



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS EP ELE 122

LV Variable Speed Drive Systems for ESP

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Owner: DEV/TEC

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1. Scope

This specification defines the minimum requirements for design, manufacture, inspection and testing of LV variable speed drive systems dedicated to supply Electric Submersible Pump. It has to be read in conjunction with the corresponding project specification and/or data sheets.

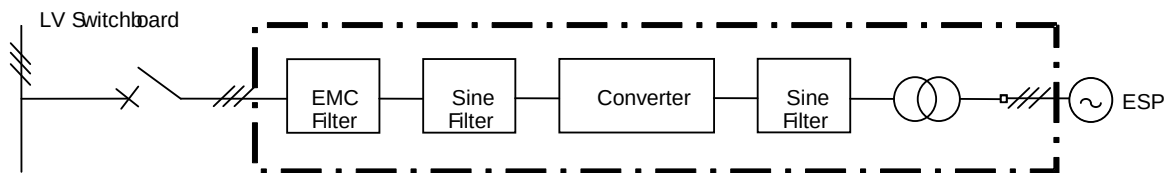
The Supplier shall clearly identify in his technical offer any deviation to these specifications.

The LV variable speed drive system comprises as shown below EMC filter, input and output sine filter, converter and step up transformer including CT, VT and a possible change over switch depending of the configuration.

2 configurations are possible as described here under.

Configuration 1

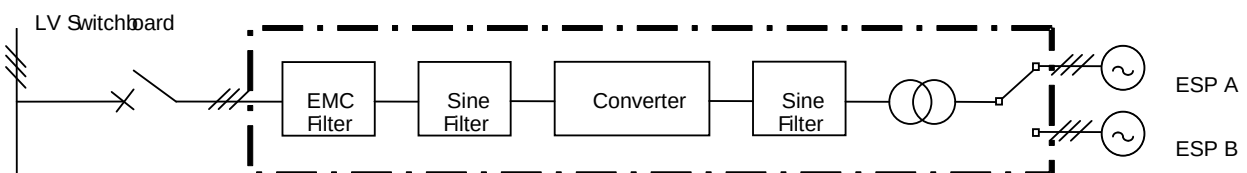
LV variable speed drive system supplies one Electric Submersible Pump.



LV Variable Speed Drive System

Configuration 2

LV variable speed drive system supplies two Electric Submersible Pumps (one running, one in standby) located in the same well.



LV Variable Speed Drive System

2. Reference documents

The reference documents listed below form an integral part of this specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Design and engineering shall conform as a minimum requirement to the current edition of the following in order of preference:

- Applicable laws and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, the French laws and regulations shall be used
- Company Particular Specifications and data sheet (if any)
- Company General Specifications
- Applicable International Electro-technical Commission (IEC) Standards

- Applicable CENELEC Standards
- Applicable recognised standards and codes (e.g. UTE-NFC, BSI, VDE, etc.) where IEC publications have not yet been issued.

Standards

Reference	Title
IEC 60076 (All parts)	Power transformers - (All parts)
IEC 60146	Semiconductor converters general requirements
IEC 60204-1	Safety of machinery - Electrical equipment of machines
IEC 60269-1	Low voltage fuses- Part 1: General requirements
IEC 60445	Basic and safety principles for man-machine interface, marking and identification
IEC 60529	Classification of degrees of protection provided by enclosures
IEC 60947	Low-voltage switchgear and controlgear
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61378 (Parts 1; 3)	Converter transformers – (Parts 1; 3)
IEC 61439	Low-voltage switchgear and controlgear assemblies
IEC 61641	Enclosed low-voltage switchgear and controlgear assemblies – Guide for testing under conditions of arcing due to internal fault
IEC 61800 (Parts 2; 3; 5)	Adjustable speed electrical power drive systems – (Parts 2; 3; 5)
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEEE Std 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
ISO 12944-2	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: classification of environments

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

**Codes**

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
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 ELE 011	Electrical requirements for packaged units
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 141	Power transformers
GS EP ELE 221	Electrical Control System (ECS)
GS EP PVV 145	Flanges
GS EP SAF 221	Safety rules for buildings
GS EP TEC 007	Obsolescence and Lifetime Cycle Management

3. Abbreviations

VSDS	Variable Speed Drive Systems
VSI	Voltage Source Inverter
DHMS	Down Hole Monitoring System
ESD	Emergency Shutdown
ESP	Electric Submersible Pump
PIM	Permanent Insulation Monitoring
VT	Voltage Transformer
CT	Current Transformer
MTTF	Mean Time To Failure



ECS	Electrical Control System
ICSS	Integrated Control and Safety System
DSC	Distributed Control system

4. Design Requirements

4.1 General

VSDS shall be suitable for continuous full load service and for the operational duty of the driven equipment within the rated conditions and specified ambient conditions without exceeding the temperature rises specified in the standards and without deleterious effects of any kind.

