

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 202

Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines

05	10/2012	General review (Language, References, Specifications)
04	10/2009	Revision § 1, 2, 3.6.1, 3.6.3.1, 3.6.3.2, 3.6.3.3 & 6.1
03	10/2008	General Review
02	10/2005	Addition of "EP" root to GS identification
00	02/2001	First issue
Rev.	Date	Purpose of the revision

Owning entity: DEV/TEC	Managing entity: DEV/TEC/GEO
------------------------	------------------------------

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 2 of 32

Contents

1. Scope	4
2. Reference documents.....	5
3. Scope of Work	6
3.1 Shallow water requirement.....	6
3.2 Standard Requirement.....	7
3.3 Specific Requirements	9
3.4 Survey after remedial/Preventive works	11
3.5 Reference specifications and parameters	11
3.6 Means and Method	13
3.7 Quality control.....	17
4. Data Processing and Mapping System	18
5. Onboard Reporting	18
5.1 Daily Progress report	18
5.2 Weekly report.....	18
5.3 Field report.....	19
5.4 Final report.....	19
6. Document delivery	23
6.1 Final report.....	23
6.2 ROV Video tapes/ DVD.....	24
6.3 Field records from analogue Survey.....	24
6.4 Field Positioning data base & reports.....	24
7. Quality Assurance - Quality Control.....	24
7.1 Quality System.....	24
7.2 Quality Audits.....	25
7.3 Project Quality plan.....	25
7.4 Quality Control Activity Plan.....	26
7.5 Documentation.....	26
8. Survey & Positioning Procedures	26



General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 3 of 32

8.1	Procedure Summary	27
8.2	Survey Procedures Content	27
9.	Bibliography	29
Appendix 1	Definitions	30

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 4 of 32

1. Scope

This General Specification describes the surveys activities to be carried out in relation with the development of offshore oil & gas field including pre-lay survey of pipeline route, flexible lines and umbilicals, mooring legs of production floating structure, subsea structures installation, as-laid and as-built of all infield system pipeline, flexible lines and umbilicals, mooring legs of fixed floating structure, subsea structures, export lines. When sea lines (pipeline, flexible, umbilical, cable) require to be dug into a trench and/or covered by dumped material, additional surveys are required.

This General Specification describes the procedures to be used in order to successfully carry out surveys and inspections, in full accordance with the state of the art practice, of the requirements of the Statutory Authorities and to the satisfaction of the Company.

This General Specification outlines the minimum requirements for the support vessel, survey equipment and ROV. It defines the content and summary of Survey reports.

This specification mainly applies to:

- The Hazard survey of conditions in any area at sea or near structures, prior to the start of the installation operations
- Accurate monitoring of the touchdown point while laying umbilicals at sea within the lay corridor, including curves, and at the required distance from existing lines and structures
- Visual inspection, accurate positioning and mapping of all installed lines, umbilicals and structures to be issued immediately after laying / installation is complete
- Final inspection, positioning and mapping of all installed lines, umbilicals, risers and moored subsea structures, after all connections and remedial work have been performed
- Cathodic Protection (CP) survey may be required at the same time.

Each operation must be covered by a separate report which will therefore be prepared and issued as a preliminary report onboard Survey vessel, then issued as final reports, within a month. This applies to:

- Pre-operation survey
- Permanent Structure installation
- Lines and umbilical laying including Inline structures
- Mooring legs of large floating structures installation
- Mooring of large floating structures FPSO, FSO, FPU, OOB, etc.
- Export line installation
- Riser installation
- Cathodic Protection Inspection.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 5 of 32

And in specific cases, to:

- Trenching (when required)
- Backfilling or material dumping (when required).

Finally, after completion of all installation works, after tie-in and remedial works have been completed, an "as-built" report shall be issued, comprising all positioning and survey results. It will provide the basis of the reference document to be used for later inspection.

This General Specification shall be read in conjunction with the particular Specification valid for the project.

All positioning aspects are detailed in Company specification **GS EP POS 001** and **GS EP POS 002**.

Pre-engineering survey, which is carried out as a basis for Front End Engineering Design (FEED) is covered by Company specification **GS EP GEO 201** referenced in section 3.

2. Reference documents

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

In addition, applicable codes and Standards which are to be used in conjunction with this specification will be listed in the Particular Specification.

The order of precedence of the applicable documents shall be:

- The Particular Specification
- The present General Specification
- The Codes and Standards in reference.

