

GENERAL SPECIFICATION

ROTATING MACHINERY

GS EP MEC 020

Rotating Machine Package Specification Turbopump

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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 turbopump 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 turbopump packages.

1.2 Application

This document applies to the design of all pumps packages driven by gas turbines.

1.3 General rules

All deviations from this specification or the documents referred to herein shall be stated in writing in the Appendix 5 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 ensure 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 5 of this specification.

This specification will then be issued in two steps:

- Issued "for inquiry"
- Issued "for purchase".

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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 specifications
- 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
API Std 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API Std 614	Lubrication, Shaft-sealing and Oil-control Systems and Auxiliaries
ASME PTC 22	Performance Test Codes - Gas Turbines
ASME VIII Division 1	Boiler and Pressure Vessel Code
DIN 55473	Auxiliary means of packaging - Desiccant in bag - Technical delivery conditions
IP 15	Area Classification Code for Petroleum Installation handling flammable fluids - July 2005 (3 rd edition)
ISO 21789	Gas Turbine applications - Safety
ISO 780	Packaging. Pictorial marking for handling of goods

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
NF H00-310	Industrial packagings. 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
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 this 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 5. The second level General Specifications 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 170	Materials for Sour Service (Upstream Applications) Specification for design
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
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 001	Electrical design criteria - Application restricted to Appendix 3
GS EP ELE 011	Electrical requirements for packaged units
GS EP ELE 031	Design of earthing and bonding systems

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Reference	Title
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 111	Induction motors
GS EP ELE 151	DC Uninterruptible Power Systems (UPS)
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 137	On/off valve control panels and actuators functional and construction requirements
GS EP INS 900	Instrument hook-up diagrams
GS EP MEC 101	Driver Power Sizing
GS EP MEC 212	Gas Turbines for the Petroleum, Chemical and Gas Industry Services according to API Standard 616
GS EP MEC 240	Special Purpose Couplings for Petroleum, Chemical, and Gas Industry Services according to API Standard 671
GS EP MEC 242	Special Purpose Gear Units for Petroleum, Chemical and Gas Service Industries According to API Standard 613
GS EP MEC 270	Supply of Mechanical Seal according to API Standard 682
GS EP MEC 271	Centrifugal Pumps for the Petroleum, Chemical and Gas Industry Services according to API Standard 610
GS EP MEC 281	Lubrication, Shaft Sealing and Oil Control Systems and Auxiliaries according to ISO 1438 / API Standard 614
GS EP MEC 292	Rotating Machines Packages Installation Requirements
GS EP MEC 300	Noise and Vibration of Rotating Machine Packages
GS EP PVV 102	Piping Hook-up Standards
GS EP PVV 112	Piping material classes
GS EP PVV 142	Valves
GS EP PVV 143	Metallic pipes

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Reference	Title
GS EP PVV 144	Fittings
GS EP PVV 145	Flanges
GS EP PVV 146	Bolting for piping
GS EP PVV 147	Gaskets for piping and vessels
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 412	Plate and frame heat exchanger
GS EP PVV 415	Design and fabrication of air cooler
GS EP PVV 511	Waste heat recovery unit
GS EP PVV 612	Piping and equipment subject to severe sour service. Metallurgical and welding requirements
GS EP PVV 622	Piping and equipment subject to intermediate sour service. Metallurgical and welding requirements
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. No amendment will be made to the GS EP MEC specifications since these documents are already amended in the paragraph 4.1 of this specification.

Project Documentations (to be completed by Company or Contractor)

	Designation	Rev	Reference
1	Pump system PFD (*)		
2	Pumping area 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 exclusion

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.



- "Y" 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	Pump including but not limited to				
1.1.1	Pump	As per GS EP MEC 271 and as per data sheet referenced paragraph 5 of this specification.	X		
1.1.2	Mechanical seals and seal system	As per GS EP MEC 270 and as per data sheet referenced paragraph 5 of this specification.	X		
1.1.3	Counter flanges for main process connections	Counter flanges as per GS EP PVV 112 or Project piping classes -if any-.	X		
1.2	Gas turbine as per GS EP MEC 212 and GS EP MEC 101 including but not limited to:				
1.2.1	Gas generator	As per GS EP MEC 212 and as per data sheet referenced paragraph 5.2 of this specification.	X		
1.2.2	Gas generator bellmouth strainer and associated instrumentation	As per GS EP MEC 212 paragraph 5.6.2.9.	X		
1.2.3	Gas generator cover for long period of rest	As per GS EP MEC 212 paragraph 5.6.2.9.	X		
1.2.4	Power turbine (if any)	As per GS EP MEC 212 and as per data sheet referenced paragraph 5.2 of this specification.	X		
1.2.5	Gas generator vibration and temperature monitoring	Shaft radial & axial-position sensors as per GS EP MEC 212 paragraph 5.4.7.8.2. Shaft bearings temperature sensors as per GS EP MEC 212 paragraph 5.4.7.5.	X		
1.2.6	Power turbine vibration and temperature monitoring	Shaft radial & axial-position sensors as per GS EP MEC 212 paragraph 5.4.7.8.2. Shaft bearings temperature sensors as per GS EP MEC 212 paragraph 5.4.7.5.	X		

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#	Item	Description	Required	Tag	Quantity
1.2.7	Blades and nozzle coating for marine environment	As per GS EP MEC 212 paragraph 4.10.1.1.	X		
1.2.8	Gas turbine local gauge panel		X		
1.2.9	Equipment turning gear if applicable	As per Manufacturer standard according GS EP MEC 212 paragraph 5.1.3.1.	X		
1.2.10	Leveling pads and screws	As per GS EP MEC 212 paragraph 5.3.2.3.	X		
1.3	Gas fuel system including but not limited to:				
1.3.1	Shut off valves and associated vent valve	As per GS EP MEC 212 paragraph 5.8.1.2.1.	X		
1.3.2	Fuel gas heat tracing and insulation	As per GS EP MEC 212 paragraph 5.8.1.2.1.3.	X		
1.3.3	Emission suppression system	As per GS EP MEC 212 paragraph 5.8.7.1.	Option		
1.4	On skid gas generator compressor washing system including but not limited to:				
1.4.1	Off-line washing system	Washing system including piping, injection nozzles and associated instruments & control as per GS EP MEC 212 paragraph 5.6.1.16.	X		
1.4.2	On-line washing system	Washing system including piping, injection nozzles and associated instruments & control as per GS EP MEC 212 paragraph 5.6.1.16.	Option		
1.5	Starting system including but not limited to:				
1.5.1	Starting driver	As per GS EP MEC 212 paragraph 5.1 and data sheet referenced in paragraph 5.2 of this specification.	X		
1.5.2	Auxiliary gear(s)	As per GS EP MEC 212 paragraph 5.2.1.	X		
1.6	Combustion air inlet system including but not limited to:				
1.6.1	Filter housing with all ancillaries	As per GS EP MEC 212 paragraph 5.6.	X		
1.6.2	Gas detectors associated with required logic	As per GS EP SAF 050 and GS EP MEC 212 paragraph 5.6.2.1.7.	X		
1.6.3	Set of instruments	Overall air inlet PDT, atmospheric absolute PT, atmospheric hygrometry transmitter as per GS EP MEC 212 paragraph 5.6.2.1.7.	X		
1.6.4	Air filter	As per paragraph 5.6.2 & Appendix 1 of GS EP MEC 212 .	X		
1.6.5	Anti-icing system	As per GS EP MEC 212 paragraphs 5.6.1.1 and 5.6.1.7.	Option		
1.6.6	Inlet air silencer	As per GS EP MEC 212 paragraph 5.6.2.5.	X		
1.6.7	Inlet air ducting	As per GS EP MEC 212 paragraph 5.6.1.1.	X		
1.6.8	Ladders, platforms and lifting devices	As per GS EP MEC 212 paragraph 5.6.2.1.7.	X		
1.6.9	Inlet plenum	As per GS EP MEC 212 paragraph 5.6.2.9.	X		

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#	Item	Description	Required	Tag	Quantity
1.6.10	Supporting steel structure	As per GS EP MEC 212 paragraph 5.6.2.1.9. On skid  Off skid 	X By others		
1.7	Enclosure including but not limited to:				
1.7.1	Complete enclosure frame and general assembly	As per GS EP MEC 212 paragraph 5.7.5 and paragraph 4.2.3.2 of this specification.	X		
1.7.2	Enclosure AC air ventilation system	Enclosure air ventilation system with inlet and outlet, air dampers, ducts, silencers, 2x100% Eexd fans, relevant instrumentation as per GS EP MEC 212 paragraphs 5.7.5.6, 5.7.5.6.3, 4.1.14 and paragraph 4.2.3.1 of this specification.	X		
1.7.3	Enclosure DC emergency air ventilation system	As per GS EP MEC 212 paragraphs 4.1.14, 5.4.6.1 and 5.7.5.6.3.	X		
1.7.4	Enclosure FG detection facilities	As per paragraph 4.2.3.5 of this specification and GS EP SAF 050 .	X		
1.7.5	Enclosure AC lighting system	As per paragraph 4.2.3.4 of this specification.	X		
1.7.6	Enclosure DC lighting system	As per paragraph 4.2.3.4 of this specification.	X		
1.7.7	Enclosure instrumentation and monitoring system		X		
1.7.8	Fire suppression system for turbine enclosure	As per paragraph 4.2.3.5 of this specification and as per data sheet referenced paragraph 5.2 of this specification and GS EP SAF 050 .  Water mist  CO ₂	X		
1.7.9	Lifting facilities	Lifting facilities for gas generator.	X		
1.8	Exhaust gas system including but not limited to:				
1.8.1	Exhaust stack		X		
1.8.2	Stack thermal insulation and cladding	As per paragraph 4.2.10 of this specification.	X		
1.8.3	Exhaust diffuser		X		
1.8.4	Expansion joint	As per GS EP MEC 212 paragraph 5.6.3.3.	X		
1.8.5	Exhaust silencer	As per GS EP MEC 212 paragraph 5.6.3.1.	X		
1.8.6	Provisions for lightning system (supports for rod and cable).	To be provisioned on the exhaust ducting.	Option		
1.8.7	Exhaust duct thermal insulation and cladding for personnel protection	Personnel protection wherever personnel access is allowed.	X		
1.8.8	Two 3.5" sampling points	As per GS EP MEC 212 paragraph 5.6.3.2.3.	X		
1.8.9	Continuous emission level monitoring	As per GS EP MEC 212 paragraph 5.8.7.2.	Option		

