

GENERAL SPECIFICATION

ROTATING MACHINERY

GS EP MEC 022

Rotating Machine Package Specification Fire Fighting Diesel Driven Vertical Pump

02	10/2012	Update
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Rev.	Date	Purpose of the revision

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1. Scope

1.1 Purpose

This specification defines the minimum design, fabrication, inspection and testing requirements for the supply of the Fire Fighting Diesel Driven Vertical Pump Packages. It is an exhaustive document detailing the scope of supply and the associated design rules requested by TOTAL E&P for the procurement of Fire Fighting Diesel Driven Vertical Pump Packages.

1.2 Application

This document applies to the design of all Fire Fighting Diesel Driven Vertical Pump Packages. The vertical shaft centrifugal pump is driven by diesel engine through a right angle gearbox. It excludes any other type Fire Fighting Pump packages.

1.3 General rules

All deviations from this specification or the documents referred to herein shall be stated in writing in the Appendix 6 of this specification. In the absence of such a statement, it is assumed that the requirements of the specifications are met without exception. Failure to meet the requirements of this specification and referenced documents shall be corrected at Supplier's cost. Exceptions and deviations to the specifications shall be part of Supplier's proposal and will be subject to Company approval.

Where this specification, or any other project document, allows the Supplier to propose an "option", the Supplier shall clearly state the selected option in his bid.

In cases the Supplier provides outsourced equipment, he shall be responsible for the coordination of the Sub-suppliers, and ensuring the full compatibility of all the equipment. In particular, they shall be compatible in terms of safety, environment, operability, dimensions, weight, performance, control, noise and vibration behavior.

Components not mentioned in this specification that are necessary for the operation of the equipment or required by certifying agency, regulatory bodies or by law, shall be Supplier standard components.

The present document remains a General Specification as long as the modifiable forms are not completed. It becomes the Project Specification once these modifiable forms are completed and shall therefore not be considered as a General Specification any more. Then, the General Specification shall be attributed a Project reference number with the associated Project front page.

Preamble shall be completed with the Project description (location, number of machines, etc.).

If Project specificities require amendments to non modifiable parts of this specification or to the documents referred to herein, they shall be considered as deviations and stated in writing in the Appendix 6 of this specification.

This document may modify or complement some requirements of [NFPA 20](#), when deemed necessary in the light of Company experience.

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This specification will then be issued in two steps:

- Issued “for inquiry”
- Issued “for purchase”.

1.4 Order of precedence

The applicable documents shall be considered in the following order:

- Local regulations
- Classification Society Rules (If applicable)
- Frame agreement if available - Frame agreement: Applicable ☐ - Not applicable ☐
- This completed specification and associated data sheets
- Referenced General Specifications
- Referenced Project documents
- Codes and standards.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
1999/92/EEC (ATEX 118 ¹ /ATEX 137 ²)	European Directive 1999/92/EEC (16/12/99) on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
94/9/EC (ATEX 100a ¹ /ATEX 95 ²)	European Directive 94/9/EC (23/03/94) on the approximation of the laws of the Member State concerning equipment and protective systems intended for use in potentially explosive atmosphere
AGMA 6000 B96	Measurement of Linear Vibration on Gear Units
AGMA 6110 F97	Standard for Spur, Helical, Herringbone and Bevel Enclose Drives
API Std 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
ASME VIII Division 1	Boiler and Pressure Vessel Code

¹ Reference to Articles 100/118 of the Treaty of Rome

² Reference to Articles 95/137 of the Treaty of Amsterdam

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Reference	Title
ASTM D975-10b	Standard Specification for Diesel Fuel Oils.
DIN 55473	Auxiliary means of packaging - Desiccant in bag - Technical delivery conditions
EN 1834-1	Reciprocating internal combustion engines. Safety requirements for design and construction of engines for use in potentially explosive atmospheres - Part 1: Group II engines for use in flammable gas and vapour atmospheres
IP 15	Area Classification Code for Petroleum Installation handling flammable fluids - July 2005 (3 rd edition)
ISO 10816-6	Mechanical Vibration - Evaluation of machine vibration by measurements on non-rotating parts - Part 6: Reciprocating machines with power ratings above 100 kW
ISO 1940-1	Mechanical Vibration - Balance quality requirements for rotors in a constant (rigid) state - Part 1: Specification and verification of balance tolerances
ISO 3046 (Parts 1; 3)	Reciprocating internal combustion engines - Performances - (Parts 1; 3)
ISO 780	Packaging. Pictorial marking for handling of goods
NF H00-310	Industrial packaging. Flexible and heat sealing protection materials of low coefficient of water vapour transmission ($P < 0.3 \text{ g/m}^2 \text{ 24 h}$)
NF H00-320	Packaging. Desiccant. Specifications and tests
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection - 2010 Edition
US MIL D 3464E	Desiccants, activated, bagged, packaging use and static dehumidification
US MIL PRF 131K	Performance specification: barrier materials, watervaporproof, greaseproof, flexible, heat-sealable
US MIL-STD-2073-1 E	Standard practice for military packaging

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

TOTAL EP General Specification Referential is applicable for the following Project:

The following Company specifications are fully applicable to all purchased equipment as listed in paragraph 3.1 completed by the technical details reported in paragraph 4 and taken into account accepted deviations as listed in Appendix 6. The second level General Specifications

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mentioned in each individual specification are not applicable if they are not listed in the below tables. The standards, professional documents, regulations and codes mentioned in each General Specification are applicable.

The following list may also be complemented with other specific Project detailed specifications which would include additional requirements, as applicable or deemed necessary by Company or Contractor.

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 351	External protection of structures and equipment by painting. Floating structures
GS EP COR 353	Design and application of passive fire protection coatings
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP COR 356	Corrosion Protection of Fasteners for Subsea and Topsides Applications
GS EP ELE 011	Electrical requirements for packaged units
GS EP ELE 031	Design of earthing and bonding systems
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 111	Induction motors
GS EP ELE 161	Electrical cables
GS EP EXP 217	Requirements to Vendors, Suppliers and EPC'S for spare parts
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 102	Instrumentation identification
GS EP INS 107	Design and installation of instrumentation links
GS EP INS 110	Instrumentation for package units
GS EP INS 120	Control and Choke Valves
GS EP INS 135	Cyber Security requirements for design and supply of ICSS and Package Systems
GS EP INS 900	Instrument hook-up diagrams
GS EP MEC 101	Driver Power Sizing
GS EP MEC 271	Centrifugal Pumps for the Petroleum, Chemical and Gas Industry Services according to API Standard 610
GS EP MEC 292	Rotating Machines Packages Installation Requirements
GS EP MEC 300	Noise and Vibration of Rotating Machine Packages

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Reference	Title
GS EP PVV 102	Piping Hook-up Standards
GS EP PVV 112	Piping material class
GS EP PVV 143	Metallic pipes
GS EP PVV 144	Fittings
GS EP PVV 145	Flanges
GS EP PVV 175	Cleaning of piping and vessels
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII
GS EP PVV 614	Welding of duplex and superduplex stainless steel
GS EP SAF 050	Fire and Gas System and Fire Suppression System for Packaged Rotating Machinery Enclosures
GS EP STR 001	Weight monitoring and weighing offshore units
GS EP STR 103	Design and fabrication of skids and equipment supporting structures



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In case one of the previous General Specifications is completed with one or more Project specific detailed specification(s), then these detailed specifications (and their respective revision) shall be added to the following list.

Project Documents (to be completed by Company or Contractor)

	Designation	Rev	Reference
1	PID's (*)		
2	Layout (*)		
3	Project specification for electrical requirements for packaged units (*)		
4	Instrument tagging specification		
5	Instrument list database specification		

Note: All the documents identified by (*) shall be available along with this specification for the issue for inquiry and for purchase.

Project data sheets are listed in paragraph 5.

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3. Scope of supply and exclusions

3.1 Scope of supply

The Vendor shall be responsible for the design, supply of materials, manufacture, assembly, supply of drawings and data, all Sub-vendor co-ordination, testing, delivery and guarantees of the below components:

Note 1: The column "Required" indicates the level of requirement of each item, according to the below rule:

- "X" means that the item is a base case requirement.

-  means that the item is an optional requirement specific to the project. "Y" for YES if the option is selected or "N" for NO if the option is not selected.

Note 2: The column "Description" may offer alternative technical choices that shall be fixed prior to the issue "For inquiry" by ticking the appropriate mark box ☒.

#	Item	Description	Required	Tag	Quantity
1	ON SKID EQUIPMENT				
1.1	Driven pump including but not limited to:				
1.1.1	Submerged Lift Pump	As per GS EP MEC 271 and as per data sheet referenced in paragraph 5 of this specification.	X		
1.2	Diesel engine and accessories as per ISO 3046 and GS EP MEC 101 including but not limited to:				
1.2.1	Diesel engine	As per ISO 3046 and GS EP MEC 101 , paragraph 4.7 and data sheet DS EP MEC 140 in Appendix 7 of this specification.	X		
1.2.2	Starting systems	Two separated independent starting systems per Package as per paragraph 4.7.2.1 of this specification.	X		
1.2.3	Cooling system	Engine mounted cooling system as per paragraph 4.7.3 of this specification.	X		
1.2.4	Lube oil pre/ post circulation system	Engine mounted lube oil pre/ post system as per data sheet referenced in paragraph 5 of this specification.	X		
1.2.5	Flexible mounts	Diesel engine flexible mounts.	X		
1.2.6	Local gauge board	Diesel engine mounted local gauge board made of AISI 316/316L stainless steel.	Option		
1.3	Liquid fuel system including but not limited to:				
1.3.1	Fuel Tank	Fuel tank in AISI 316L material as per paragraph 4.7.4.3 of this specification.	X		
1.3.2	Automatic filling	Automatic filling system with all necessary auxiliaries.	X		
1.3.3	Heat exchangers	Including but not limited to piping, heat exchangers, expansion tanks HT and LT for cooling system.	X		
1.3.4	Main fuel filters	Dual filters with changeover valves including pressure transmitters.	X		

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#	Item	Description	Required	Tag	Quantity
1.3.5	Pre fuel filters	Dual filters with changeover valves including differential pressure transmitter and water level alarm.	X		
1.3.6	Liquid fuel shutoff valve	As per paragraph 4.7.4.5 of this specification.	X		
1.4	Combustion air system including but not limited to:				
1.4.1	Air shutoff flaps	Air shutoff flaps engine mounted.	X		
1.4.2	Air inlet filter	Air inlet filter including ducting as per paragraph 4.5.1.3 of this specification.	X		
1.5	Exhaust gas system including but not limited to:				
1.5.1	Exhaust silencer	AISI 316 exhaust silencer as per paragraph 4.7.7 of this specification.	X		
1.5.2	Exhaust Ducting	AISI 316 exhaust ducting as per paragraph 4.7.7 of this specification.	X		
1.5.3	Spark arrestor	Spark arrestor in AISI 316L.	X		
1.5.4	Exhaust thermal insulation and sheeting	As per paragraph 4.7.7 of this specification.	Option		
1.5.5	Auxiliaries for gas tight exhaust system	Exhaust system gas tight as per Project requirements.	Option		
1.5.6	Exhaust pipe downstream silencer	Exhaust pipe downstream silencer in AISI 316L and drain system for vertical stack installation.	Option		
1.5.7	Platform and ladders	All necessary access platforms, ladders, roof handrail grating and access way for easy and safe maintenance on the enclosure roof for all above equipment and associated fixation.	Option		
1.6	Power transmission equipment including but not limited to:				
1.6.1	Right angle gearbox	As per paragraph 4.4.13 of this specification.	X		
1.6.2	Spacer type coupling	As per paragraph 4.4.15 of this specification.	X		
1.6.3	Coupling guard	As per paragraph 4.4.15 of this specification.	X		
1.7	Enclosure including but not limited to:				
1.7.1	Acoustic and fire resistant enclosure frame	As per paragraph 4.5.1 of this specification.	Option		
1.7.2	Enclosure air ventilation system	As per paragraph 4.5.1.3 of this specification.	Option		
1.7.3	Enclosure fire and gas detection system	UV/ IR flame detectors, gas detectors, heat detectors as per GS EP SAF 050 .	Option		
1.7.4	Enclosure fire fighting system	As per GS EP SAF 050 .  Water mist  CO ₂	Option		
1.7.5	Handling inside enclosure	Monorail and associated hoist inside enclosure.	Option		
1.7.6	Engine slide out arrangement	Internal arrangement and necessary tools for pulling off engine through opening in enclosure sidewall.	Option		
1.7.7	Enclosure lighting systems	Normal and emergency lighting systems as per paragraph 4.9.4 of this specification.	Option		

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#	Item	Description	Required	Tag	Quantity
1.8	Base plate including but not limited to:				
1.8.1	Fabricated steel common base plate	As per paragraph 4.6.1 of this specification.	X		
1.9	Control and instrumentation including but not limited to:				
1.9.1	UCP	As per GS EP INS 110 and paragraph 4.10.2 of this specification. UCP is including PLC, panel mounted HMI.	X		
1.9.2	ICSS interface	Communication cards, relays, signal convertors, etc. to interface with ICSS and support systems.	X		
1.9.3	FGS system requirement	SIL2 Fire and Gas PLC system integrated in package UCP.	X		
1.9.4	FGS system integrated	Control and monitoring of package fire extinguishing system integrated in UCP Fire and Gas PLC.	Option		
1.9.5	Junction boxes	All terminal junction boxes located at skid edge as per GS EP INS 101 and GS EP INS 107 .	X		
1.9.6	Cable glands	Cable glands for departing multi-core cables, defined by Project and blinded off suitably for transport and storage. In case the option is not selected, the gland plates shall be pre-drilled and blinded off.	Option		
		For all other cables, junction boxes shall be provided with cable gland plates and associated cable glands.	X		
1.9.7	Instrumentation cables	All instruments cables between instruments and skid mounted terminal junction boxes / local gauge board/ UCP as per GS EP ELE 161 and GS EP INS 107 .	X		
1.9.8	Instruments cables trays	All necessary cables trays with covers made of AISI 316L between instruments and skid mounted junction boxes as per GS EP INS 107 . Empty cable trays shall be installed for the departing multi-core cables -supplied and installed by others- between the terminal junction boxes and the skid edge.	X		
1.10	Electrical including but not limited to:				
1.10.1	MCC	Skid mounted MCC for all electrical motors and consumers mounted on skid.	Option		
1.10.2	Batteries	Batteries installed in protective box as per paragraph 4.9.2 of this specification.	X		
1.10.3	Battery charger	As per paragraph 4.9.2 of this specification.	X		
1.10.4	Electrical cables	As per GS EP ELE 161 , between the MCC and the electrical consumers mounted on skid.	Option		
1.10.5	Electrical cables trays	All necessary cables trays with covers made of AISI 316 between all electrical consumers mounted on skid and the skid edge.	Option		
1.10.6	Cable glands	All electrical equipment shall be provided with cable glands.	X		
2	OFF SKID EQUIPMENT (shipped loose)				
2.1	Mini flow recirculation valve	As per paragraph 4.3.2 and GS EP PVV 112 or Project Piping class. D-2 super duplex material code	X		