The VSDS shall be capable of withstanding the thermal and dynamic stresses and transient such as those resulting from a short circuit. Any damage resulting from such a short circuit or internal fault shall be confined to the component concerned to avoid damage to other parts of the VSDS.

The Supplier shall provide at the bid stage, the heat generated by all indoor equipment across the full operating range of the VSDS.

4.2 Environmental Conditions

Unless otherwise specified, indoor electrical equipment shall normally be installed within a separate non-hazardous, pressurised, air conditioned, clean and dry building or container with an average ambient air temperature of 25°C but they shall be able to operate as long as room temperature does not exceed 40°C.

Outdoor electrical equipment shall be designed to operate continuously in an ambient temperature corresponding to the extreme outside temperatures as defined in the project specific environmental data.

VSDS and all associated equipment shall be suitable for the specified place of installation with typical atmosphere of dusty and corrosive.

Power transformers will be located outdoor.

4.3 Power Supply Conditions

4.3.1 Voltages and neutral earthing

Unless otherwise specified in Project particular specification, the voltages provided by the Company for auxiliary equipment at 50Hz shall be:

- Motive and main power distribution: 400 V or 690V AC - 3 phases – 3 wires- IT system
- Lighting and small power distribution: 400V / 230 V AC - 3 phases - 4 Wires - TT system
- UPS distribution: 400 V / 230 V AC – IT system
- DC distribution: 24, 48 or 110 V DC unearthed.

Use of voltage levels and/or frequencies not herein recommended is subject to written Company approval.

Any other voltage required (control circuit, safety control voltage, etc.) shall be built in the package.



If a backed-up or uninterrupted voltage is required, Supplier's bid shall clearly mention it.

Auxiliary power supplies shall be provided at a single point. Package internal distribution shall be arranged from this delivery point to the different consumers.

4.3.2 Electrical System Variations

Electrical equipment shall be designed for variations as follows:

- AC Voltages: $\pm 10\%$, frequency: $\pm 5\%$
- DC voltages: $\pm 10\%$

4.4 Operational Safety, Availability, Reliability, Maintainability

The design of the VSDS shall be based on the provision of a safe and reliable supply of electricity at all times. Safe conditions shall be ensured under all operating conditions, including those associated with start-up and shut-down of plant and equipment and throughout the intervening shut-down periods.

For all operational and maintenance purposes, modules which need to be changes or maintained shall be removable and replaceable without dismantling other components.

The design of the VSDS shall ensure periods of continuous operation of at least 5 years.

The VSDS including all individual components forming part of the system shall have an availability of at least 0.997 and a minimum MTTF of 5 years.

The VSDS shall be designed for 20 years operation under the specified operating conditions and adapted inspection, maintenance and repair program.

All hardware and software that may be developed by the Supplier further to the VSDS delivery, shall ensure full ascending compatibility to allow for easy replacement of equipment that became obsolete.

The Supplier shall guarantee such hardware and software support during the expected lifetime of the facilities.

The VSDS converter cubicle shall have a front door emergency stop button which shall be guarded with plastic cover to protect them from accidentals shutdown.

4.5 Degree of Protection

Minimum degree of protection of equipment shall be:

- Outdoor equipment: IP55
- Indoor equipment: IP21

4.6 Internal Arc Fault

The VSDS shall be designed to withstand an internal arc fault.

4.7 Outdoor Equipment in Hazardous Areas

All outdoor equipment shall be suitable for Zone 2, category 3G, gas group IIA - temperature T3 minimum.



GS EP ELE 079 shall be applied. Equipment and materials to be installed in hazardous shall bear the CE mark in accordance with ATEX. Each component and equipment shall bear an additional marking clear indication of the mode of protection.

4.8 Output VSDS Frequency Range

The operating frequency of the ESP motor will be in the range of 40 to 70 Hz.

4.9 Mode of Operation

The VSDS shall have the capability to deliver sequential starting and load operating point duties without restriction.

4.10 Emergency Shutdown

For process ESD purpose, VSDS shall be fitted with a stop function category 0 as per [IEC 60204-1](#).

4.11 Acceptable Technologies

Converters shall be based on PWM technology.

Converters rectifier topology shall be based on Active Front End type (PWM regenerative rectifier) with use of an EMC and Sine Filter.

4.12 VSDS Rating

The equipment shall be capable of carrying the specified load plus 20% on continuous basis without overheating.

VSDS shall meet the torque requirements at any line voltage between 90% and 110 % of rated voltage.

The detailed characteristics of the equipment will be fully indicated, by the Supplier, in the regarding part of the project data sheets.

4.13 Rating of Converter Electronic Components

The ratings of the semi-conductors shall be based on data given by the manufacturer within his catalogue or in official data sheets.