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#	Item	Description	Required	Tag	Quantity
1.8.10	Supporting steel	Supporting steel structure for all above equipment completely laid down onto package baseplate with all necessary fixation device. On skid ☐ Off skid ☐	☒ By others		
1.8.11	Ladders and platforms	Access ladder and platform to exhaust sampling connections as per GS EP MEC 212 paragraph 5.6.3.2.3. On skid ☐ Off skid ☐	☒ By others		
1.8.12	Waste heat recovery unit	As per GS EP PVV 511 and data sheet referenced in paragraph 5.7.	Option		
1.9	Power transmission equipment including but not limited to:				
1.9.1	Gearbox	As per GS EP MEC 242 and as per data sheet referenced paragraph 5 of this specification. ☐	N/A if pump direct driven. ☐	X	
1.9.2	Temperature and vibration probes	As per GS EP MEC 242 paragraph 6.4.2. ☐	N/A if pump direct driven. ☐	X	
1.9.3	LS flexible spacer type coupling	As per paragraph 4.2.4 of this specification. ☐	N/A if pump direct driven. ☐	X	
1.9.4	LS coupling guard	As per paragraph 4.2.4 of this specification. ☐	N/A if pump direct driven. ☐	X	
1.9.5	Torquemeter with complete monitoring system in UCP		X		
1.9.6	HS flexible spacer type coupling	As per paragraph 4.2.4 of this specification.	X		
1.9.7	HS coupling guard	As per paragraph 4.2.4 of this specification.	X		
1.10	Mineral lube oil system (As per GS EP MEC 281 and as per data sheet referenced paragraph 5.4 of this specification) including but not limited to				
1.10.1	Lube oil tank	As per GS EP MEC 281 part 2 paragraph 4.3.13.	X		
1.10.2	Oil mist separator	As per GS EP MEC 281 part 2 paragraph 4.3.5.1.	X		
1.10.3	Main oil pump	Driven by AC motor following GS EP ELE 111 .	X		
1.10.4	Standby oil pump	Driven by AC motor following GS EP ELE 111 .	X		
1.10.5	Post lube	Emergency oil pump driven by DC motor as per GS EP MEC 281 part 2 paragraph 4.1.19. ☐	Cool down tank made of AISI 316. ☐	X	
1.10.6	Lube oil run down tank	Made of stainless steel 316 as per GS EP MEC 281 part 2 paragraph 4.9.2.	X		
1.10.7	Lube oil cooler	Lube oil air cooler made of AISI 316 stainless steel as per GS EP PVV 415 and as per GS EP MEC 281 part 2 paragraph 4.5. If any, this cooler shall also be used for synthetic lube oil cooling. ☐	Lube oil water cooler as per GS EP PVV 412 (oil pressure above water pressure) as per GS EP MEC 281 part 2 paragraph 4.5. If any, this cooler shall also be used for synthetic lube oil cooling. ☐	X	

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#	Item	Description	Required	Tag	Quantity
		 N/A Off skid			
1.10.8	Oil filters for lube oil	Twin AISI 316 stainless steel oil filters with continuous flow transfer valve for lube oil.	X		
1.10.9	All associated piping, piping accessories and valves	All associated interconnecting piping, piping accessories and valves made in AISI 316/316L stainless steel on the whole system as per paragraph 4.2.8 of this specification. Tubing is not allowed, except for the instruments impulse lines as per GS EP PVV 102 , GS EP INS 107 and GS EP INS 900 .	X		
1.10.10	All associated instrumentation	As per data sheet referenced paragraph 5.4 of this specification, as per paragraph 4.2.6 of this specification.	X		
1.10.11	Local gauge panel	Made of AISI 316/316L stainless steel with instruments as per as per data sheet referenced in paragraph 5.4 of this specification.	X		
1.11	Synthetic lube oil system (If any) including but not limited to (as per GS EP MEC 281 and GS EP MEC 212 paragraph 4.9)				
1.11.1	Lube oil tank	Made of stainless steel AISI 316 with electrical heater.	X		
1.11.2	Main lube oil pump	Shaft driven by gas generator auxiliary gear.	X		
1.11.3	Hydraulic oil pump	Driven by gas generator auxiliary gear.	X		
1.11.4	Scavenge oil pumps	Driven by gas generator auxiliary gear.	X		
1.11.5	Lube oil cooler	As per Manufacturer standard.			
1.11.6	Filters for lube oil	Twin oil filters made of AISI 316L stainless steel with continuous flow transfer valve for lube oil.	X		
1.11.7	Filters for control oil	Twin oil filters AISI 316L stainless steel with continuous flow transfer valve for control oil.	X		
1.11.8	All associated piping, piping accessories and valves	As per Manufacturer standard.	X		
1.11.9	All associated instrumentation, including chip detector	As per paragraph 4.2.6 of this specification.	X		
1.11.10	Local gauge panel	Local control panel frame made of AISI 316/316L stainless steel showing the following information:	X		
1.12	Baseplate including but not limited to				
1.12.1	Fabricated steel common baseplate	As per paragraph 4.2.2 of this specification.	X		
1.12.2	Baseplate supports	 3 point support	X		
		4 temporary supports and jacking points as per paragraph 4.2.2.1 of this specification.  N/A if concrete foundations or multipoint rigid supports.	X		
1.13	Controls & Instrumentation including but not limited to:				
1.13.1	Terminal Junction boxes	All terminal junction boxes located at skid edge as per GS EP INS 101 and GS EP INS 107 .	X		
1.13.2	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		

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		For all other cables, junction boxes shall be provided with cable gland plates and associated cable glands.	X		
1.13.3	Instrumentation cables	All instrument cables between instruments and skid mounted junction boxes / local gauge board indicator as per GS EP ELE 161 and GS EP INS 107 .	X		
1.13.4	Instrumentation Cable trays	All necessary cables trays with covers made of AISI 316 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		
1.13.5	Shut down push buttons		X		
1.14	Electrical including but not limited to				
1.14.1	Electrical cables trays	All necessary cables trays with covers made of AISI 316 between all electrical consumers mounted on skid and the skid edge.	X		
2	OFF SKID EQUIPMENT (shipped loose)				
2.1	Fuel gas liquid detection pot with associated instruments and piping including but not limited to:				
2.1.1	Skid mounted fuel gas liquid detection pot with its associated instrumentation	As per GS EP MEC 212 paragraph 5.8.1.2.1.3.	X		
2.1.2	Liquid detection pot supporting skid with its drip pan		X		
2.1.3	3-way valve or equivalent	As per GS EP MEC 212 paragraph 5.8.1.2.1.3.	X		
2.1.4	Fuel gas calorimeter, chromatograph or Wobbe index meter	As necessary, as per GS EP MEC 212 paragraph 5.8.7.2.	X		
2.1.5	TIT	As per GS EP MEC 212 paragraph 5.8.1.2.1.3.	X		
2.2	Mineral lube oil system including but not limited to:				
2.2.1	Lube oil cooler	Lube oil air cooler made of AISI 316 stainless steel as per GS EP PVV 415 and as per GS EP MEC 281 part 2 paragraph 4.5. If any, this cooler may also be used for synthetic lube oil cooling.	N/A, located on skid. X		
2.3	Valves, instruments and piping including but not limited to:				
2.3.1	Minimum flow protection valve	Flow control valve as per GS EP PVV 112 or Project piping classes (if any), GS EP PVV 142 and GS EP INS 120 .	X		
2.3.2	Flame arrestors	As per paragraph 4.2.8.2 of this specification.	X		

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#	Item	Description	Required	Tag	Quantity
2.3.3	Interconnecting piping between the fire fighting system and the main base plate	As per GS EP PVV 112 or Project piping classes –if any-.	X		
2.4	Controls and instrumentation including but not limited to:				
2.4.1	UCP	As per GS EP INS 110 , including separate PLCs for control/safety and F&G, panel mounted HMI. Full licenses for all software.	X		
2.4.2	ICSS interface	Communication cards, relays, signal convertors, etc. to interface with ICSS and support systems (if any).	X		
2.4.3	Shut down push button	Mounted on the UCP.	X		
2.4.4	VTMS	Vibration and Temperature Monitoring System to control the complete shaft line vibration and temperature sensors integrated inside UCP.	X		
2.4.5	Load sharing control	Software and panel-mounted hardware to control the pumps load sharing, integrated inside the UCP.	Option		
2.5	Electrical				
2.5.1	DC uninterruptible power system	As per GS EP ELE 151 and Appendix 3 of GS EP ELE 001 .	Option		
2.6	Spare parts and special tools including but not limited to:				
2.6.1	Spare parts for commissioning and start up	Detailed scope is given in paragraph 8.1.1 of this specification.	X		1 set
2.6.2	Capital spare parts	Detailed scope is given in the paragraph 8.1.2 of this specification.	X		1 set
2.6.3	Special tools	Detailed scope is given in the paragraph 8.2 of this specification.	X		1 set
2.6.4	Tools trolley	Lockable trolley to carry the turbopump package tools and special tools.	X		1
3	MISCELLANEOUS				
3.1	Baseplate anchors and shims	As per paragraph 4.2.2 and Appendix 2 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	Piping	All necessary on-skid tubing / piping.	X		
3.4	Documentation	Set of documents as per Appendix 3 of this specification.	X		1 set
3.5	Package 3D model review	Review of the turbopump package 3D models for maintenance areas review as per paragraph 4.2.12 of this specification.	X		1
3.6	Maintenance laptop	Including software for UCP configuration.	X		1
3.7	Personal protection	As per paragraph 4.2.10 of this specification.	X		
3.8	Painting and coating	As per paragraph 4.2.9 of this specification.	X		
3.9	Limit flanges	All limit flanges as per GS EP PVV 112 or Project piping classes-if any- equipped with blind flanges for transportation.	X		



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#	Item	Description	Required	Tag	Quantity
3.10	Package packing and preservation	As per paragraph 9 of this specification.	X		
3.11	Earthing network	Earthing design and implementation as per GS EP ELE 031 and GS EP INS 107 .	X		
3.12	Cleaning system washing cart	Mobile washing trolley for gas turbine compressor cleaning.	X		1
3.13	Oil conditioner	Mobile trolley as per GS EP MEC 212 paragraph 4.9.5.	X		1
3.14	Lube oil system flushing kit	Kit made of all necessary flexible hoses for machinery bearings bypass.	X		X set
3.15	Walkways and ladders	Walkways and ladders to make access to any equipment mounted on the package.			
3.16	Lifting tools for the complete package	Consists of slings, shackles, and spreader bar as per paragraph 4.2.2.4 of this specification and as per GS EP STR 103 .	X		
3.17	Backup	Complete backup hard disk with application software, PLC program, HMI and any firmware prior to shipment.	X		
3.18	Software	OEM CD/DVD for any software used with full licenses.	X		
3.19	Specific climate considerations	☐ Tropicalization ☐ Winterization ☐ None	X		
4	TESTS				
4.1	Factory tests				
4.1.1	Pump	As per paragraph 7.3 of GS EP MEC 271 .	X		
4.1.2	Gas turbine	As per paragraph 6.3 of GS EP MEC 212 .	X		
4.1.3	Gearbox (if any)	As per paragraph 4.3 of GS EP MEC 242 .	X		
4.1.4	Lube oil unit(s) and lube oil cooler(s)	As per part 1 paragraph 7.3 and part 2 paragraph 7.3 of GS EP MEC 281 .	X		
4.1.5	Mechanical seals	As per paragraph 10 of GS EP MEC 270 .	X		
4.1.6	UCP	As per paragraph 7.4 and Appendix 5 of GS EP INS 110 , including communication test with the ICSS.	X		
4.1.7	Complete unit tests	As per paragraph 7 of this specification.	X		
4.1.8	Fire protection test	As per GS EP MEC 212 paragraph 6.3.5.13.	X		
4.1.9	Noise and vibration tests	As per paragraph 7 of this specification.	X		
4.2	Site Acceptance Tests				
4.2.1	Complete unit tests	As per paragraph 7.5 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.



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3.2 Exclusions

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

- Counter flanges, gasket and bolting for connecting flanges at battery limits of Vendor's supply (except pump companion flanges in Vendor's scope)
- All piping outside the package (except the interconnecting piping between the off skid fire fighting skid and the main base plate to be supplied by Vendor)
- 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 Particular specification for rotating equipment

This paragraph indicates where the Company General Specifications Project specificities are covered. The paragraphs mentioned in the following charts refer to TOTAL EP General Specifications Referential **2013**.