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#	Item	Description	Required	Tag	Quantity
2.2	Automatic air release valve	As per paragraph 4.4.1 of this specification. D-2 material.	Option		
2.3	Interconnecting Extinguishing piping	Piping between fire fighting cabinet and module in SS316L material.	Option		
2.4	Flame arrestors	As per paragraph 4.16.4 of this specification.	X		
2.5	Pressure transmitter	Pressure transmitter located downstream minimum flow recirculation valve.	Option		
2.6	Special tools	Refer to paragraph 8.2 of this specification.	X		
2.7	Spare parts for commissioning and start-up	Refer to paragraph 8.1.1 of this specification.	X		
2.8	Capital spare parts	Refer to paragraph 8.1.2 of this specification.	X		
2.9	Anodes	Set of sacrificial anodes for submerged pump and pipe stack (if any), 5 years lifetime duration.	X		
3	MISCELLANEOUS				
3.1	Base plate anchor bolts and shims	As per Appendix 3 of this specification.	X		
3.2	Off skid equipment anchors and shims	All anchors and shims for all off skid equipment supplied by SUPPLIER.	X		
3.3	Grating arrangement	Hot dip galvanized carbon steel grating.	X		
3.4	Maintenance laptop	Including software for UCP configuration.	Option		
3.5	Lube oil system flushing kit	Kit made of all necessary flexible hoses for machinery bearings bypass.	Option		
3.6	Inflation kit	Inflation kit for accumulators nitrogen charging.	Option		
3.7	Lifting tools for the complete package	Consists of slings, shackles, and spreader bar as per paragraph 4.16.5 of this specification and as per GS EP STR 103 .	X		
3.8	Battery limit flanges	All limit flanges as per GS EP PVV 112 or project piping classes if available and equipped with blind flanges for transportation.	X		
3.9	Documentation	Set of documents as per Appendix 4 of this specification.	X		
3.10	Package 3D model review	Review of the package 3D models for maintenance areas review.	X		
3.11	Earthing network	Earthing design and implementation as per GS EP ELE 031 and GS EP INS 107 .	X		
3.12	Package packing, marking and preservation	As per paragraph 9 of this specification.	X		
3.13	Painting and coating	As per paragraph 4.14 of this specification.	X		
3.14	Personal protection	As per paragraph 4.15 of this specification.	X		
3.15	Backup	Complete backup hard disk with application software, PLC program, HMI and any firmware prior to shipment.	X		
3.16	Software	OEM CD/ DVD for any software used with full licenses.	X		

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#	Item	Description			Required	Tag	Quantity
3.17	Specific climate considerations	☐ Tropicalization	☐ Winterization	☐ None	X		
4	TESTS						
4.1	Factory tests						
4.1.1	Diesel Engine	As per paragraph 7 of this specification.			X		
4.1.2	Submerged lift pump	As per paragraph 7 of this specification.			X		
4.1.3	Right angle gear	As per paragraph 7 of this specification.			X		
4.1.4	Auxiliaries	As per paragraph 7 of this specification.			X		
4.1.5	UCP	UCP integration and communication test at Sub-vendor premises as per paragraph 7 of this specification and paragraph 7.4 and Appendix 5 of GS EP INS 110 .			X		
4.1.6	Complete unit tests	As per paragraph 7.2.7 of this specification.			X		
4.1.7	Noise and vibration test	As per paragraph 7 of this specification.			X		
4.2	Site Acceptance Tests						
4.2.1	Complete unit tests	As per paragraph 7.2.9 of this specification.			X		
4.2.2	Fire suppression system test	As per paragraph 3.5.2 of GS EP SAF 050 .			X		

Vendor shall be responsible for the physical and technical compatibility of the entire package and shall ensure that all equipment and components provided are suitable for the operations intended.

3.2 Exclusions

The following equipment are not included in the scope of supply:

- Counter flanges, gaskets and bolting for connecting flanges at battery limits of Vendor's supply
- All piping outside the package except when specified here above
- Electric and instrument cables outside the package
- All earthing cables outside the package.

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4. Basis of design

This paragraph details the technical specificities of _____ project that are not covered in the Company General Specifications nor in the Project documents.

4.1 General considerations / safety and environment

The complete package shall be designed for _____ years of operation at least.

Environmental conditions for the equipment design are indicated in the paragraph 6 of this specification.

When packages have to be installed in hazardous area zone 2, as per [IP 15](#), they shall be specified for gas group IIA and temperature class T3 (200°C) and [ATEX European directives 94/9/EC](#) and [1999/92/EEC](#) shall be applied.

In this case, packages shall be certified ATEX **Ex** II 3G and CE marked with the following requirements:

- Any diesel engine shall be selected in accordance with [EN 1834-1](#), certified ATEX **Ex** II 3G and CE marked
- Unit Control Panel shall be ATEX **Ex** II 3G and CE marked
- Any instrumentation component shall be certified ATEX **Ex** II 2G and CE marked. For facilities located outside the European Union (EU countries), alternative IECEx scheme can be applied (IEC Scheme for Certification relating to Equipment for use in Explosive Atmospheres)
- Any electrical component shall be selected in accordance with [GS EP ELE 079](#)
- Any mechanical component certified ATEX **Ex** II 3G and CE marked.

Any equipment or system required to be left in operation when a safe or a hazardous area zone 2 becomes a hazardous area zone 1 (such as presence of gas, ventilation failure, etc.) shall be certified ATEX **Ex** II 2G and CE marked.

Package and all accessories shall bear their own marking, according to the mode of protection used.

The package enclosure (when required) will be as follows:

- Classified as safe area when pressurization and ventilation are in operation with no presence of gas.
- Classified as Zone 1 area category 2G as per ATEX Directives upon ventilation failure and gas detection.

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However, the following equipment and systems shall be certified ATEX **Ex II 2G** and CE marked:

- Unit enclosure ventilation systems
- Fire and gas detection and monitoring systems
- Fire dampers with associated power supply distribution panels
- Fire suppression system
- Emergency lightings.

4.2 Package design

The design of Fire Fighting Diesel Driven Vertical Pump Package shall include provision for full replacement / component replacement with minimum disruption to plant operations.

Only high integrity and proven equipment shall be considered. Prototype equipment and components shall not be used.

The fire fighting pump package may be run continuously for long periods during the construction and the commissioning phases and also capable of intermittent duty (1 hour per week).

4.2.1 Fixed structures

For Fire Fighting pump applications in fixed structures where the total riser column length does not exceed 15 m, long-shaft vertical suspended pumps and pumps driven by a submerged electrical or hydraulic motor shall be accepted.

For applications where the total riser column length exceeds 15 m, this specification is not applicable and long-shaft vertical pumps are not allowed.

4.2.2 Floating structures

This specification is not applicable for Floaters. Only submerged electrical or hydraulic motor driven pumps shall be accepted.

The Fire Fighting Diesel Driven Vertical Pump Package data sheets will specify whether the fire fighting pump package is to be installed in a fire pump room supplied by others or in a dedicated enclosure furnished by the Vendor.

4.2.3 Tropicalization

For pumps and equipment installed and operated in tropical conditions, special design considerations shall be taken for ventilation systems, air and cooling systems, material choices, surface treatment etc and shall be based on environmental conditions such as air humidity, air temperature, air temperature variations, surface temperature, cooling water design temperature.

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4.2.4 Winterization

For Fire Fighting Diesel Driven Vertical Pump Package installed in arctic or in extremely low temperature areas, following measures shall be taken to secure the equipment:

- All seawater in the cooling water system shall be automatically drained during standby
- Riser pipe sections installed below sea level shall be thermally insulated, heated to avoid stagnant water and freezing in the riser pipe sections and submerged pump
- Diesel tank heater to maintain adequate fuel viscosity
- Thermostatically controlled heater and circulation pump shall be installed to preheat charge air cooler on diesel engine to ensure sufficient temperature in cylinders to start combustion
- Measures to avoid freezing of air inlet louvers (de-icing heaters, heat tracing, snow cowls etc.) shall be taken if deemed necessary
- Measures to facilitate cold restart of Fire Fighting Diesel Driven Vertical Pump Package after a period of complete blackout of all systems shall be taken.

4.3 Shafts speed

Pumps maximum operating speed shall be as follows:

Pump Power Rating	< 200 kW	> 200 kW
Submerged Vertical pump	3000 RPM	1500 RPM

Drivers maximum operating speed shall be as follows:

Driver Power Rating	< 200 kW	> 200 kW
Diesel Engine	3600 RPM Subject to Company approval	1800 RPM

For submerged vertical pumps, riser pipe sections and pump hydraulics will be delivered loose for field reassembly by Contractor under the responsibility of the Vendor.

4.3.1 Submerged lift pump

4.3.1.1 Pump unit

Static submergence shall be as specified in the data sheet **GS EP MEC 271**. NPSHr shall be at least 1 m less than NPSHa for all flow conditions between minimum and maximum flow rates. Pump discharge head elevation shall be as specified on the data sheet **GS EP MEC 271**.

4.3.1.2 Column riser sections

A riser pipe length of up to six (6) meters is preferred providing necessary space for maintenance purpose. Three (3) meters riser pipe length could be considered as an alternative.

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Riser pipes shall be equipped with Aluminum Anodes designed for minimum 5 years lifetime.

4.3.1.3 Caisson

Submerged pump shall be installed in a dedicated caisson provided by other.

4.3.1.4 Anti fouling

The Vendor shall provide anti-fouling dosing system at the vertical pump suction strainer within the caisson. Single flanged connection on the top plate and bottom injector shall be in titanium material.

4.3.2 Minimum flow protection

Each Fire Fighting Diesel Driven Vertical Pump Package shall be provided with a “self-controlled combined check and minimum flow recirculation valve” type Schroeder or Schroedahl. The valve shall be provided shipped loose for vertical installation. Dump and ring main pipes shall be upward routed in such a way that minimum flow recirculation valve is always kept water filled. A small bore bypass line across this minimum flow recirculation valve shall be installed in order to water fill the section between the minimum flow recirculation valve and the main check valve.

Other alternative like self controlled valve or pneumatic operated control valve may be proposed for fixed structures but subject to Company approval.

4.3.3 Surge protection

The pump shall start against a restricted air release / vent line normally routed to overboard by Contractor. If deemed necessary, an anti-surge tank shall be installed at the pump outlet, upstream the discharge check valve, to provide damping of water hammer.

4.4 Comments and/or additions to NFPA 20

Following are the comments and/or additions to the corresponding paragraph numbers of NFPA 20:

4.4.1 NFPA 20 - paragraph 4.8 - Centrifugal fire pump capacities

The fire fighting pump package duty is given in the data sheets. Individual capacity shall not exceed 2800 m³/h. The fire fighting pump package capacity shall additionally include any cooling water requirements of the diesel engine driver, gear cooling etc. The additional capacity shall be determined by the Vendor.

4.4.2 NFPA 20 - paragraph 6 - Centrifugal pumps

The pump design, construction and testing shall meet the requirements of NFPA 20 and API Std 610 as supplemented by this specification and the equipment data sheets listed in paragraph 5 of this specification.

All Fire Fighting Diesel Driven Vertical Pumps shall be suitable for parallel operation even if normal operation does not require all fire pumps running in parallel.

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4.4.3 NFPA 20 - paragraph 7- Vertical shaft turbine

Vertically mounted pump shall be radially split, multi-stage bowl assembly and speed shall not exceed 1500 rpm for rating power higher than 200 kW.

4.4.4 NFPA 20 - paragraph 7.1.2 - Characteristics

According to NFPA 20 paragraphs 7.1.2.1 and 7.1.2.2, Fire Fighting Diesel Driven Vertical Pump shall have a stable head / capacity curve rising continuously to shut-off. The head at shut-off shall not exceed 140% of the head at the rated capacity.

Fire fighting pump shall provide not less than 150% of the rated capacity at a total head of not less than 65% of the head at the rated capacity.

Submergence requirements to satisfy NPSH margin requirements shall be determined at the NFPA 20 150% flow case.

4.4.5 NFPA 20 - paragraph 7.3 - Pump

Fire Fighting Diesel Driven Vertical Pump materials shall be as specified in the equipment data sheets listed in paragraph 5 of this specification.

Guidance for the selection of the pump materials shall be as follow:

- For seawater application, pump materials and wetted parts shall be selected according to API Std 610 Table H1, material class D-2.
- For fresh water application, pump materials shall be selected according to API Std 610 Table H1, S6 minimum.

In his proposal, Vendor shall clearly identify selected materials for all parts of the pump unit, with reference to Company approved standards including the material grade as per ASTM or equivalent.

4.4.6 API Std 610 - Section 8.3 - Vertically suspended pumps

Vertically suspended pumps shall apply with the following comments:

- API Std 610 - Paragraph 8.3.1.1: Specified discharge pressure shall be at pump unit discharge connection. Hydraulic performance shall be corrected for column static and friction head losses. Bowl or pump casing performance curves shall be furnished with the correction indicated.
- API Std 610 - Paragraph 8.3.3: Impellers and line shaft couplings shall be dynamically balanced to ISO 1940-1 Grade G2.5 and balance certificates must be provided.