Current rating of the converter semi-conductor component shall not be less than 130 % of the maximum current flowing through the elements at full load throughout the whole operation speed range. Parallel-connected semi-conductors shall have current ratings not less than 140%.

4.14 Electromagnetic Compatibility

The VSDS shall meet the immunity levels of [IEC 61800-3](#) with criterion 'A'.

4.15 Harmonics at the Line Side

The emission levels of harmonics shall meet the requirements of [IEEE Std 519](#). Voltage THD shall not exceed 3%.



Calculations at the Point of Coupling (PC) of the VSDS to demonstrate compliance with above including size and effect of residual harmonics shall be provided by the Supplier. Such calculation shall cater for the specified short-circuit impedance and harmonic contribution from other drives. The details of the electrical network shall be provided by the Contractor.

Where [IEEE Std 519](#) levels requirements cannot be met, the Supplier shall propose corrective options, e.g. filters, and include such options in the quotation, taking into account any interaction with other system components.

VSDS's Supplier shall make available harmonics rejection information to Contractor for an overall harmonic study of the electrical network by Contractor.

4.16 Step-up Transformer

Transformer shall be designed, manufactured and tested in accordance with [IEC 61378-1](#) and [IEC 61378-3](#).

Transformer shall be compliant to [GS EP ELE 141](#).

Transformer shall be oil immersed type.

Transformer is used at variable frequency from 0 to 70Hz with $U/F=\text{Constant}$.

Transformer shall be suitable for operation with the non-sinusoidal current wave shapes and DC components under normal and abnormal (e.g. short circuits) conditions of the VSDS without exceeding its temperature or other limits under the operating conditions defined within this specification.

Maximum transformer induction shall be 1.2 Tesla.

Rated lightning impulse withstand voltage shall be in accordance with [IEC 60076-3](#) taking into account the highest value.

Transformer insulation level shall take into account a running mode with a permanent earth fault.

4.17 Capacitors

Capacitors with a lifetime of at least 10 years shall be selected taking into account the highest temperature inside the converter cubicle.

4.18 Noise Levels

Unless otherwise specified, noise levels shall meet limit of [GS EP SAF 221](#) under any load and/or frequency condition within the operational speed range of the VSDS.

4.19 ESP Insulation Measurement

For 59N protection, even if DHMS is able to monitor ESP insulation level, a PIM device shall be added to allow running of ESP when DHMS is out of order. In case of earth fault, an alarm shall be raised.

The PIM device shall be located on the HV neutral point of the step up transformer.



5. Construction Requirements

5.1 Converter

5.1.1 Converter Elements

Each converter shall consist as a minimum of the following minimum elements:

- Input Sine Filter
- Input EMC Filter
- Combination as applicable of PWM rectifier, DC link and PWM inverter
- Auxiliary equipment supply and distribution system
- Control system and triggering equipment
- Protection, supervision and alarm equipment and measuring / testing facilities
- Output Sine Filter.

Warning labels shall be fitted in prominent positions advising care to be taken when accessing to live equipment.

5.1.2 Cabling / Wiring

5.1.2.1 Power cable

The Supplier shall provide detailed cable specification and calculation for all inter connecting power cable taking into account current and voltage stress of the VSIDS.

Contractor shall give installation details of the cable.

Cable specification and calculation shall include the cables connecting the converter to the step up transformer and the converter to the switchgear (i.e. insulation of the main conductors, quantity and physical arrangement of the main conductors, screening of the main conductors, etc.).

Conditions and detailed arrangement of the power conductor screen earthings at both transformer and converter sides shall also be provided.

5.1.2.2 Terminations

Fixed internal wiring, e.g. between modules, shall be terminated by wire wrap, solder or equivalent and connected plugs to allow rapid module exchange.

Site installed wiring and connections between panels shall be terminated on terminals that will not loosen in service through the effects of heat or vibration, e.g. between transport units, cubicles and from the field. Individual terminals shall be provided for all wires.

Terminals shall be provided with test links or facilities to carry out diagnostic testing.

Space provision shall be made between connections and cable glands taking into account number of cables to be installed.

5.1.2.3 Wiring

Wiring shall be able to withstand the most stringent operational conditions specified.



The wiring shall be readily identifiable and related to terminals.

For detail refer to **GS EP ELE 011**.

5.1.2.4 Cable termination

Unless otherwise specified, cables shall enter the converter from below. Cable clamping, earthing, supporting devices and terminals shall be provided.

5.1.3 Earthing

Converter cubicles shall be equipped with an earthing bar of high conductivity copper. The earthing bar shall be of adequate cross-sectional area and mechanical strength to allow convenient connection of all cable earthing connectors.

All major metal parts, which may become energised during fault conditions, shall be connected to the earthing bar.

The doors of each panel shall be connected to earth through a bonding strip.

