6.15 Noise Level

The noise limits for this equipment shall comply with the relevant standard.

The Noise level measurement shall be carried out in accordance with the requirement of IEC standard.



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Suitable enclosure for the Package (gas engine, gearbox and generator) shall be considered.

6.16 Balance and Vibration

Non-contact vibration pick-ups shall be installed at all hydrodynamic bearings in the numbers and positions specified in the Data Sheets. These pickups shall come complete with instrumentation for detection, alarm point selection, alarm and shutdown output.

6.17 Surge Protection

Surge protection shall be provided for each generator where specified in the data sheets.

The surge protection shall be either inside the generator enclosure or as close to the generator phase terminals as practical.

6.18 Quality Control

Vendor shall submit his Quality Control Plan and related check sheets for review by the Owner. This Quality Control Plan should include the engineering, design, fabrication, assembly and testing (ITP and test procedures) of the Generator and all related equipment, software and programming.

6.19 Earthing System

The earthing system for the Gas Engine Generator(s) shall comply with relevant document for earthing and Neutral Earthing Resistor(s).

The manufacturer shall provide suitable grounding pads for connection to the ground grid.

A separate grounding bus bar shall be provided for grounding of cable shields, conduits and generator frame.

6.20 Fire and Gas Detection System

The fire and gas detection system for the Gas Engine Generator enclosures shall be considered.

6.21 Cables

Cables shall comply with related specifications and requirements.

Generally, conductor cross-sections shall be selected in accordance with the relevant sections of IEC for ampere capacity and derating, depending on installation conditions and so on.

Trays shall be stainless steel 316L.

Electronic, instrument, communication and signal cables shall be segregated from power and control cables by 600mm minimum along parallel runs.

All cables shall be numbered with the cable number at both ends near the gland termination. All cables terminated at junction boxes and shall be ferruled.

The interconnection of terminal blocks shall be by means of screwed jumper bars.

An undrilled gland plate shall be provided at the bottom of the panel for cables by the vendor.

Cabling and wiring shall comply with relevant sections of BS 7671. (Equivalent IEC standards are also acceptable.)



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7 PACKAGED EQUIPMENT CONTROL SYSTEMS

7.1 Control Power

The plant normal supply or emergency generator will supply 230/400 Vac power for the control system UPS. The system control voltage shall be decided by vendor and confirmed by owner.

Vendor shall advise UPS loads in the proposal.

Vendor shall supply a sealed rechargeable nickel cadmium battery system for the packaged units to supply direct current (DC) power. Vendor shall state the capacity of the battery system being supplied. See requirements of Specification for DC UPS.

7.2 Control System Flexibility

The generating units shall be equipped with microprocessor based control system with redundancy facilities.

The redundancy shall be considered for the power supply and control unit at least.

The suitable human-machine interface (HMI) shall be considered.

The control system shall be so designed as to permit control from the PMS.

7.3 Shutdown Conditions

In addition to normal start / stop control, the TUCP shall provide safety shutdowns for the packaged unit. The safety shutdowns are divided into two groups: Non-Lockout and Emergency Stop Lockout.

The conditions for initiating the stops are as follows:

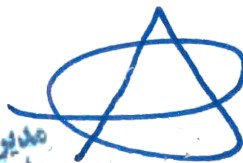
- Non-Lockout
 - generator winding temperature
 - switchgear malfunction
- Emergency Stop Lockout
- AS STIPULATED BY THE PACKAGER TO PROTECT EQUIPMENT SUPPLIED

Non-Lockout shutdowns will stop the packaged unit in a normal manner but not allow them to be restarted until after a Time Period (adjustable).

Emergency Stop Lockout shutdowns will stop the packaged unit in the shortest possible time and isolate it from the plant gas supply. The unit shall require a local reset before being restarted.

8 ELECTRICAL COMPONENTS AND REQUIREMENTS

8.1 General



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This section covers the requirements for the supply, design, fabrication, and testing of the electrical, control and power equipment provided with the Packaged Gas Engine-Generator sets. Its coverage includes all fixtures, instrumentation devices, switches, motors, heaters, junction boxes, relays, solid-state devices, cabling and wiring, trays.

8.2 Power Supply Characteristics

Electrical power available to the units will be as follows:

- 400 Volts ac, 50 Hertz, 3 phase.
- 230 Volts ac, 50 Hertz, 1 phase.
- UPS by vendor.

Packager shall state in the proposal, the load requirements in the above listed voltages, and in the following categories:

- Control
- Instrumentation
- Power (heating, motors, etc.)
- Equipment that requires uninterruptible power.
-

9 PAINTING

The paint system that is supplied must be in accordance with project documents.

Manufacturer's standard finish that meets or exceeds these requirements may be accepted upon customer approval.