The fire fighting pump shaft line shall be suitably sized to transmit the maximum torque required under any operating conditions and to withstand continuously all stresses resulting from supported weights, thrusts, and starting sequences.

The fire fighting pump bowl shaft shall be of one piece.

- API Std 610 - Paragraph 8.3.5: For 400 m³/h flow pumps and above, the Vendor shall carry out a dynamic study of the whole discharge column, pump and shaft to determine the natural frequencies and associated modes under the following conditions: fixed on top

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(stiffness 10^{-7} m/N), free at bottom, pump and column filled with water, both at design bearing clearances and at twice design bearing clearances.

The Vendor must specify:

- The design assumptions and method
- Field experience references in this range
- The tolerance on these calculated frequencies.
- [API Std 610](#) - Paragraph 8.3.6.1: Bearings bush shall be non metallic, seawater lubricated and shall have a dry running capability sufficient to cater for most adverse fire fighting pump start-up conditions.

Distances between column bearings shall comply with figure 32 of [API Std 610](#). This requirement is applicable for all pumps size, regardless of flow.

The Vendor shall advise in his bid the bearing materials proposed and the dry running time limitations.

4.4.7 [NFPA 20](#) - paragraph 7.3.2 - Column

Supplier shall ensure that the pump will be installed in the riser with sufficient clearance to avoid stress in the column. In addition the riser shall be considered to have a vertical offset of 5/1000.

The fire fighting pump discharge column shall be supplied in flanged sections. Section lengths shall be optimized for ease of handling, available headroom for dismantling purpose and shaft dynamics considerations.

The method of dismantling and reassembly of the discharge column shall be discussed with Contractor at design stage such that the optimum section length can be established.

The fire fighting pump discharge head shall be designed to accommodate the forces and moments specified elsewhere by the Contractor.

4.4.8 [NFPA 20](#) - paragraph 7.3.2.2

The Supplier shall provide parallelism and concentricity control reports for all column flange faces and bearings supports.

4.4.9 [NFPA 20](#) - paragraph 7.3.4 - Suction strainer

The Vendor shall furnish a coarse mesh strainer meeting the requirements of [NFPA 20](#) clause 7.3.4. Material shall be selected in super duplex D-2.

4.4.10 [NFPA 20](#) - paragraph 7.3.5.2 - Automatic air release

Submersible pumps installed in a pump caisson shall be fitted with an Automatic Air Release valve (AAR). The AAR valve can be either installed inside the enclosure directly mounted on the surge tank or tied onto the discharge of vertical pump, immediately upstream of the check valve and the minimum flow connection.

The AAR valve shall be sized according to [NFPA 20](#) paragraph 7.3.5.2.

The AAR valve shall be made of super duplex D-2 material code for sea water service for offshore applications.

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4.4.11 Bolting

To facilitate dismantling and maintenance, internal and external bolting shall be fully resistant to the fluid pumped. Bolting material including the material grade as per ASTM shall be specified in the proposal.

4.4.12 Pump Mechanical seals

The shaft sealing on pump head shall be ensured by means of a stuffing box. The packing material shall be compatible with sea water.

The shaft shall be sleeved. The permanent leak shall be drained to the riser. A sea water flush for the seal, taken from the fire fighting pump discharge and returned to the fire fighting pump caisson could be proposed.

Ample space shall be provided for replacement of the packing so as to minimize any removing or dismantling.

4.4.13 NFPA 20 - paragraph 7.5.1.7 - Gear drives

Power could be transmitted from the diesel engine to the vertical fire fighting pump by means of a right-angle gear unit. Right angle gears shall have a hunting tooth ratio.

Right angle gears shall be of hollow shaft type to permit the fire fighting pump thrust bearing to be located in the top of the gear unit.

Gear units shall be totally enclosed and comply with [AGMA 6110 F97](#).

They shall be manufactured and assembled to meet the [AGMA](#) quality number of 12 minimum.

Gears shall be rated for the driver rated power with an [AGMA](#) service factor of not less than 2.0.

The right angle gears oil shall be cooled with a pumped water/oil exchanger of exactly the same design as that of the engine. It shall be independent of the right angle gears to permit its changeover, if necessary.

Pressurized oil system achieved by a mechanical shaft driven oil gear pump shall be provided.

Right angle gears bearing housing shall be designed with 3/8" NPT stud mounting flat surface for vibration monitoring purpose in accordance with the [API Std 670](#) Appendix C guidelines.

These flat surfaces shall be an integral part of the right angle gears casing and shall be located to measure the vibrations in the 3 directions on both shafts.

Gear and pinion teeth shall be finished by grinding.

4.4.14 Gear drive accessories

The right angle gears shall be provided with:

- Lifting eyes or lugs
- An anti-reverse rotation ratchet wheel
- Casing oil level glass
- Filling / topping-up connection
- A valved and plugged casing oil drain connection

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- Gear unit oil pressure and temperature shall be instrumented and alarmed
- Water oil cooler.

4.4.15 NFPA 20 - paragraph 7.5.1.8 - Couplings and coupling guards

All flexible couplings shall be provided with spacer positively constrained from flying out if failure of flexible elements occurs. They shall not require continuous lubrication. Shafts and couplings shall be capable of withstanding 120% of the maximum possible torque that can be generated by driver at start up without exceeding allowable yield stress of any components.

Universal joint transmissions are acceptable for operating speed below 1500 RPM.

A double-universal joint (Cardan) shaft could be installed between the engine and gear unit. The Vendor shall provide details in his bid of the couplings provided between the engine and Cardan shaft and between the Cardan shaft and gear unit.

Power transmissions shall be balanced to G 6.3 according to [ISO 1940-1](#) and balance certificates must be provided.

All moving parts shall be protected from human contact by suitable guards made in non-sparking material. Aluminum and stainless steel are not considered as a non-sparking material.

4.5 Equipment protection

4.5.1 Enclosure

Acoustic enclosure shall be provided if required to comply with the specified environment conditions and noise requirements. The enclosure shall be made of painted carbon steel or SS316 if Project duration life is higher than 20 years. The internal perforated liners shall be made of AISI 316L stainless steel.

The enclosure shall include side doors and removable panels to allow equipment maintenance and removal. Hinges, rod assemblies and door handles shall be of heavy duty type and made of AISI 316L stainless steel. Doors shall be fitted with anti-panic handles on the inside.

Provision inside the enclosure shall be done for diesel engine removal by side away pulling through removable enclosure panel.

Certified travelling hoist and lifting lugs as required for lighter maintenance shall be provided inside the enclosure.

4.5.1.1 Fire rating

The enclosure shall be designed to fulfill requirements for fire rating specified in paragraph 6.1 of this specification. This may be achieved with external spray-on passive fire protection, internal fire rated insulation or a combination of both.

4.5.1.2 Design loads

The enclosure shall be designed to withstand environmental loads, including blast load as described in paragraph 6.1 of this specification.

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4.5.1.3 Air ventilation system/ air combustion intake

If the Fire Fighting Diesel Driven Vertical Pump Package is located in hazardous area, the diesel engine shall be installed in an enclosure protected by internal ventilation.

Enclosure internal ventilation shall be designed to:

- Provide temperature control to ensure the intended operation of equipment is achieved
- Control hazardous zones and promote the dilution of flammable gas, vapour and mist leaks.

The Vendor shall source the air combustion and the inlet ventilation ducting system in AISI 316L for fresh air intakes to enclosure with following main features:

- Fresh air intakes to enclosure shall be located in a safe area, at least 2 meters away from a hazardous area
- The location of the air filter intake shall not be less than 2 meters above local ground level to prevent from ingress of swirling dust, insects, etc.
- Enclosure Ventilation air outlet shall be located 5 meters at least from any machinery combustion air exhaust termination

The Vendor shall provide a complete air intake system as following:

- Air inlet filter designed to meet diesel engine Manufacturer requirements. Filter shall be equipped with weather louvers and coalescer to prevent rain ingress
- Filter differential pressure gauge
- If installed in hazardous area, provisions for a gas detector shall be included in the inlet ducting
- A silencer shall be installed in the inlet ducting if required to meet external noise requirements
- Flexible joints between ducting and engine
- Emergency over-speed shut-down flaps with fully closed and open limit switches and manual reset facilities
- If installed in hazardous area, the combustion air ducting upstream the filter unit shall be ducted to safe area location and provided with a weather louver at the inlet.

Stainless steel grade AISI 316L shall be used for ducting upstream flaps. The air inlet system downstream the flaps shall be designed to withstand complete vacuum.

Enclosure internal ventilation shall be insured by a main ventilation system backed up by a standby ventilation system. Ventilation of the enclosure shall be achieved by a fan powered from an engine power take off through either a mechanical or electrical transmission as per **GS EP ELE 111**. Driven ventilation fans shall be in 2 x 100% duty.

Enclosure ventilation system shall be designed to limit the enclosure internal temperature to a temperature compatible with electronic devices within the enclosure and outlet air temperature to the rated site temperature plus 15°C at the rated engine power.

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Pneumatically operated fire dampers shall be installed on both inlet and outlet connections. The fire dampers shall have limit switches and shall be designed for direct and remote actuation via the F&G system.

If the Fire Fighting Diesel Driven Vertical Pump Package is located in hazardous area, the ventilation outlet shall have a pressure control damper installed to maintain a constant overpressure of 50 Pa.

4.5.1.4 Module cooling

The enclosure shall be equipped with an internal independent cooling system to maintain an acceptable room temperature in cases where the ventilation system is shut down due to external fire or gas detection.

4.6 Package configuration

Whatever the type of supporting structure is concrete or offshore structure, package base plate shall be multipoint rigid design with jacking bolts for leveling purpose.

Supporting shall comply with the requirements of **GS EP MEC 300** and **GS EP STR 103**.

Vendor shall provide matched loose soleplates intended for welding to structure on deck, and set of necessary SS316 shims for alignment of package in compliance with Appendix 3 of this specification.

Contractor shall install and weld the sole plates on all packages in accordance with the Project specifications, if any, and Vendor requirements.

The supporting structure shall be machined prior to welding soleplates.

4.6.1 Base plate construction details

Package base plate shall be in carbon steel material and coated as per **GS EP COR 350**. It shall be multipoint rigid design with jacking bolts for leveling purpose. Package base plate design shall conform to **GS EP STR 103** to maintain alignment of the machinery under all operating conditions whether normal, transient and abnormal.

Package base plate shall be designed with either:

- A non slip decking steel plate covering the top of the base plate and a drip pan and gutter all around with 2 drains points of 2" diameter minimum
- or
- Grating covering the top of the base plate and a steel plate continuously welded at the bottom of base plate recovering any oil spill and drain points of 2" diameter minimum.

All the equipment supported by the skid shall be contained within the skid projection footprint (meaning that no equipment overhung/projection outside the skid footprint is allowed).

The base plate shall incorporate a drip pan to collect spillage from the engine and its accessories. The design of the drain pan and the location of the drain openings shall ensure complete drainage under the most adverse floating vessel motions.

Baseplate structural welds shall be continuous and closed.

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If part of an enclosed package, the baseplate shall be insulated to fulfill applicable requirements for fire rating and/or noise emission from package as specified in the paragraph 6.1 in this specification.

Baseplate design and its anchor bolting shall take into consideration requirements for blast load as listed in paragraph 6.1 of this specification.

4.6.2 Base plate drains

All drains which are an interface between the Vendor and Contractor shall be routed to the skid edge and shall terminate by 2" ANSI 150 # RF flanges fitted with a blind flange.

The drains shall be routed to plant hazardous open drain by the Contractor

4.7 Diesel engine

Engine rating shall be as per **GS EP MEC 101**, **NFPA 20**, section 11.2.2 requirements, in accordance with **ISO 3046-1**, ICFN rating.

The Vendor shall provide details of engine rating calculation in his proposal.

When installed in hazardous area zone 2, the diesel engine shall be ATEX Category 3 certified, designed for T3 surface temperature.

4.7.1 Engine heater

Vendor shall provide electric heating and pre/post circulation for the diesel engine cooling water so that, on start-up, the diesel engine can immediately run safely under full load.

Heaters shall be powered from the unit control panel, be thermostatically controlled and be de-energized when the engine starts.

4.7.2 Starting systems

Diesel engine shall be provided with two distinct starting systems completely independent of the plant support facilities:

4.7.2.1 Main starting system

a) **Electric starting** if chosen shall be in accordance with **NFPA 20** section 11.2.7.2, and the following additional requirements:

- Nickel Cadmium batteries
- Battery banks shall be installed in SS 316 battery racks with removable protective covers made of glass reinforced plastic
- Two battery chargers powered from the control panel
- Manual start-up facility by-passing the driver controller
- Electric starters shall be 24 Volts DC pre-engaged pinion type. Electric start systems shall include load disconnect circuit breaker.

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b) **Air starting** shall be selected when Fire Fighting Diesel Driven Vertical Pump packages are installed in hazardous area zone 2 and will be in accordance with [NFPA 20](#) section 11.2.7.4 and the following additional requirements:

The air starter shall be rotor type starter motor. The air start device shall include:

- Compressed air vessel(s) located in the mainframe, sized according to [NFPA 20](#) paragraph 11.2.7.4.4.1, i.e. "180 seconds of continuous cranking without recharging". These vessel(s) shall be easily accessible and removable, designed and built in accordance with the [ASME VIII](#)
- Non return valve(s) on the air vessel
- Pressure transmitter on the air vessel
- Vessel pressure gauge
- Compressed air amplifier fed by the instrument air system at 7 barg
- Manual push button on the solenoid valve
- Air pressure reducing valve designed to feed the starter with the correct pressure and flow if necessary.

