




KPD-TAY COMPRESSION PROJECT

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CLIENT : OIL & GAS DEVELOPMENT COMPANY LIMITED

PROJECT : KPD-TAY COMPRESSION PROJECT

**SPECIFICATION FOR
GAS ENGINE DRIVEN GENERATORS**



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SPECIFICATION FOR
GAS ENGINE DRIVEN GENERATOR

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SPECIFICATION FOR
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1. PURPOSE

This document is intended to specify the basic requirements for designing, engineering, selection, sizing, procurement, testing, installation, pre-commissioning and commissioning of Gas Engine Driven Gen-sets to be used in **KPD-TAY Compression Project** which deemed necessary for defining minimum requirement at FEED stage and shall not be considered comprehensive and final for procurement. This specification does not absolve the CONTRACTOR from his responsibility of supplying, installing and commissioning suitable Gas Gen-sets complete in all respect. The CONTRACTOR shall develop detailed datasheets, specifications, ITP and installation details based on this specification and submit to the COMPANY/CONSULTANT for approval during detailed engineering stage.

The offered Gas Gen-sets shall comply with the *Reference Standards and Codes*. Where the manufacturer's standards differ from other supplementary requirements of this specification details shall be submitted to the COMPANY/CONSULTANT for approval.

In case discrepancies are found between this specification and other documents, COMPANY/CONSULTANT shall be referred for correct interpretation.

1.1. Definition

Where used in this specification, the following terms shall have the meanings indicated below unless otherwise clearly indicated by context of their use.

COMPANY – Oil & Gas Development Company Limited (OGDCL)

CONSULTANT – The party which carries out the Basic Engineering/FEED of the Project.

CONCESSION REQUEST - A deviation requested by the CONTRACTOR or VENDOR, usually after receiving the contract package or purchase order. Often, it refers to an authorization to use, repair, recondition, reclaim, or release materials, components or equipment already in progress or completely manufactured but which does not meet or comply with COMPANY/CONSULTANT requirements. A Concession Request is subject to COMPANY/CONSULTANT approval.

CONTRACTOR - The party which carries out all or part of the design engineering, procurement, construction and commissioning or management of the project.

DRAWINGS - Drawings provided by the CONTRACTOR/VENDOR.

SUPPLIER/MANUFACTURER - The party which manufactures and/or supplies the material/equipment, and provides technical documents/drawings and services to perform the duties specified by the COMPANY/CONTRACTOR.

PROJECT – KPD-TAY Compression Project



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1.2. Errors & Omissions

- The review and comment by COMPANY/CONSULTANT of any CONTRACTOR's/VENDOR's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the CONTRACTOR/VENDOR of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.
- Any errors or omissions noted by the CONTRACTOR/VENDOR in this Specification shall be immediately brought to the attention of COMPANY/CONSULTANT.

1.3. Deviations

- All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of COMPANY/CONSULTANT as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of COMPANY/CONSULTANT prior to execution of Work. Such deviations shall be shown in the documentation prepared by the CONTRACTOR/VENDOR.

1.4. Conflicting Requirement

- In the event of any conflict, inconsistency or ambiguity between CONTRACTOR's/VENDOR's scope of work, this Specification, National Codes and Standards, and referenced in the Project Specification or any other documents, the CONTRACTOR/VENDOR shall refer to COMPANY/CONSULTANT whose decision shall prevail.

1.5. Reporting Procedure

- A reporting and documentation system shall be agreed between the CONTRACTOR/VENDOR and COMPANY/CONSULTANT for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. The CONTRACTOR/VENDOR shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY/CONSULTANT.
- Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to COMPANY/CONSULTANT.

1.6. Third Party Inspection:

- In addition to the inspection and witnessing of tests by the inspectors to be appointed by the COMPANY/CONSULTANT during the manufacturing and shipment of the equipment/material, COMPANY/CONSULTANT may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at VENDOR's facility under this specification.
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- Information w.r.t inspection and testing purposes as per applied reference Standards and Codes shall be submitted to COMPANY/CONSULTANT.

1.7. Unit Responsibility

- The CONTRACTOR / VENDOR shall be responsible for the complete design, materials, construction, supply, inspection and testing, packing, delivery and performance of factory assembled Gas Engine Driven Gen-sets including full compliance with all applicable design codes and standards, including those listed in "Section-2" of this document and the requirements of the certifying authority, if applicable. The CONTRACTOR/VENDOR shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing.
- The CONTRACTOR/VENDOR shall guarantee that all the material and parts included in construction of the specified Gas Gen-sets shall be new, unused and of the required/ specified grade.

1.8. Documentation

- Documents, calculation sheets, drawings, etc., to be submitted to the COMPANY/CONSULTANT shall be in English Language.
- Unless otherwise specified, the metric units shall be used in documents and drawings by the CONTRACTOR/VENDOR.
- The form of drawings and documents may be as per the CONTRACTOR/VENDOR's Standards. However, the format of the data sheet will be submitted to COMPANY/CONSULTANT for approval.
- Variations from or additions to this specification shall be called to the attention of the COMPANY/CONSULTANT and approved in writing by the COMPANY/CONSULTANT prior to starting manufacturing.

2. REFERENCE STANDARDS & CODES

The equipment and material selection w.r.t Gas Engine Driven Gen-sets design, manufacturing, testing and inspection supplied by the CONTRACTOR/VENDOR shall comply with this Specification, the latest edition of the General Specification for Electrical Installation Workmanship to be used in **KPD-TAY Compression Project**; and material selection shall confirm to the relevant and latest version of the following reference Standards and Codes.

It shall be manufacturer's responsibility to be, or to become, knowledgeable of the requirements of these reference Standards and Codes. Any changes, alteration and necessary re-certification of the equipment for compliance with the applicable Standards and Codes shall be at the expense of the Manufacturer.



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- International Electro Technical Commission (IEC).
- American National Standard Institute (ANSI).
- International Organization for Standardization (ISO).
- Institute of Electrical & Electronics Engineers (IEEE).
- National Electrical Manufacturing Association (NEMA)
- Electricity Act 1937 (Govt. of Pakistan)
- IEC-60034: Rotating electrical machines
- ISO 3046-1:2002 Reciprocating internal combustion engines
- ISO 8528: Reciprocating internal combustion engine driven alternating current generating sets
- NFPA-70/ National Electric Code.
- NFPA-37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).