The Supplier shall advise the Company of the need for any special earthing requirements for any item of the drive system where normal substation earthing practice would not be suitable.

5.1.4 Converter Cabinets

Converter will be installed in a technical room with false floor.

Converter will be mounted on frames (provided by other) with bottom cable entry for control and power cables.

Mounting plate and cable glands are not required for cable entries.

All converter components shall be fully accessible.

Converter elements shall be arranged in a logical segregated manner to allow easy removal of components and safe maintenance work.

Exposed parts within LV compartments of the converter accessible during normal operation for measuring, adjusting, resetting, etc..., shall have an enclosure to a degree of protection of at least IP 20 when the door is open.

Filters shall preferably be arranged inside the converter cabinets.

Cubicles shall be designed to be lifted by use of removable eyebolts.

Mechanical key interlocks shall be provided on all doors. Interlocking shall be fully coordinated to prevent access when line power is applied.

5.1.5 Converter cooling

Supplier shall include in the quotation all necessary equipment for cooling.

Cooling shall be of forced air or water type.

For converters with heat losses in excess of 15kW and unless otherwise specified in the data sheets, cooling methods shall be indirect using a heat transfer agent, e.g.:

- Air-to-water cooling
- Water-to-water cooling.

Cooling systems shall be designed to permit safe cool down without damage of the VSDS following total electrical blackout after sustained full load operation at maximum ambient.

In case of air cooled type converter: air will be blown in the false floor by the HVAC system, therefore air converter cooling will be drawn from the false floor.

In case of use of water cooling system:

- Replacement of filter, deioniser resin shall be possible without unloading a running unit
- Conductivity probe shall be redundant
- Indoor heat dissipation in air due to water cooled pipe shall be stated for air conditioned design
- Piping interface shall be compliant to **GS EP PVV 145** paragraph 3 and 5
- Converter cooling system shall maintain system coolant temperature within a safe minimum and maximum temperature to avoid dew point.

Note: **GS EP PVV 145** is not applicable for flange inside the converter cubicle, it must be considered only for piping interface.

5.2 Step-up Transformer

Transformer rating shall correspond to ONAN mode of operation at full capacity.

When installed in hazardous area, transformer shall be suitable for Zone 2, category 3G, gas group II-A with T3 temperature minimum.

The transformer shall be fitted with 3 or 6 HV terminals in order to connect either one of the two ESPs via a key interlocked off-load change-over switch.

On the high voltage side, transformer off load tap changer shall comprise 12 taps.

Tapping range definition is customized for each project.

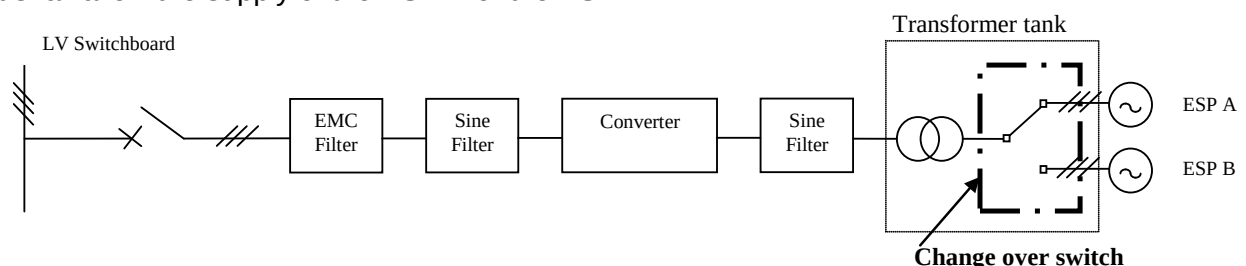
Transformer shall be able to provide motor rated current for each tap position.

Transformer accessories

Change over switch for dual pump application

Transformer shall be fitted with a manual oil immersed switch with an external operating handle.

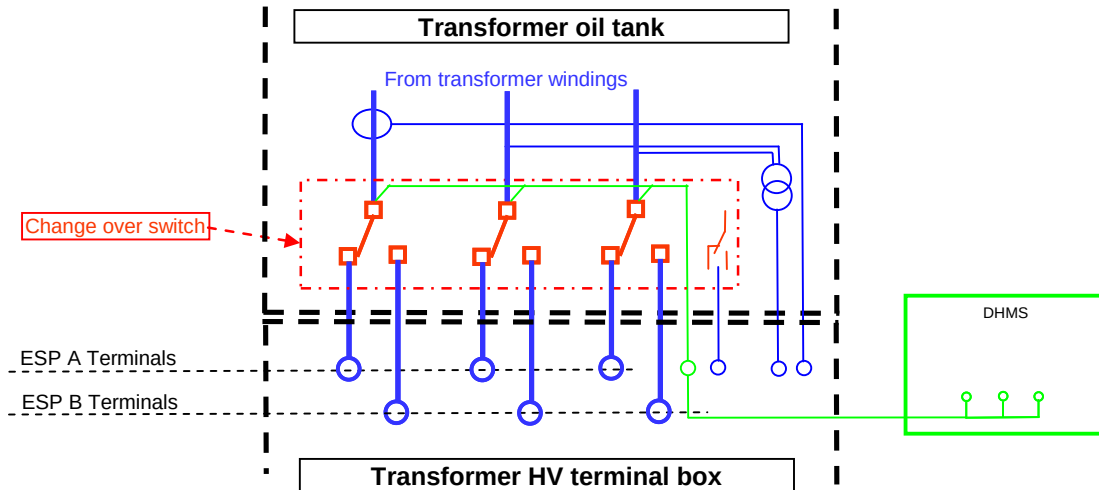
It shall allow the supply of the ESP A or the ESP B.