4.7.2.2 Back up starting system

Engine shall be provided with a hydraulic back-up start system as per [NFPA 20](#) paragraph 11.2.7.3 requirements consisting of:

- An hydraulic motor starter
- Hydraulic storage bottle(s) sized according to [NFPA 20](#) paragraph 11.2.7.3.5 (5), but as this hydraulic starting system is a backup system, bottles capacity shall allow three cranking cycles of not less than 5 seconds each. These bottles shall be easily accessible and removable, designed and built in accordance with the [ASME VIII](#)
- Electric motor or pneumatic driven pump to permanently pressurize the storage bottle(s) with the powering fluid (diesel engine driven pump is not allowed)
- Manual pump to pressurize the storage bottle(s)
- Safety devices and associated instrumentation to safely operate and monitor the system
- Manual starting facility by-passing the driver controller.

Both systems shall be installed on the diesel engine base plate and shall be arranged to facilitate ease of maintenance.

When required by Vendor, the diesel engine shall be provided with starting aids such as pre-lube system and water jackets heaters or other devices to ensure safe and reliable start-up.

4.7.3 Cooling system

Diesel engine cooling system shall be based on closed treated water cooling system and either an air cooler or a water to water heat exchanger.

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When the pump unit is installed offshore, treated water to sea water heat exchanger shall be provided and the sea water shall:

- Be fed from the firewater pump discharge as per Appendix 2
- Be delivered to the various users through a Y type strainer
- Return to the pump caisson or a separate overboard dump caisson.

Each user branch shall be provided with restrictive orifice for field flow and pressure adjustment purpose.

Cooling piping system shall be rigid. Flexible parts shall be limited to join static and moving equipment and shall be as short as possible. Piping between pump and engine exchanger shall be made of duplex stainless steel.

Expansion cooling tank shall be provided with low alarm level, relief valves, valved drain and filling connections.

Low points and high points in the coolant circuit shall be fitted with a drain valve or a vent valve, as appropriate.

4.7.4 Diesel fuel system

4.7.4.1 Fuel quality

The engine shall be capable of operation on diesel fuel oil - [ASTM D975-10b](#), Gr 2-D. Supplier shall advise the maximum allowable quantity and size of solids and water in the fuel oil upstream of the engine-mounted filters.

4.7.4.2 Fuel supply pumps and filtration

The fuel supply and filtration system shall include at least the following:

- Water coalescer separator with drain valves and vent valves
- Engine-driven fuel supply pump
- Fuel filters with a differential pressure indicator, drain valves and vent valves
- Manual fuel priming pump.

Dual fuel filters with a change-over valve shall be supplied.

Fuel spill-back shall be routed to the fuel day tank. If recommended by the engine manufacturer a fuel return cooler shall be installed.

4.7.4.3 Diesel fuel day tank

The diesel fuel shall be fed from a day tank. For Fire Fighting Diesel Pump package supplied in enclosure, the day tank shall be located within the enclosure and mounted on the pump unit base-plate, the elevation being such that the maximum permissible static pressure head at the diesel engine is not exceeded.

The day tank shall be sized for 12 hours (18 hours for Floater application) continuous running based on the engine driver consumption at its rated power, after the low alarm level is reached.

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The tank shall be made of stainless steel AISI 316L.

The day tank shall be fitted with a remote and locally operated automatic filling system, an overflow and a flow glass, a sludge trap, a valved drain point, a level gauge and transmitter, a flanged vent connection provided with a flanged SS316L flame arrestor.

The following connections are required on the tank but not limited to:

- Diesel fuel supply inlet/ outlet to engine
- Fuel spill-back line (if any)
- Valved drain connection
- Overflow and flow glass
- Flanged vent connection line with flanged flame arrestor
- Manhole
- Accessible level gauge and level transmitter.

The fuel outlet to the engine shall be not less than 50 mm above the bottom of the tank.

Automatic top-up is required and manual filling shall also be possible. Diesel filling will be via an automatically operated pneumatically actuated on/off valve, controlled from a separate tank level transmitter.

All fuel lines shall be in AISI SS316L.

4.7.4.4 Fuel interconnecting piping

All piping shall be metallic. High pressure fuel lines on engine shall be double wall design. All fuel piping off engine shall be AISI 316L stainless steel.

When required, flexible connections shall be reduced to the minimum and special care shall be taken to ensure adequate support at the rigid end pipes.

4.7.4.5 Fuel shut-off valve

An instrumented manual isolation fuel valve installed between the day tank and the diesel engine and operable from outside the enclosure shall be provided by the Vendor. The release device shall be installed in a cabinet with breakable glass, located easily accessible from outside enclosure.

4.7.4.6 Fuel cooling

The fuel oil return line shall include if required seawater cooled titanium plate heat exchanger to prevent heat to accumulate in the day tank during continuous running.

4.7.5 Lube oil system

Electric driven pre/post lube oil circulation pump shall be installed adjacent to engine to keep engine bearings and turbocharger lubricated and ready for start and run down after stop at full engine load.

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4.7.6 Driver installation

Diesel engine shall be installed with flexible isolator mountings.

Base plate supporting structure in front of the flexible isolator mountings shall be locally reinforced.

Drip pan underneath the diesel engine shall be provided to protect any accessories from oil spillage.

If necessary, platform with access ladders shall be provided at each side of the diesel engine to have access to top of the diesel engine, for operation and maintenance purpose (manual speed control lever arm, injectors, valve rockers, cooling expansion tank).

4.7.7 Exhaust system

Machinery combustion exhausts shall meet the following criteria:

- Be located 2 meters away from any hazardous area
- Be completely heat insulated with an appropriate thermal insulation in accordance with hazardous area classification.

A complete exhaust system made from stainless steel AISI 316L supported from the package base-plate shall be provided and shall consist of:

- AISI 316 exhaust silencer and ducting
- Expansion bellows between engine and ducting
- Roof mounted exhaust silencer fitted with AISI 316L spark arrestor designed to meet the Project noise specification
- Exhaust pipe downstream silencer in AISI 316L and drain system for vertical stack installation
- Adequate supporting steel structure mounted on the enclosure roof for all above equipment and associated fixation
- Access ladder to roof enclosure
- Roof handrails and walkways.

The routing of the exhaust ducting from the engine expansion joint to discharge to atmosphere shall be agreed between Contractor and Vendor.

Diesel engine Manufacturer shall advise the maximum allowable back pressure at the exhaust Customer connection at the rated power exhaust gas flow.

Exhaust system shall be suitably cooled or lagged to obtain surface temperature less than 70°C for personnel protection.

If Fire Fighting Diesel Driven Vertical Pump Package is installed in hazardous area, measures to keep the exhaust system surface temperature below temperature class T3 are required. Preference shall be given to gas tight insulation rather than water-spray exhaust cooler.

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4.7.8 Flexible hoses

If used, flexible hoses shall be of oil resistant rubber of two-ply reinforced construction and external metal braid protection. Each flexible hose shall terminate in an approved screwed union connection with shrouded ferrules. Mating screwed connectors shall be provided at each rigid pipe end. Union connectors shall be arranged so that no bending or torsion is applied to either the hose, ferrule ends or rigid pipe ends.

4.8 Fire and gas system and Fire suppression system

The fire and gas system and the fire suppression system of the Fire Fighting Diesel Driven Vertical Pump Package shall comply with **GS EP SAF 050**.

4.9 Electrical

4.9.1 General

The design, manufacture, inspection and testing of electrical equipment provided with the packaged unit shall comply with **GS EP ELE 011**.

- Electrical equipment shall be selected from Project nominated Vendor list
- All electrical equipment that shall remain energized in an emergency situation shall be designed for Zone 1 operation
- Cable glands for all interface cables, defined by Project shall be installed and blinded off suitably for transport and storage. In case the option is not selected, the gland plates shall be pre-drilled and blinded off
- Cable trays made of AISI 316L shall be installed between electrical equipment and UCP or multi cable transits for project cables.

4.9.2 Batteries and charger

The Vendor shall provide batteries type Cadmium Nickel designed for 72 hours standby power and 18 hours power supply during operation for engine and control system. The batteries shall be housed in Ex certified boxes, self-ventilated, non-corrosive battery boxes and located on the package. They shall be mechanically protected against shock and liquid projection.

4.9.3 Electrical earthing

Electrical earthing shall be as per **GS EP ELE 031**. Two earthing bosses at each opposite side of all skid units shall be provided for connection to Project's earthing system. All on skid equipment shall be bonded to these earthing bosses, directly or via earth rails on the skid unit.

4.9.4 Lighting

The lighting inside enclosed areas, such as package enclosure shall be designed for routine maintenance and inspection. It shall be permanent and supplied from the essential switchboard. An emergency lighting shall be provided with dedicated battery sets suitable for use in Zone 1 hazardous area to allow for escape.

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4.10 Instrumentation

The package instrumentation shall comply with **GS EP INS 101**, **GS EP INS 102**, **GS EP INS 107**, **GS EP INS 110** and **GS EP INS 120**.

4.10.1 General

The package is categorized as "P3 type Package".

- Instruments shall in general be selected from project nominated Vendor list. For particular items on the package (typically diesel engine), for which no nominated instrument is available on the market or impractical to install, manufacturer's standard instrumentation shall be selected upon case-by-case agreement of Company.
- Instrument tubing and fittings shall be of a single manufacturer and size (imperial or metrical sized) as chosen for the entire facility (by Company or EPC Contractor) and comply with **GS EP INS 107**.
- All instruments shall be installed and terminated up to skid edge junction boxes, local gauge boards or to unit control panel.
- Cable glands for all interface cables, defined by Project shall be installed and blinded off suitably for transport and storage. In case the option is not selected, the gland plates shall be pre-drilled and blinded off.
- All instruments cables between instruments and skid mounted terminal junction boxes / local gauge board/ UCP shall be as per **GS EP ELE 161** and **GS EP INS 107**.
- Segregation of signals between LV, control, safeguarding, digital and analog cables and terminals shall be done as per **GS EP INS 110** requirements. I/O signals for control/alarm, voting and safeguarding shall have segregated I/O cards.
- Cable trays with cover made of AISI 316L shall be installed between instruments and skid mounted junction boxes as per **GS EP INS 107**. Cable trays may share various types of signal cables as long as they are of the same voltage level (i.e. < 50 Volt), although only the same type of signal cables (i.e. analogue, digital, LV) may be bundled together, and cables of different signal type shall have some spacing between them. Cables powering high-wattage (> 1 Amp) solenoids shall remain at least 50 mm (2 inch) spacing from any other type of signal cable. Cable wraps shall be plastic-covered AISI 316; non-metallic cable wraps are not permitted.
- Empty cable trays shall be installed for the departing multi-core cables -supplied and installed by others- between junction boxes and the skid edge. Potential clash between package cabling and interconnecting cables shall be avoided; the layout and routing of interconnecting cables towards the junction boxes is considered a shared responsibility between the Package Vendor and Contractor.
- Instrument hook-up, including isolation valves, shall comply with **GS EP PVV 102** and **GS EP INS 900**. Exceptions may be granted for Vendor or machine specific sensors for which no alternative is possible, subject to a case-by-case approval by Company.
- All electronic instruments shall be SMART, analogue 4-20 mA, HART protocol, 24 VDC, full AISI 316 housing and support, with LCD indicator for sensors. Exceptions may be

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granted for Vendor or machine specific sensors for which no alternative is possible, subject to a case-by-case approval by Company

- Furthermore, machinery protection and monitoring system shall comply with [API Std 670](#) requirements.

4.10.2 Unit Control Panel

Each Fire Fighting Diesel Driven Vertical Pump Package shall be supplied with its dedicated UCP compliant with [GS EP INS 110](#) and [GS EP INS 135](#) requirements. The various earthing systems (i.e. IE, IPE, ISE) and their segregation, isolation and bonding shall be in compliance with [GS EP INS 107](#) and/or with the equivalent project specification for instrument and UCP earthing principles.

The various possible interfaces with ICSS and facility support systems (e.g. IMS, PDS) shall comply with [GS EP INS 110](#) and/or with the equivalent project specification, which may require the provision of particular interface equipment inside the UCP (e.g. a HART MUX board for HART compliant instruments), as per project requirements.

The Package Vendor shall apply the specific SIL application and configuration instructions of PLC Manufacturer associated to the required SIL level. Design details which may cause common-mode failures (e.g. a collective fuse in the power feeder to a number of relays) shall be searched for and eliminated.

The UCP shall integrate all main controls with an HMI, which shall also display the information from subsystems such as engine electronic control module. HMI and subsystem controllers shall be panel mounted. HMI shall be touch screen and provide adequate protection against modifications by password as per [GS EP INS 135](#).

UCP functionality shall comply with the [NFPA 20](#), enclosed to IP 65 standard as per [GS EP INS 101](#) and [GS EP INS 102](#), fitted with anti-condensation heater, installed on the main unit base plate with anti-vibration mountings.

The Unit Control Panel shall be:

- Designed to execute the operating philosophy described in paragraph 4.11 of this specification.
- Provided with the following devices, not limited to:
 - Mode selector switch
 - Control of the start and shutdown sequences
 - Manual start
 - Test start
 - Control of both starting systems
 - Control of diesel engine and auxiliaries
 - Diesel engine over-speed reset.

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- Provided with the following metering devices, not limited to:
 - Diesel engine tachometer
 - Hours run meter
 - Diesel engine oil pressure and water temperature
 - Diesel engine exhaust temperature
 - Battery voltage and ammeter.
- Provided with the following status, alarms, shutdown, not limited to:
 - Status
 - . FWP available
 - . FWP on demand
 - . FWP running
 - . FWP failed to start
 - . FWP start inhibited
 - . Fire fighting activated
 - . Diesel engine air flaps status, open and close.
 - Alarms
 - . Low cooling water level
 - . Low fuel level
 - . Low engine lube oil pressure
 - . High engine lube oil temperature
 - . High cooling water temperature
 - . Diesel engine high exhaust temperature
 - . Starting systems (low pressure, low voltage)
 - . Gear bearings temperature
 - . Weekly start due
 - . Shutdown
 - . Diesel engine over-speed.

The controller circuitry shall be arranged to provide volt free contacts to give remote annunciation as follows:

- "FWP on demand": upon reception of the starting signal and during the starting sequence
- "FWP started": when the driver has reached 90% of the rated speed
- "FWP fail to start": when all start attempts have failed
- "FWP available": when the pump unit is ready for a remote start

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- "FWP unit fault": when any of the alarms, shutdowns and abnormal status as here above listed have been annunciated at the controller
- "FWP start inhibited acknowledgement": upon reception of the "inhibit automatic start" remote signal
- Fire dampers status.