In the event of conflict between Standards, the most stringent shall prevail.

All standards, regulations and codes of practices used shall be of latest current issues at the date of contract award.

The CONTRACTOR/VENDOR shall be responsible for the availability of the above mentioned specifications/publications, standards, and codes of practices and any other relevant documents and shall collect these documents on its own. The CONTRACTOR/VENDOR shall make sure that these documents are available all times and shall submit/present to COMPANY/CONSULTANT on request.

The design and installation shall also include the requirements of any applicable local laws, standards having jurisdiction over the site location following the principles and practices detailed in this document.

3. SERVICE CONDITIONS**3.1. Site Conditions**

Electrical design shall be based on the following environmental conditions:

PARAMETERS	VALUE/UNIT
MAXIMUM AMBIENT TEMPERATURE	118 °F
MINIMUM AMBIENT TEMPERATURE	36 °F
WET BULB TEMPERATURE (DESIGN)	88 °F
MAXIMUM RELATIVE HUMIDITY	77%
MINIMUM RELATIVE HUMIDITY	20%
WIND VELOCITY	101 (Miles/Hour)
ELEVATION ABOVE MEAN SEA LEVEL (GPF)	250 ft.
SEISMIC ZONE	Zone 2A of Uniform Building Code- UBC-1997.



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* The CONTRACTOR shall update site conditions during detailed engineering.

4. SCOPE

This specification covers the minimum requirement for the supply, design, materials, construction, testing, inspection, packing, delivery and performance of factory assembled packaged Site rated gas engine driven generators (rating as per relevant SLD) for TAY-03 @ GGS and Thora Deep @ GGS Facility. Each gas engine generator set shall be pre-wired & minimum shall include but not limited to the following:

- Gas Engine complete with Synchronous AC generator & excitation equipment.
- All necessary auxiliaries & equipment complete with ventilation and pressurization system, cooling system, radiator, Air Intake system, fuel gas system, pressure regulation, knockout drum, all interconnected piping, valves and IP-54 protected sound proof canopy.
- Engine and Generator control panel(s)
- All necessary noise and vibration suppression equipment
- Combined base plate
- Engine starting system with Ni-cadmium battery sets
- Engine and generator cooling systems
- Couplings and guards;
- All necessary interconnecting pipe work and valves, including drain connections.
- Local gauge panel and instrumentation;
- Complete Metering & protection relays
- All CTs and VTs (incl. those for installation in the switchboard). Note that CT's for protection shall be separate from metering CT.
- All special tools required for operation & maintenance of the package.
- All documents requested in this specification & attachments.
- All interconnecting cables among Engine/Generator control panel(s), load sharing & synchronization module (s) and incomers for Gas genset set except main power cable from genset to incomer breakers (to be supplied by the CONTRACTOR).

The continuous net power output of each generator shall be (rating as per relevant SLD), at 3-phase, 4-wire, 400 Volts AC, 50 Hz at site/ambient conditions.

The purpose of this specification is to define the minimum criteria that the supplied / Manufacturer gas generators shall meet. These minimum criteria may require enhancement by the Supplier to meet other performance related criteria. This is the complete responsibility of the Supplier to identify the complete requirement in order to ensure the reliable and safe continued operation of the complete power generation system.



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The genset Supplier scope shall include supply of aforementioned equipment including of meet criteria defined in section-3 with installation supervision, testing, pre-commission & commission of complete power generation system.

One set of spare parts to cover the erection, pre-commissioning, commissioning and performance testing for installed electric power generator set and its auxiliaries. These spares shall be fully detailed.

The Supplier shall provide the list of two years spare parts with unit price for each spare this shall include the spares for the first top end over hauling and operational spares.

Supplier/Manufacturer shall study the transient behavior with considering starting of largest motors as per relevant facility's load list and motor starters, along with a base load (as per load list finalized during detailed engineering) on any two (02) operating gas gensets and guarantee that voltage drop during motor starting is not more than 15%.

The gas generator set shall be placed in generator shed; however Genset Supplier/Manufacturer provided each control panel(s), will be placed in LV Switchgear/MCC room.

The tentative distance between Gas gen Set & Control panel is 50 meters.

The Supplier/Manufacturer shall offer standard equipment to perform the duty stated in this specification and the data sheet. Any variations of the Supplier/Manufacturer's standard package from this specification must be stated by the Supplier/Manufacturer; otherwise it will be assumed that all equipment offered is in accordance with this specification. Equipment manufacturing record books, equipment record books (Data Books) and operating and maintenance manuals are required.

5. POWER GENERATION PHILOSOPHY

The design of the electrical Power generation system will be carried out generally in accordance with the requirements of COMPANY/CONSULTANT.

The main gas generators will be sized such that in normal operation one no. (01) of operating generator will be sufficient to enable direct-on-line starting/Soft starting/VFD of the largest induction motor, at any level of system utilization, without detriment to other running loads.

As gas-engines do not have an overload capacity, the continuous output (COP) rating of the gas-engine generators will be selected to match the plant peak demand.

There will also be facilities at the Gas & diesel gensets Control Panel for manual start up and synchronizing, to allow for regular maintenance and operation of the unit.



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For each generator set and its auxiliaries, including its unit local control panel, shall be mounted on a rigid base plate suitable for mounting on a flat concrete base. The control panels shall be pre-wired.

The Supplier shall provide fully instrumented, piped and wired sets with all necessary ancillary items so that the minimum effort is required at site to install, commission, synchronize and run.

All equipment shall be fully works tested and shall not be released for shipment until the tests and inspections on the subject equipment item are completed.

All equipment shall be provided painted and protected suitable for installation at the job site in Pakistan and export packed for ocean transport. Spare parts shall be packed for long term storage at site.

Equipment shall be selected of the highest quality and reliability to ensure high availability of the complete package. All equipment shall be of type suitable for continuous used over 25 years under the site conditions listed. This requirement applies to the selection of materials as well as the basic design of the equipment. Particular care must be taken to ensure that equipment purchased can be supported over 25 years operational life of the plant. Assurances must also be obtained from Contractors for long term spare part availability.