Where this specification states no overriding requirements, the referenced Codes and Standards shall apply in full. Standards equivalent to those referenced herein shall not be substituted without written approval from the Company.

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
IAGC	Marine Geophysical Operations Safety Manual 7 th edition, 1991
BS EN 14161	Petroleum and natural gas industries — Pipeline transportation systems
DNV	Rules for Submarine Pipeline Systems December 1996
ISO 13623	Petroleum and Natural Gas Industries - Pipeline Transportation Systems
Nederlands Normalisatie Instituut	Requirements for steel pipeline transportation systems

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 6 of 32

Reference	Title
UKOOA guidelines	Guidelines for the Conduct of site Surveys for Mobile Drilling Rigs, 1995 Guidelines on the use of differential global systems in offshore surveying, 1994
ISO 9001	Quality management systems - Requirements
ISO 9000	Quality Management Systems - Fundamentals and Vocabulary

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.

Reference	Title
GS EP COR 502	Control by electrical measurements of cathodic protection of submerged pipelines
GS EP GEO 110	Requirements to Offshore Survey Vessels
GS EP GEO 201	Offshore geophysical surveys
GS EP GEO 203	Geophysical survey for offshore pipeline inspection
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works

3. Scope of Work

3.1 Shallow water requirement

In water depth shallower than 50 m, Survey requirement shall be simplified. Due to shallow water depth, Interim survey shall not be required, as TDP can easily and accurately be extrapolated from surface position.

3.1.1 Pre-lay survey

Not earlier than one month before the start of the laying operation, a survey using multi-beam echo sounder side scan sonar, sub-bottom profiler shall be performed along the intended routes, in order to determine precisely the position and dimensions of any obstacle, buried or unburied, natural or man-made obstruction (wrecks, debris, depressions, rock outcrops, etc.) within the laying corridor.

In addition, Kullenberg coring may be performed to confirm the nature of the seabed and sub-surface soils.

When buried pipes or power cable are present, high resolution magnetometer shall be used in order to provide a good cartography of their position.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 7 of 32

When an anchored laying barge is involved in operation, an additional Side scan sonar survey shall be carried out over the areas of interaction of Barge anchors and anchor wire with the seabed.

3.1.2 As-laid survey

As-laid Survey shall be carried out using Multi-beam Echosounder and Side scan sonar.

Free spans shall be identified using Side Scan Sonar technique. Side scan sonar fish shall be positioned using an USBL system.

3.2 Standard Requirement

At each step of the field installation, surveys shall be carried out with a survey vessel and/or an Inspection/ Work ROV, fully equipped with required survey sensors and positioned with an USBL system, or with an LBL array.

3.2.1 Pre-lay survey

Pre-lay survey shall be carried-out with a ROV equipped with High definition sonar, Dual Head Scanning Sonar (DHSS), bathy-system, pipe tracker and positioning from Survey Vessel. The pre-lay survey is to be done not earlier than one month before the start of the laying operation,

The speed of the ROV shall be maintained below 1 knot in order to obtain the best possible recording quality. The requirements include, but are not limited to the following:

- Continuous sonar and visual inspection, production of commented color video recording of the sealine route as per latest revision of alignment sheets
- Visual inspection and commented color video recording of any subsea structure
- Visual identification and positioning of any obstacle or obstruction, located close to the installation areas, identified during pre-engineering survey, any sonar target or structure detected during the actual survey
- Buried lines and/or obstacles detection with pipetracker
- Visual inspection and positioning of any existing sealine electrical cable, or umbilical
- Selected still photographs or good quality video-grabs in areas of interest
- Trench profiling along the route
- Cartography of the ROV survey.

The video recordings and video-grabs shall include at least the following overlaid information: identification, date, time, UTM co-ordinates, KP, heading, depth.

In areas where permanent poor visibility does not allow to carry out a visual inspection, the video recording shall include sequences with Obstacle Avoidance Sonar recording and Side Scan Sonar.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 8 of 32

3.2.2 Interim survey

During laying operations, a ROV shall monitor continuously, the sealine touchdown position in order to ascertain engineering parameters are satisfied, maintain a minimum distance from existing structures, perform crossing monitoring, laying over mattresses, etc.

This task shall be performed either directly from the installation vessel, or from the Survey vessel and video transmitted to Installation vessel.