The change over, ESP A to ESP B (and reverse) will be done off-load.

An auxiliary contact shall be provided for remote indication of the running ESP to the DCS.

Connection of the Down Hole Monitoring System (DHMS) to the HV power terminals of the ESP shall be done as per below schematics.



For safety reason an interlock system using a key shall allow switch change over when converter circuit breaker is disconnected.

Current and Voltage measurement

On the high voltage side of the transformer one CT(In/1A) and one VT(Un/100V) (phase to phase measure) shall be housed either in the terminal box or immersed in the oil transformer tank. These CT and VT will send the value of the current drawn by the motor and the voltage applied to the motor to the DCS via 4-20mA converters located in the low voltage switchboard or converter cubicle. VT shall be equipped with fuse.

5.3 Output Sine Filter Reactor

Depending of Supplier design, output sine filter reactor may be located in the transformer's tank.

5.4 Painting

For indoor equipments, unless otherwise specified, painting and colour system shall be Supplier standard.

For outdoor equipments, painting system shall be suitable for the site environmental conditions. The coating shall comply with Company General Specification **GS EP COR 350** (Offshore) or **GS EP COR 354** (Onshore). The Supplier may submit his coating system for protection against external corrosion for Company approval. Proposed coating must be suitable for the category of corrosion defined for the site of installation as per **ISO 12944-2**, and shall provide a warranty of 5 years - with a rusting degree $R_i = 2$. Colour shall be of Supplier's standard, unless otherwise specified in the project specification.

6. Control System, Protection and Alarm Equipment

6.1 General

The VSIDS system shall ensure the utmost reliability and shall be based on a well proven technology. Any new or unproven technology will not be accepted by Company.



All control system, protection and alarm equipment for the entire drive system and its auxiliary equipment shall be provided.

Printed circuit boards shall be installed in standardized electronic equipment frames.

Assembled cabinets shall be factory-wired and shall be functionally tested as a complete system before dispatch.

The VSDS control system equipment shall use microprocessor-based systems and programmable logic controllers.

The VSDS control system equipment shall be provided with self-check facilities, including watch dog signalling features.

The VSDS control system shall have a memory function to retain program, software parameters and alarm/fault in case of power failure.

Restarting of the system after power failure (either main line or auxiliary line) shall be automatic.

All service adjustments required in the field shall be possible from the front of the equipment. Measuring and test points shall be front-accessible as well.

6.2 Control System Performances

VSDS shall be speed controlled.

VSDS shall be able to run through voltage dips down to 80% of rated voltage.

In case of power failure of more than 500msec flying restart is not allowed.

The control system shall be immune from spikes and voltage distortions due to operational and/or fault conditions within the VSDS.

Braking function and power feedback operation (four quadrant) are not required.

6.3 Interface and External Signals

VSDS shall be controlled by the following external signals:

- 4-20 mA reference for speed
- Remote start and stop signals.

The relationship between the speed and the reference signal within the operational speed range shall be linear.

A reference signal of 4 mA shall correspond to the minimum operational speed and a reference signal of 20 mA to the maximum speed of the VSDS, as indicated in the data sheets. The speed range shall be adjustable.

Transformer faults shall be sent to LV switchboard for trip and to ICSS for information.

Transformer alarms shall be sent to ICSS for information.

Provision shall be made for a serial link protocol interface located within the VSDS control panel for all information to be exchanged between VSDS control and protection panels and ICSS, in this case as a minimum here under information shall be exchanged:

- VSDS Output speed
- VSDS Speed reference

- VSDS Output active power
- VSDS Ready for operation
- VSDS Running
- VSDS Alarm
- VSDS Fault
- VSDS Output current
- VSDS Output voltage
- Pump Back spin
- Motor Stalled.

Speed measurement shall be sent to ICSS through 4-20mA signal.

The VSDS control system shall be able to be synchronized with ICSS in order to stamp VSDS electrical alarms and faults. Time synchro accuracy and time discrimination between two critical events shall be in accordance with **GS EP ELE 221** § 9.1.