The controller shall accept the following remote signals:

- "Start": upon reception of any of the start signals, the pump unit automatic start sequence must be initiated
- "Inhibit automatic start": upon reception of this signal, the pump unit automatic start sequence is inhibited
- Ultimate start from a dedicated pressure transmitter on fire ring main.

4.11 Operating philosophy

4.11.1 Stand-by/ startup conditions

Each Fire Fighting Diesel Driven Vertical Pump Package will normally be held in stand-by. In this condition the package shall be available for immediate start-up on receipt of a remote signal, or under local manual control.

4.11.2 Operating modes

Four modes will be made available by means of a mode selector switch:

- Automatic
- Manual
- Test
- Off.

4.11.3 Automatic mode

The Fire Fighting Diesel Driven Vertical Pump Package shall start automatically and immediately upon reception of anyone of the following signals:

- A remote signal from the main Fire and Gas detection system
- A remote signal from the main control room
- A signal indicating a low pressure in the fire water ring main through the pressure signal on the UCP (ultimate start).

Once the starting signals have been cleared, the shutdown shall be possible only manually at the fire fighting pumps package by pressing the stop push button located on the UCP. Only the diesel over-speed device shall remain operative as a trip in automatic mode, all other malfunctions shall annunciate an alarm only.

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4.11.4 Manual mode

The Fire Fighting Diesel Driven Vertical Pump Package shall start immediately upon manual activation of the start local push button on the UCP.

Shut-down shall be possible only manually at the fire fighting pumps package by pressing the stop push button located on the UCP.

Only the diesel over-speed device shall remain operative as a trip in manual mode, all other malfunctions shall annunciate an alarm only.

4.11.5 Test mode

Test mode is activated by pressing the test start pushbutton on the UCP with the mode selector switch in Automatic mode. In this mode the package shall be running with enhanced protection and shall be tripped on all critical alarms mode (ex low cooling water level, low lube oil pressure, high lube oil temperature, high cooling water temperature etc).

Shut-down shall be possible only manually at the fire fighting pumps package by pressing the stop push button located on the UCP.

If the UCP receives a remote start signal when running in test, the mode shall automatically and immediately change to automatic mode. The unit shall continue running with the over-speed trip as the only operative protection device.

4.11.6 Off mode

Automatic start up and manual start up initiated from the UCP are inoperative.

All starting devices are inoperative. This mode shall be used only for maintenance purposes and shall be indicated at the main Fire and Gas system.

4.11.7 Start up and operation in case of gas detection

In the event of flammable gas detection by the plant system, or locally if Fire Fighting Diesel Driven Vertical Pump Package is located in a hazardous area, a signal will be generated to the fire fighting pumps package UCP and the following actions shall occur:

- Electrical power supplies to the fire fighting pumps package shall be interrupted
- The batteries shall be isolated by means of isolators.

Nevertheless, Fire Fighting Diesel Driven Vertical Pump Package shall remain capable of being started manually using the non electrical starting facility even with all electrical systems isolated,

- The UCP shall be provided with a local annunciator that the fire fighting pump package has been electrically isolated
- The diesel engine shall be inhibited from starting automatically
- Fire fighting pumps package that are already running shall continue. The governor system of the diesel engine shall therefore not require external power.

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4.11.8 Additional shutdown facilities

4.11.8.1 Over-speed shutdown

The over-speed shut-down is operational under all operating conditions. The diesel engine air flaps shall be triggered closed during an over-speed shutdown by the fire fighting pumps package UCP.

Before restarting, the engine air flaps must be manually reset as well as the diesel engine over-speed device, if any.

4.11.8.2 Fuel valve

By closing manually the diesel fuel supply valve.

4.12 Piping, valves and pressure vessels

The fabrication, inspection and shipment of pipes, fittings and flanges shall comply with Company [GS EP PVV 143](#), [GS EP PVV 144](#), [GS EP PVV 145](#) and [GS EP PVV 614](#).

Package limit flanges shall be in accordance with [GS EP PVV 112](#) or Project piping classes (if any).

If the interconnecting piping between main base plate and fire fighting cabinet, main base plate and submersible lift pump are part of Vendor scope of supply, the [GS EP PVV 112](#) or Project piping classes (if any) will be applicable.

Tubing material shall be sourced in SS904L, fittings in SS316.

The pressure vessels shall be designed, manufactured and inspected as per [GS EP PVV 211](#).

All main piping systems shall have low point drains. These drains and vents shall terminate with an isolating valve plugged.

All interconnecting piping at skid edge shall be identified and tagged.

Any required cleaning of interconnecting piping systems and/or vessels at Vendor's facilities shall comply with [GS EP PVV 175](#).

4.13 Installation

The package shall be installed as per [GS EP MEC 292](#) requirements.

Vendor shall clearly indicate his layout requirements to ensure proper operation of the lube oil system and the drain system.

Vendor scope of supply shall include a vibration study according to [GS EP MEC 300](#).

4.14 Painting

Package unit shall be painted according to [GS EP COR 350](#) or [GS EP COR 354](#) according to site environment.

For packages to be operated offshore or in coastal environment:

- Package skids and support structures, piping and pressure vessels within the scope of supply shall be painted according to [GS EP COR 350](#) system P01

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- When required by **GS EP COR 350**, paragraph 3.2, components made of stainless steel shall be painted according to **GS EP COR 350**, paragraph 3.2
- Rotating machines shall be painted according to Supplier standard suitable for offshore environment, if approved by Company, or according to **GS EP COR 350** system P14.

All submerged parts including pump head, columns, etc. shall be painted as per **GS EP COR 351**.

For fire fighting package where a Passive Fire Protection coating is required, the fire protection of the unit shall be compliant to **GS EP COR 353** requirements.

4.15 Health Safety and Environment

4.15.1 Hot surfaces

Any hot surface that can be reached by Operators shall be insulated in such a way that their maximum skin temperature be lower than 70°C.

4.15.2 Noise requirements

All definitions, notations, testing methods, calculation methods and calculation procedures shall be in accordance with **GS EP MEC 300**.

All efforts shall be deployed to limit the average sound pressure level around the package at following values :

- Equipment within an enclosure: 85 dB(A) at one meter
- Equipment without enclosure: 90 dB(A) at one meter.

Supplier shall submit during tender the expected noise map at one meter of the sound pressure levels in dB(A) per octave bands and the maximum sound power level for each of the following:

- Package
- Driver inlet filter and exhaust
- Lube oil air coolers (if located off the main package skid).

4.16 Miscellaneous

4.16.1 Bolting

Package bolting shall be as follows:

- For diameter above 24 mm, bolting shall be according to **GS EP COR 356** paragraph 6
- For diameter up to and including 24 mm, bolting shall be of AISI 321 Stainless steel as a minimum.

4.16.2 Name plate's tags and labels

All major equipment shall be identified by AISI 316L stainless steel nameplates attached by AISI 316L stainless steel pins or screws.

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Instruments shall be tagged with stainless steel tag signs attached by stainless steel wire and identified with signs fixed adjacent to each instrument.

All operating notices, warning notices and nameplates shall be in the English and language.

4.16.3 Rotation arrows

Direction of rotation arrows shall be clearly and permanently marked on all rotating equipment.

4.16.4 Vents

All vents which are interfaced between the Supplier and Contractor shall be routed to the skid edge or to a more appropriate location to be agreed with Contractor and shall terminate by a flange fitted with a blind flange for transportation purpose.

Flame arrestors shall be heavy duty type, flanged design in AISI 316L material.

4.16.5 Package lifting appliances

Package lifting appliances, such as lifting beams or spreader bars, slings, shackles, etc., shall be included in the Vendor scope of supply and designed, tested and certified by an approved authority in accordance with **GS EP STR 103**.

Lifting appliances shall be load tested at 125% of the safe working load and certified. Visual inspections and NDT (dye penetrant and ultra sonic inspections) shall be performed after the load test.

4.16.6 Maintainability and accessibility

For all items within the package, Vendor shall comply with the following requirements:

- Accessibility for operation (position of instruments, legibility of readouts, operation of valves, etc.) and for maintenance. If necessary, an access platform with stairs or ladder shall be provided for equipment that cannot be accessible from the ground
- Removable gratings or plates shall be provided around the machines to allow access and to protect equipment located in the bottom part of the package
- Maintainability (disassembly, reassembly, adjustment) with the necessary space and handling devices as appropriate to bring any piece of equipment to dedicated lay down areas
- Safety instructions.

All the above requirements shall be fully supported by an engineering handling study during Contract execution, for the following components but not limited to: driver, rotors, couplings, electric motors, gears, piping spools, etc.

A design review of the package accessibility and maintainability shall be organized with Company and Contractor prior to package construction. This review shall be supported by Vendor 3D CAD models.

For equipment over 20 kg, jack screws, lifting lugs, eyebolts, or equivalent shall be provided to perform alignment, disassembly and re-assembly.

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Equipment/driver alignment must include a minimum of:

- 20 mm AISI 316 stainless steel machined shims
- 3 mm AISI 316 stainless steel final adjustment shims.

These shims are part of the Vendor scope of supply.

4.16.7 Inspections

The inspections shall be conducted according to the Project ITP. As a minimum, the requirements reported in Appendix 5 shall apply. The weight control shall be performed as per **GS EP STR 001**.

4.16.8 Engineering documentation language and units

The engineering documentation shall be developed as follows:

Language: English and

Units:

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5. Data sheets

5.1 Submerged shaft line pump

Reference / Revision: /

5.2 Diesel Engine (refer to Appendix 7)

Reference / Revision: /

5.3 Gearbox

Reference / Revision: /

5.4 Noise

Reference / Revision: /

5.5 Weight

Reference / Revision: /

5.6 Data sheet templates

Each data sheet requested in the VDR enclosed in the Appendix 4 of this specification shall be filled in by the Vendor in the Company template format.

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6. Site conditions and utilities

6.1 Site conditions

LOCATION

ALTITUDE

CLIMATE

ATMOSPHERIC PRESSURE

Average		mbar
Minimum		mbar
Maximum		mbar

AMBIENT TEMPERATURE

Design (minimum / maximum)		°C
Normal		°C
Minimum		°C
Maximum		°C

WIND

Normal		m/s
Design		m/s
Direction		

RELATIVE HUMIDITY

Minimum		%
Maximum		%

ENVIRONMENT

Dust	
Smoke	
Other	

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BLAST

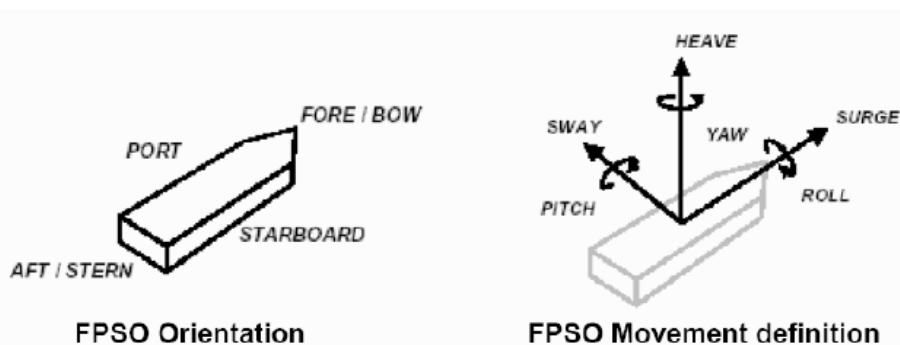
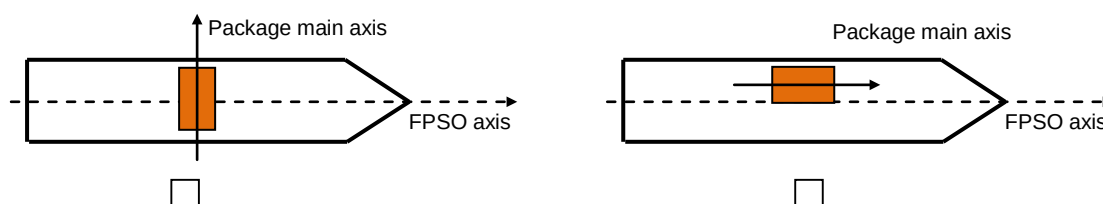
Equivalent static pressure (mbar)

FIRE RATING
CLASSIFICATION TYPE AREA
OPERATIONAL DESIGN CONDITIONS

Project Phase:	During towing	On site	On site	
Condition:	Dry	Operating	Damaged	
Longitudinal acceleration (Surge)				m/s ²
Transversal acceleration (Sway)				m/s ²
Vertical acceleration (Heave)				m/s ²
Trim angle (Pitch)				°
List angle (Roll)				°

The motions and accelerations are given in the following way (typical):

Surge	X	Roll / List	Rotation / X
Sway	Y	Pitch / Trim	Rotation / Y
Heave	Z	Yaw	Rotation / Z


PACKAGE ORIENTATION ON FPSO


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6.2 Utilities

ELECTRICITY

Refer to:

- Project specification for electrical requirements for packaged units:

rev

- **GS EP ELE 011**

UCP UPS Earthing Regime:

UCP Normal Power Regime:

INSTRUMENT AIR

Type	Instrument Air	
Min/max operating temperature		°C
Operating temperature		°C
Min/max operating pressure		Barg
Operating pressure		Barg
Oil concentration		
Dew point		°C @ barg

COOLING WATER SYSTEM

Type	Sea Water	Fresh Water		
Normal inlet temperature				°C
Min/max inlet temperature				°C
Min outlet temperature				°C
Max outlet temperature				°C
Supply pressure				Barg
Max allowable delta P				Bar
Calorific capacity				kJ/kg°C
Fouling factor				m ² .°C.h/kcal

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7. Tests

7.1 Factory tests (workshop)

The scope of this chapter is to describe the factory tests to be carried on the Fire Fighting Diesel Driven Vertical Pump package in Vendor facilities before unit shipment.