GS EP MEC 212		
Paragraph	Data Sheets	Project
4.1.3	X	
4.1.8		Maximum allowable emissions level:
4.1.19	X	Installation type: ☐ Indoors heated ☐ Indoors unheated ☐ Outdoors with a roof ☐ Outdoors without a roof
		Environmental conditions are reported in paragraph 6 of this specification.
4.4.1	X	Refer to Project station layout.
4.7.5.2.1		Refer to paragraph 7.6 of this specification.
4.10.1.1	X	Environmental conditions are reported in paragraph 6 of this specification.
4.10.1.14.2	X	Additional PMI testing:
5.1.1.1	X	Starting or helper driver: ☐ Required ☐ Not required
		Driver type (when required):
5.1.1.6	X	Refer to Project Documents in paragraph 2 of this specification.
5.3.2.1		Refer to paragraph 3.1 of this specification.
5.4.5.3.2		Control and instrumentation wiring: ☐ Armored cable ☐ Metal conduit
5.6.1.1		Anti-icing system: refer to 5.6.1.7. Emission control system: refer to 5.8.7.2
5.6.1.6	X	Refer to paragraph 3.1 of this specification.
5.6.1.7	X	Anti-icing system: ☐ Required ☐ Not required
5.6.1.8		Refer to paragraph 6 of this specification.

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Paragraph	Data Sheets	Project	
5.6.1.9.1		a) sodium (Na)	
		b) potassium (K)	
		c) calcium (Ca)	
		d) chloride (Cl-)	
		e) sulphate (SO4)	
		f) nitrate (NO3-)	
		g) trace metals (e.g., V, Pb, Ni, Zn)	
		h) sulphur dioxide (SO2)	
		i) ammonia (NH3)	
		j) nitrous oxide (NOx)	
		k) hydrocarbons (VOC)	
		l) hydrogen sulphide (H2S)	
		m) chlorine gas (Cl2)	
		n) hydrochloric acid (HCl)	
		o) neon (Ne)	
		p) ozone (O3)	
		q) helium (He)	
		r) methane (CH4)	
		s) krypton (Kr)	
		t) hydrogen (H2)	
		u) nitrous oxide (N2O)	
		v) carbon monoxide (CO)	
		w) xenon (Xe)	
		x) nitrogen dioxide (NO2)	
5.6.1.9.2		Refer to Project station layout.	
		Potential source of contaminants	Distance
		a) sea water, coastal water	
		b) dry lake beds	
		c) roads with heavy traffic	
		d) cooling towers at site close to the GT plant	
		e) petrochemical industry	
		f) fossil fired power plants	
		g) general chemical industry	
		h) paper and pulp industry	
		i) cement production, quarries	

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Paragraph	Data Sheets	Project	
		j) agricultural activities	
		k) production of fertilizers	
		l) mining and metallurgical activities	
		Potential contaminants	Quantity
		a) water spray, NaCl	
		b) NaCl	
		c) Particulates, VOC, SO ₂ , NO _x , chlorides	
		d) drift, thermal plume	
		e) sulphur compounds, VOC	
		f) fly ash, coal dust, SO ₂	
		g) SO ₂ , HCl, H ₂ S, NH ₃	
		h) fibers, SO ₂ , H ₂ S	
		i) CaCO ₃ , SiO ₂	
		j) particulates, nitrates, phosphates, seeds, insects, pollen	
		k) ammonia, phosphates, nitrates, calcium	
		l) particulates	
5.6.1.11	X	Refer to 5.6.1.9.1 and 5.6.1.9.2 and paragraph 6.	
5.6.1.16		On-line washing system:	☐ Required ☐ Not required
5.6.3.1.5	X	Exit stack supporting:	☐ Required ☐ Not required
5.7.1.2		Refer to paragraph 4.2.10 of this specification.	
5.7.4.2	X	Sound restrictions:	☐ Yes ☐ No
		Sound "far field" or neighborhood restriction level:	
5.7.5.6		Enclosure pressure requirement: ☐ Under pressure where the turbine enclosure is surrounded by a safe area ☐ Overpressure where the turbine enclosure is surrounded by a hazardous area	
5.8.1.1	X		
5.8.1.2.1.3		Fuel gas compression system:	☐ Required ☐ Not required

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Paragraph	Data Sheets	Project
5.8.2.2.1	X	Concentration of contaminants:
		Tar, carbon black and coke:
		Water:
		Solids:
		Naphtalene and gas hydrates:
5.8.2.3.1	X	Hydrogen sulphide:
		Sulfur dioxide:
		Sulfur trioxide:
		Total sulfur:
		Alkali metals:
		Chlorides:
		Carbon monoxide:
		Carbon dioxide:
5.8.2.4.1	X	
5.8.3.14	X	Liquid fuel heating system: ☐ Required ☐ Not required
5.8.3.15	X	Liquid fuel transfer equipment: ☐ Required ☐ Not required
5.8.4.3.1	X	ASTM fuel grade:
5.8.4.3.2	X	ASTM fuel grade:
5.8.4.3.3	X	
5.8.5.1	X	Single fuel system.
5.8.7.1		Refer to paragraph 3.1 of this specification.
5.8.7.1		Emission suppression system ☐ Required by local country regulation ☐ Not required by local country regulation
5.8.7.2		Continuous emission level monitoring ☐ Required by local country regulation ☐ Not required by local country regulation
5.8.7.4	X	Wet suppression system: ☐ Required ☐ Not required

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GS EP MEC 212

Paragraph	Data Sheets	Project
6.3.5.2.2	X	Torsional vibration measurements ☒ Required ☐ Not required
6.3.5.14		List of extra tests and inspections:

GS EP MEC 240

Paragraph	Data Sheets	Project
5.3	X	
10.3	X	Site conditions as per paragraph 6.1 of this specification.
12.5.2	X	
12.5.3	X	
13.2.2.1		Drawings as per Appendix 3 of this specification.
A.2.5	X	Site conditions as per paragraph 6.1 of this specification.
A.4.1	X	Site conditions as per paragraph 6.1 of this specification.

GS EP MEC 242

Paragraph	Data Sheets	Project
2.1.4	X	
2.1.6		Control of sound pressure level method: Refer to paragraph 4.2.10.2 of this specification for the maximum allowable sound pressure level.
2.1.10		Refer to paragraph 6.1 of this specification.
2.1.14	X	Refer to paragraph 6 of this specification.
2.1.16	X	
3.1	X	List of accessories to be supplied:
3.3.1.1	X	Gearbox mounted on:
4.1.1	X	

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GS EP MEC 242

Paragraph	Data Sheets	Project
4.3.2.2.12	X	
4.3.2.2.16		Additional speeds to be tested: Duration and data to be recorded:

GS EP MEC 270

Paragraph	Data Sheets	Project
7.2.1.4	X	
7.3.1.1	X	
8.5.5.2	X	
9.1.4		Refer to paragraph 4.2.6 of this specification.
9.6.2		Refer to paragraph 4.2.6 of this specification.
9.7.2		Refer to paragraph 4.2.6 of this specification.
9.8.3		Refer to paragraph 4.2.6 of this specification.
10.3.1.1.2	X	
J.7.2.c		Refer to Appendix 4 of this specification.

GS EP MEC 271

Paragraph	Data Sheets	Project
6.1.2	X	For site and utility conditions, refer to paragraph 6 of this specification.
		HPRT (Annex C) applicable ☐ Yes ☐ No
6.1.8	X	
6.1.14	X	
6.1.22	X	
6.1.29.1	X	
6.2	X	

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GS EP MEC 271

Paragraph	Data Sheets	Project
6.4.1.2	X	
6.4.3.1	X	
6.8.9		Additional flush port: ☐ Required ☐ Not required
6.8.13	X	
6.8.14	X	This barrier fluid refilling unit installed: ☐ on skid ☐ transportable trolley
6.10.1.6		Bearing system life calculation: ☐ Required ☐ Not required
6.11.13	X	
6.12.1.1	X	
6.12.1.5	X	
6.12.1.9	X	
6.12.1.12	X	
6.12.1.12.3	X	
6.12.4.1	X	
6.12.4.3	X	
7.2.10	X	Refer to paragraph 4.2.4 of this specification.
7.2.15		Ignition hazard assessment: ☐ Required ☐ Not required
7.3.6		Stainless steel spacer plate: ☒ Required ☐ Not required
7.3.14		Refer to paragraph 4.2.2.3
7.4.1	X	
7.4.2.1	X	Refer to paragraph 4.2.6 of this specification.
7.4.2.4	X	
7.5.2.4	X	
8.2.1.1	X	
8.2.1.3	X	
8.2.2.6	X	
8.2.2.7	X	

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GS EP MEC 271

Paragraph	Data Sheets	Project
8.2.2.8	X	
8.3.2.6	X	
8.3.3.4	X	
8.3.3.6		NPSHA no more than 110% of specified NPSHA on the data sheet: ☐ Required ☐ Not required
8.3.4.1	X	
8.3.4.3.3	X	
8.3.4.4.1		Refer to paragraph 7 of this specification.
8.3.4.5		Refer to paragraph 7 of this specification.
8.3.4.6		Refer to paragraph 7 of this specification.
8.3.4.7		Resonance test: ☐ Required ☐ Not required
8.4.1		Refer to paragraph 9 of this specification
9.1.3.6		Separated threaded solid bar thermowell: ☐ Required ☐ Not required
8.2.6.1	X	
9.2.6.4	X	
9.2.8.2		Refer to paragraph 9 of this specification.
9.2.8.3		Refer to paragraph 9 of this specification.
9.2.8.4		Refer to paragraph 9 of this specification.
9.3.9.2		Resonance test: ☐ Required ☐ Not required
10.2.5		Refer to paragraph 7 of this specification.
10.3.2.3	X	
C.3.1.1	X	
C.3.1.2	X	
J.4.1.2	X	Residual unbalance check

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GS EP MEC 281

Paragraph	Data Sheets	Project
Part 1		
4.5.2		Environmental conditions are reported in paragraph 6 of this specification.
4.6.2		List of additional inspections required:
5.1.18		List of special requirements for piping, flanges, gaskets, instruments and o-rings, valves:
5.1.32		Valves according to ☐ Vendor ☐ CPY Standard.
6.2.1.3		☐ HA motor ☐ HOA starting switch for pump ☐ Required ☐ Not Required
6.2.2.2	X	
6.2.2.4	X	
6.3.8.1	X	
6.4.2		Refer to paragraph 6 of this specification.
Part 2		
4.1.4	X	
4.4.13		Refer to paragraph 6 of this specification.
4.5.4.3		Separate supply of air cooled heat exchanger. Sizing and configuration of connections:

4.2 Particular specification for rotating equipment - Packaging

4.2.1 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.

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

- 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 will be as follows:

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

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 systems
- Emergency lube oil systems with associated power distribution panels, if any
- Turning gear systems with associated power distribution panels, if any
- Emergency lightings.

4.2.2 Package configuration

4.2.2.1 Number of package base plate supporting point and type

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

When installed on concrete foundations, package base plate shall be multipoint rigid design with jacking bolts for leveling purpose.

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When supported on 3 point:

- The location of the 3 points shall be subject to Company approval
- Package base plate shall be designed with 4 points for transportation purpose between the supporting facility fabrication yard and the site.

Package base plate shall be designed with 4 jacking points for leveling purpose and transportation support removal and 3 points installation at site. 20 mm thickness stainless steel shim packs and 50 mm thickness stainless steel sole plates of all the packages as well as anchor bolts shall be provided by Supplier.

Contractor shall install, weld sole plates of all the packages in accordance with the Project specifications and Supplier requirements (number, size, location, material, strength and tightening torque).

The supporting structure shall be machined prior to welding the soleplates.

Refer to Appendix 2 for details.

4.2.2.2 Three points base plate package configuration

3 points base plate package shall be designed to accommodate as a minimum the driving and driven machineries with associated ancillaries.

However, for special applications, Projects may specify the whole scope of supply (with the exception of loose process component) be installed and supported by the package base plate only:

Additional equipment to be installed and supported by the package baseplate:

4.2.2.3 Package base plate construction details

Package base plate design shall conform to **GS EP STR 103** to maintain alignment of the line shaft under all operating condition 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 baseplate and a steel plate continuously welded at the bottom of base plate recovering any oil spill and drain points of 2" diameter minimum.