6.4 Protection and Alarm Equipment

A fully electronic protection system is preferred obviating the need for specific ultra-rapid semiconductor fuses.

Fault diagnostic and indication logic shall be equipped with a memory function to retain information regarding the cause of tripping of the VSDS.

All earth potential connections shall be connected to earth via one common connection to allow checking of insulation resistance to earth.

2nd stage thermal overload of the motor, transformer or converter shall trip the VSDS.

Protection and alarm functions shall follow as a minimum the following table:

Protections	Alarm	Trip	Action by
Line over voltage	X	X	VSDS
Line under voltage	X	X	VSDS
Rectifier over current		X	VSDS
Inverter over current		X	VSDS
Inverter over voltage	X	X	VSDS
Inverter over load	X	X	VSDS
Converter ground fault		X	VSDS
Converter cooling fault		X	VSDS
Converter over temperature	X	X	VSDS
Transformer gas relay	X	X	LV switchboard or VSDS
Transformer over temperature	X	X	LV switchboard or VSDS

Protections	Alarm	Trip	Action by
Transformer low oil level	X	X	LV switchboard or VSDS
Transformer over pressure		X	LV switchboard or VSDS
U/F ratio incorrect	X		VSDS
Motor Stalled		X	VSDS
5% deviation from set point	X		VSDS
Motor ground alarm	X		ICSS
Watch Dog		X	LV switchboard
Emergency stop		X	LV switchboard

6.5 Alphanumeric Display

The following indications shall be available on the converter as a minimum (with alphanumeric display).

- Output frequency
- Output current
- Output voltage
- Speed reference
- Output speed
- Output active power
- Elapsed time running meter
- Indication lights using LED for the following signals:
 - Ready for operation
 - Running
 - VSDS alarm
 - VSDS trip.

7. Inspections and Tests

7.1 Fabrication and Quality Control Plan and Inspections

Inspection and testing activities shall be defined by the Supplier on the Fabrication and quality control plan based on the minimum requirements established within the Inspection and test plan.

During the manufacturing period, VSDS and associated equipment could be subject to inspection by Contractor or Company inspectors or by others appointed by Contractor or by the Company. Accessory material could be subject to inspection too.

The Supplier shall allow the free access of inspectors to the workshop, shall give all information required and shall make available all copies of internal orders to other sub-Suppliers.



7.2 Factory Tests

Routine tests shall be carried out on all equipments.

The tests shall be carried out in Supplier workshop at his care and expense.

Even in case Contractor waives to witness the tests, the Supplier shall draw up the certificate of the tests carried out containing a full report and all the results and the measures of the tests.

The tests shall be carried out in accordance with the requirements of IEC codes and of the Inspection and Test Plan. Refer also to the project specification requirements for the individual tests relating to others equipments.

The Supplier shall state in his proposal the methodology that will apply and the availability / adequacy of the necessary equipment and testing infrastructure for performing satisfactorily the different tests.

8. Design Life & Obsolescence

Facilities are typically designed with an expected design life in the order of 25 years.

The VSDS design shall therefore take into account the requirement that the equipment will most probably require to be upgraded during the design life of the facilities in particular for all the electronic based components (Control system, electronic protection relays, etc.). These requirements shall be incorporated from Basic Engineering stage.

The design will include provisions to allow an upgrade of the VSDS to be performed with minimal disturbance.

All hardware and software that may be developed by the Supplier further to the VSDS delivery shall ensure full ascending compatibility to allow for easy replacement of equipment that became obsolete with limited reconfiguration.

At the Bid stage, the VSDS Supplier shall detail his lifecycle management strategy focusing on product obsolescence, support options and further migration alternatives. The lifecycle/obsolescence management plan and associated cost shall be part of the Bid process evaluation.

The VSDS Supplier shall complete an inventory of all provided equipment (hardware and software) matching to different lifecycles phases, including all Sub-Vendors equipment (e.g. CPU, protection relays).

VSDS Supplier shall guarantee that:

- VSDS components (including software and hardware) shall remain in the “active products” range (i.e. supporting developments and releases) over a period of at least 15 years after the SAT
- An announcement to Customer is provided 5 years prior the end of the commercial phase
- VSDS components (including software and hardware) shall be fully supported and available over a period of at least 25 years after the SAT
- Maintenance services including availability of engineering services shall be available to support the VSDS during the plant life time.

Obsolescence and life time cycle management shall be in accordance with **GS EP TEC 007**.



9. Documentation

As a minimum and unless defined in a project particular specification, the following drawings and documentation shall be supplied in a timely manner according to the specified schedule.