Factory tests shall demonstrate the correct design, manufacture and operation of the equipment and its satisfactory performance in accordance with the conditions identified in the mechanical data sheet.

The following tests shall be carried out:

- Performance testing of individual equipment item (diesel engine, gearbox, submerged vertical line pump, UCP)
- Pre-test activities
- Performance and mechanical running test of Fire Fighting Diesel Driven Vertical Pump package. This activity shall include the functional test of all the main auxiliary systems of the package
- Mock-up test with complete line shaft assembly and top plate
- Assembled package shall be weighted before packing and shipment.

The following documentation shall be issued by Supplier prior the factory tests in workshop:

- Factory test procedures
- "As built" drawings relevant to factory test.

The test procedure shall be issued 8 weeks prior the test (including noise and vibration measurement proposed procedure).

Detailed procedures for all tests, which shall include the acceptance criteria for all monitored parameters, shall be reviewed and accepted by the Company prior to the commencement of tests. Failure of any aspect of the testing shall require corrective action and a full complete re-test.

The results of each test shall be recorded in appropriate log sheets provided by Vendor and signed as "witnessed" by all the parties.

After the completion of the tests, Vendor shall issue an official test report including all the above log sheets. Copy of raw data registered during the tests shall be handed over immediately after each test activity for Contractor inspection record.

All tests identified as factory tests will be witnessed by Company or their representative.

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7.2 Performance tests

7.2.1 Acceptance criteria

Following acceptance criteria are valid for both Vendor facilities and field tests:

- Performances and tolerances:
 - Vertical line shaft pump as per [NFPA 20](#) and [API Std 610](#)
 - Diesel engine as per [ISO 3046-3](#).
- Mechanical:

Vibration levels over the whole operating range:

 - Vertical line shaft pump as per [API Std 610](#)
 - Driver as per [ISO 10816-6](#) (as per Table A-1, classification number 5, zone A/B)
 - Gear as per [AGMA 6000 B96](#) - Class B
 - Base-plate and right angle gears: 4.5 mm/s RMS.
- Noise as specified in data sheets. If not, guaranteed noise level as per paragraph 4.15.2.

7.2.2 Pump performance test

Fire fighting pump performance test shall be conducted at rated speed and at minimum submergence. Supplier's test facility may lead to reduce the length of the discharge column but the number of column elements should not be less than three, with at least one shaft bearing inserted. In such cases, the Supplier shall state in their test procedure the necessary corrections to be made to the test results to account for the reduced discharge column length and friction losses.

The Fire Fighting Diesel Driven Vertical Pump package performance guarantee shall be for the fully assembled unit.

The Fire Fighting Diesel Driven Vertical Pump package shall include at least the following test points:

- Closed valve for 5 minutes
- Minimum continuous stable flow for 15 minutes
- Intermediate between minimum continuous stable flow and rated flow for 15 minutes
- Rated flow for 15 minutes
- And 150% rated flow for 15 minutes.

Additional test points shall be taken as necessary to accurately establish the full Fire Fighting Diesel Driven Vertical Pump curve.

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7.2.3 NPSH and mini submergence test

NPSH test shall be carried out at the following points:

- Minimum continuous stable flow
- Intermediate between minimum continuous stable flow and rated flow
- Rated flow
- Intermediate between rated flow and 150% of rated flow
- 150% of rated flow.

Minimum submergence test is required on the Vertical line shaft pump.

The Vendor shall provide the method to achieve the above test and the correspondent test procedure.

7.2.4 Right angle gearbox test

The gearbox shall undergo mechanical tests which shall demonstrate the satisfactory operation of the complete unit and its oil system.

Additionally, the gearbox shall be tested to transmit full rated power at rated input speed. A gear tooth contact pattern shall be achieved after all tests have been concluded.

7.2.5 Diesel engine test

The diesel engine tests at the engine Manufacturer's works shall include measurement of power, fuel consumption and lubricating oil consumption according to [ISO 3046-3](#) requirements.

7.2.6 Pre-test activities

Before commencing the factory testing of the completely assembled packages, the following minimum pre-test activities shall be carried out:

- Checking the compliance of the equipment with the project specifications
- Checking the certificates of compliance for the hazardous area components
- Calibration of all Project instruments. Relevant calibration certificates shall be available at the time of the test for Purchaser review. Spot checks of instruments calibration shall be required before test commencing.
- Instrumentation and electrical equipment insulation and continuity tests
- All instrumentation and electrical equipment functions shall be verified, including simulation, shut-downs and remote signals
- Control loops check and functional tests
- Instruments, controls, alarms and safety devices
- Safety and protection devices operational checks
- Serial link test
- Equipment tagging and labeling check

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- Mechanical equipment alignment check
- Pneumatic pressure tested piping system
- Leakage tests
- Hydrostatic tests
- Lube oil flushing and cleanliness
- Weights and dimensional checks
- Verification of the dynamic stiffness of the test bench as per **GS EP MEC 300**.

The reports relevant to the mechanical equipment alignment check and to flushing and cleanliness checks shall be available for Contractor review during test.

Before commencing the tests the package shall be cleaned by Vendor and shall be visually inspected by Contractor.

7.2.7 Performance and mechanical running tests

Supplier shall provide all temporary equipment required for implementation of the tests, including, but not limited to temporary connections, hardware to simulate signals and interfaces external to the supplied equipment etc.

Supplier shall be responsible, as well for providing all utility services needed to perform the test in proper conditions.

Each complete Fire Fighting Diesel Driven Vertical Pump package shall undergo a complete unit test, four (4) hours uninterrupted continuous duration and be carried out on units fully erected, pre-commissioned and shall involve all contract equipment listed in the scope of supply.

The complete unit test shall demonstrate the proper functioning of all sub-systems, instruments, controls and safety systems.

The complete unit test shall consist of but not limited to:

- Performance and mechanical test of Fire Fighting Diesel Driven Vertical Pump package with all contract components and sub-components, all contract off-skid auxiliaries items, contract UCP and associated instrumentation etc.
- The primary and backup diesel engine functional tests including starting sequence shall be demonstrated. A manual start using the back-up system shall be made with the engine cold.
- The capacity of starting systems accumulator(s) shall be demonstrated.
- The proper functioning of the primary (battery) starting system if selected shall be demonstrated by starting the engine manually from the UCP.
- Operational checks such as but not limited to Start/Stop normal sequences, Emergency stop sequences etc.
- Diesel engine over-speed test, air flap reset test and Emergency fuel shut-off valve test.

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- The parameters to be monitored on diesel, pump and gear shall include but not limited to pump pressures, flow, speed, temperatures, vibration levels of bearings and baseplate, cooling flows.
- Sound level tests with the Fire Fighting Diesel Driven Vertical Pump package operating at rated conditions shall be performed for all Fire Fighting Diesel Driven Vertical Pump packages. Noise measurement shall be performed in accordance with **GS EP MEC 300** for all equipment. Sound power levels and sound pressure levels shall not exceed the data sheet values.
- Vibration shall be measured during the shop test of the assembled machine operating over the agreed speed.
- Package vibration test as per **GS EP MEC 300**.
- Fire Fighting Diesel Driven Vertical Pump package fuel consumption shall be measured.

Test duration

The mechanical running test shall be conducted initially at operating point and when oil temperatures and all other parameters have been observed stabilized.

- Four (4) hours continuous running at the operating point
- Minimum one (1) hour continuous running at 150% of rated flow.

All running parameters shall be recorded every thirty minutes.

Each test shall be subject to a test report issued by Vendor and submitted to Company and Contractor.

7.2.8 UCP and ICSS communication link test

The FAT shall include exhaustive UCP FAT and ICSS communication link(s) tests, as detailed and in compliance with paragraph 7.4 and appendix 5 of **GS EP INS 110**. The principle rule and objective shall be that all outstanding punch item(s) from these tests shall be closed out before expedition of the UCP.

The Package Vendor shall include and provide all the necessary means for the ICSS vendor to participate in the ICSS communication link test. The ICSS communication link(s) test may be conducted at a different time and place when deemed more practical, but it shall be conducted and successfully closed out before UCP FAT. The ICSS communication link(s) tests shall be conducted with ICSS equipment and link being identical to the final ICSS equipment and link, i.e. not by means of simulating/emulating PC/laptops through a general PLC communication port.

All I/O shall be fully simulated with real analogue and digital signals/indicators, i.e. not by forcing /monitoring the I/O via the application software. Voting inputs function (e.g. F&G detectors) shall be fully tested.

Verification and validation of the package's instrument ranges (i.e. instrument index), alarm & trip setting list, as well as data exchange table list with the ICSS shall be an integral and mandatory part of the UCP FAT, and be included in the FAT procedure and FAT report.

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7.2.9 Site acceptance tests (SAT)

All packages shall be submitted to Site Acceptance Tests (SAT). Such tests shall demonstrate that the Fire Fighting Diesel Driven Vertical Pump package meets the mechanical and performance requirements within the specified operating range and conditions.

Site acceptance of the units will be pronounced only after the satisfactory completion of the field acceptance tests.

This test shall be carried out on the site or at integration yard, in operating conditions, with the fire fighting pump package connected to the distribution network. Each pump shall be tested at 150% rated capacity.

7.2.10 Post-test activities

After the SAT, the Vendor shall supply a detailed SAT report including as a minimum the following elements:

- List of the instruments used during the test
- Test points log sheets.

Summary chart of the package performances converted from the test to the data sheet conditions.

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8. Spare parts and special tools

This paragraph gives the minimum requirements of spare parts and special tools for this project. It shall be read in conjunction with **GS EP EXP 217**.

8.1 Spare parts

8.1.1 Commissioning and start-up spare parts

Following spares shall be provided but not limited to:

- **Diesel Engine**
 - Lube oil filter cartridges
 - Diesel main and pre-fuel filter cartridges
 - Air filter elements (pre-filter, coalescer)
 - Filter elements for air starting system if any
 - Shims for diesel engine alignment.
- **Vertical line shaft Pump**
 - O-Rings, backup rings, bolts, nuts and washers
 - Bearings and sleeve
 - Mechanical seals
 - Wear rings.
- **Top Bend**
 - O-Rings.
- **UCP including Fire and Gas panel**
 - Relays, Fuses, Lamps and bulbs
 - One (1) power supply card
 - One (1) communication interface card
 - One (1) analogue/ digital input card
 - One (1) analogue/ digital output card.

8.1.2 Capital spare parts

The Vendor shall quote a complete vertical line pump, complete with testing identified as per paragraph 7 of this specification.

8.2 Special tools

Where special tools and fixtures are required to disassemble, assemble or maintain the packages unit, they shall be identified, listed and included in the Supplier quotation and furnished as part of the initial supply of the package.

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As per **GS EP INS 110**, a dedicated engineering laptop, with original application software and actual PLC/VDU programming on CD/DVD, including full and unlimited duration licenses, shall be supplied for the PLC and VDU with the package. If any modifications have been made during on-site commissioning or acceptance tests, then the Package vendor shall ensure that a backup of the latest programming/configuration is supplied with the final IOM documents.

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9. Preparation for shipment

The purpose of the preservation and shipment requirement is to assure the best economical protection against adverse atmospheric weather, corrosion build up and mechanical damage due to storage and transportation from Vendor (manufacturers, packagers and contractors) premises to Contractor yard and from Contractor yard to Company site.

The Vendor and/or Manufacturer shall issue necessary procedures which shall be applied to any equipment to cover:

- The preservation during workshop storage
- The preservation, packing and fastening of equipment during transportation from Vendor facilities to Contractor yard construction
- The preservation during the construction works on the Contractor yard
- The preservation, packing and fastening of equipment during towing from Construction yard to Company site.

The procedures shall contain a check list including all preservation and packing tasks.

The hereafter requirements shall also be applied to the capital spares delivered with the contract. The capital spares shall always be preserved and packed for long term outdoor storage.

9.1 Preservation

The preservation duration will be selected by the Project in the package data sheet and/or equipment data sheets.

Two types of preservation can be applied depending on Project needs: short term preservation or long term preservation.

The considered preservation shall be valid for shipment between:

- Vendor premises and Contractor yard
- Contractor yard and site.

The short term preservation shall cover a period up to six (6) consecutive months after processing of the preservation. The considered storage shall be outdoor without protection.

The long term preservation shall cover a period up to twelve (12) consecutive months and be annually renewable during five (5) years.

The desiccant products shall be free of DMF (dimethyl fumarate) content and shall be selected from Silica base. The regeneration of desiccant products is a mandatory requirement and shall be done by heating.

The desiccant products shall conform to the [NF H00-320](#) or [DIN 55473](#) or [US MIL D 3464E](#) standards.

The VCI (Volatile Corrosion Inhibitor) and VPI (Vapor Phase Inhibitor) shall conform to the [US MIL-STD-2073-1 E](#) standard. However necessary care shall be taken to use approved products compatible with the materials needing to be preserved.

All desiccant products locations shall be provided with a metallic label indicating their presence.

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The last mechanical and/or performance runs can be done with anti-corrosion additives mixed with the lube oil. However Vendor shall demonstrate that the anti-corrosion additives shall not compromise the life of the equipment.

All opening shall be closed with metallic blind and gasket to be air and water sealed.

Metallic labels with necessary cautions and instruction to remove preservative products prior equipment start-up shall be provided. The labels shall be made of metal with black marking on yellow back ground.

9.1.1 Diesel engine

After completion of the tests, the following shall be performed as a minimum:

- Draining of liquid as water, diesel from systems
- Drying of systems
- Cleaning of reservoirs with non pilled clothes
- Spraying of Tectyl™ or VCI in the diesel system including reservoir
- Spraying of Tectyl™ or VCI in the air system
- Spraying of Tectyl™ or VCI in the water cooling system
- Spraying of Tectyl™ or VCI in the lube oil system
- Insertion of dessicant product in the diesel, water, oil and air systems by means of perforated metallic baskets fixed to blinds
- Preservation from foreign matters entrance
- Sealing of opening.

