

PACKAGED UNIT AC GENERATOR SETS

DEP 33.65.11.32-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies the minimum requirements for the design, manufacturing, assembly, inspection, and testing of packaged unit AC generator sets, hereafter referred to as generator sets. A generator set consists of a synchronous AC generator, an engine driving the generator, their control, protection and relay panels, auxiliary equipment and a baseplate. Generator sets may be driven by either gas or diesel engines.

This DEP is intended for AC generator sets in the design power range from approximately 100 kVA to 1250 kVA. In exceptional circumstances, the Principal may approve the application of this DEP to generator sets outside this range.

The applicable project requirements shall be given in requisitions DEP 33.65.11.94-Gen., DEP 31.29.80.93-Gen. and DEP 33.65.11.93-Gen. The type of engine shall be specified in requisition DEP 33.65.11.94-Gen. The Packager shall provide the information requested by completing the data sheets.

In the event of conflict between documents the following hierarchy shall apply:

- 1st priority: purchase order and variations thereto;
- 2nd priority: requisition sheets and project specification;
- 3rd priority: this DEP.

The equipment and services to be provided in accordance with this DEP excludes the supply of:

- civil engineering such as buildings, cable floors, trenches, foundations and protective fences;
- cabling between skids;
- cable tray systems, except as fitted on the package;
- switchboards, including the generator circuit breaker.

This DEP is a revision of the publication of the same number and title dated October 1994. A summary of the major changes from the previous edition is listed in (1.7).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them (i.e. the distribution code is "F" as described in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants, oil and gas production facilities (both onshore and offshore) and supply/marketing installations. When DEPs are applied, a Management of Change (MOC) process should be implemented. This is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General Definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Packager** is the party that designs, manufactures, assembles, inspects and tests the complete generator set.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Technical definitions

Air to air cooled machine

A closed machine with an integral or machine mounted heat exchanger, using air as the primary and secondary coolant.

Air to water cooled machine

A closed machine with a heat exchanger using air as primary coolant and water as secondary coolant.

Certificate

Document issued by a recognised authority certifying that it has examined a certain type of apparatus and, if necessary, has tested it and concluded that the apparatus complies with the relevant standard for such apparatus.

Certificate of conformity

Certificate stating that the electrical apparatus complies with the relevant standards for apparatus for potentially explosive atmospheres.

Declaration of compliance

Document issued by the Manufacturer stating that the electrical apparatus complies with the requirements of IEC 60079-15.

Hazardous area

An area in which an explosive gas mixture is or may be expected to be present in a quantity such as to require special precautions for the construction, installation and use of electrical apparatus.

Land installation

An installation located at sufficient distance from open saliferous water to minimize the effect of a salt-laden atmosphere.

Lifetime

The lifetime of a generator set is the time during which the generator set remains suitable for the application for which it was made, provided it is regularly inspected, examined and serviced in accordance with the Manufacturer's instructions, with replacement of lubricants and of parts subject to wear.

Low voltage

A set of voltage levels used for the distribution of electricity and whose upper limit is 1000 V AC.

Marking

Data put on the electrical apparatus by the Manufacturer giving information for the safe use of the apparatus.

Rated value

A quantity value assigned, generally by the Manufacturer, to a specific operating condition of a component, device or equipment.

Site conditions

The external factors, e.g. altitude, air temperature, wind velocity, vibration, earthquake, black body temperature and relative humidity, which may influence the operation of a machine or apparatus.

Test report

Document prepared by the Manufacturer indicating in detail the tests and verifications to which the apparatus has been subjected, and their results.

Vital service

A service which, when failing in operation or when failing if called upon, can cause an unsafe condition of the process and/or electrical installation, jeopardize life, or cause major damage to the installation.

Voltage deviation

The difference, generally expressed as a percentage, between the value at a given instant at a point in the system, and a reference voltage such as a nominal voltage, a mean value of operating voltage or a declared supply voltage.

Zone 1 (In the classification of hazardous gas areas)

An area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2 (In the classification of hazardous gas areas)

An area in which an explosive gas atmosphere is not likely to occur in normal operation and if it does occur it will exist for a short period only.

1.3.3 Frequently used expressions

Emergency generator sets

Generator sets that are infrequently operated and for a relatively short duration. They will only operate in case of a power failure of the main grid system for a relatively short period, e.g., 24 hours. When the main grid system is available, the starting ability of these generators will be tested at regular intervals, e.g., once every week.

Generator sets for continuous operation

Generator sets that provide power to the connected installation and may run in single operation, in parallel with the main grid system, or in parallel with other generators on a continuous basis. The nature of the operation shall be specified in the requisition.