The design and engineering services and Drawings to be render by the Supplier/Manufacturer shall include but not be limited to, the execution of basic and engineering design work and preparation of complete engineering specifications, power & control schematics, relay chart, operating manual and schedules, MTO, with all necessary drawings to allow the Supplier to furnish and to enable the Supplier to install and Erect all equipment with the overall objective of ensuring design compatibility within the Plant and ensuring adherence to safety requirements, all as provided in the Contract.

The Supplier shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and documents prepared by it, whether such specifications drawings and documents have been reviewed or condensate by the COMPANY/CONSULTANT or not.

The Supplier shall provide all technical data, information, schematics, literature and calculations for various systems at the request of the Owner to enable a review of the Drawings submitted by the Supplier.

All materials and equipment specified, the design of the generating set and all work carried out shall comply in respects with the latest edition of Pakistan Electricity Act.



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The generator set rating shall be as defined below which is the total net output rating at the generator terminals. The component (e.g. engine, generator, coolers, etc.) with the lowest individual rating shall provide the limit for defining the net output of the generator set. The rating of any significant electrical auxiliaries, such as electric cooling fans if any, shall be deducted from the output rating. The generator set shall have a continuous power rating as stated below, at a power factor of 0.8 lagging.

CLASS	CONTINUOUS RATING
QUANTITY	Refer relevant SLD
RATED OUTPUT	Refer relevant SLD (Net output under actual site conditions operating at facility gas)
RATED VOLTAGE ON LOAD	400V \pm 5%
PHASE	3 PHASE + NEUTRAL
FREQUENCY	50 Hz \pm 1%
POWER FACTOR	0.8
RATED SPEED	1500 RPM
CLASS OF INSULATION	CLASS F
TEMPERATURE RISE	B
IP PROTECTION (Generator and Exciter)	IP23
IP PRTECTION (Control, Protection and Monitoring Panel)	IP55 (outdoor/generator shed) IP42 (indoor/MCC Room)

All neutral points and negative of DC supplies shall be connected directly to earth.

Note: The rating of Gas generator is site rating at ambient conditions defined in project specification and the load to be catered are defined in project load list. As the loads that are considered are tentative, therefore, CONTRACTOR shall finalize the generator rating further in view of vendor load details during detailed engineering envisaging future growth (min. 20% allowance to be made) as well , however, minimum rating shall be considered as mentioned in relevant Single line diagram.

7. ENGINE REQUIREMENTS

The Gas engine with 1500 rpm 4 strokes mounted on a skid steel shape bedplate common to the generator. Engines shall be designed and supplied generally in accordance with the requirements of the International Standard. Engine Supplier shall furnish the engine with all necessary auxiliaries and accessories minimum of following for operation of the engine:

- Cooling system including jacket water and auxiliary coolant pump, after cooler (for turbocharged engine).
- Lubrication system including oil strainer, pump, filter, oil cooler etc.
- Fuel gas system
- Exhaust system including expansion joint, residential grade exhaust muffler etc.



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- Gas discharge system
- Starting system
- Sound Absorber

7.1. Air Intake System:

The Air intake system shall draw air from safe area outside the power generation shed. All air filters shall be sheltered from rain ingress.

Genset Supplier/Manufacturer shall provide the mounting & complete air filters, and all piping and ductwork between the air filter and the engine. Intake ducting or piping shall be properly supported to prevent excessive strains being applied to the engine intake nozzle. Expansion bellows provided by the engine Supplier shall be installed in the locations approved by the engine Supplier. All intake ductwork shall be swabbed and blown clean of any debris before final assembly.

Paint or similar coatings shall not be applied to the internal surfaces of combustion air ducting downstream of the air filter. Filter shall be sized and rated for full load (100%) operating condition of the gas engine driven generator set.

7.2. Exhaust System:

The exhaust outlet shall discharge to a safe area outside the power generation shed. Genset Supplier/Manufacturer shall provide the silencer (spark arrestor type), mounting for the silencer and all piping and ductwork between the silencer and the engine and all associated parts for the overall exhaust system.

The exhaust system shall be designed and installed with a minimum gas emission as required by the local government agency rules and regulation and as per international laws and environmental standards.

Exhaust ducting or piping shall be properly supported to prevent excessive strains being applied to the exhaust nozzle on the engine. Due account shall be taken of thermal expansion and the expansion bellow provided by the engine Supplier shall be installed in the locations approved by the engine Supplier.

Exhaust pipe shall be extended out from the shelter's roof or wall as the generator set package shall be installed inside a shed. Further, the orientation of the exhaust shall be agreed with the COMPANY/CONSULTANT, taking account of the location of adjacent equipment and the prevailing wind.



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7.3. Gas Fuel System

The fuel to be used shall be natural gas, suited for the gas engine drive. The engine shall accept a Raw Gas composition (refer in **Annexure-A**) for continuous operation on that gas composition.

The fuel system shall consist of following for the air-fuel ratio/mixture control to the engine.

- Fuel gas connection from process suction.
- Manual block valve for fuel gas supply.
- Fuel gas filter.
- carburetor
- Fuel gas supply high pressure regulator(s) as required
- Pressure relief valve
- Fuel gas pressure indicator
- Fuel gas knockout drum complete with level gauge high level switch and drain valve.
- Low pressure regulator(s)
- Flexible connecting lines
- Differential pressure indicator for fuel gas filter.

The fuel system components shall be mounted either on the engine or supplied loose to the package for mounting on the base plate.

All gauges and instrumentation shall be provided for the complete engine fuel gas system.

7.4. Ignition System:

The ignition system shall be the low tension type and consist of magneto, transformer, and spark plugs

7.5. Cooling System

The engine shall be cooled by water with added scale and corrosion inhibitors.

The cooling system shall be a separate heat exchanger type design external to the engine frame with a separate mounting skid or as advised by the Genset Supplier/Manufacturer.

This external heater exchanger shall be complete with engine coolant piping lines of high quality material with insulation and shall have motor operated extraction fans suitably sized and quantity to facilitate heat exchange or dispersion of heat from the engine's cooling system.

The cooling system shall be provided complete with level indicators, pressure gauge, pressure relief valve, piping connections, motors, coolant and all other appurtenances.

All low and high points in the coolant circuit shall be fitted with drain or vent cocks.