10 INSPECTION AND TESTING

10.1 General

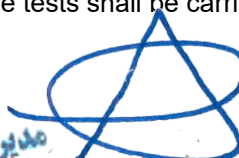
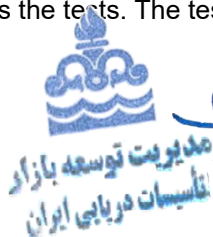
During the manufacturing period, the Gas Engine Driven Generators shall be subject to inspection by representatives of the owner and purchaser. The owner and purchaser's inspectors or their authorised representative shall have free access to the manufacturing plant engaged in the manufacture of the equipment to carry out necessary inspection at any stage of work.

Inspection may include a visit to quality control laboratories, workshops, testing bays, etc.

The supplier shall make available technical data, test pieces and samples that the owner and purchaser's representative may require for verification of quality and / or workmanship in conjunction with specification and data sheets.

Tests shall be carried out in the manufacturers factory by the manufacturer and at his expense.

The manufacturer of the Gas Engine Driven Generators shall submit to the Engineer standard factory test certificates of each test of the unit even if the owner and purchaser waives the right to witness the tests. The tests shall be carried out in accordance with the IEC standards.



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The factory/shop tests for gas engine generator sets shall be carried out in accordance with codes and standards defined in this and other relevant specifications unless an exceptions list was issued in vendor's proposal and accepted by the owner.

10.2 Wiring Check

After all the power, control and instrumentation devices are installed and wired, and prior to the gas engine – gas engine factory tests, the Packager shall perform the following tests:

- (a) Point-to-point continuity check of all wiring to assure that all circuits are properly connected in accordance with the applicable wiring diagrams.
- (b) Conductor-to-ground open circuit megger test of all on-package wiring, to assure that the resistance-to-ground of all non-grounded series and multiple circuits is adequate.
- (c) Conductor-to-conductor open circuit megger test of all power wiring.
- (d) Functioning tests of all electrical and control circuits and equipment.

Defects revealed by any test shall be promptly corrected and the test shall be redone.

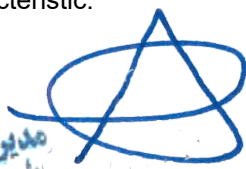
10.3 Tests

Certificates of tests carried out in accordance with I.E.C. publications on a machine with identical characteristics shall be provided with the tender.

When appropriate type test certificates do not exist, tests shall be made at the time of manufacture of the equipment to which this specification refers, subject to agreement by the company.

Furthermore, the following tests shall be conducted on one machine, the first complete machine, to confirm the design and performance:

- Full load heat run (during 4 hours). When the shop power capabilities are not adequate, the manufacturer shall propose an alternate test for company approval.
- Hot winding resistance measurement.
- Generator characteristics in open circuit and short circuit excitation and losses.
- High voltage dielectric test.
- Hot spot temperature tests.
- Sudden short circuit test for reactance and time constant determination.
- Efficiency at 25%, 50%, 75% and 100% load, rated power factor.
- Bearing temperature rise.
- Winding insulation resistance before and after heat run, or before and after the sustained short circuit test.
- Measurement of polarization test of generator stator winding.
- Phase sequence.
- No load characteristic.



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- Temperature rise.
- Measurement of reactances.
- Determination of moment of inertia.
- Response of automatic voltage regulation and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively.
- Measurement of insulation of pedestal/housing.
- Noise level test.
- Over-voltage test (120% - 3 minutes).
- Over-speed test (120% - 2 minutes).
- Shop verification of unbalanced response analysis.
- Waveform examination and frequency analysis up to 5kHz.
- Test certificates shall supplied to the company:
 - Immediately upon completion of the tests, in the case of tests performed in the presence of a representative of the company.

10.4 Gas Engine Factory Acceptance Tests

Packager shall perform an OBSERVED factory Mechanical Running Test on the gas engine in accordance with their standard procedure. The test procedure and schedule shall be submitted to the Purchaser in advance of testing.

Factory acceptance tests shall be carried out in the presence of the company representative. These tests will be carried out individually on each machine and will comprise tests in accordance with the relevant standards and codes, and especially:

- visual check, dimension controls,
- cold winding resistance measurement,
- no-load saturation test,
- sustained short circuit test, (unless agreed otherwise by the company),
- calculated stator and rotor winding resistance at 20°C,
- rotor balancing test,
- vibration test,
- power frequency voltage withstand test,
- insulation resistance test on all windings, heaters, etc.,
- continuity test on RTDs,
- sleeve bearing inspection,
- physical inspection for compliance with specification and standards,
- current transformer primary injection,



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- potential transformer ratio check,
- protection relay secondary injection,
- test on chargers (compliance with the relevant specification and standards,
- tests on all auxiliary devices.

10.5 Generator Factory Mechanical Tests

Packager or Generator Subcontractor shall submit to the Purchaser in their proposal an outline of the anticipated mechanical tests to be completed. Any mechanical checks and inspections that will be completed on equipment drive train should be detailed.

10.6 Lubrication Oil Systems Tests

The Packager and/or the Generator Subcontractor shall pressure test all piping components of the Lubrication Oil System(s) with an oil, selected in agreement with the Purchaser, to one and one-half (1½) times design pressure. No other oil shall be introduced into the oil system equipment at any time.