Priority shall be given to single structural welded baseplate supporting both driver and driven equipment. In case of separated driver skid and driven equipment skid, both skids shall have machined and doweled mating surfaces. Sections shall be bolted and fitted with suitable pins to form a single continuous structurally integral skid base for single lift prior to Ex-works delivery. The design of the bolted assembly shall be subject to Company review and approval.

The consideration of a single sub-frame (or soleplate) underneath to support driver/driven skids shall be subject to Company approval.

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In any case, the complete shaft line skid mounted package shall be shipped in one piece and shall not be disassembled after the string tests.

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).

4.2.2.4 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.

4.2.3 Enclosure and associated systems

This chapter only applies to the gas turbine enclosure.

4.2.3.1 Air ventilation system

The complete air ventilation system shall be made of AISI 316L stainless steel.

Damper hinges shall be of heavy duty type and made of 316L stainless steel that does not require periodic greasing.

The air inlet ventilation duct shall be equipped with cleanable, barrier type filters.

Refer to Project specification for general arrangement layout. Scope of supply for ducting shall be clarified during bid evaluation.

Fresh air intakes to any machinery enclosure shall be located in a safe area, **at least 2 meters away from a hazardous area**, and should be up the prevailing wind from the rest of the installation.

Machinery enclosure ventilation air exhaust shall be located 5 meters at least from any machinery combustion air exhaust termination.

4.2.3.2 Gas turbine enclosure

For offshore and coastal environment, the enclosure shall be made of AISI 316L stainless steel.

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, made of AISI 316L stainless steel.

Doors shall be fitted with anti-panic handles on the inside.

Gas turbine enclosure shall be provided with a ventilation system for cooling and dilution purposes as per **ISO 21789** requirements.

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Gas turbine enclosure ventilation shall be insured by a main ventilation system backed up by a standby ventilation system.

Both main and standby ventilation systems shall be sized for 100% duty.

The standby ventilation system shall automatically start on loss of main ventilation.

Standby ventilation system (including motor starter) shall be fed from an emergency power source independent from normal power and shall be suitable for Zone 1.

For standardization purpose, electric motors used as driver for main and standby ventilation fans shall be suitable for Zone 1.

When ventilation is in operation, enclosure is considered as a safe area; however, all electrical equipment shall be suitable for Zone 2 Hazardous area.

In case of enclosure main ventilation failure, enclosure is considered as Zone 1 Hazardous area and all electrical equipment shall be de-energized, except those required to be left in operation for a safe cool down of the gas turbine and these electrical equipment shall be suitable for use in Zone 1 Hazardous area.

4.2.3.3 Machinery combustion air exhausts

Machinery combustion air 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.

4.2.3.4 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.

4.2.3.5 Fire & gas system and fire suppression system

The fire and gas system (FGS) and the fire suppression system (FSS) of the package shall comply with **GS EP SAF 050**.

4.2.4 Load couplings

Couplings shall conform to **GS EP MEC 240**.

4.2.5 Installation

The package shall be installed as per **GS EP MEC 292** requirements.

For packages to be installed on a floating structure, Vendor shall indicate the special devices installed to cope with the FPSO motions and accelerations indicated in the paragraph 6 of this specification. In any case, Vendor shall clearly indicate his layout requirements to ensure proper operation of the lube oil system and the drain system.

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Vendor scope of supply shall include a vibration study according to and if required by **GS EP MEC 300**.

4.2.6 Instrumentation

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

Thermowell design and instruments hook ups shall comply with **GS EP PVV 102** and **GS EP INS 900**.

Furthermore, machinery protection and monitoring system shall comply with paragraphs 6.4.2.2, 6.4.2.3 and 6.4.2.5 of **GS EP MEC 271**.

Supplier shall provide with its technical proposal a preliminary set of vibration and temperature P&ID and interconnecting diagram.

Junction boxes shall be mounted at 1.6 m above grating.

4.2.6.1 General

The package is categorized as "P3 type Package".

4.2.6.2 Package control system configuration

Each package unit shall be supplied with its dedicated UCP compliant with **GS EP INS 110** and **GS EP INS 135** requirements.

A separate PLC shall be used for F&G function.

The SIL requirements for the PLCs are listed in the **GS EP INS 110**.

Signals from any on package skid instrument required by the package control or F&G system, or by the ICSS, shall be wired up to dedicated junction boxes located at the package skid edges.

Interconnecting cables between UCP and skid, and in between UCP and ICSS/MCC will be supplied and installed by Contractor. Package Vendor shall adapt the number of terminals in marshalling cabinets and junction boxes to the type of multi-core cables in accordance with Contractor specifications. All spare wires shall be earthed through individual terminals, bonding is not permitted.

In addition, UCP shall include following systems:

- A vibration monitoring system
- A fire and gas monitoring system
- A fire fighting control system.

The package shall be installed as per **GS EP MEC 292** requirements including remote access for vibrations analysis system.

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4.2.6.3 Package control system philosophy

The control system of the package shall perform the main following functions:

- Sequencing
- Control
- Protection
- Monitoring and display and maintenance functions
- Pump load sharing.

4.2.6.4 Sequencing

The sequencing shall include:

4.2.6.4.1 Starting

Initiated by the Operator from the UCP panel, or/and from the central control room through ICSS Operator working station.

4.2.6.4.2 Loading

The sequencing shall include at least the turbopump ancillaries.

4.2.6.4.3 Stopping

The package may be shutdown either manually or automatically.

Manual stop shall be either:

- A normal stop leading to a cool-down stop with unloading of the gas turbine and running at idle speed for a set time to allow the gas turbine to cool before the fuel gas valves are closed
- An emergency stop leading to an immediate unloading of the gas turbine and fuel gas valves closing.

Automatic stops shall be the responses of the control system to specific malfunction conditions of the packages or of the plant.

Depending on the type of malfunction, these shutdowns shall be:

- Cool down stops identical to normal stops
- Fast stops identical to emergency stops.

4.2.6.4.4 Post lube

In all cases, after the package has come to a complete stop and a rundown timer has timed out, the post lube cycle shall start.

4.2.6.5 Monitoring and display and maintenance functions

Refer to **GS EP INS 110** relevant paragraphs.

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4.2.7 Electrical

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

4.2.8 Piping, valves and vessels

4.2.8.1 Piping, tubing and pressure vessels

The fabrication, inspection and shipment of pipes, fittings and flanges shall comply with Company piping classes **GS EP PVV 112**, **GS EP PVV 143**, **GS EP PVV 144**, **GS EP PVV 145**, **GS EP PVV 146** and **GS EP PVV 147**.

When required by **GS EP COR 170**, **GS EP PVV 612** and **GS EP PVV 622** shall apply to fuel gas system containing H₂S and CO₂.

However, Manufacturer standard piping specifications are acceptable in the package for all utility lines (oil, water, air, nitrogen) and for fuel gas lines after the Shut-Off Valve. Manufacturer standard piping specifications shall be first provided to Company for approval.

All equipment piping systems shall have flanged high point vents and flanged low point drains.

These drains and vents shall terminate with an isolating valve and a blind flange.

All interconnecting piping shall be identified and tagged.

All on-skid piping shall be correctly supported to avoid piping unacceptable vibration.

A single block and bleed valve assembly shall be installed in each instrument take-off connection, except thermowell and vibration probes, and shall be located as close to the parent pipe or equipment as possible.

Double block and bleed valve assemblies instead of single block and bleed shall be provided when normal operating pressure is over 70 barg (normal operating pressure is the highest normal operating pressure of all process cases when the plant operates at steady state conditions).

Take-off connections, including the first valve shall be in accordance with the General Specifications and/or Project piping specification.

Each air-consuming instrument shall be provided with an AISI 316 filter regulator fitted with an AISI 316 pressure gauge and an AISI 316 isolating valve (refer to **GS EP PVV 102**, **GS EP INS 137** and **GS EP INS 900**). Instrument air tubing shall be made of AISI 316L. Fittings and accessories shall be made of AISI 316L stainless steel.

Threaded connections on any pipework or vessels are not permitted, except tapping points on instrument air distribution header(s).

Pressure vessels as defined per **ASME VIII Division 1** paragraph U.1 shall be designed as per **GS EP PVV 211** and shall be certified by an authorized agency agreed by the Company. ASME U stamp is not required.

Any required cleaning of piping systems and/or vessels at Vendor's facilities shall comply with **GS EP PVV 175**.

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4.2.8.2 Vents

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

Oil fume vents shall be provided with oil demisters and flanged flame arrestors with internals made of AISI 316L stainless steel.

Gas vents to atmosphere shall be provided with flanged flame arrestors with internals made of AISI 316L stainless steel.

4.2.8.3 Baseplate drains

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

The drains relevant to the combustion air system and gas turbine washing system shall be routed separately from other drains at the skid edge or to a more appropriate location to be agreed with Contractor.

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

4.2.9 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
- 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.

4.2.10 Health Safety and Environment

4.2.10.1 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.

Combustion air exhaust ducting located in a restricted area shall be insulated in such a way to limit their skin temperature at 80% of the ignition point temperature, of the hydrocarbon mixture that can be present in the Hazardous area. By default, the surface temperature shall not exceed 200°C (corresponding to ATEX requirement for T3 skin temperature).

4.2.10.2 Noise level

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

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All efforts shall be deployed to limit the average sound pressure level around the turbopump package (and lube oil air coolers located off the main package skid) at 90 dB(A) at one meter.

However and in any case, no external noise attenuation devices and/or enclosures are allowed on the pump and gearbox.

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

- Pump package
- Driver inlet filter and exhaust
- Lube oil coolers (if located outside the main package skid).

For centrifugal pumps, the maximum sound pressure levels required shall be respected even during the operation at maximum flow.

4.2.11 Miscellaneous

4.2.11.1 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
- Piping bolting shall be in compliance with **GS EP PVV 112** and **GS EP PVV 146**.

4.2.11.2 Interconnections

The package shall be designed to maximize factory assembly and testing, thus simplifying and reducing to a minimum installation and commissioning operations.

The package shall be wired and designed to ensure minimum installation operations on site. All external connections shall be brought to skid edge:

- Within interconnecting junction boxes for instruments and controls, except for the electric motors and heaters power cables. Segregation shall be as per **GS EP INS 110** requirements
- With flanges for piping, as per **GS EP PVV 112**, and with counter flanges and associated bolting for pump main flanges (the drawing of these counter flanges shall be submitted to Company for approval)
- Each utility which is interfaced between the Supplier and Company shall be routed through a manifold to a single point.

Interconnecting instruments junction boxes shall be provided with cable gland plates and associated cable glands.

For DC connection (if any), intermediate junction box shall be provided by Vendor, if required to accommodate Company interconnecting cables.

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Any structure or item not installed for the transportation shall in any case be fully erected in the Supplier's workshop, match-marked for ease of reassembly at site.

In addition the package shall be suitable for an exposure to firewater (sea water, when located on offshore site) deluge.

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

4.2.11.4 Rotation arrows

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

4.2.12 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.

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.

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The inspections shall be conducted according to the Project ITP. As a minimum, the requirements reported in Appendix 4 shall apply. The weight control shall be performed as per **GS EP STR 001**.