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7.6. Lubrication System

Genset Supplier/Manufacturer shall identify the requirements and provide complete lubrication system for COMPANY/CONSULTANT approval.

The lubrication system shall consist of minimum:

- Lubrication oil tank make-up devices, level switches for local and remote indication
- Circulation system with pump mechanically operated during the normal operation.
- Duplex filters full flow type with wide passage section
- Complete instrumentation of the lubricating system shall be provided for alarm indications, control and shutdown purposes.

7.7. Starting System

The starting system shall be supplied complete with batteries, starter control, starter contactor and starter over speed limiting switch. A timer shall limit the duration of each start attempt. Starting control may be integrated with the package control system.

A set of starting batteries (24V-DC) shall be provided. Batteries shall be rated for six (6) sequential starts.

Alarm contact shall be provided in case of starting procedure failure.

Batteries shall be charged either by an AC mains charger or by an engine driven alternator. Provision of both an engine driven alternator and a main battery charger shall be provided, in which case a change-over system shall also be supplied. Battery chargers and change-over systems shall be installed in the engine control panel, as required.

During standby, batteries shall be charged by engine control panel supply via change over switch.

7.8. ACOUSTIC ENCLOSURE

Supplier/Manufacturer shall provide an acoustic enclosure over all the equipment requiring noise limitation treatment & weather protection (IP-54) of Genset.

The acoustic enclosure shall allow access for routine on-line maintenance and for overhaul of the enclosed equipment. All doors shall be fitted with emergency opening bars on the inside. Opening any door for access during generator set operation shall initiate an alarm, but shall not cause a shutdown of the generator set.

This type of enclosure shall allow easy access for maintenance by means of maintenance doors. For overhaul of the equipment, easy removal of the enclosure by the lifting off or taking apart of panels is required.



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Mechanically induced ventilation shall be installed, so as to provide not less than 20 changes of air per hour within the enclosure, or to limit the temperature rise within the enclosure to not more than 5 °C above the ambient air temperature, whichever requires the greater flow rate. Failure of the airflow to the enclosure or excessive temperature rise in the enclosure shall shut down the generator set.

A two-stage filter, comprising an inertial stage followed by a viscous impingement stage, shall filter ventilation air.

An enclosure surrounding a gas-fuelled engine installed in a non-hazardous area shall have extractor fans maintaining a negative pressure within the enclosure with gas detectors on the ventilation air outlet, utilizing a two out of three voting system to shut down the engine upon gas detection. The ventilation shall remain in operation.

The enclosure shall be fitted with two heat detectors above the engine, either of which shall shut down the engine upon fire detection. Initiation of a shutdown shall cause a release of extinguishant into the enclosure and simultaneously cause the shutting of a damper in the exhaust air from the enclosure and shutdown of the ventilating fans.

7.9. Piping:

All connections shall be conveniently located near the extremities of the engine or its auxiliaries. All connections shall be rigidly anchored and fitted with flexible connections in a material suitable for the service. Reinforced elastomers are acceptable for non-hydrocarbon duty.

All sizing of piping shall be based on 100% rated plus 10 % of the full load condition.

All mechanical accessories like flanges, elbows, tees, etc. shall be fully compliant with the above standards.

7.10. Electronic Governor

The governor shall be Woodward, Electronic type 2301A or equivalent subject to approve by COMPANY/CONSULTANT. The governor shall have minimum load share & speed control feature with self-contained load sensor. Speed droop shall be externally adjustable from 0 (isochronous) to 10% from no load to full rated load. Steady state frequency regulation shall be $\pm 1/4$ of 1 percent of rated speed. It shall be capable of sharing load within $\pm 5\%$ when paralleled with similarly equipped engines.

Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear.

8. ALTERNATOR

The Generator shall be of the self-exciting synchronous brushless type excitation with enclosure degree of protection is IP-23.

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The phase connection is star connected. Neutral point will be connected directly to ground or Suggested as per parallel operation of generator. The pole quantity shall be 4 with the star center is same box with internal separation wall.

The generator set shall be designed to operate for a minimum of as per manufacturer standard h between major overhauls and shall have an expected lifetime of at least 25 years.

The stator winding of the generator shall have form wound construction & 2 embedded temperature detectors (PT-100) per phase for alarm and trip functions.

Generators shall be equipped with a damper winding on the rotor. If more than one star point of parallel operating generators will be earthed, the Supplier/Manufacturer shall ensure that third harmonic currents circulating through the star point connections are minimized

Generator units shall be capable of operating continuously at rated voltage & frequency on an unbalanced load at rated current containing a negative sequence component as per IEC-60034, without exceeding the temperature rise.

Generators shall normally be required to operate in parallel .i.e. either in parallel with similar rating or in some cases in parallel with different rating.

Frequency stability in accordance with governing class A1, as defined in ISO 3046-4, shall be provided for the engine.

The short circuit ratio referred to the rated voltage at saturated condition shall not be lower than 0.6 which is further as per manufacturer advised as per load & to maintain system transient stability.

Generators shall be capable of withstanding without damage, a three phase, a line to line, a line to earth or two lines to earth at generator terminals of 3 seconds.

The insulation of generator & exciter shall be class F & temperature rise limit shall be that of class B.

The generator and exciter enclosures shall be fitted with suitable inspection plates and access covers which shall be designed for quick and simple removal. Access covers to the rotating excitation rectifier equipment shall be adequately sized to permit easy maintenance by personnel using both hands.

The generator shall be provided with an external earthing terminal bolt, which shall be clearly marked with the appropriate symbol.



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Generator frame, including bearing supports, shall have sufficient strength and rigidity to avoid distortion or increased vibration as a result of external mechanical forces.

Lifting hook or eye bolt shall be provided as per standard for handling or loading/unloading of generator body.

Generator may be of either single or double bearing design for drive and non-drive end. A lifetime or long life sleeve bearings shall be preferred with fill cup and sight glass for each oil lubrication assembly.

The generator efficiency at nominal load and a power factor of 0.8 shall be not less than 93-95%.

Possibility of automatic and manual both operations shall be provided.

Suitably rated anti-condensation heaters shall be installed within each separate enclosure. Location and maximum surface temperatures of the heaters shall be such that no damage can be caused to any insulation when they are switched on. The performance of the equipment shall nevertheless be guaranteed in the event that the heaters are not in operation.