Generator sets for parallel operation

Generator sets with an ability to operate without permanent supervision in parallel with the main grid system, in parallel with other generators, or both.

Generator sets supplying large non-linear loads

Generator sets with an ability to supply large non-linear loads, e.g. rectifiers, while operating within their temperature limits.

1.4 ABBREVIATIONS

AC	Alternating Current
AISI	American Iron and Steel Institute
AVR	Automatic Voltage Regulator
CT	Current Transformer
ESD	Emergency Shut Down
IP	The degree of ingress protection of an enclosure according to IEC 60529 (for example: IP 41)
LED	Light Emitting Diode
RMS	Root-Mean-Square
VA	Voltage-Ampere
VT	Voltage Transformer

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (13).

1.6 UNITS

Technical units, quantities etc. are and shall be expressed, used and abbreviated according to the SI system and DEP 00.00.20.10-Gen.

1.7 CHANGES FROM THE PREVIOUS EDITION

The previous edition of this DEP was dated October 1994. Other than editorial changes, the following are the major changes to the previous edition.

Old Section	New Section	Subject
1.3	2.2	Section on pre-manufacturing meeting moved; other sections in (1) and (2) re-numbered accordingly.
1.3.2	1.3.2	References to IEC standards removed from the technical definitions.
6.1	6.1	Requirements for combined packaged unit control panel clarified.
6.3.1	6.3.1	Bearing and winding temperature added.
7.1	7.1	Anti-vibration mounts made mandatory, unless specified otherwise in the requisition.
8.2	8.2	Maximum time allowed for the emergency generator to accept the normal load has been revised from 10 s to 25 s. Also added that starting system and autonomy to be specified in the requisition.
9.2.1	9.2.1	Exhaust temperature added.

1.8 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the DEP Administrator at standards@shell.com.

Shell staff may also post comments on this DEP on the Surface Global Network (SGN) under the Standards/DEP 33.65.11.32-Gen. folder. The DEP Administrator and DEP Author monitor these folders on a regular basis.

2. BASIC REQUIREMENTS

2.1 GENERAL

The generator set shall be the product of a Packager regularly engaged in the production of such sets. The generator set shall be of modern design and proven performance. Design and construction of the generator set shall provide accessibility for all components requiring routine operational attention and maintenance.

The requirements in (2) to (7) apply to all generator sets. The requirements for specific modes of operation are given in (8).

For certain special applications it may be necessary to deviate from this DEP. Any special requirements shall be stated in the requisition.

2.2 PRE-MANUFACTURING MEETING

If deemed necessary, a pre-manufacturing meeting shall be arranged with all parties concerned. This shall be stated on the requisition or may be initiated by the Packager.

The purpose of this meeting is to define the scope and parameters of the order and the responsibilities of each party involved. The final list of deviations to the specification shall be agreed. Agreement shall be reached with respect to administrative, production and test procedures.

Minutes of the pre-manufacturing meeting shall be made by a mutually agreed party and be sent to the Principal for approval within 14 days. After the Principal has approved the draft minutes, the final minutes shall be issued within 14 days.

2.3 SAFETY

The generator set shall be designed to minimize any risk of internal short circuits and to ensure personnel and plant safety under all prescribed conditions of operation, inspection and maintenance.

The generator set shall be designed to withstand the thermal and dynamic stresses and transient mechanical torques such as those resulting from a short circuit and circuit switching operations. Damage arising from component failure should be confined to the component concerned.

Products that are very toxic (see DEP 01.00.01.30-Gen.) shall not be used.

All exposed rotating or moving parts shall be protected by guards in accordance with BS PD 5304 or equivalent national standard. The guards shall be readily removable for plant maintenance purposes.

Exposed surfaces which attain a temperature in excess of 70 °C under normal operation and which are a potential hazard to personnel shall be screened.

All flexible drive belts shall be of anti-static material in accordance with ISO 1813.

2.4 SERVICE CONDITIONS

2.4.1 General

The site environmental conditions shall be given in the requisition. The equipment shall in all respects be suitable for operation in a saliferous and dusty atmosphere. The possibility of condensation on equipment surfaces shall be taken into account.

The generator set shall be suitable for unattended operation.

Unless otherwise specified in the requisition, the following conditions shall apply:

2.4.2 Seismic conditions

Generator sets for installation offshore shall be designed for shock accelerations of 20 m/s^2 whilst in operation, without interference to operation.

2.4.3 Hazardous areas

The Principal should install generator sets in a non-hazardous area. However, if the circumstances of the installation dictate that the installation will be in a hazardous area, it shall be stated in the requisition. All equipment in the package shall then be suitable for operation in the hazardous area.