4.2.14 Engineering documentation language and units

The engineering documentation shall be developed as follows:

Language: English and

Units:

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Date:**5. Data Sheets****5.1 Pump**

Reference / Revision: /

5.2 Gas turbine

Reference / Revision: /

5.3 Gearbox (if any)

Reference / Revision: /

5.4 Mechanical seal and lube oil system

Reference / Revision: /

5.5 Noise

Reference / Revision: /

5.6 Weight

Reference / Revision: /

5.7 Waste heat recovery unit

Reference / Revision: /

5.8 Data sheets templates

Each data sheet requested in the VDR enclosed in the Appendix 3 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

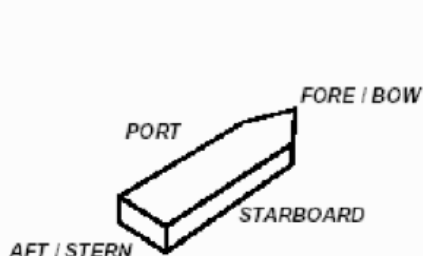
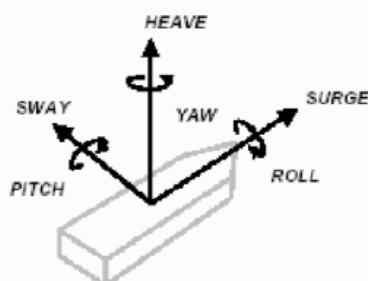
Equivalent static pressure (mbar)

CLASSIFICATION TYPE AREA
OPERATIONAL DESIGN CONDITIONS

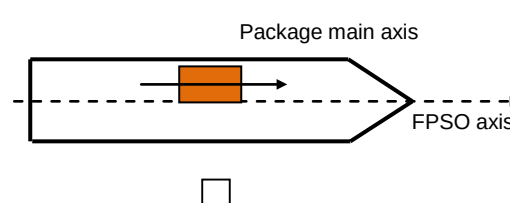
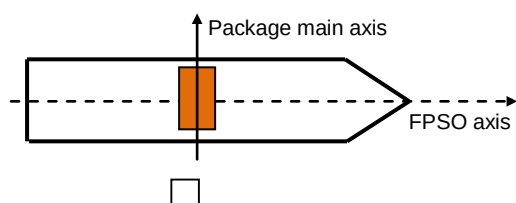
Project Phase:	During towing	On site	On site	
Condition:	Dry	Operating	Damaged	
Longitudinal acceleration (Surge)				m/s ²
Transversal acceleration (Sway)				m/s ²
Vertical acceleration (Heave)				m/s ²
Trim angle (Pitch)				°
List angle (Roll)				°

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


FPSO Orientation

FPSO Movement definition
TECHNICAL ROOM ENVIRONMENTAL CONDITIONS

The environmental conditions of technical room in which the UCP will be installed are specified in the document revision .

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 and NITROGEN

Type	Instrument Air	Nitrogen	
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
Minimum inlet temperature			°C
Maximum inlet temperature			°C
Minimum outlet temperature			°C
Maximum 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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HOT WATER SYSTEM

Type	Main Process	Topsides Service	Hull Service	
Normal inlet temperature				°C
Minimum inlet temperature				°C
Maximum inlet temperature				°C
Minimum outlet temperature				°C
Maximum outlet temperature				°C
Supply pressure				Barg
Max allowable delta P				Bar
Calorific capacity				kJ/kg°C
Fouling factor				m ² .°C.h/kcal

FLARE

Type	HP	LP	
Max operating temperature			°C
Normal temperature			°C
Max operating pressure			Barg
Normal pressure			Barg

FUEL GAS

See gas turbine data sheet.

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7. Tests

The scope of this chapter is to describe the performance tests (pump and gas turbine) and the string test to be carried on the completely assembled turbo pump package in Vendor facilities before unit shipment.

The scope of these tests is to verify the satisfactory performance of the centrifugal pump and of the gas turbine, to demonstrate the satisfactory mechanical behavior of the complete pumping train under full load conditions and to demonstrate the functionality of the main auxiliary systems of the package.

The pump performance tests may also be performed prior to the string test with testbed equipment. However, pump performance test during string test shall be privileged.

Note: An [ASME PTC 22](#) test shall be carried out on all gas turbines in accordance with [GS EP MEC 212](#), before performing the complete package test.

As a reminder, the following sequence must be performed for gas turbines:

n packages		1	n-1	Fuel	Test objectives	Duration	Required by
Gas turbine							
1	Gas generator test*	Standalone @ Vendor's	Standalone @ Vendor's	Gas	Thermodynamic and mechanical performance check	Vendor's standard (minimum 1 hour)	GS EP MEC 212
2	Power turbine Spin test**	Standalone @ Vendor's	Standalone @ Vendor's	N/A	Mechanical performance check	Vendor's standard	GS EP MEC 212
3	Gas turbine API Std 616 MRT***	Standalone @ Vendor's	Standalone @ Vendor's	Gas	Mechanical performance check	Minimum 4 hours	API Std 616
4	Gas turbine PTC 22***	Standalone @ Vendor's	Standalone @ Vendor's	Gas	Thermodynamic performance check	As per PTC 22	GS EP MEC 212
Package							
1	Package full load string test	Yes	No	Gas	Functional and mechanical performance check	Refer to this specification	This specification
2	Package no load string test	No	Yes	Gas	Functional and mechanical performance check	Refer to this specification	This specification

* Including spare gas generator

** Including spare power turbine

*** Including spare gas turbine

In the previous chart, "standalone @ Vendor's" means that the test will be performed with the gas turbine alone, i.e. not in string test configuration.

The following tests shall be carried out on the completely assembled package:

- Pre-test activities
- Centrifugal pump performance test as per [GS EP MEC 271](#)

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- Package full load string test in full speed, full power. This activity shall include the functional test of all the main auxiliary systems of the package and package vibrations measurements if required by **GS EP MEC 300**
- Special tools test
- One fully assembled package shall be weighted before packing and shipment.

The fully assembled and erected turbo pump package shall consist of the following main Project components:

- Gas turbine fully assembled with all the relevant auxiliaries:
 - Auxiliary gear
 - Starting equipment
 - Lube-oil system
 - Hydraulic oil system
 - Gas fuel system (including KO pot and associated instrumentation)
 - Atomizing air system
 - Intake system (with filters chamber and silencers)
 - Exhaust system (with duct and silencers)
 - Enclosure with the associated equipment (including ventilation system and gas detection and fire suppression systems)
 - Fire protection
 - Anti-icing.
- Centrifugal pump fully assembled including all the auxiliary sealing system and lube oil piping
- Increasing/reducing speed gearbox (if applicable)
- Common base plate fully assembled
- Couplings and torque meter (if applicable)
- Mineral and synthetic (if applicable) lube oil console including lube oil coolers
- Mineral and synthetic (if applicable) lube oil console interconnecting piping (if lube oil system is installed on common base plate)
- Gas turbine and centrifugal pump Control Panels (UCP) including fire and gas system
- Gas turbine fire suppression system
- All the instrumentation
- All the support structures for combustion and ventilation air systems and for exhaust system.



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The following main shop items shall be used for the string test:

- Water coolers for test process cooling
- Automatic acquisition system (for process and machinery data)
- All the equipment necessary for test conduction (piping, throttling valves, motors control center etc.).

Project special tools shall be used for unit erection.

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

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 right after each test activity for Contractor inspection record.

The following minimum information shall be clearly indicated in the completely assembled turbo pump package test procedure for Contractor quick reference during the test:

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Gas Turbine

Mineral lube oil type			
	Unit	Min	Max
Mineral lube oil pressure	barg		
Mineral lube oil temperature	°C		
Synthetic lube oil type (if applicable)			
	Unit	Min	Max
Synthetic lube oil pressure (if applicable)	barG		
Synthetic lube oil temperature (if applicable)	°C		
Gas Generator speed range (if applicable)	rpm		
Power turbine speed range	rpm		
Power turbine 100% speed	rpm		
	Unit	Alarm	Trip
Casing seismic vibration at maximum continuous speed	mm/s		
Shaft radial vibration unfiltered peak to peak (*)	μm		
Journal bearings white metal temperature(*)	°C		
Thrust bearings white metal temperature (*)	°C		

(*) If any, this information shall be indicated for both Gas Generator and Power Turbine.



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Gearbox (if applicable)

Lube oil type			
	Unit	Min	Max
Lube oil pressure	barg		
Lube oil temperature	°C		
Low speed shaft speed	rpm		
High speed shaft speed	rpm		
Gear Ratio			
	Unit	Alarm	Trip
Journal bearings white metal temperature	°C		
Thrust bearings white metal temperature	°C		
Low speed shaft radial vibration unfiltered peak to peak DE	μm		
Low speed shaft radial vibration unfiltered peak to peak NDE	μm		
High speed shaft radial vibration unfiltered peak to peaked DE	μm		
High speed shaft radial vibration unfiltered peak to peak NDE	μm		

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Pump

Lube oil type			
	Unit	Min	Max
Lube oil pressure (journal bearings)	barg		
Lube oil pressure (thrust bearing)	barg		
Lube oil temperature	°C		
Lube oil supply header pressure	barg		
Lube oil supply header temperature (set point)	°C		
100% speed	rpm		
Maximum continuous speed	rpm		
Minimum operating speed	rpm		
	Unit	Alarm	Trip
Journal bearings white metal temperature	°C		
Thrust bearings white metal temperature	°C		
Shaft radial vibration unfiltered peak to peak DE	µm		
Shaft radial vibration unfiltered peak to peak NDE	µm		
Shaft axial displacement	mm		

Mechanical Seal System

	Unit	Min	Max
API plan			
Mechanical seal leakage	l/h		
Mechanical seal consumption	l/h		

7.1 Pre-test activities

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

- Calibration of all job instruments. Relevant calibration certificates shall be available at the time of the test for Contractor review. Spot checks of instruments calibration shall be required before test commencing
- Instrumentation and electrical equipment insulation and continuity tests
- Control loops check and functional test
- Safety and protection devices operational checks

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- Serial link test
- Equipment tagging and labeling check
- Mechanical equipment alignment check
- Leakage tests
- Lube oil system flushing and cleanliness tests according to [API Std 614](#) Annex D.3
- Verification of the dynamic stiffness of the test bench if required by, and as per [GS EP MEC 300](#)
- Direction of rotation check.

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 Centrifugal pump [API Std 610](#) performance test

The pump performance tests shall be carried out according to [GS EP MEC 271](#) to demonstrate the satisfactory performance of centrifugal pump.

If more than one identical turbo pump packages are supplied, this test shall be carried out on all units, including spare cartridge, if any.

This test shall be carried out operating the pump in a dedicated closed loop.

The test procedure shall include a summary table (see below) clearly indicating [API Std 610](#) performance test conditions for each guaranteed point as well as the corresponding site conditions.

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	Unit	Guaranteed Conditions	Measured Value	Deviation Test/Guaranteed	Limits
Specific Gravity					
Speed	rpm				Exhibit D
Suction Pressure	barA				
Suction Temperature	°C				
Flow Rate	m ³ /h				Exhibit D
Differential Head	m				Exhibit D
NPSH 3%	m				Exhibit D
Discharge pressure	barA				
Discharge Temperature	°C				
Efficiency	%				Exhibit D
Absorbed Power	kW				Exhibit D

The test procedure shall cover as a minimum the following requirements:

- A minimum of 5 test points evenly spaced from shut-off to maximum flow on the speed line corresponding to the guaranteed point. One of the five points shall correspond to the guaranteed point
- A minimum of 5 points evenly spaced from shut-off to maximum flow at maximum continuous speed and at minimum operating speed.

In addition to the readings necessary for the performance test, a complete set of mechanical readings, including vibrations spectra, shall be taken for each test point.

A FFT real time analyzer shall be available during the test allowing checking the vibration spectra anytime.

7.3 Package full load test

This test shall be carried out to demonstrate the satisfactory mechanical behavior of the complete package under full load conditions and to demonstrate the functionality of the main auxiliary systems of the package.

If more than one identical turbo pump packages are supplied, this test shall be carried out on all units.

This test shall be carried out according to the following test sequence.

1. Cold start up of the unit with minimum lube oil temperature (permissive to start temperature).
2. Increase the speed up to pump minimum operating speed (MOS) and take a complete set of mechanical readings. Set the pump discharge valve to place the operating point in the middle of the operating envelope.