8.1. Excitation System

The excitation system shall be of the brushless type (self-excited), consisting of a Permanent Magnet Generator(PMG), AC exciter, rotating diode rectifier, Digital automatic voltage regulator (AVR), voltage adjuster, facilities for remote manual voltage control, automatic changeover to hand control incorporated on voltage failure of reference voltage to AVR, automatic adjusting of manual field rheostat by the automatic part of the AVR, and generator trip contacts on voltage failure to the AVR.

The excitation system shall be able to cope with any field forcing conditions that the generator is required to supply, e.g., starting large motors. The field forcing capability shall be sufficient to enable adequately graded relay settings to be made for system fault current protection.

The excitation system shall be capable to meet the requirements under a.c. generator short circuit Conditions specified in this Specification.

8.2. Automatic Voltage Regulator (AVR)

The AVR shall be of the electronic type provided with a fine voltage adjuster and a switch for selecting hand or automatic control, and shall include frequency sensing circuitry to limit ceiling voltage and prevent damage to components when the generator is driven at reduced speeds such as when starting or idling of the prime mover. It shall have a droop of maximum 4%, adjustable over the full range and have characteristics for reactive load sharing. The voltage level shall be adjustable within +5% and -5% of the rated value.



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The regulator shall be robustly built and shall contain components with adequate design and rating margins to ensure long life of equipment. A small heater shall be provided so as to prevent condensation when the equipment is on standby.

The Genset Supplier/Manufacturer shall include in his supply the provision of AVR current transformers for mounting in the terminal box.

The AVR and associated equipment shall be mounted on the Generation Unit local control panel by the Genset Supplier/Manufacturer.

The AVR shall be suitable for local adjustment, alternatively provision for remote adjustment from controlling circuit shall also be provided according to position of a "Local/Remote" change over switch on the local control panel.

The Vendor shall guarantee that the AVR is matched to the generator characteristics and is of adequate construction and design so as to fully meet the operational and performance requirements of this Specification.

The AVR shall be provided with over-voltage and under-voltage with all field failure protecting features.

8.3. Winding Termination

Stator windings shall be star connected with six ends brought out into separate line and neutral terminal boxes.

The neutral end of the windings shall be star connected within the neutral terminal box by means of an adequately sized removable solid copper link and a similar removable copper link shall be provided between the winding star connection and the point of connection of the generator neutral earthing cable.

Terminal boxes shall be adequately sized to facilitate easy access for connection and removal of the cables, and sufficient space within them to permit the inclusion of the current transformers required for protection, load sharing and earth fault detection.

A terminal marking plate shall be fitted at an agreed position near the terminal box to facilitate the correct cabling and checking of the phase rotation.

Phase sequence shall be in the order U-V-W in accordance with BS 4999 Part 3 or equivalent (I.E.C Standard) when the machine is driven in the correct direction of rotation by the prime mover.



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Cables will be terminated by means of compression type cable glands supplied by genset supplier/manufacturer. Tapped ISO metric entries shall be provided in the cable box as per calculated cable nos. of runs and size.

8.4. Fans & Couplings

The external fan and internal fans, if applicable, shall be individually balanced.

An integrally flanged shaft end design or a tapered shaft end design with hydraulically fitted hubs is preferred.

Diaphragm or flexible disc type couplings with marked shaft rotation are preferred.

9. CONTROL PANEL & INSTRUMENTATION

Each generator set shall be provided with the following monitoring, control and protection equipment:

- Local gauge panel for the engine
- Engine control panel
- Generator control panel

The engine control panel may be combined with the generator control panel in one freestanding cubicle. Clear physical segregation between engine and generator controls shall be provided.

9.1. Generator Control Panel

A local control panel shall be provided by the Genset manufacturer. It shall be ingress protected to IP42 minimum and fabricated from heavy gauge sheet steel with fully opening gasketed doors. Cable entry shall be provided using removable brass gland plates.

The control panel shall be complete with all internal wiring, relays and terminal blocks to receive the Purchaser's connections. All terminal blocks and connectors are to be numbered and all wires to be numbered and identified with core markers. Genset Supplier/Manufacturer shall prepare terminal block diagrams to clearly indicate the interface among Generation Unit terminations, genset manufacturer provided intelligent load management system and COMPANY incoming connections, and also between each item of the Generation Unit package.

A final as delivered" schematic and wiring diagram shall be fixed to the inside of the panel door suitably protected by a transparent cover.

Current Transformers (CTs) separate required for the metering and protections for each Generation Unit shall be provided, housed and wired.

Voltage signals from voltage transformers (VTs) or fuses at the switchgear shall be provided by others.



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The Control panel of each Genset shall provide the following features:

- Start-up control system utilizing a 24V dc supply provided by the Genset Supplier/Manufacturer.
- Automatic start-up and shut down equipment initiated from a remote signal by Genset supplier/Manufacturer intelligent load management system
- Tripping of automatic fuel shut off valve on shutdown, ESD or loss of auxiliary supplies.
- Battery chargers for the starter batteries. The chargers shall drive power from supplies provided by Genset Supplier/Manufacturer.
- Automatic voltage regulator and field forcing circuit.
- Excitation controls
- Electronic governor controls
- Engine Protections
- Local Control & indications:
 - Emergency stop button.
 - Manual/Auto/Test selector switch for engine start.
 - Local/Remote selector switch for manual start Manual start/stop.
 - Raise/Lower speed adjustment.
 - Raise/Lower Voltage adjustment.

Genset supplier/Manufacturer shall provide minimum following features in their IP-42 floor standing Control panel of each genset.