Offset from existing structures shall be measured, directly by ROV positioning system or using the Obstacle Avoidance Sonar. If an existing sealine is buried, it shall be relocated at regular intervals, using the pipe tracker, in order to keep the required minimum distance from the sealine being laid.

3.2.3 As-laid survey

As-laid survey shall be carried-out with ROV equipped with High-Resolution sonar, dual-head scanning sonar (DHSS), Bathy-System, dual boom cameras, pipe tracker (if required) and USBL positioned from Survey Vessel immediately after the completion of the installation of each sea line.

The speed of the ROV shall be maintained below 1 knot in order to obtain the best possible recording quality.

The aim of this survey is to provide the following information:

- Integrity of the coating (and strapping if sea lines are laid in bundles)
- Integrity, functioning and X, Y position of all anodes
- Evidence of any anomaly such as damage to coating, anodes, obstructions or obstacles within the corridor
- The Attitude, orientation and X, Y, Z position of any specific feature such as: T-piece, SDU, ILT, PLET, crossing, etc.
- The X, Y, Z position of the sealine
- The relative position of the sealine to the seabed, buried sections, free spans
- An accurate identification, visual inspection and metrology of free spans (KP, length, max height, profile). This inspection shall be repeated after remedial work has been carried out.

3.2.4 Final as-built Survey

In water depth up to 200 meters, as-built survey shall be limited to the results of as-laid/ as installed survey and the inspection data of all areas where remedial work has been carried out.

For deep-water field development, the as-built survey shall comprise the survey of all structures installed, including fixed structures, sea lines, umbilicals, risers, export lines, mooring lines of permanent floating structures (FPSO, FPU, OOB, etc., final position of permanent floating structures.

In the case of permanent floating structures, the following procedure shall be followed out once final positioning and tensioning adjustments have been performed:

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 9 of 32

As-built of all permanent systems, export lines, mooring lines and related tensioning data, environmental data (wind, waves, currents) should be part of a single document. The document should also comprise the following:

- Position and heading of each permanent floating structure
- LBL position attitude, orientation of each anchor
- LBL position of the mooring lines TDP
- XYZ of each mooring line including accurate position fixing at mid-depth
- Position and depth of any export line, any float, when applicable.

3.2.5 CP survey

If required, CP survey shall be carried out, in accordance with **GS EP COR 502**, as part of the final As-built Dossier.

3.3 Specific Requirements

In some specific areas additional surveys can be required when trenching and backfilling are performed.

3.3.1 Pre-trenching survey

A pre-trenching survey shall be performed prior to trenching operations if a long period of time (more than one month) has elapsed or if other works have been performed since the "as laid" survey.

The goal is to spot any anomaly appeared since the end of laying. During this ROV inspection (with continuous video recording), special attention shall be paid to:

- Any damage to coatings (and strapping if sea lines are laid in bundles)
- Possible debris on the sealine or within the laying corridor that may endanger the trenching machine.

Trench profiler data (typical distance between scans: 25 m) shall be used as a reference for the post trenching survey.

3.3.2 Post-trenching survey

The aim of this survey is to check that the top of the trenched-in sealine is at the required depth of burial below the mean undisturbed seabed level, as defined in the job specification, and to detect any free span, exposure or debris, etc.

In order to measure the depth of burial, the ROV shall be equipped with a TV, a trench profiler and a pipe tracker.

Measurements shall be taken (ROV) static every 10 m or less if required.

3.3.3 Out of Straightness survey

If the pipe is expected to be subject to Upheaval Buckling, Contractor shall perform a specific Out Of Straightness survey (OOS). Contractor shall give accurate variations of elevation of the

Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines

Rev.: 05

Effective date: 10/2012

Page: 10 of 32

pipeline using relevant equipment (odometer, digital depth sensor, etc.). From this acquired detailed Bathymetry and pressure gauge data, a comprehensive assessment of the OOS survey shall be submitted to Company under the form of tables and graphs.

In the event of buried pipe sections, a pipe tracker shall be used.

Prior to any section of as-trenched or as-backfilled being ROV surveyed, and at intervals of no greater than two hours, the pipe tracker shall be compensated for Manufacturers quoted "field strengths" based on pipeline diameters. All such compensation checks shall be recorded on video tape and shall form an integral part of the ROV dive.

Should the ROV mounted Pipe Tracker fail to provide the relevant depth of burial and OOS information, Contractor shall propose alternative solutions. The alternative methodology and instrumentation should have sufficient accuracy in order to match the UHB prevention factors as defined from the engineering study.