See DEP 31.29.90.30-Gen. for gas engine fuel gas systems with respect to hazardous areas.

2.5 MATERIALS

All components shall be of a quality commensurate with the requirements of a secure power supply system. Component materials shall be flame retardant, and moisture and fungus resistant whenever practicable. Equipment destined for humid tropical environments shall be compatible with these environments.

2.6 SCOPE OF SUPPLY

The generator set shall, in general, consist of:

- engine complete with all necessary auxiliaries;
- synchronous AC generator complete with excitation equipment;
- combined baseplate;
- engine and generator control panel(s);
- all necessary noise and vibration suppression equipment;
- engine starting system;
- engine and generator cooling systems;
- lubrication system;
- combustion air intake system;
- exhaust system;
- engine fuel system;
- fuel day tank (diesel engines);
- couplings and guards;
- all necessary interconnecting pipe work and valves, including drain connections terminating at the edge of the baseplate;
- local gauge panel and instrumentation;
- all CTs and VTs (incl. those for installation in the switchboard).

The Packager shall advise in its tender any deviation from this DEP.

3. PERFORMANCE REQUIREMENTS

3.1 RATING

The generator set rating shall be 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, shall be deducted from the output rating. The generator set shall have a continuous power rating as stated on the requisition, at a power factor of 0.8 lagging.

3.2 NOISE

Noise control requirements in accordance with DEP 31.10.00.31-Gen. shall be adhered to. The Principal shall specify the noise limitations of the generator set, using data sheet DEP 31.10.00.94-Gen., which forms part of the requisition.

The Packager shall submit guaranteed sound power levels and sound pressure levels of the packaged unit, together with any other relevant information in accordance with DEP 31.10.00.94-Gen. The Packager shall indicate what special silencing measures, if any, are proposed in order to meet the specified levels.

3.3 TORSIONAL VIBRATIONS

The Packager shall perform a torsional vibration analysis. The necessary remedial measures shall be implemented in accordance with DEP 31.29.90.30-Gen. or DEP 31.29.80.30-Gen.

3.4 LATERAL VIBRATIONS

The lateral vibration severity of the complete generator set shall not exceed 4.5 mm/s RMS in accordance with ISO 10816-1, ISO 10816-5, and ISO 10816-6.

The vibration levels of individual auxiliary low voltage electric motors shall be in accordance with DEP 33.66.05.31-Gen.

4. ENGINE REQUIREMENTS

4.1 GENERAL

The requirements for the drive engine are given in DEP 31.29.80.30-Gen. (for diesel fuelled engines) and DEP 31.29.90.30-Gen. (for gas fuelled engines), as specified in the requisition. In general, the engine Supplier shall furnish the engine with all necessary auxiliaries and accessories for operation of the engine. This section describes the packaging requirements for installation of the engine. This section is intended for use in those cases where these auxiliaries and accessories are not mounted directly on the engine but require assembly by the Packager as part of his scope of work.

4.2 AIR INTAKE SYSTEM

If the engine Supplier supplies an air intake filter loose, the Packager shall provide the mounting for the air filter 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.

4.3 EXHAUST SYSTEM

If the engine Supplier supplies an exhaust silencer, the Packager shall provide the mounting for the silencer and all piping and ductwork between the silencer and the engine.

Exhaust ducting or piping shall be properly supported to prevent excessive strains being applied to the engine exhaust nozzle. Due consideration shall be paid to thermal expansion, and the expansion bellows provided by the engine Supplier shall be installed in the locations approved by the engine Supplier.

The orientation of the exhaust shall be agreed with the Principal, taking account of the location of adjacent equipment and the prevailing wind.

4.4 FUEL SYSTEM

Shutoff valves for fuel gas shall be supplied loose by the engine Supplier. These valves shall be installed in locations agreed with the Principal, taking account of the hazardous area classification. The routing and point of emission of all fuel gas vents shall not infringe the hazardous area classification.

4.5 COOLING SYSTEM

If the engine Supplier supplies engine and lube oil coolers loose, the Packager shall install them.

If the cooler location is remote from the engine, e.g., in the wall of an enclosure or free standing adjacent to the baseplate, the piping shall be installed by the Principal.

The orientation of the air flow from the cooling fan shall be away from the package. The Packager shall ensure continued adequate cooler performance when the wind is blowing directly against the cooler with a maximum wind velocity as stated in the requisition.

NOTE: If wind data are not available, a maximum velocity of 50 knots shall be assumed.

If a remotely located cooler has a fan that is mechanically driven from the engine, the Packager shall provide lineshafting and belt drive as necessary.