DESCRIPTION	DISPLAY	ALARM	SHUT-DOWN	INTERFACE WITH ICS
No. of Gen-sets Running	√			√
Gen-set & Bus Coupler Breaker Status	√			
Running Load (kW, kVAR, Amperes)	√			
All Metering (V, Hz, P.f)	√			
Gen-set Selected Mode (Remote/Manual)	√			√
Running Mode (Fixed/Load share)	√			√
Hour-Meter for Each Gen-set	√			√
Engine coolant temperature (deg.c)	√			√
Engine oil temperature (deg.c)	√			√
Engine oil pressure (kpa)	√			√
Battery voltage (v)	√			√
Oil filter differential pressure	√			
Inlet manifold temperature	√			√
Exhaust manifold temperature	√			√



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Fuel temperature	√			√
Engine speed	√			
Fuel pressure	√			
Crank case pressure	√			
Cylinder 1-20 exhaust port temperature	√			
Generator front bearing temperature (deg.c)	√			√
Generator rear bearing temperature (deg.c)	√			√
Generator phase a, b &c winding temperature (deg.c)	√			√
Fuel usage (m ³)	√			√
Oil pressure (kpa)	√			√
Oil temperature (degrees c)	√			√
Oil filter differential pressure (kpa)	√			
Gen. set not available for auto start	√	√		√
Engine fails to start	√	√	√	√
Low lube oil pressure	√	√	√	√
High lube oil temperature	√	√	√	√
High jacket water temperature	√	√	√	√
Engine over speed	√	√		
Exhaust temperature high	√	√		
Battery volts low	√	√		
Battery charger failure	√	√		
High generator winding temp.	√	√		
High generator bearing temp.	√	√		
Generator field failure	√	√	√	√
Inlet gas pressure low	√	√	√	√
Cooler fan motors stopped	√	√		
Shutdown from ESD system	√		√	√
Air cooler, CW level low	√	√	√	√
Generator winding fault	√	√	√	√
Inlet gas pressure high	√	√	√	√
Load threshold limit	√	√		
Air inlet filter high differential pressure	√	√		
Low lube oil level	√	√	√	√
Engine vibration	√	√	√	√
Fuel shutdown valve	√	√	√	√

*Provision for interfacing with ICS shall be provided for future connection.

Notes:



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- a. Indication shall be provided at Generator control panel as per Manufacturer standard & COMPANY/CONSULTANT requirement.
- b. Complete, Intelligent sharing module with all relays .i.e. generator auxiliaries relay, processor running relay, watch dog relay, frequenting sensing relay, trip relay, Voltage regulator failure relay, generator start & control relay, engine failure, engine fault available relay, load shed really with max. Of 5 loads each, PLC etc. complete scope included in genset Supplier/Manufacturer scope.
- c. Control Panel shall be able to connect to Standard Personal Computer to download data and information from module and to program the Module. The tender shall tabulate all parameters, signals, safety devices and other facilities available in the Microprocessor Control Panel.
- d. Volt free contacts for signaling a common unit fault and also a shutdown are to be provided. The signals will be used for indication purposes both on the remote circuit breaker panel and in the Control Room.
- e. The panels shall be complete with all internal wiring, PLC, relays, numbered terminal blocks and connectors for external cables. All cables are to be clearly identified in accordance with the Vendor's drawings.
- f. Provision shall be made to accept an emergency shutdown signal from a remotely located ESD panel.
- g. Such items as the manual/auto/test selector switch and the fuel supply control or isolating devices which prevent an automatic start up and auto connection to the bus bars shall be fitted with auxiliary contacts so as to provide the "Generator set not available for auto start" alarm or indication.

ICS- integrated control system.

ILMS- Intelligent load Management System (Load share, load shedding, interlocking & synchronization) provided by Genset Supplier/Manufacturer for each genset.

CP- Control Panel

The Intelligent load management system panel shall have following minimum control & indications:



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DESCRIPTION	CONTROL	INDICATION	INTERFACE WITH ICS
Emergency stop button	√		√
Manual/Auto/Test selector switch for engine start	√		
Field/Close selector switch for engine manual start	√		
Breaker Control Switch Close/Auto/Trip	√		
Raise/Lower speed adjustment	√		
Raise/Lower Voltage adjustment	√		
Common alarm indicating lamp, flushing with accept alarm acknowledge button	√	√	√
Common shutdown/fault indicating lamp, flushing with accept alarm acknowledge button	√	√	√
Circuit Breaker open		√	√
Circuit Breaker Close		√	√
Circuit Breaker Trip/Lock out		√	√
Processor not running		√	√

*Provision for interfacing with ICS shall be provided for future connection.

9.2. Protections

The Generator Vendor shall prepare a proposal for the protection relay settings. The final relay settings shall be agreed between the CONTRACTOR/VENDOR and COMPANY/CONSULTANT.

All protection relays shall be of the digital electronic/Microprocessor type and shall be installed so that they are clearly visible. Components requiring inspection or adjustment shall be accessible from floor level. Protection relays shall be clearly labeled and shall be equipped with visible flag indicators or other means of indication used on electronic type relays, e.g., LEDs. Protection relays shall have manual reset facilities and shall not be sensitive to vibration, shocks or transients. Dust proof flush mounted protection relays of the removable type and provided with calibrating and testing facilities should be provided. For withdraw- able protection relays, the terminals connected to CTs shall be automatically short circuited on withdrawal. Multiple function elements such as tripping and alarm duties shall have separate operating contacts for each function and shall be brought out to separate terminals. CTs for over-current protection shall have an appropriate VA rating and accuracy to energize the relays, without causing damage. Contact rating and performance shall be in accordance with IEC 60255.

Genset Supplier/Manufacturer shall provide minimum following protections for each genset with all CT's as required to achieve aforesaid protection; CT's for protection shall be separate from metering.



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DESCRIPTION	STATUS	ALARM	TRIP
Instantaneous phase over current			X
Definite Time phase over current			X
Voltage Restrained phase over current relay			X
Stator earth fault			X
Ground time overcurrent relay			X
Under voltage		X	X
Over voltage		X	X
Under frequency		X	X
Over frequency		X	X
Reverse power			X
Negative phase sequence			X
Phase failure protection			X
Phase Sequence		X	X
Loss of excitation			X
Stator winding temperature - high		X	X
Diode failure		X	X
Bearing temperature - high		X	X
Local ESD			X
Remote ESD			X
AVR failure		X	
Lock-out general		X	
On acoustic enclosures:			
• enclosure door(s) open		X	
• ventilation air flow-low		X	X
• ventilation air temperature-high		X	X
• fire (heat) detection		X	X
• gas detection on gas fuelled engines		X	X

Notes:

Minimum Accuracy class of protection current transformer = 5P10

Minimum Accuracy class of Measuring current transformer = 0.5

9.3. Cables & Junction Box

Complete supply of power & control interconnecting cables among generator/engine, MCC auxiliaries and control panel with intelligent load management system except main power cable from each generator to MCC are in scope of Gen-set Supplier/Manufacturer. The associated cable glands with all accessories required on the supplied equipment solely covered in Gen-set Supplier/Manufacturer. All glands shall be equipped with shrouds.