The completed system equipment shall be run in the factory to test operation and cleanliness. Test duration time shall be four (4) hours minimum during which time the system equipment shall be examined for leaks and all controls, instruments and mechanical items checked for leaks and proper functioning.

At the end of the test all filter elements shall be examined and then replaced with new elements.

10.7 Pressure Gauge And Switch Panels Tests

After completion of the panels, Packager and/or Generator Subcontractor shall pressure test all panel pneumatic and hydraulic operated equipment and all tubing at the design operating pressures to ensure that there is no leakage. All electrical circuits shall be tested and confirmed as operational. All instruments in the panels shall be calibrated.

The test procedure prepared by the Packager or Generator Subcontractor shall include details of the test methods. This procedure shall be submitted to the Purchaser for review and approve prior to the testing.

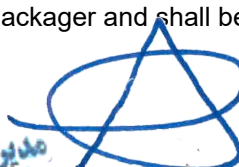
10.8 Gas Engine Unit Control Panel Test

All components of the Engine Unit Control Panel shall be factory checked and calibrated by the Packager or the Panel Subcontractor and a full operational test of the panel completed. During the test all power circuits shall be energized and signals simulated by an external signal generator.

The test procedure prepared by the Packager or Panel Subcontractor shall include details of how the external signal generator will function and other test details. This procedure shall be submitted to the Purchaser for review and agreement prior to the testing.

10.9 Generator Site Test

At a time agreed between the Purchaser and Packager, a Site Performance Test of the generator shall be conducted. The test will be based on a procedure to be agreed upon between the Purchaser and the Packager and shall be followed as closely as possible, as limited by field conditions.



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11 NAMEPLATE / RATING PLATE

The nameplate and the rating plate shall be of stainless steel.

The rating plate shall be affixed in a visible location to a non-removable part of the gas engine, generator, control panels and auxiliary equipment.

The nameplates and signs shall be in English and Farsi.

The nameplate shall be permanently engraved with the manufacturers name, serial number of the equipment, and model number as per IEC requirements.

In addition to the information required by paragraph 27 of IEC 60034-1 standard the following shall be included on the nameplate:

- Type of protection
- Net weight (Kg) of the generator
- Serial number
- Electrical characteristics.
- Nominal voltage, current, frequency, and maximum continuous power rating
- Type and size and voltage and power of space heater
- Voltage current, power, type of exciter
- Voltage current, power, type and size of P.M.G. (if any).

The following signs and labels shall also be provided:

- Purchaser's tag number
- Warning and danger signs
- Labels for major accessories.

12 SPARE PARTS / SPECIAL TOOLS

The supplier shall provide any special tools for installation and commissioning and a list of essential spare parts required for 2 years operation.

When more than one unit is purchased from a single supplier, corresponding parts of similar units shall be interchangeable.

One litre of primer and one litre of finish paint shall be supplied per unit for touch up of scratches incurred during transit.

13 SHOP DRAWINGS AND DOCUMENTATION

Manufacturer shall submit shop drawings in accordance with purchaser's requirements / standards.



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Manufacturer shall provide operation and maintenance data for units for incorporation into maintenance manual.

Vendor shall submit the following drawings at agreed times after placement of the purchase order:

- Installation drawings, detail for on site erection together with operation and maintenance instruction manuals fully detailed.
- Out line and dimensional drawings of the complete gas engine and the complete generator.
- Connection diagram
- Static and dynamic loads
- Terminal box detail drawings
- Rotor drawings
- Current transformers connections
- Wiring diagrams of all devices with switches or electrical connections
- All wiring diagrams of control panel including alarms indicators, meters switches and relays.
- Equipment schedule with exact sub-vendor reference.
- Schematic diagrams showing in detail connections of all internal equipment.
- Arrangement of equipment.
- All control system hardware
- All software and list of all applicable programs
- Datasheets
- Test reports

14 PACKING AND SHIPMENT

Individual packing list shall be provided for each crate and package.

Rust preventive coating, adequate for 360 days of protection under site conditions, shall be applied to the machined surfaces. The coating shall be easily removable.

Sufficient bracing on the crates shall be provided to prevent damage due to shock and vibration during transportation.

Warning signs shall be provided for each piece of equipment against improper lifting and handling.



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15 GUARANTEE

- In this document the effect of the warranties are limited to the technical warranty.
- Gas Engine Generators shall be guaranteed in accordance with Request for Quotation.
- The period of warranty is given in the purchasing conditions.
- The warranty shall include defective parts, replacement, man-hours, instructions and transportation of parts from Supplier's place to site without extra cost.
- The supplier shall provide his gas engine generators in full operational order.

The supplier is responsible for the following:

- Manufacture and procurement of his components, supply, factory acceptance test, packaging, etc.
- Supplier shall ensure that all sub-suppliers comply with all applicable parts of specification and related documents, standards, codes and the selected quality level.
- The warranties against faulty design and construction: Compliance with the provisions of this specification does not relieve supplier of the responsibility of supplying equipment and accessories of the proper design.



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