Processed data from the as-trenched survey and as-backfilled survey, including depth of burial and selected trench profiles, shall be incorporated in-the as-built report.

3.3.4 Pre-backfilling or dumping survey

If a long period of time (more than one month) has elapsed or if other works have been performed since the post-trenching survey, a pre-dumping survey shall be performed prior to backfilling or dumping.

This survey shall be carried out using the same equipment and procedures as as-laid survey.

3.3.5 Post-backfilling or dumping survey

The aim of this survey is to ascertain that the sealine has been covered according to job Specification.

This survey shall be carried out using the same equipment as listed in paragraph 3.3.1. Cross profile measurements shall be taken with the ROV static and correlated with pre-dump survey measurements (± 1 m longitudinal position) to be to provide:

- The thickness of material coverage over the top of the sealine
- The lateral extension of the berm.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 11 of 32

3.4 Survey after remedial/Preventive works

Remedial/preventive works can include but may not be limited to the possible dumping of gravel over spool pieces and flanges, the installation of anti-scouring mats, the installation of free span correction devices, mattresses and pre-lay pipeline route preparation works and straightness correction.

Should rock/gravel dumping be required for pre-lay route preparations or post-lay interventions, the survey Scope of Work shall comprise HSS imagery and bathymetry profiles together with data from the pipe tracker.

- A main line along the centreline of the spool piece/pipeline by ROV, obtaining data from the ROV echo-sounder, DHSS (or Sea Bat) and pipe tracker.
- Cross lines at 5 m intervals perpendicular to the spool piece/pipeline obtaining data from the ROV echo sounder, DHSS (or Sea Bat) and pipe tracker. Cross lines shall extend for a minimum of 10 m either side, and for the whole length, of the dump material.
- Continuous video recordings and snapshot of specific areas of interest.

3.5 Reference specifications and parameters

Works shall comply with Contractual obligations, particularly requirements of Company specification [GS EP GEO 203](#), Geophysical survey for offshore pipeline inspection.

Works shall be carried out with due consideration to best industry practice, and published guidelines. Refer: [BS EN 14161](#), Pipeline Design, Construction and Installation; [DNV](#), Rules for Pipeline Systems, 1996; [ISO 13623](#), Pipeline Systems; [Nederlands Normalisatie Instituut](#), steel pipeline systems.

Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines

Rev.: 05

Effective date: 10/2012

Page: 12 of 32

3.5.1 Table of Tolerance and accuracy

Accuracies quoted correspond to 95% confidence level (or 2-Sigma one-dimension accuracy).

Installation tolerances given are considered as typical. They shall be in accordance with relevant Company's construction specification.