Cabling on the base plate and the engine cooler assembly shall be flame retardant and oil resistant, complete with galvanized steel wire braiding and interwoven copper earth wires. The insulation level shall be 600/1000 V.



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Control and other small wiring shall be carried out with multi-stranded copper conductors with a minimum size of 2.5 sqmm.

All wiring shall be clearly identified by means of permanent cable identification markers. BLUE colored control wiring is for intrinsically safe circuits only and shall not be used for any other circuits.

Circuits and terminals operating at different voltages and/or performing a different function shall be segregated.

Terminals associated with external sources of supply shall be fully shrouded and shall carry a label warning personnel to isolate the supply at source before commencing work.

All control cable and wiring shall have reduced fire propagation qualities to at least IEC 332-3.

All insulating material shall be flame retardant with low halogen content.

Cable running on the generation unit shall be neatly run, properly supported and protected from mechanical damage.

Control wiring leaving the gas engine and associated a.c. synchronous generator shall be terminated at a skid mounted control panel. Each group of terminals shall be clearly identified.

All junction / terminal boxes shall have a minimum degree of ingress protection of IP 55 & suitable for environmental condition.

9.4. MCC for Generator Auxiliaries

MCC for each genset auxiliaries solely shall be covered in genset Supplier/Manufacturer scope. Offered MCC shall comply the requirements mention in Specification for LV Switchgear/MCC (165-4-SPE-005)

10. SEQUENCE OF OPEARTION

The mode of operations of the gas engine driven power generator(s) with diesel generator shall be based on the following requirements:

10.1. Blackout condition

During black start operation, emergency diesel genset shall start & online with dead essential bus. Thereafter, available Gas genset synchronize with normal bus-A/B depends on availability & shall online after receiving start signal/command. Subsequently, when the starting order is initiated, the gas engine starting sequence shall automatically/manually be carried out to commensurate plant load requirements & run on both KW & KVAR load sharing. In the



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meantime, trip signal shall be issued to emergency diesel genset. The emergency diesel genset shall remain in operation till the bus coupler close & concerned load transfer.

The aforesaid starting condition is initiated by either manually option or through intelligent load management system depend on COMPANY/CONSULTANT consent while Manual starting shall be carried out locally from the generator control panel.

10.2. Normal operating condition

In normal operation, One no. (01) gas genset will online & run load (kW & kVAR) to cope the plant peak demand. In the event of the loss of one generator whilst operating, it is required that the standby gas generator shall automatically start-up and when at full speed and having established full voltage it shall automatically cope the peak load of this facility.

Further, Provision shall also be integrated for all the gas genset (s) and emergency DG set run in parallel & load sharing mode to cater the plant requirement.

Consequently, genset Supplier/Vendor shall provide complete intelligent load management system, PLC, load shedding system with all relays and equipment to attain above scenarios along with complete provision of manual too.

11. NAMEPLATE

The nameplate shall be Series 300 Stainless Steel securely fastened by pins of similar material and shall be located for easy visibility.

The rated conditions and other data, in English language, as below, shall be clearly stamped on the nameplates:

- Manufacturer's name.
 - Serial number.
 - Model Number.
 - Item Tag Number.
 - Duty Type.
 - Enclosure type.
 - Frame Size
 - kW and kVA rating.
 - Voltage.
 - Phases.
 - Frequency.
 - Efficiency.
 - Power Factor.
 - Full Load Amperes (FLA)
-



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- Nominal Speed (RPM)
- Temperature Class.
- Direction of Rotation
- Oil flow rate
- Oil pressure required

12. TEST AND INSPECTION

The complete each genset package, together with the control console, shall be witness tested under load at the Supplier/Manufacturer's assembly workshop as an integrated system to verify that the supply conforms to the specifications in the order from the stand point of mechanics, safety devices, accessories, guaranteed performance, etc.

The following tests and checks shall be performed as a minimum:

- Insulation resistance.
- Measurement of winding resistance.
- Determination of short circuit characteristics.
- Determination of excitation system characteristics.
- Fuel system test.
- Measurement of nominal no-load speed.
- Fuel measurement, temperature and pressure measurements.
- Testing of all control and protective devices.
- Testing of all control and logic circuits.
- Operation of the completed generator package at $\frac{1}{4}$ load for 30 minutes, $\frac{1}{2}$ and $\frac{3}{4}$ load for 1 hour and full load for 4 hours.
- Voltage and frequency regulation measurements.
- Temperature rise at rated load and frequency.
- Measurement of fuel consumption.
- Measurement of exhaust gas temperature.
- Phase sequence.
- Determination of efficiency and power factor at 100%, 75% and 50% of full load.
- Parallel operation and Load sharing.
- Measurement of vibration.
- Measurement of noise.

13. COMMISSIONING

The Supplier/Vendor is required to arrange commissioning and start-up of generator by Gen-set Supplier/Manufacturer service engineer at site.



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14. PERFORMANCE TEST

The Gen-set Supplier/Manufacturer hereby guarantees that the following output figures shall be achieved during performance tests.

- Output of generator kVA at the generator terminal under site conditions.

The following field inspection and test to be carried out:

- Inspection and checking of units
- Startup and trial operation

After the test has been completed the following test shall be conducted as follows at site.

- Starting and stop operation test.
- Synchronizing and parallel operation test.
- Load test (25%, 50%, 75%, 100% & 110%)
- Operation test of auxiliary equipment.

The Genset Supplier/Manufacturer shall provide the load bank with all accessories arrangement to perform the above test.

15. TEST CERTIFICATES

The Supplier/Vendor shall record all test results and issue test certificates, which shall record all calculated parameters (e.g. reactance's, efficiencies, etc.).

16. SPARE PARTS

The Gen-set Supplier/Manufacturer shall submit with the quotation comprehensive fully detailed schedules of spare parts with separate prices of each covering all equipment for two years operation. All spare parts supplied shall be new and fully interchangeable with the main equipment being supplied.