9.1.2 Pump

After completion of the tests, the following shall be performed as a minimum:

- Draining of liquid such as water from systems
- Drying of systems
- Cleaning of reservoirs with lint-free rags
- Spraying of Tectyl™ or VCI in the reservoir, lube system and casing
- Spraying of Tectyl™ or VCI in the air system
- Spraying of Tectyl™ or VCI in the pump casing
- Spraying of Tectyl™ or VCI in the seal system
- Insertion of desiccant product inside the reservoir, the pump casing and the seal system by mean of metallic basket welded to the closing blinds
- Sealing of openings with metallic blinds.

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9.1.3 Instrumentation and electrical auxiliaries

After completion of the tests, the following shall be performed as a minimum:

- Draining
- Drying
- Insertion of soft bags desiccant products in instrument junction boxes and in instrument head
- Sealing of openings.

9.1.4 Control panels

After completion of the tests, the following shall be performed as a minimum:

- Draining, where needed
- Drying
- Cleaning of panels
- Packing of all equipments not rack mounted
- Insertion of soft bags desiccant product inside the control panel
- Positive locking of all doors
- Sealing of openings.

9.1.5 Auxiliaries

The package auxiliaries generally include piping, filters, heat exchangers, valves, ducting, structural frames.

- Draining
- Drying
- Cleaning
- Spraying, if any, of Tectyl™ or VCI
- Spraying Water resistant wax Tectyl™ and wrapping on all non painted interfaces
- Sealing of opening.

9.2 Packing

9.2.1 Weather protection

The design of the packing shall procure an optimal weather protection during oversea transportation and contractor yard storage.

During the detail engineering phase, Contractor, in conjunction with Vendor, has to issue and submit the preservation and sea fastening procedures to Company representative for approval.

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Contractor shall be fully responsible of equipment preservation until provisional acceptance on site.

The weather protection shall be made of heat welded multilayer film (polyester, aluminum, polyethylene) and shall be installed around the package. All lifting appliances and lifting points shall be provided outside the weather protection and shall not be subject to losses of sealing. The film shall conform to the [NF H00-310](#) or [US MIL PRF 131K](#) standards.

Prior to weld and seal the multilayer film, the hereafter sequences shall be applied, but are not limited to:

- A sweeping with Nitrogen shall be performed in order to remove the internal moisture as much as possible to get low residual humidity.
- A set of desiccant bags shall be included to absorb residual moisture and trap during transportation and storage the moisture passing through the multilayer film envelope.
- A moisture indicator (sensitive paper) shall be included inside the envelope prior sealing to perform the traceability of the internal atmosphere during transport and storage.

9.2.2 Mechanical and infestation protection

The mechanical and infestation protection shall be performed by a use of multilayer wooden plates (plywood).

The multilayer wooden plates shall be sea water resistant in case of overseas transportation. A selection of multilayer wooden plates in accordance with marine immersion resistant, french standard CTBX or equal classification requirements is required.

The construction of the overall mechanical protection shall be done in such a way that internal or external members shall not damage the weather protection.

The construction shall be in such a way that rodents and insects cannot enter inside the box.

All sensitive parts like antifriction bearing, rotor shaft, shall be locked in place and insulated by means of shock absorber. The rotor locking devices shall be labeled with metallic instructions and cautions label with black making on yellow colored back ground labels shall be provided.

9.2.3 Fastening

All devices needed for the fastening whatever the transportation mode considered (sea, onshore, dirty and/or ice road) shall be provided external to the mechanical protection. The fastening shall not affect the weather/mechanical protection integrity.

The fastening shall be part of the equipment engineering design and shall be provided to avoid any modification and/or welding on the equipment during its installation until completion.

9.2.4 Marking

The minimal requirements for marking shall conform to the [ISO 780](#) code in addition to the specific requirement of the project.

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9.2.5 Pump specific

The pumps shall be preserved as per clause 9.1.2 and packed as per clause 9.2 during transportation from Vendor facilities to Contractor yard and from Contractor yard to Company site.

For light pump rotors, the use of own bearing supports during transportation is allowed. However Vendor has to demonstrate that transportation with pump rotor in place shall not impact the integrity and capability of the pump to recover original performances during commissioning and start-up at site.

Rotor shall be locked in position for transportation. The locking devices shall be supplied by the Vendor.

For capital spares, internal or external vibrations and shocks absorbers and shock loggers shall be provided. Drop acceleration limit shall be indicated by the Supplier.

9.2.6 Loose shipped items and auxiliaries

The loose shipped items delivered with the contract (including commissioning and start-up spare parts) shall be preserved as per clause 9.1 and shall be packed inside a VCI plastic bags as per clause 9.1 and clause 9.1 during transportation from Vendor facilities to Contractor yard and from Contractor yard to Company site, except for structural frames and ducting when part of the scope of supply.

The packing boxes shall be provided with:

- Internal or external vibrations and shocks absorbers
- External lifting and handling devices and fastening provisions
- External marking in accordance with [ISO 780](#) and Project specific requirements
- Internal harness and/or means for fastening
- Moisture indicator
- Internal or external provision for documentation storage
- External blank marking area and/or location to attached the AWB (Air Way Bill).

9.3 Transportation

The Notified body responsible for transportation between Vendor facilities and port of shipment shall perform the assessment of the means, risks and constraints.

It shall be clearly specified in the Vendor proposal the means to be used for transportation, the loading of the equipments and the induce constraints due to sea, road, rails transportation in term of equipment assembly and number of packs.

A preliminary packing list including packing dimensions and weight table shall be attached to the Vendor proposal to give possibility to Company to assess the transportation impacts prior contract award.

The handling, loading and unloading procedures and the lifting drawings shall be part of the engineering phase and shall be developed by the Vendor.

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The spreader bars, the lifting beams and ancillaries (slings, shackles) shall be supplied by Vendor and shall be load tested and certified by third party notified body. The use of synthetic slings is not allowed.

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Appendix 1

Appendix 1 Definitions and Abbreviations

AAR	Automatic Air Release
Company	Total E&P or any Total E&P subsidiary
Contractor	Any company Total E&P has signed a contract with for the Engineering, Procurement, Construction and Installation of a part of a project
DMF	Dimethyl Fumarate
ESD	Emergency Shut down
FGS	Fire and Gas System
FO	Field Operations
FSS	Fire Suppression System
HMI	Human Machine Interface
ICSS	Integrated Control Safety System
ITP	Inspection Test Plan
MCC	Motor Control Center
NDT	Non Destructive Test
OEM	Original Equipment Manufacturer
Package	Prefabricated process or utility self-contained unit, generally able to operate on its own, supplied fully tested and ready for immediate installation
PLC	Programmable Logic Controller
SAT	Site Acceptance Test
SIL	Safety Integrity Level
SPL	Spare Parts List
Supplier or Vendor	The package Supplier or Vendor
UCP	Unit Control Panel (or Controller as per NFPA 20)
VCI	Volatile Corrosion Inhibitor
VPI	Vapor Phase Inhibitor

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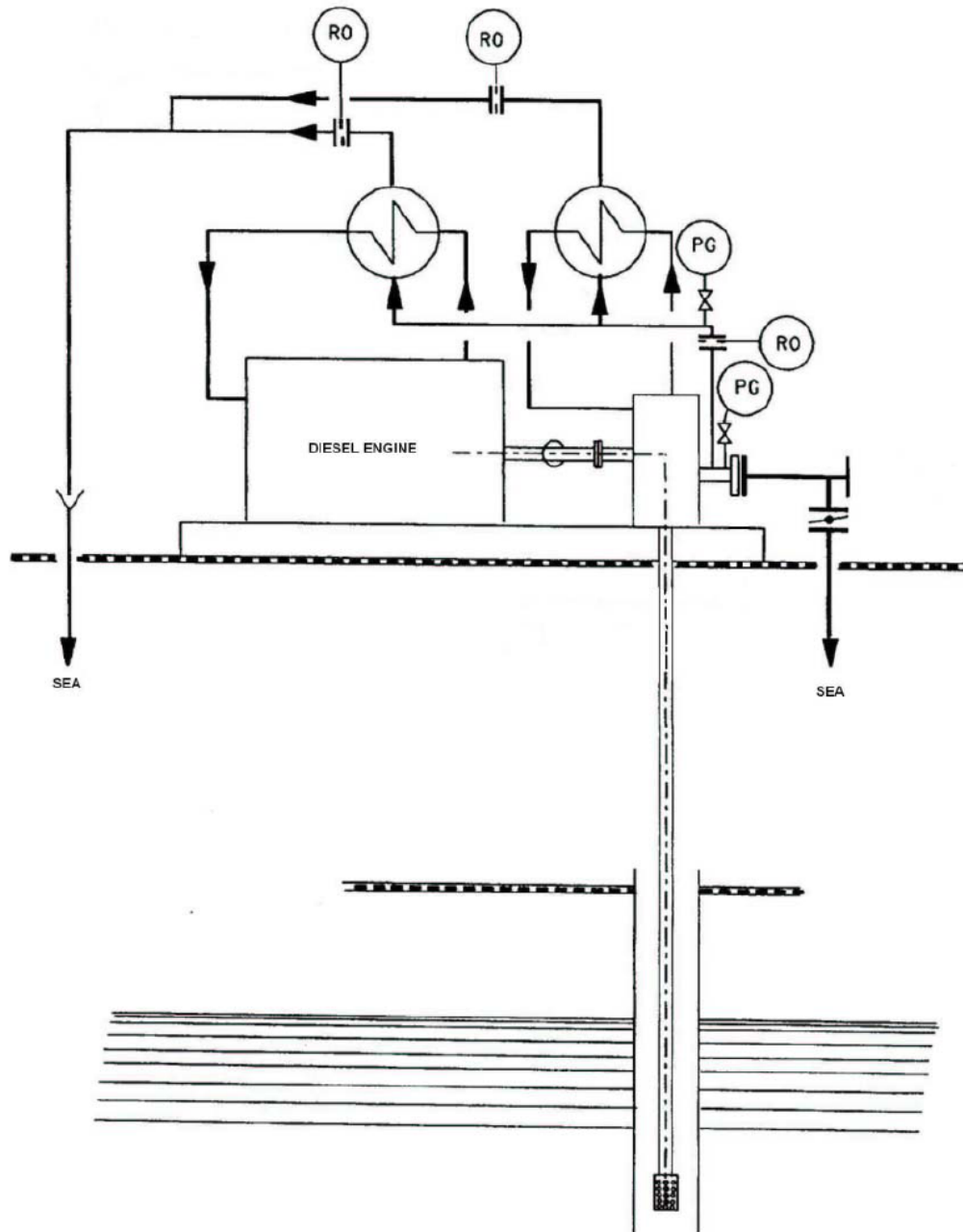
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Appendix 2

Appendix 2 Cooling circuit arrangement



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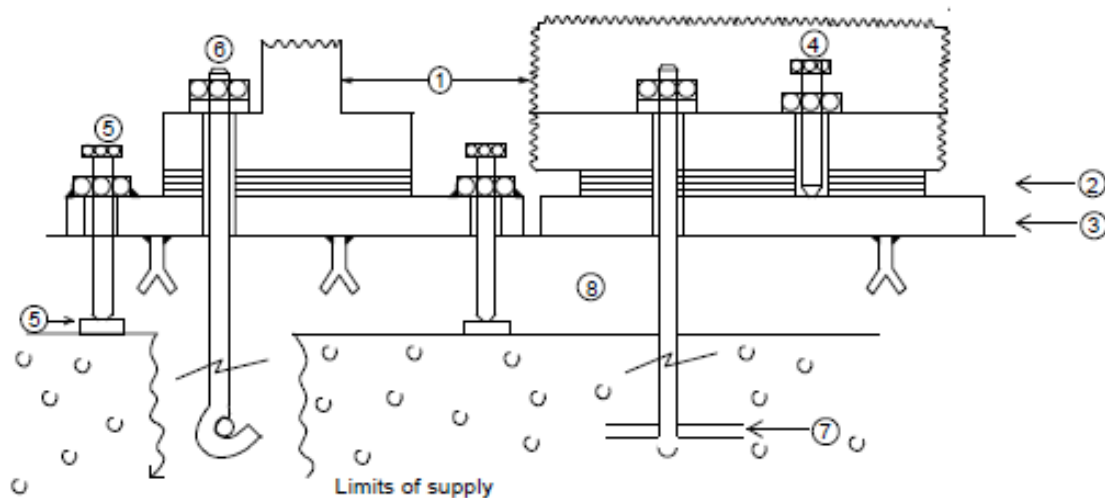
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Appendix 3

Appendix 3 Baseplate installation

CONCRETE FOUNDATION

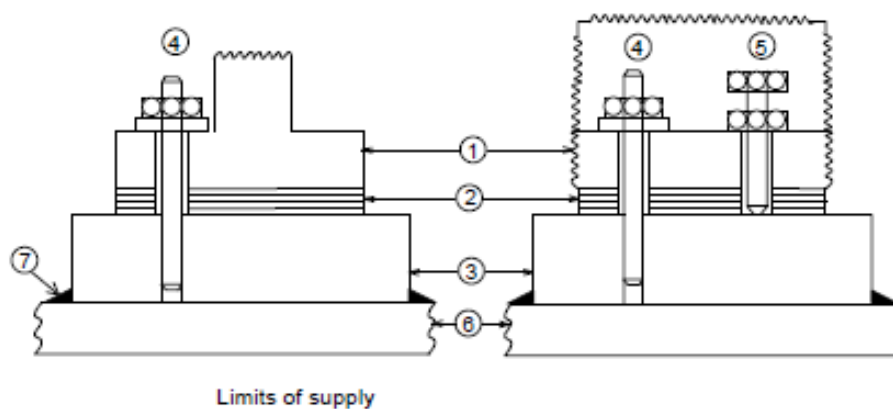

SUPPLIER

- ① Base plate
- ② Shims (20 mm min)
- ③ Sole plate (30 mm min)
- ④ Base plate levelling screws
- ⑤ Soleplate levelling screws
- ⑥ Anchor bolts
- ⑦ Anchor bars

CONTRACTOR

- ⑧ Non shrinking epoxy grout

STEEL STRUCTURE FOUNDATION


SUPPLIER

- ① Baseplate or Gimbals or AVM
- ② Shims (20 mm min)
- ③ Soleplate (50 mm min)
- ④ Anchor bolts
- ⑤ Levelling screws

CONTRACTOR

- ⑥ Deck
- ⑦ Welding

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Appendix 4

Appendix 4 Vendor Document Register (VDR)

The following documents shall be delivered by the Package Vendor. This list is a mandatory base frame but might be extended on a Project basis.