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3. Increase the speed by 10% increments up to pump maximum continuous speed (MCS) and take a complete set of mechanical readings for each speed increment.
4. Run at maximum continuous speed for minimum 30 minutes. Take a complete set of mechanical readings every 10 minutes.
5. Adjust pump process conditions to perform pump performance test as described in data sheet referenced paragraph 5.1.
6. If the performance test has already been performed with the test bed equipment, then record two operating points at two different speeds to crosscheck the performance results.
7. Set the process conditions for the 4 hours endurance test at full speed full load. For this endurance test, the lube oil shall be at maximum temperature.

During this test a complete set of mechanical readings shall be taken every 15 minutes.

During this test all the job filters, pumps, fans and coolers shall be subject to a changeover test. No trip of the unit shall occur during this activity.

1. Trip, wait 30 minutes, and restart the unit bringing the speed up to maximum continuous speed. The trip may be obtained simulating a train over speed, a lube oil low pressure etc.
2. Shut down the unit by a normal stop. Record the rundown time of the machine.

The following verifications/measurements shall be performed during the string test:

- Verify correct location of the emergency stops
- Ensure that there is no piping vibration
- Verify cleanliness report of the lubricating oil
- Measure the seal consumption
- Noise emissions shall be measured and recorded according to the testing procedure proposed by Vendor and approved by Contractor. Noise measurement shall be performed in accordance with **GS EP MEC 300** for all equipment
- Base plate vibrations measurement and recording according to (if required by) **GS EP MEC 300**.

7.4 Post test inspections

The following inspections shall be performed after the test:

- Post test inspection of the pump shall be as per **GS EP MEC 271**
- The gas turbine shall be subject to a boroscopic inspection.

7.5 Site acceptance test

All packages shall be submitted to Site Acceptance Tests (SAT) including a performance test done with the field instrumentation and additional, mutually agreed Contractor instruments, in order to check that the packages comply with the Exhibit D guarantees.

Vendor shall submit a site acceptance test procedure for Company approval. The final test program shall be issued at the ex-works delivery.

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The test program shall be established using the following requirements as a minimum:

7.5.1 Pre-test activities

As a minimum, the following activities shall be performed prior to SAT.

- Lube oil circuit cleaning and cleanliness test according to [API Std 614](#) annex D3
- Safety and protection devices operational checks
- Calibration of all Project instruments
- Control loops check and functional test
- Serial links test
- Instrumentation and electrical equipment insulation and continuity tests
- Mechanical equipment alignment check
- Test run of the turbopump
- These activities are carried out under the responsibility of the Vendor.

Note: These checks shall be part of Company's pre commissioning and commissioning and start-up procedures.

7.5.2 Test conduction

The purpose of this test is to demonstrate that the package exhibits a sound mechanical behavior **and** complies with the Exhibit D guarantees during 72 hours continuous run.

In particular, the following activities shall be done during the 72 hours:

- Pump performances evaluation following the below methodology:
 - The test shall be conducted following the [API Std 610](#) requirements. In case the [API Std 610](#) requirements cannot be fulfilled, the test conditions shall be agreed with Company
 - The analysis of the guarantee point(s) will be done through the capture of three (3) test points (one on the guarantee flow, one on the guarantee flow minus 4% and one on the guarantee flow plus 4%)
 - The verification of the pump operating range will be done on the iso-speed of the guarantee point. In case of multiple guaranteed points, this step of the test shall be conducted for the point having the highest rotating speed. Five (5) test points will be captured (three on the guarantee point as per the above, one close to mini flow and one at the maximum flow).
- Gas turbine performances evaluation following the below methodology:
 - The pump shall be loaded in order to act as a brake for the gas turbine and in order to reach the maximum gas turbine available power at ambient temperature during the test
 - The gas turbine shaft power shall be calculated taking into account the pump global absorbed power (hydraulic power plus mechanical losses) and the power losses of the gearbox (if applicable)

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- The test shall be performed in new and clean conditions meaning within the 200 operating hours after acceptance test otherwise performance derating curves (to be provided by Vendor) shall apply
- Test analysis will be carried out with the gas turbine current performances curves provided by Vendor
- Verification of the mechanical behavior of the complete shaft line running at maximum available power at ambient temperature during the test and maximum continuous speed
- Measurement of the NOx, CO, unburned HC emissions levels (for low emissions gas turbines only) by the package EMS. In case the EMS is not supplied in the package, the Vendor shall provide a portable stand alone measuring device for the duration of the test).
- Waste Heat Recovery Unit test:
 - This test shall be performed during the performance test of the gas turbine to which the WHRU is connected.
 - The purpose of the site performance test is to verify the overall operational performances of the WHRU and to check that there is no apparent problem.
 - The WHRU test procedure shall be validated by Company prior to the beginning of the tests. This procedure shall clearly indicate if specific running conditions out of normal Acceptance Test program of the gas turbine are required.
 - A representative of the WHRU Vendor shall attend the test.
 - He shall provide a test report showing test recorded data versus the expected values from the data sheet. Any deviation to the expected values shall be clarified and explained.
 - All the reserves from Company shall be put in the report which shall be signed by the following parties:
 - . Company
 - . Gas turbine Vendor representative
 - . WHRU Vendor representative.
 - As a minimum the following site data shall be recorded.
 - . Process data on the exhaust gas side and on the heating medium side with a simplified thermal calculation showing that the WHRU delivers the expected thermal duty
 - . Pressure drop on the exhaust gas side
 - . Pressure drop on the heating medium side
 - . Noise level (as part of the overall noise level assessment procedure of the complete package: gas turbine, driven machine, WHRU).
 - The report shall also include an assessment of the overall condition of the WHRU. This includes but is not limited to:
 - . Aspect of the external painting system

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- . Infra Red (using an IR camera and its dedicated software) examination of the entire casing to detect hot spots
- . Abnormal displacements or vibrations (including the stack)
- . Exhaust gas leaks through gaskets or through the packing of the bundle
- . Leak of the heating medium.
- . Proper running conditions and leakage rates of the bypass.
- The test of the dual damper system for the fail safe position shall be performed.
- After the completion of the gas turbine test, an internal inspection of the WHRU shall be performed to assess the condition of the thermal insulation cladding and to verify that all internal parts are properly hold in place.

The management of the SAT shall be as per the following scheme:

- SAT preparation by the Contractor (including the coordination with FO to implement the package test procedure in the production environment)
- Package test procedure by the Vendor
- Conduction of the test by FO based on the process conditions requirements given by the Vendor and the Contractor
- The package remains under the Vendor's responsibility during the SAT.

All the equipment necessary to perform the site acceptance tests shall be provided by the Contractor.

In case of any trip caused by any component of the package itself, the complete 72 hours shall be repeated from the beginning. In case of any trip caused by any external source (process, external power supply, etc.), the test shall be restarted from the point of interruption.

7.5.3 Post-test activities

After the SAT, the following activities shall be performed:

- Removal of the temporary strainer.
- Vendor shall supply a detailed SAT report including as a minimum the following elements:
 - List of the instruments used during the test
 - Gas analysis reports (process gas and fuel gas)
 - Test points log sheets
 - Thermodynamic calculations summary for each test data point (including, but limited to, fuel gas consumption, NOx, CO, unburned HC emissions...)
 - Summary chart of the package performances converted from the test to the Exhibit D conditions.

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7.6 Acceptance criteria

The acceptance criteria for pump [API Std 610](#) performance test and gas turbine [ASME PTC 22](#) performance shall be those indicated in the Exhibit D of the Contract.

The following tables summarize the mechanical acceptance criteria for the centrifugal pump, the gearbox (if applicable), the gas turbine and the base plate which are applicable to the whole complete unit string test (including site acceptance test).

Centrifugal pump, gas turbine and gearbox (if any) vibrations:

Gearbox Low speed shaft radial Vibrations (µm pk to pk)	Gearbox High speed shaft radial Vibrations (µm pk to pk)	Centrifugal pump Radial vibrations (µm pk to pk)	Power turbine Radial vibrations (µm pk to pk)
$25.4 \times \sqrt{\frac{12000}{N}} \times \sqrt{2}$ Or 36 Whichever is less	$25.4 \times \sqrt{\frac{12000}{N}} \times \sqrt{2}$ Or 36 Whichever is less	$\sqrt{\frac{5200000}{N}}$ Or 50 Whichever is less	$25.4 \times \sqrt{\frac{12000}{N}} \times \sqrt{2}$ Or 36 Whichever is less

Any stable discrete, non synchronous vibration exceeding 20% of the allowable vibration as defined above shall be cause of rejection of the package.

Any unstable non synchronous vibration shall be cause of rejection of the package.

Centrifugal pump, gas turbine, gearbox (if any) journal and thrust bearing temperatures:

		Bearings metal temperature					
		Gearbox		Centrifugal pump		Power turbine	
Oil Inlet temperature (°C)	ΔT On bearings return lines (°C)	Journal (°C)	Thrust (°C)	Journal (°C)	Thrust (°C)	Journal (°C)	Thrust (°C)
50	25	90	90	85	90	85	90
60	25	100	100	95	100	95	100

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Absolute vibrations:

- 3 points support:

		On bearing housings (mm/s rms)	On connecting point of the main rotating equipment to the baseplate (mm/s rms)	On connecting points of the baseplate to the test bench support (mm/s rms)
Gas turbine	Aero design	Gas generator: 6.3 Power turbine: 4.5	Gas generator: 6.3 Power turbine: 4.5	3.5
	Other	4.5	4.5	
Pump		Refer to API Std 610 , table 7 and Fig. 29	3.5	
Gearbox		3.5	3.5	
		In all directions From 10 Hz up to 1000 Hz		

- Multipoint rigid supports:

		On bearing housings (mm/s rms)	On connecting point of the main rotating equipment to the baseplate (mm/s rms)	On connecting points of the baseplate to the test bench support (mm/s rms)
Gas turbine	Aero design	Gas generator: 6.3 Power turbine: 4.5	Gas generator: 6.3 Power turbine: 4.5	2.3
	Other	4.5	4.5	
Pump		Refer to API Std 610 , table 7 and Fig. 29	2.3	
Gearbox		2.3	2.3	
		In all directions From 10 Hz up to 1000 Hz		

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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

The Vendor shall provide the spare part lists on Company SPL forms, fully filled up. Company will provide electronic format of these SPL forms.

All spare parts shall have protective coatings applied and be uniquely packed and tagged.

Packing shall give protection for up to 18 months outside storage.

The Vendor shall be fully responsible for all claims attributable to unsuitable or unsatisfactory packing and protection.

Spare parts shall be separately crated from turbopump loose items.

8.1.1 Commissioning and start-up spare parts

Supplier shall include in the scope of supply spare parts for commissioning and start up, covering the whole scope of supply of one turbopump package, and taking into account the number of pumping units to be delivered:

- Recommended spare parts for driver
- Recommended spare parts for gearbox, if any
- Recommended spare parts for pump
- Recommended spare parts for any auxiliaries of the here above machinery's.

As a minimum the following spare parts shall be included in the Supplier scope of supply (quantity for 1 or 2 pump trains installed, to double if more than 2 pump trains are installed):

- Ten (10) sets of filter cartridges for any filters of any oil systems,
- Ten (10) sets of filter cartridges for any filters of the fuel gas system
- For pump:
 - Two (2) sets of O'rings for the pump cartridge
 - Two (2) off mechanical seal cartridges (Drive End and Non Drive End)
 - One (1) off power coupling
 - One (1) set of calibrated screws for the power coupling
 - One (1) set of journal bearings pads
 - One (1) set of thrust bearing pads
 - One (1) set of bearing housing dynamic seal
 - Two (2) off vibration probes.