The spare parts for construction/commissioning/start-up shall be delivered at the same time as the main equipment. The spare parts for two years operation may be delivered at the same time as the main equipment but shall be packed separately.

The spare parts for two year operation will not be included in the financial evaluation.

17. AFTER SALES SERVICE

The Manufacturer/seller should have good established facilities in Pakistan for after sales service, maintenance cells and spare parts supply, the bidder should provide the proof of these facilities and COMPANY/CONSULTANT will have the right to visit these facilities prior to finalization of order.



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The Genset Supplier/Manufacturer shall provide a complete set of special tools and devices necessary for the lifting, erection, testing and maintenance of the generating set.

These shall be supplied in a purpose-made container suitable for wall mounting and complete with padlock and keys.

19. FIRST AID SPARE PARTS

Independent of the spare parts, which may be involved in the bids, the Genset Supplier/Manufacturer shall supply with the equipment:

- Spare parts for construction/start-up and commissioning.
- One cartridge for air filter, per unit.
- The quantity of oil, corresponding to the first emptying, per unit.
- 10% of fuses and lamps of all types, with a minimum of four of each type.

20. OPERATION AND MAINTENANCE MANUALS

The Operation and Maintenance manuals of equipment supplied shall be furnished with the generator set with detail diagram of wiring of equipment, frequency of lubrication, operating instructions, etc.

21. DRAWINGS AND DATA

All the drawings and data shall be provided in accordance with the Project Specification for QA/QC and minimum two sets of following drawings shall be submitted to COMPANY/CONSULTANT. Each set shall include:

- Factory published specification sheet indicating standard and optional accessories, ratings, etc.
 - Supplier/Manufacturer's catalog cut sheets of all auxiliary components such as isolators, battery charger, silencer, exhaust flex main circuit breaker, etc.
 - Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
 - Weights of all equipment.
 - Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
 - Interconnect wiring diagram of complete Genset system, including generator, switchgear, remote pumps, battery charger and remote alarm indications.
 - Completed data sheets.
 - Piping layout.
 - Instrument diagram.
-



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- General arrangement drawing of all equipment also showing dry and operating masses, arrangement of components, cable entry details, minimum space required for erection and maintenance;
- Schedule and drawing of electrical, instrument and mechanical termination points.
- Foundation design data.
- Base-plate construction data.
- Dynamic performance calculations.
- Torsional and lateral vibration data.
- Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation airflows, noise data, fuel consumption, etc.
- Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
- Generator resistances, reactance and time constants.
- Generator current decrement curve.
- Generator motor starting capability.
- Generator thermal damage curve.
- Jacket water heater connection diagram.
- AC & DC Control panel schematics with complete schematics of intelligent load sharing system.
- Relays Chart with sequence of operation
- Automatic load transfer switch (es)
- Oil sampling analysis, laboratory location, and information.
- Supplier/Manufacturer's and dealer's written warranty.
- Emissions data
- Generator inertia value (WK^2) for generator, coupling and prime mover with associated curve.

ANNEXURE-A**Gas Composition of TAY-03 @ GGS**

Components	Gas
	Mole Fraction
Hydrogen	0.0000
H ₂ S	0.0000
CO ₂	0.0590
Nitrogen	0.1360
Methane	0.6639
Ethane	0.0753



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Propane	0.0328
i-Butane	0.0051
n-Butane	0.0092
22-Mpropane	0.0000
i-Pentane	0.0028
n-Pentane	0.0028
n-Hexane	0.0047
Mcyclopentan	0.0005
Benzene	0.0001
Cyclohexane	0.0006
n-Heptane	0.0010
Mcyclohexane	0.0007
Toluene	0.0002
n-Octane	0.0006
E-Benzene	0.0000
p-Xylene	0.0001
o-Xylene	0.0000
n-Nonane	0.0003
n-PBenzene	0.0000
n-Decane	0.0001
n-C11	0.0000
n-C12	0.0000
n-C13	0.0000
n-C14	0.0000
n-C15	0.0000
n-C16	0.0000
n-C17	0.0000
n-C18	0.0000
n-C19	0.0000
n-C20	0.0000
n-C21	0.0000
n-C22	0.0000
n-C23	0.0000
n-C24	0.0000
n-C25	0.0000
n-C26	0.0000
n-C27	0.0000
n-C28	0.0000
n-C29	0.0000
n-C30	0.0000
n-DotriC32	0.0000
n-HexatriC30	0.0000
H2O	0.0042



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Minimum Supply pressure is 185 psig
Max Supply Temperature ranges 136-150 °F
Ambient Temperature ranges 36-118 °F

Gas Composition of Thora Deep @ GGS

Components	Gas
	Mole Fraction
Hydrogen	0.0000
H2S	0.0000
CO2	0.0735
Nitrogen	0.0106
Methane	0.7981
Ethane	0.0621
Propane	0.0265
i-Butane	0.0043
n-Butane	0.0075
22-Mpropane	0.0000
i-Pentane	0.0021
n-Pentane	0.0021
n-Hexane	0.0069
Mcyclopentan	0.0001
Benzene	0.0001
Cyclohexane	0.0001
n-Heptane	0.0003
Mcyclohexane	0.0003
Toluene	0.0003
n-Octane	0.0003
E-Benzene	0.0000
p-Xylene	0.0002
o-Xylene	0.0000
n-Nonane	0.0001
n-PBenzene	0.0000
n-Decane	0.0001
n-C11	0.0000
n-C12	0.0000
n-C13	0.0000
n-C14	0.0000
n-C15	0.0000
n-C16	0.0000
n-C17	0.0000
n-C18	0.0000



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n-C19	0.0000
n-C20	0.0000
n-C21	0.0000
n-C22	0.0000
n-C23	0.0000
n-C24	0.0000
n-C25	0.0000
n-C26	0.0000
n-C27	0.0000
n-C28	0.0000
n-C29	0.0000
n-C30	0.0000
n-DotriC32	0.0000
n-HexatriC30	0.0000
H2O	0.0044

Minimum Supply pressure is 185 psig

Max Supply Temperature ranges 136-150 °F

Ambient Temperature ranges 36-118 °F

Note: This Gas composition of both the facilities are based on primary data at FEED stage, CONTRACTOR to finalize/update the gas composition during detailed engineering stage and shall be submitted to Genset Supplier/Vendor accordingly.