TYPICAL SUMMARY OF TOLERANCE/ MEASUREMENT ACCURACY

FIELD DEVELOPMENT PROJECT

ITEM	DESCRIPTION	INSTALLATION TOLERANCE (+/-)	AS-BUILT ACCURACY	A	PROPOSED METHODS	ACCURACY
1	FLOWLINES	CORRIDOR	1.5	HORIZONTAL	DGPS1+HIPAP USBL	0.5% WD
2	FLOWLINES 2000M FPSO/FPU	CORRIDOR	5	HORIZONTAL	MF LBL	0.3m
3	FLET	CUT-TO-LENGTH	5	CUT-TO-LENGTH	MF LBL	0.3m
		LATERAL	2.5	LATERAL	MF LBL	0.3m
		ATTITUDE	2.5	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	1	ORIENTATION	ROV GYROCOMPASS	0.2deg
4	ILT	LONGITUDINAL	5	LONGITUDINAL	MF LBL	0.3m
		LATERAL	2.5	LATERAL	MF LBL	0.3m
		ATTITUDE	2.5	ATTITUDE	2 AXIS INCLINOMETRE	0.01m
		ORIENTATION	1	ORIENTATION	ROV GYROCOMPASS	0.2deg
5	FLOWLINE 500 M FIXED STRUCTURE	CORRIDOR	5	HORIZONTAL	DGPS1+HIPAP USBL	0.5% WD
6	RISERS	TDP	5	HORIZONTAL	MF LBL	0.3m
7	MANIFOLDS	HORIZONTAL	2.5	HORIZONTAL	MF LBL	0.3m
		ATTITUDE	1	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	2.5	ORIENTATION	U/W GYROCOMPASS	0.2deg
8	MANIFOLDS ANCHORS	HORIZONTAL	2.5	HORIZONTAL	MF LBL	0.3m
		ATTITUDE	1	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	2.5	ORIENTATION	ROV GYROCOMPASS	0.2deg
9	WELLHEAD	HORIZONTAL	2.5	HORIZONTAL	MF LBL	0.3m
		ATTITUDE	1.5	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	5	ORIENTATION	ROV GYROCOMPASS	0.2deg
		ELEVATION	1	ORIENTATION	BATHY SYSTEM ALTIMETER	0.1m
10	FPSO	HORIZONTAL	5	HORIZONTAL	DGPS1/ DGPS2	1m/3m
		ORIENTATION	2.5	ORIENTATION	SURVEY GYROCOMPASS	0.2deg
11	FPSO MOORING LEGS	CORRIDOR	1.5	HORIZONTAL	DGPS+HIPAP USBL	0.5% WD
12	FPSO SUCCION ANCHOR	HORIZONTAL	5	HORIZONTAL	LF/MF LBL	1m/0.3m
		ATTITUDE	5	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	5	ORIENTATION	ROV GYROCOMPASS	0.2deg
13	OOB/SPM	RADIUS	13	HORIZONTAL	DGPS1/ DGPS2	1m/3m
14	OOB/SPM MOORING LEGS	CORRIDOR	1.5	HORIZONTAL	DGPS+HIPAP USBL	0.5% WD
15	OOB/SPM SUCCION ANCHOR	HORIZONTAL	5	HORIZONTAL	LF/MF LBL	1m/0.3m
		ATTITUDE	5	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	5	ORIENTATION	ROV GYROCOMPASS	0.2deg
16	UMBILICAL	CORRIDOR	1.5	HORIZONTAL	DGPS+HIPAP USBL	0.5% WD
17	UMBILICAL TDP	LONGITUDINAL	5	HORIZONTAL	MF LBL	0.3m
18	SUT	LONGITUDINAL	5	LONGITUDINAL	MF LBL	0.3m
		LATERAL	5	LATERAL	MF LBL	0.3m
		ATTITUDE	5	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	5	ORIENTATION	ROV GYROCOMPASS	0.2deg
19	OIL OFFLOADING LINES	LONGITUDINAL	7	LONGITUDINAL	DGPS+HIPAP USBL	0.5% WD
	OIL OFFLOADING LINES	VERTICAL	2.5	VERTICAL	DIGIQUARTZ	0.02% WD
20	PRODUCTION WELL JUMPER SPOOLS	HORIZONTAL	0.05	HORIZONTAL	EHF LBL/ METROLOGY TAUT WIRE	0.03m
		VERTICAL	0.05	VERTICAL	ROV BATHY-SYSTEM/ TP DIGIQUARTZ	0.02%WD
		ATTITUDE	0.1	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	0.1	ORIENTATION	U/W GYROCOMPASS	0.2deg
21	WI WELL JUMPER SPOOLS	HORIZONTAL	0.05	HORIZONTAL	EHF LBL/ METROLOGY TAUT WIRE	0.03m
		VERTICAL	0.05	VERTICAL	ROV BATHY-SYSTEM/ TP DIGIQUARTZ	0.02%WD
		ATTITUDE	0.1	ATTITUDE	2 AXIS INCLINOMETRE	0.01deg
		ORIENTATION	0.1	ORIENTATION	U/W GYROCOMPASS	0.2deg
22	CONTROL JUMPERS/ FLYING LEED	HORIZONTAL	5	HORIZONTAL	USBL RELATIVE	1
		ATTITUDE	6	ATTITUDE	ROV INCLINOMETRE	0.01deg
		ORIENTATION	2	ORIENTATION	ROV GYROCOMPASS	0.2deg

HIGH ACCURACY
MEDIUM ACCURACY
LOW ACCURACY

Note: Accuracies are stated at 95% confidence level.