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- For the UCP:
 - One (1) power supply card
 - One (1) digital input card
 - One (1) analog input card
 - One (1) digital output card
 - One (1) analog output card
 - One (1) communication interface card.
- For the UCP fire and gas system:
 - One (1) FG detector of each type
 - One (1) FG power supply card
 - One (1) FG digital input card
 - One (1) FG analogue input card
 - One (1) FG digital output card.
- For the UCP machinery vibration system:
 - Five (5) sensors of each type
 - One (1) monitoring power supply card
 - One (1) monitoring card of each type
- Miscellaneous:
 - Five (5) IS barriers of each type
 - Five (5) relays of each type
 - Two (2) fuses of each type
 - One (1) UCP HMI screen.

All parts used during this commissioning/startup phase shall be replaced to complete the Capital spare parts list hereafter.

8.1.2 Capital spare parts

The following Capital spare parts shall be included in the Supplier scope of supply (quantity for 1 or 2 turbopump skids, quantity to be agreed if more than 2 pumps)

- For gas turbine:
 - One (1) spare gas generator with N2 pressurized and pressure monitored steel container
 - One (1) complete free power turbine with N2 pressurized and pressure monitored steel container
 - One (1) gas turbine starter (hydraulic motor and clutch assembly, if any, or electric motor)

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- One (1) fuel gas metering valve (one per valve type in case of Low Emission type)
- One (1) fuel gas metering valve driver card
- One (1) set of primary and secondary shut off fuel valves
- One (1) set of fuel burners
- Two (2) sets of pre filters and high efficiency filters of the gas turbine air inlet systems.
- For pump:
 - One (1) pump complete cartridge, including bearings and mechanical seals, with N2 pressurized and pressure monitored steel container.
- For gearbox, if any:
 - One (1) set of low speed and high speed shaft main load couplings
 - One (1) set of bull and pinion gears with N2 pressurized and pressure monitored steel container
 - One (1) set of gearbox journal and thrust bearings.
- For couplings:
 - One (1) coupling.
- For lube oil system:
 - One (1) set of AC lube oil pump and motor, if any
 - One (1) set of DC lube oil pump and motor, if any.
 - One (1) temperature control valve.

8.2 Special tools

All special tools required for the site installation, commissioning and maintenance of the package and their auxiliaries shall be furnished.

All special tools required to perform the following activities shall be provided:

- Erection, operation and maintenance: these tools will remain the property of Company
- Commissioning: These tools will be sent back to Supplier at his own cost.

As a minimum the following shall be supplied:

- For erection, operation and maintenance:
 - All necessary spreader bars and slings to lift into position the unit
 - Jigs for shaft alignment
 - Bolt tensioning or torquing devices for pump
 - Hydraulic cartridge removal system including rotor handling facilities, i.e. spreader bar, slings, runners, beams, etc.
 - Removal tool kit for any main load coupling

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- Thrust bearing removal kit
- Handling and lifting equipment (extended beam with trolley) for gas generator and power turbine removal and installation
- Free power turbine manual barring device for boroscope inspection, if required
- Gas Turbine special tools
- Driven equipment special tools
- Recharging kit for any blade accumulator
- Pump erection tools
- One stand for gas generator removal
- One stand for power turbine removal, when required.
- For PLC based control systems, a programming console with a personal laptop, as applicable, shall be supplied complete with:
 - Development software
 - Application programs
 - Diagnostic software
 - Cord sets i.e. power supply and link with PLC's CPU
 - All rack-mounted control equipment shall be supplied with their extension cards. Cards to be inserted between rack mother boards and control cards for trouble shooting purpose
 - Calibration kits for each type of fire and gas sensors.
- For site commissioning and start up:
 - Vibration probe calibrations equipment (wobulator)
 - Portable multi channel analyzer
 - Digital voltmeter
 - Proximitior
 - Portable particles counter
 - Portable electronic RPM counter
 - Millivolt and milliamp sources
 - DC power supply
 - Variable resistor
 - Pneumatic pressure pump.
- Flushing kits for all lube oil systems consisting of:
 - Portable electric pump unit when the pumps of the systems are not AC electrical driven
 - Hoses and flange adapters to bypass all bearings and to establish flushing circuits



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- Flushing blocks for electro-hydraulic servo-valves
- Screen mesh or equivalent.

A detailed list with comprehensive identification, part number, tool drawing and application tool drawing shall be provided during Contract stage.

Any tools, standard and special, required to perform the pre-commissioning and commissioning activities at the Supplier premises shall be provided.

All special tools shall be properly identified and tagged.

Their functionality shall be described in the operating manuals.

Supplier shall provide a lockable weatherproof container for storage of special tools fitted with shelves and bench with vice.

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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 equipments 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 equipments 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 spare 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 and VPI 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 tight.

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 Gas turbine (gas generator and power turbine)

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

- Engine Soak wash, rinsing from washing detergents, drying and inhibiting
- Draining of liquid such as water, diesel, lube oil from systems
- Drying of systems
- Cleaning of reservoirs with lint-free rags
- Spaying 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 lube oil system
- Insertion of desiccant product inside the reservoir and under weather protection envelop by mean of desiccant bags
- Preservation from foreign matters entrance by blinds
- Sealing of openings.

9.1.2 Gearbox

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

- Draining of liquid such as water, lube oil from systems
- Drying of systems
- Cleaning of reservoirs with lint-free rags
- Spaying of Tectyl™ or VCI in the reservoir and casing
- Spaying of Tectyl™ or VCI on the gear teeth
- Insertion of desiccant product inside the gear casing by mean of metallic basket welded to the closing blinds
- Preservation from foreign matters entrance by blinds
- Sealing of openings.

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9.1.3 Pumps

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

- Draining of liquid such as water, lube oil from systems
- Drying of systems
- Cleaning of reservoirs with lint-free rags
- Spaying 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
- Preservation from foreign matters entrance by metallic blinds
- Sealing of openings.

9.1.4 Instrumentation and electrical auxiliaries

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

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

9.1.5 Control panels

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

- Draining of liquid such as water, where needed
- Drying of systems
- Cleaning of panels with lint-free rags
- Packing of all equipments not rack mounted
- Insertion of desiccant product inside the control panel, by means of soft bags
- Preservation from foreign matters entrance by metallic blinds
- Positive locking of all doors
- Sealing of openings.

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9.1.6 Auxiliaries

The package auxiliaries generally include piping, filters, coolers, heat exchangers, heaters, valves, tanks, boosters, ducting, structural frames, walk ways, ladders and stairs, equipment needed for the operation of the package and not herewith listed.

- Draining of liquid such as water, lube oil from systems where required
- Drying of circuits
- Cleaning of reservoirs lint-free rags
- Spraying of Tectyl™ or VCI in the air system
- Spraying of Tectyl™ or VCI in the water cooled system
- Spraying of Tectyl™ or VCI in the lube oil system
- Spraying Water resistant wax Tectyl™ and wrapping on all non painted interfaces
- Insertion of desiccant product in the piping system, junction boxes, equipments cases (including ducting) by means of perforated metallic baskets fixed to blinds or soft bags
- Preservation from foreign matters entrance
- Sealing of opening.

9.2 Packing

9.2.1 Weather protection

The design of the packing shall procure an optimal weather protection during overseas 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.

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.

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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, rails, dirty and/or ice roads), 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 design engineering phase and shall be provided to avoid any modification and/or welding on the equipment during its installation until completion.

During towing transportation, the 3 points mounted packages shall be locked in position to avoid any failure of the supports.

The AVM's (Anti-Vibration Mount) shall be delivered with the dedicated locking tools and locking devices for transportation.

The gimbals (spherical bearing supports) shall be delivered with the dedicated locking tools and locking devices for transportation.

The use of jacking tools and temporary support tools may be required for installation and/or transportation. The supply of those tools shall be done by the package Vendor along with the sub plate and the sole plate for the fixing of these tools.

The sub plate shall be directly welded by the Vendor and/or Manufacturer on the main base plate during the construction of the base plate, the sole plate shall be directly welded to the support by the Contractor during the construction of the support.

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.

9.2.5 Gas turbine specific

The aero-design gas generators and aero-design power turbines shall be removed from their package supports, preserved and packed inside Plain Multilayer Marine Plywood boxes as per here above clause 9.2.2.

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The aero-design gas generators and aero-design power turbines shall be removed from the packages after completion of the tests and commissioning works for the transportation from Vendor test facilities to Contractor yard and from Contractor yard to Company site.

The design of the Plain Multilayer Marine Plywood boxes shall be done in such a way that it can be re-usable after re-packing in accordance with the herewith clause 9.2.1 for transportation from Contractor yard to Company site.

Contractor has the responsibility to store in a dry and clean location the Plain Multilayer Marine Plywood boxes delivered with the aero-design gas generators and aero-design power turbines.

All necessary lifting and handling tools of the Plain Multilayer Marine Plywood boxes shall be fully engineered. All the necessary tools shall be delivered by the Vendor with the equipment.

The capital spares delivered with the Contract shall be preserved as per clause 9.1 and shall be packed inside specific N2 pressurized container design for airways transportation. The containers shall be sealed type, re-usable and shall be provided with:

- Internal or external vibrations and shocks absorbers and shock loggers. Drop acceleration limit shall be indicated by the Supplier
- External marking in accordance with [ISO 780](#) and Project specific requirements
- External lifting and handling devices and fastening provisions
- Atmospheric seals by means of replaceable gaskets or o-rings (air tight design)
- Internal rotors locking devices
- Internal harness for fastening
- Engine blinds
- Gauge for internal pressure measurement
- Pressure safety valve (bursting discs are not allowed)
- N2 filling port
- N2 pressure release and N2 container sweeping connection
- Monitoring device with announcement when reaching the N2 low pressure setting (to be connected to Company and/or Contractor storage monitoring system)
- Moisture indicator
- Internal provision for documentation storage
- Internal provision for desiccant products storage
- External 50 liters N2 filled bottle for emergency refilling
- Name plate
- Notified body certification plate with certification validity period
- External blank marking area and/or location to attached the AWB (Air Way Bill).

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9.2.6 Pumps Specific

The pumps shall be preserved as per clause 9.1.3 and packed as per clause 9.2 during transportation at rest on skid 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 at rest shall not impact the integrity and capability of the pump to recover original performances during commissioning and start-up at site.

For heavy rotors, the bearings shall be removed prior packing and replaced by dummies.

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

The capital spares delivered with the Contract shall be preserved as per clause 9.1.3 and shall be packed inside specific N2 pressurized container design for airways transportation. The container shall be sealed type, re-usable and shall be provided with:

- Internal or external vibrations and shocks absorbers and shock loggers. Drop acceleration limit shall be indicated by the Supplier
- External marking in accordance with [ISO 780](#) and Project Specific requirements
- External lifting and handling devices and fastening provisions
- Atmospheric seals by means of replaceable gaskets or o-rings (air tight design)
- Internal rotors locking devices
- Internal harness for fastening
- Gauge for internal pressure measurement
- Pressure safety valve (bursting discs are not allowed)
- N2 filling port
- N2 pressure release and N2 container sweeping
- Monitoring device with announcement when reaching the N2 low pressure setting (to be connected to Company and/or Contractor storage monitoring system)
- Moisture indicator
- Internal provision for documentation storage
- Internal provision for desiccant products storage
- External 50 liters N2 filled bottle for emergency refilling
- Name plate
- Notified body certification plate with certification validity time
- External blank marking area and/or location to attached the AWB (Air Way Bill).

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The design of the container has to provide capability of vertical storage and anchor points to change position from horizontal to vertical by means of lifting apparatus. The transportation shall always be done in horizontal position.

9.2.7 Shipped loose 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 9.2.1 and clause 9.2.2 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).