9.1 Within the offer

- Deviation list to project specifications
- Completed data sheets
- Power cable sizing note
- Preliminary VSDS overall arrangements, sizes and weights
- Preliminary harmonics study at line side.
- Description and guarantee of control hardware and software support during the expected lifetime of the VSDS
- VSDS torque-speed curve in all speed range superimposed to load starting curve.
- VSDS listing of losses for power equipment(filters, converter, step up transformer) and auxiliaries
- Preliminary list of AC consumers
- Description of VSDS earthing means
- Available type test certificate
- Component/equipment obsolescence plan

9.2 Within project execution:

- Final completed Data sheet
- Final VSDS overall arrangements, sizes and weights
- Layout of connection cubicle
- Foundation guide details if required
- Arrangement details of auxiliary equipment
- Cable specification and calculation for power and control cables
- Schematics, wiring and termination diagrams
- Network harmonics study report
- Alarm and fault list
- Final list of AC consumers
- Operation and maintenance manuals
- Detailed component/equipment obsolescence plan



- Type test report if required
- FAT report
- As built

10. Other References

Following documents are applicable:

- Standards: [IEC 60146](#), [IEC 60269-1](#), [IEC 60445](#), [IEC 60529](#), [IEC 60947](#), [IEC 61000](#), [IEC 61439](#), [IEC 61641](#), [IEC 61800 \(Parts 2; 5\)](#), [IEC 62262](#)



Appendix 1 Data Sheet LV Variable Speed Drive Systems for ESP



Exploration & Production

DATA SHEET

ELE

DS EP ELE 122

LV Variable Speed Drive Systems for ESP

00	02/2011	First issue
Revision	Date	Notes



Exploration & Production

General Specification

Date: 01/2012

GS EP ELE 122

Rev: 01

Appendix 1

 TOTAL Exploration & Production		COMPANY PROJECT NAME DATA SHEET LV Variable Speed Drive Systems for ESP			
Doc. number:		Contractor document N°:		Page 1 / 4	
Equipment location:		Model:			
Tag No:		Serial No:			
System No:					
Sub-system No:					
Supplier:					
Manufacturer:					
Reason for issue	Rev.	Stat.	Date	By:	Checked by:
1 GENERAL DATA					
2	Items:			Quantity:	
3	Material Requisition N°:			Service:	
4	Project Specifications:			Standards, Codes (see note 1):	
5	Supplier:			Manufacturer:	
6 ENVIRONMENTAL CONDITIONS					
7	Installation (Onshore / Offshore):			Ambient Type:	
8	Altitude: m			Hazardous area classification:	
9	Min. Operating Temperature: °C			Relative Humidity @Min. operating temperature: %	
10	Max. Operating Temperature: °C			Relative Humidity @Max. operating temperature: %	
11	Minimum Temperature For Transport / Storage: °C			Seismic activity:	
12					
13 POWER SYSTEM					
14	Supply Network Voltage: V ± %			Supply Network Frequency: Hz ± %	
15	Supply Network Neutral system:			Supply Network Earth Fault Current:	
16	Maximum THDU required at Min. Fault Level:			Supply Network existing THDU: %	
17	Supply Network 3 Phases Max. Fault Level:			Supply Network 3 Phases Min. Fault Level:	
18	Auxiliary Voltages: V			V	V
19	AC UPS Voltage: V			DC UPS Voltage: V	
20					
21	Minimum PF required at VSD system connection:			@ all operating points	
22	Minimum efficiency required:			@ all operating points	
23	Note 1: General specification GS EP ELE 122 standards as a minimum				
24					



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Appendix 1

TOTAL Exploration & Production	COMPANY PROJECT NAME DATA SHEET LV Variable Speed Drive Systems for ESP	
Doc. number:		Contractor document N°:
Equipment location:		Page 2 / 4
Tag No:	Refer to page 1	Model:
System No:		Serial No:
Sub-system No:		
Supplier:		
Manufacturer:		
Reason for issue	Rev.	Stat.
1	VSD DATA	
2	Converter Type:	System configuration (see note 1):
3	Nominal output power: kVA	Nominal output voltage: V
4	VSD FABRICATION DATA	
5	Protection Degree: IP	Connection Entry:
6	Access:	Cable Type:
7	Cable opening cover: Yes/No	Rating plate language:
8	Anti-condensation heater: Yes/No	Painting Color: RAL
9	Painting (Manufacturer Standard, ...):	Raw water inlet temperature: °C
10	Cooling Method (see note 2):	Interface characteristics (flange, etc):
11	Cooling media characteristics:	
12	REMOTE CONTROL AND MONITORING	
13	Link type for ICSS connection:	Digital output Earth fault leakage alarm: Yes/No
14	Digital output Run status: Yes/No	Digital output Stop status: Yes/No
15	Digital output VSD Fault status: Yes/No	Digital output Motor Fault status: Yes/No
16	Digital output Back spin protection: Yes/No	Digital output Main power On/Off: Yes/No
17	Analog output Motor current: Yes/No	Analog output Motor voltage: Yes/No
18	VSD CUBICLE CONTROL AND MONITORING (as minimum)	
19	Operating Speed if Loss of Speed Signal: rpm	Flying restart: Yes/No
20	Acceleration slope setting: t1 sec t2 sec	
21	Note 1: Configuration 1 or 2 as defined in General specification GS EP ELE 122 Note 2: Forced air or water	
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Appendix 1