(1) Documents to be supplied with offer.

Item	Designation	(1)
1	General	
1.1	Vendor document register	X
1.2	Deviation list	X
1.3	Monthly report	
1.4	Sub-Vendors List	X
1.5	Quality Plan	
1.6	Inspection and Test Plan	X
1.7	Declaration of conformity for ATEX	
2	Arrangements	
2.1	General Arrangement drawing for FWP Package	X
2.2	General Arrangement drawing for submersible lift Pump	X
2.3	Foundation Drawings	
2.4	Limits of supply table (interface and connection schedule)	X
2.5	Allowable nozzles loads	
2.6	Lifting Drawing	
2.7	Unit Control Panel drawing	
2.8	Fire fighting cabinet drawing	
3	Data sheets	
3.1	Driver data sheet	X
3.2	Submerged shaft line Pump data sheet	X
3.3	Gearbox data sheet	X
3.4	Exchangers data sheet	
3.5	Mini Flow valve data sheet (if any)	X
3.6	Noise data sheet	
3.7	Weight data sheet	
3.8	Maintenance data sheet	
3.9	Instruments data sheet	
3.10	Other data sheets (LV motors, valves, lube oil filters, etc.)	
4	P&IDs & Lists	
4.1	P&ID symbols table	X
4.2	PFD and PID's	X
4.3	Equipment list / Bill of materials	X

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Item	Designation	(1)
4.4	Load and Utilities List	
4.5	Lubrication list and schedule	
4.6	Sign and Tag schedule	
4.7	List of hazardous area certificates	
5	Detail drawings	
5.1	Submerged lift pump Outline drawings	
5.2	Submerged lift pump sectional drawing and associated part list	
5.3	Outline drawings equipment (mini flow valve, flexible mounts, silencers, vessels, coupling, heat exchangers, filters...)	
5.4	Gearbox Outline drawing	
5.5	Gearbox sectional drawing and associated part list	
5.6	Fire fighting cabinet outline drawing	
5.7	Local gauge outline drawing	
5.8	Fuel tank outline drawing	
5.9	Starting systems Outline drawing	
5.10	Equipment data plate drawing	
5.12	Interconnecting piping Isometrics	
5.13	Piping Classes	X
6	Electrical / Instrumentation and Controls	
6.1	Junction Boxes dimension and termination diagram	
6.2	Control philosophy and Functional analysis	
6.3	Instruments hook up Diagrams	
6.4	Instruments list	
6.5	HMI displays	
6.6	PLC software data base exchange	
6.7	Instruments and electrical cables list	
6.8	Modbus list including addressing	
6.9	I/O list	
6.10	Instrument index S4I format	
6.11	Alarm / shut down list	
6.12	Interconnecting diagram (instrumentation and electrical)	
6.13	Earthing diagrams	
6.14	Logic diagrams	
6.15	Cause and effect chart	
6.16	Instrument loop diagrams	
6.17	UCP terminal strips	
6.18	Junction boxes terminal strips	
6.19	Wiring diagrams	

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Item	Designation	(1)
6.20	Obsolescence dossier	
6.21	Single line diagram	
6.22	Block Diagrams	
7	Calculations and Performances data	
7.1	Pump performance curves	X
7.2	Lateral and Torsional critical speed analysis calculation note	
7.3	Baseplate calculation note	
7.4	Safety relief valve calculation	
7.5	Starting systems calculation note	
7.6	Other calculation notes (anodes, water hammer etc..)	
8	Manuals/procedures/other lists	
8.1	Painting specification	
8.2	Installation and operating manual index	
8.3	Installation and operating manual	
8.4	Special tools list	
8.5	Start up and commissioning spare parts list	X
8.6	Priced operating spare parts list	
8.7	Capital spare parts list	X
8.8	Packing index and final packing list	
8.9	Storage prior and after erection procedure	
8.10	Weighing procedure	
8.11	Performance/ mechanical running test procedures	
8.12	UCP test procedure	
8.13	Factory test for complete package procedure	
8.14	SAT procedure	
8.15	Reports for the above tests (2)	
8.16	Preservation procedure	
8.17	Packing procedure	
9	Manufacturing/Quality/HSE documents	
9.1	NDE procedures	
9.2	Welding procedures	
9.3	Material certificates	
9.4	All tests and inspections certificates	
9.5	QA/ QC (Manufacturing data book) index	
9.6	QA/ QC (Manufacturing data book) Dossier	

(2) The package string test report shall include pictures of the package (four side views and four isometric views).

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Appendix 5

Appendix 5 Minimum inspection requirements

As a minimum, the following inspections shall be witnessed by the Company:

- Vertical shaft line pump performance test
- Vertical shaft line pump NPSH/Submergence test
- Gearbox running test
- Functional, performance and mechanical running test of the Fire Fighting Diesel Driven Vertical Pump package
- Final inspection
- Final dossier data book review.

Note: This list does not include the inspections to be conducted on each individual component constituting the package.

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Appendix 6

Appendix 6 Deviations to the contractual documents

If deviations are waived during the bid phase, they shall be listed in the following pages in the purchase revision.

The deviation list shall exhibit at least the following:

- Reference of the specification
- Paragraph of the specification
- Description of the deviation
- Reason for deviation
- Vendor proposal
- Company final position.

The deviations that are not accepted by Company shall appear in this list in order to give a complete overview of the technical discussions.

The following list contains pages.

Note: The deviation list might not be attached to this specification but referenced under a project document (as reported below).

Project document reference:

Revision

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Gas and Diesel Engines Data Sheets DS EP MEC 140.

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Appendix 7

		DATA SHEET				N°	
		Main Title				DS EP MEC 140	
		Secondary Title				Page 1 of 3	
Issuing Dpt	Rev. / Date	0/	1/	2/	3/	4/	
TEC/MTH	Written by :						
ENGINE							
1	Applicable to	☐ : Proposals ☐ : Purchase ☐ : As Built Gas Engine ☐ Diesel Engine ☐ Crude Oil Engine ☐					
2	Manufacturer	Size and Type					
3	Service:	Continuous (2) ☒ Intermittent ☐ ISO Classification A ☐ B ☐ C ☐ D ☐					
4	Driven Equipment						
5	OPERATING CONDITIONS				SITE DATA		
6	ISO Power (ISO 3046)		kW	Speed		RPM	Altitude
7	Site continuous power		kW	Speed		RPM	Atmospheric Pressure
8	Overload {	Site power	110%				Ambient Temperature: Norma
9		Speed	100%				Max.: Min.: Design:
10		Duration	1 Hour				Relative humidity Max.: Min.:
11							
12	Direction of rotation (view from coupling)	☐ : CW ☐ : CCW					
13	Speed range: From		To				
14	Idle Speed			RPM			
15	Loading time						
16							
17	PERFORMANCES						
18	Speed						
19	% of maximum continuous site power	110	100	75	50		
20	Fuel specific consumption kg/kWh + 0%						
21	Lubrication oil consumption g/kWh						
22	Nox Emission						
23							
24	SHOP TEST - INSPECTION				ENGINE PAINTING		
25	Shop Inspection		Non Witnessed	Witnessed	Standard		
26	By Third Party				Other		
27	Manufacturer Standard						
28	Hydrostatic				SHIPMENT		
29	Mechanical				Standard		
30	With auxiliary equipment				Sea boxing		
31	Performance				Outdoor storage		
32	Certification Test						
33							
34							
35	ACCESSORIES BY MANUFACTURER (M) OR OTHER (O)						
36	Base plate		Special tools (1)				
37	Foundation bolts		Wiring				
38	Engine fitting bolts		Battery				
39	Flywheel + Guard		Control panel				
40	Gear		fuel interconnecting piping				
41	Coupling and Guard		Walkways, Ladders				
42	Coupling bolts		Instrumentation				
43	Air ducting		Turbocharging system				
44	Exhaust ducting		Inlet air filter				
45	Explosion proof system		Fuel tank				
46	Starting system		Overspeed safety device				
47	Barring system		Oil cooler				
48	Anti-vibration device		Water cooler				
49	Auxiliary power take off		Air cooler				
50							
51	Remarks: (1) List shall be attached with Bid						
52	(2) Even for intermittent duty, equipment shall allways be designed for continuous operation						
53							
54							
55							

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		DATA SHEET		N°	
Main Title		Secondary Title		DS EP MEC 140	
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ENGINE					
CHARACTERISTICS			INLET SYSTEM		
1 Cycle: ☐ 2 Stroke ☐ 4 Stroke 2 Number of cylinders: Position: 3 Bore / Stroke: / Capacity: Liters 4 BMEP: bar 5 Piston Speed: m/s @ RPM 6 Cooling System: ☐ Air ☐ Water 7 Turbocharger: ☐ : 8 Number: Manufacturer: Model: 9 Pressure Ratio: Speed: RPM			Filter: Number: Manufacturer: Type: Turbocharging air cooler ☐ Type: Number: Manufacturer: Piping ☐ Expansion joints ☐ Supports ☐ Silencer ☐ Air Cut-off system ☐		
STARTING SYSTEM			MATERIAL		
10 : Produced by 11 Number of tanks: 12 Pressure: Bar Capacity: m³ 13 Number of starts without refilling: 14 ☐ Electrical: Total Capacity: Ah 15 Starting circuit: ☐ Single ☐ Duplex 16 Starting motor: ☐ Single ☐ Duplex 17 ☐ Hydraulic: 18 Accumulator ☐ Motor ☐ 19 Inertia: 20 Manual ☐ Motor ☐ 21 Starting: ☐ Local ☐ Remote			Frame Crankshaft Cylinders Camshaft Liners Connecting rod Tie-rods Crosshead Cylinder-head Pistons Crosshead guides Pistons rings Valves Exhaust Spark arrestor Oil cooler: Tubes Shell Oil filter element Oil heating coil Oil lubricating piping before/after filter / Bolting		
BARRING SYSTEM			FUEL GAS or LIQUID FUEL		
22 Manual ☐ Pneumatic ☐ Electrical ☐ Hydraulic ☐			Liquid Fuel or Gas analysis see attached sheet N° Required Pressure Max/Min (Barg) / Fuel gas temperature Max/Min (°C) / LHV (MJ/M³/hr)		
LUBRICATION			FUEL SYSTEM PIPING		
23 Splash system ☐ Pressure system ☐ 24 Oil Quantity l Oil Quality: 25 Pump: Main Auxiliary 26 Type 27 Flow l/min 28 Driver 29 Speed RPM 30 Power kW 31 Material			By pass and vent valve ☐ Isolation block valves ☐ Flange rating		
29 Auxiliary pump used for: 30 Pre-lube: ☐ Starting: ☐ Stand by: ☐ 31 Oil cooler: ☐ Single ☐ Duplex 32 Change-over while running: ☐ Temperature Regulator: ☐ 33 Inlet / Outlet oil temperature: / °C 34 Oil Heater: ☐ 35 Type: Electrical ☐ Other ☐ 36 Power kW Explosion Proof ☐ 37 Steam coil ☐ Consumption (l) kg/h 38 Flanges In / Out Ø / Rating / 39 Minimum Starting oil temperature °C 40 Oil tank ☐ Capacity l			GOVERNOR		
41 Remarks: (1) Indicate pressure and temperature 42 43 44 45 46 47 48 49 50 51 52 53 54 55			☐ Constant Speed ☐ Variable Speed Reset by: ☐ Pneumatic signal ☐ Electronic signal ☐ Manual Speed Range, RPM: Max. Min. Governor MFR:		
			IGNITION		
			Magneto: Type , Number Manufacturer Model Cabling: ☐ Shielded ☐ Ignition system compliant to code:		
			EXHAUST SYSTEM		
			Engine pipe outlet ☐ Spark arrestor ☐ Exhaust Silencer ☐ Exhaust silencer MFR: Shutter ☐ Expansion joint ☐ Engine exhaust manifold ☐ Watercooled ☐ Insulated Turbocharger exhaust gas temperature Catalytic exhaust system ☐		

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**General Specification****GS EP MEC 022****Rotating Machine Package Specification
Fire Fighting Diesel Driven Vertical Pump**

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		DATA SHEET		N°	
		Main Title		DS EP MEC 140	
		Secondary Title		Page 3 of 3	
FUEL SYSTEM					
1 Type ☐ Gas ☐ Liquid ☐ Complete Fuel Receiving System					
2					
3					
4 FUEL GAS ANALYSIS - Mol %					
5					
6 Composition Mol Weight Normal Starting Alternate					
7 Air 29					
8 Oxygen 32					
9 Nitrogen 38					
10 Water vapor 18					
11 Carbon monoxide 28					
12 Carbon dioxide 44					
13 Hydrogen 2					
14 Methane 16					
15 Ethylene 26					
16 Ethane 30					
17 Propylene 42					
18 Propane 44					
19 I-Butane 58					
20 N-Butane 58					
21 I-Pentane 72					
22 N-Pentane 72					
23 Hexane plus					
24					
25					
26 Total					
27 Average Mol. weight					
28 Corrosive agents PPM					
29 Contaminants PPM					
30					
31 LHV MJ/M ³ /HR					
32 Fuel pressure Max / Min. (kPaG) (BARG)					
33					
34					
35 Fuel Temperature Max/l °C					
36					
37 ☐ Fuel Pressure Required					
38 Max / Min (kPaG) (BARG)					
39					
40					
41					
42					
43					
44 FUEL SYSTEM PIPING					
45 ☐ By pass and vent valve ☐ Isolation block valves ☐ Flange rating					
46 ☐ Twin Y-Type Strainer with Continuous Flow ☐ Nace Material Standards					
47 ☐ Transfer valve					
48					
49 Remarks :					
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52					
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