The structural frames and ducting (when part of the scope) shall be packed as follow:

- Transportation steel frame where required including all necessary certified means for handling, lifting, loading, unloading
- Metallic blinds on all openings provided with welded metallic baskets for desiccant bags storage
- External marking in accordance with [ISO 780](#) and Project specific requirements
- 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

AVM	Anti-Vibration Mount
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
EMS	Emission Monitoring System
FO	Field Operations
FSS	Fire Suppression System
HMI	Human Machine Interface
ICSS	Integrated Control and safety System
IR	Infra Red
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
ROR	Rate Of Rise (applies to fire detectors)
SAT	Site Acceptance Test
SPL	Spare Parts List
Supplier or Vendor	The package Supplier or Vendor
UCP	Unit Control Panel
UV	UltraViolet (applies to fire detectors)
VCI	Volatile Corrosion Inhibitor
VPI	Vapor Phase Inhibitor
VTMS	Vibration & Temperature Monitoring System

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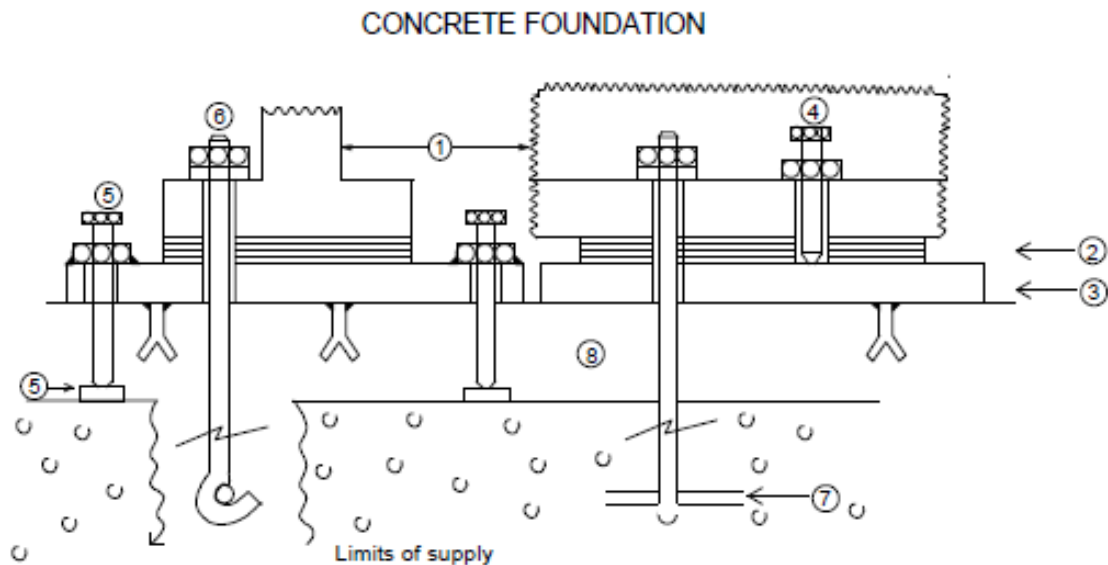
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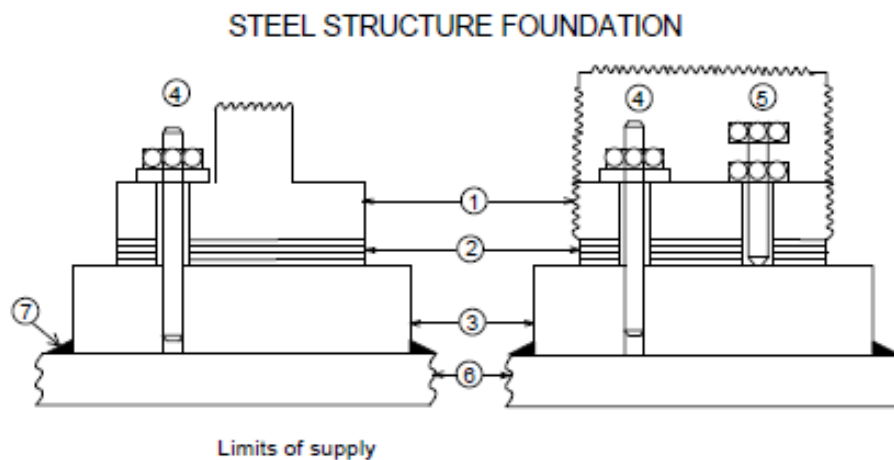
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Appendix 2
Appendix 2 Baseplate installation

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


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 3

Appendix 3 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 DOCUMENTS	
1.1	General	
1.1.1	Vendor document register	X
1.1.2	Installation and operating manual index	
1.1.3	Installation and operating manual	
1.1.4	Preservation procedure	
1.1.5	Packing procedure	
1.1.6	Weight data sheets with CoG	X
1.1.7	Special tools list	
1.1.8	Start up and commissioning spare parts list	
1.1.9	Operating spare parts list (with prices)	
1.1.10	Capital spare parts list	
1.1.11	Extinguishing medium calculation notes	
1.1.12	Declaration of conformity for ATEX	
1.1.13	Monthly report	
1.2	Procedures & Reports	
1.2.1	Painting procedure	
1.2.2	Pump performance (API Std 610) test procedure	
1.2.3	Gearbox test procedure	
1.2.4	Gas generator test procedure	
1.2.5	Gas turbine performance (ASME PTC 22) and mechanical test procedure	
1.2.6	Lube oil system test procedure	
1.2.7	Mechanical seals test procedure	
1.2.8	Package full load string test procedure	
1.2.9	Package site acceptance test procedure	
1.2.10	Reports for all the above tests ⁽²⁾	
1.3	Manufacturing / Quality / HSE documents	
1.3.1	Quality control plan	
1.3.2	Inspection and test plan	
1.3.3	NDE procedures	
1.3.4	Welding procedures	
1.3.5	Vessel/exchanger code calculation notes	

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Item	Designation	(1)
1.3.6	Material certificates	
1.3.7	All tests and inspections certificates	
1.3.8	QA/ QC (Manufacturing data book) index	
1.3.9	QA/ QC (Manufacturing data book) Dossier	
2	STRUCTURAL	
2.1	Foundation drawing (multipoints, or 3 point arrangement) - Plan view	
2.2	Foundation drawing (multipoints, or 3 point arrangement) - Elevation view	
2.3	Foundation loadings (static and dynamic loads, permanent and temporary location)	
2.4	Baseplate calculation note including modal analysis and lifting appliance	
2.5	Lifting equipment general arrangement including lifting calculation	
3	MECHANICAL	
3.1	Arrangements	
3.1.1	General arrangement drawing - Plan view	X
3.1.2	General arrangement drawing - Elevation view	X
3.1.3	General arrangement drawing - Isometric view	X
3.1.4	General arrangement drawing including piping (plan, elevation and isometric views)	
3.1.5	Limits of supply table (interface and connection schedule)	
3.1.6	Allowable nozzles loads	
3.1.7	Lube oil console arrangement drawing	
3.1.8	Mechanical seal system arrangement drawing	
3.1.9	Fire fighting skid general arrangement	
3.2	Data sheets	
3.2.1	Centrifugal pump data sheet (as per GS EP MEC 271)	X
3.2.2	Gearbox data sheet (as per GS EP MEC 242)	X
3.2.3	Gas turbine data sheet (as per GS EP MEC 212)	X
3.2.4	Couplings (low and high speed) data sheets	
3.2.5	Lube oil system data sheets (as per GS EP MEC 281)	
3.2.6	Mechanical seal data sheet (as per GS EP MEC 270)	
3.3	P&IDs & Lists	
3.3.1	Lube oil system P&ID (mineral and synthetic)	X
3.3.2	Lube oil shaft line P&ID	X
3.3.3	Lube oil purifier P&ID	
3.3.4	Mechanical seal system P&ID	X
3.3.5	Lube oil system P&ID bill of material	
3.3.6	Lube oil shaft line P&ID bill of material	
3.3.7	Mechanical seal system P&ID bill of material	
3.3.8	Fire and gas systems P&ID	X
3.3.9	Gas turbine washing system P&ID	

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Item	Designation	(1)
3.3.10	Fuel gas system P&ID	X
3.3.11	Gas turbine air combustion system P&ID	X
3.3.12	Gas turbine enclosure P&ID	X
3.3.13	P&ID symbols table	
3.3.14	Utility list	X
3.3.15	Equipment list	
3.3.16	Lubrication list and schedule	
3.4	Detail drawings	
3.4.1	Pump outline drawing	
3.4.2	Pump cross section drawing	X
3.4.3	Pump sub assemblies drawings (rotor, casing, bearings...)	
3.4.4	Mechanical seal drawing	
3.4.5	Gearbox outline drawing	
3.4.6	Gearbox cross section drawing	
3.4.7	Gas turbine outline drawing	
3.4.8	Gas turbine cross section drawing	
3.4.9	Gas turbine air inlet general arrangement	
3.4.10	Gas turbine exhaust system general arrangement	
3.4.11	Gas turbine enclosure general arrangement	
3.4.12	Couplings (low and high speed) drawings	
3.4.13	Nameplate drawings (pump, gearbox and gas turbine)	
3.5	Calculations & Performances data	
3.5.1	Pump performances curves	X
3.5.2	Gas turbine performances curves	X
3.5.3	Pump thrust bearing sizing calculation	
3.5.4	Pump lateral analysis	X
3.5.5	Gearbox lateral analysis	
3.5.6	Gas turbine lateral analysis	X
3.5.7	Shaft line torsional analysis	
3.5.8	Package noise data sheet	
4	ELECTRICAL	
4.1	List of required documents as per GS EP ELE 011 and GS EP ELE 111 . The data sheets will be supplied according to GS EP ELE 011 , GS EP ELE 111 .	X
4.2	Lube oil heater data sheets	
4.3	Electrical load list	X
5	INSTRUMENTATION	
5.1	General	
5.1.1	Package functional analysis (including pump, turbine, fire and gas system and all auxiliaries)	

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Item	Designation	(1)
5.1.2	Load sharing functional analysis	
5.1.3	Instruments hook ups	
5.1.4	All UCP general arrangements	
5.1.5	VDU displays (HMI video pages)	
5.1.6	PLC software	
5.1.7	UCP factory tests procedure	
5.1.8	Obsolescence dossier	
5.2	Data sheets	
5.2.1	Instruments data sheets	
5.3	P&IDs & Lists	
5.3.1	Vibration and temperature P&ID	X
5.3.2	Instruments list including service, range, trip and alarm levels	
5.3.3	Instruments and electrical cables list	
5.3.4	Modbus list including addressing	
5.3.5	I/O list	
5.3.6	List of software used	
5.4	Diagrams	
5.4.1	Control system architecture (including power supply)	
5.4.2	Interconnecting diagram (instrumentation and electrical)	X
5.4.3	Earthing diagram	
5.4.4	Logic diagrams	
5.4.5	Cause and effect chart	
5.4.6	Instrument loop diagrams	
5.4.7	UCP terminal strips	
5.4.8	Junction boxes terminal strips	
6	PIPING, VALVES and VESSELS	
6.1	General	
6.1.1	Piping classes	X
6.2	Data sheets	
6.2.1	Minimum flow valve data sheet	X
6.2.2	Oil cooler data sheets	
6.2.3	Lube oil filters data sheets	
6.2.4	PCV data sheet	
6.3	Drawings	
6.3.1	Minimum flow valve drawing	X
6.3.2	Oil cooler drawing (general arrangement and internals drawings)	
6.3.3	Lube oil filters drawings	
6.3.4	PCV drawing	

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Item	Designation	(1)
6.3.5	Run down tank drawing	
6.4	Calculations & Performances data	
6.4.1	Calculation notes for safety relief valves	

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



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Appendix 4

Appendix 4 Minimum inspection requirements

As a minimum, the following inspections shall be conducted on the package:

- Functional, performance and mechanical running test of all units
- 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 5

Appendix 5 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.²

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