 TOTAL Exploration & Production	COMPANY PROJECT NAME DATA SHEET LV Variable Speed Drive Systems for ESP	
Doc. number:		Contractor document N°:
Equipment location:		Page 3 / 4
Tag No: Refer to page 1		Model:
System No:		Serial No:
Sub-system No:		
Supplier:		
Manufacturer:		
Reason for issue	Rev.	Stat.
1 VSD MANUFACTURER DATA		
2	Converter Type:	Protection Degree: IP
3	Nominal Input Voltage: V	Nominal Input Current: A
4	Nominal Input Frequency: Hz	Nominal Output Power: kVA
5	Switching frequency: Hz	Earth fault current Limitation:
6	Nominal Output Voltage: V	Nominal Output Current: A
7	Nominal Output Frequency: Hz	BIL rating:
8	Maximum Connection capability: mm²	Painting Color: RAL
9	Rectifier semiconductor type with rating:	Inverter semiconductor type with rating:
10	Rectifier semiconductor number per arm:	Inverter semiconductor number per arm:
11	Rectifier operating semiconductor junction temperature: °C	Inverter operating semiconductor junction temperature: °C
12	Cooling Method:	Number of Fans or Pumps: No.
13	Raw water inlet flow: m³/h	Water to Glycol percentage: %
14	Heat Losses for dedicated cooling system: kW	Heat Losses inside building for HVAC sizing: kW
15	Global Efficiency of VSDS (see note 1): %	Global input PF of VSDS at rated power:
16	Protection scheme in accordance to GS EP ELE 122: Yes/No	Interface signal scheme in accordance to GS EP ELE 122: Yes/No
17	Maximum THDU: %	Noise Level At Full Load (at One Meter): dB(A)
18	Cubicle Length: mm	Cubicle Width: mm
19	Cubicle Height: mm	Cubicle Weight: kg
20	Maximum distance between step-up Transformer and ESP: m	Connection Entry:
21	Input power cable type:	Input power cable cross section: mm²
22	Power cable type to sinus filter:	Power cable cross section to sinus filter: mm²
23	Power cable type to step-up transformer:	Power cable cross section to step-up transformer: mm²
24	Note 1: The global efficiency at rated power/speed shall include losses of converter, filters, auxiliary and transformer.	
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 TOTAL Exploration & Production	COMPANY PROJECT NAME DATA SHEET LV Variable Speed Drive Systems for ESP	
Doc. number:		Contractor document N°:
Equipment location:		Page 4 / 4
Tag No: Refer to page 1 System No: Sub-system No: Supplier: Manufacturer:		Model: Serial No:
Reason for issue	Rev.	Stat.
1 STEP-UP TRANSFORMER DATA		
2	Project Specifications: GS EP ELE 141 and GS EP ELE 122	Output sine filter reactor location (see note 1):
3	Off-load change over switch: Yes / No	CT and VT location (see note 2):
4	Note 1: Output sine filter reactor location as defined in General specification GS EP ELE 122	
5	Note 2: CT and VT location as defined in General specification GS EP ELE 122	
	Transformer data sheet DS EP ELE 141 shall be attached to this VSD data sheet	
1 ESP MOTOR DATA		
2	Rated electrical power: kW	Rated voltage: V
3	Rated frequency: Hz	Rated speed: rpm
4	Frequency range: Hz	
5		
6		
1 SINUS FILTER MANUFACTURER DATA		
2	Input filter type (see note 3):	
3	Input filter cut off frequency: Hz	Input filter heat losses: kW
4	Total reactive power at fundamental frequency: kVAR	Input sinus filter reactor: mH
5	Input sinus filter capacitor: μF	Input sinus filter reactor 2 for LCL filter only: mH
6	Cubicle Length: mm	Cubicle Width: mm
7	Cubicle Height: mm	Cubicle Weight: kg
8	Output filter type (see note 3):	
9	Output filter cut off frequency: Hz	Output filter heat losses: kW
10	Total reactive power at fundamental frequency: kVAR	Output sinus filter reactor: mH
11	Output sinus filter capacitor: μF	Output sinus filter reactor 2 for LCL filter only: mH
12	Cubicle Length: mm	Cubicle Width: mm
13	Cubicle Height: mm	Cubicle Weight: kg
14	Note 3: Filter type being either LC or LCL.	