Horizontal 2D accuracy = 2.45 SIGMA

Vertical 1D accuracy = 1.96 SIGMA - where SIGMA is standard deviation

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 13 of 32

3.5.2 Survey Sensor typical accuracy

- Shallow Bathymetry (surface echo sounders) < 0.03% of water depth
- SV sensor/profiler accuracy 0.01 m/s @ 2 Sigma
- CTD device accuracy 0.005% (salinity), 0.02% (temp), 0.5% (depth range)
- Bathy-System / Digiquartz pressure sensor < 0.01% of water depth
- ROV precision echo sounder accuracy 0.5% measured distance
- ROV pressure sensor accuracy 0.01% scale range
- ROV gyro-compass absolute direction accuracy 0.2° (dynamic)
- ROV gyro-compass absolute direction accuracy 0.1 degree
- ROV scanning profiler short range accuracy 0.02 m.

3.5.3 Survey datum

3.5.3.1 Geodetic parameters

The geodetic datum system for the performance of the work shall be defined by Company in the Particular Specification.

All the co-ordinates shall be based on a single reference datum.

3.5.3.2 Vertical datum

All bathymetry measurements shall be referenced to the Lowest Astronomical Tide (LAT) - (unless otherwise stipulated) determined using standards recognized by the Company and related to the working area.

Tides shall be measured from tide gauges deployed offshore by Contractor.

3.6 Means and Method

Vessel(s) used shall comply with **GS EP GEO 110**, for applicable field conditions or depths.

The Survey vessel shall be at the minimum a DP1 Class (DP2 for deep-water survey operation), equipped with a 75HP inspection ROV (min. 100HP Workclass type for deep-water surveying) and fast winch.

The vessel shall fully comply with the requirements of **GS EP POS 001** Surface positioning and **GS EP POS 002** Sub-surface Positioning specifications.

For subsea positioning, Survey vessel shall be equipped either with a portable USBL System with an over-the-side pole-mounted transducer, having an accuracy compatible with-shallow waters or with built-in, high-accuracy USBL system, interfaced to DP system, with retractable built-in pole for transducer, with an accuracy around 0.5% of slant range (95% confidence level), for deep-water Survey.

In order to use Vessel USBL system for Survey purpose, Contractor shall verify and provide evidence, that the sensors associated to USBL system are compatible with the level of accuracy

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 14 of 32

required. In particular, Gyro-compass and VRU shall be survey grade equipment, recently serviced and checked, and fully calibrated.

The minimum requirements for a Survey Vessel are:

- High accuracy Surface positioning System interfaced to DP system
- High accuracy Subsea Positioning interfaced to DP system (DP2 or above)
- Min a 75HP Inspection ROV, a 100HP Work ROV for deep-water
- CCTV system with ROV Video channels
- Close loop local network for data transfer between ROV control room, Survey room, Processing and mapping office
- Intercom system between, ROV control room, survey, deck and bridge, with VHF working on a dedicated channel for contingency
- Data and video transmission to other surface units
- Data Processing and mapping facility installed in a dedicated Reporting office
- Video review and analysis facility
- Full communication capability including telecom and high-speed internet access in the client office for Client dedicated computer, plus an internet hub allowing Company computer connection to internet (alternatively an WIFI network)
- Client dedicated computer shall be provided with the latest update of the following software(Office suite, Autocad, Win project)
- A min 15 T crane for Stand deployment (when required) and large deck space.

3.6.1 ROV Spread

The proposed ROV and acoustic positioning equipment must be adapted to the water depth and environmental conditions expected in the area. A TMS (Tether Management System) shall be required for deep-water operations.

The ROV must have sufficient power (min 75 HP) to withstand currents up to 2.0 knot from any direction and overcome drag forces of the umbilical.

3.6.1.1 ROV system and Survey Sensors

Survey Construction support ROV shall be equipped with the following tools and sensors.

- High Resolution sonar
- High Resolution cameras (one SIT and 2 color)
- CCTV including all video visualization, recording and capture required
- Survey-grade underwater gyro-compass
- Video unit interfaced with Navigation system
- Bathy-System with multi-beam echo sounder and Digiquartz depth sensor

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 15 of 32

- Trench profiler or multi-beam sonar with pitch/roll correction from the ROV VRU
- Dual boom cameras system and associated video visualization suite
- State-of-the-art Cable/ Pipe tracker
- Acoustic transponder/responder (USBL system compatible with survey vessel acoustic system)
- LBL Acoustic transceiver (for positioning ROV inside an LBL array)
- 5-function manipulator (grabber)
- 7-function manipulator
- Cable cutters (1.5 / 3' diameter)
- ROV carriage with Rollers adjustable to pipe diameter
- CP system for continuous remote CP readings and Stab for direct readings.

The umbilical capacity and multiplexer system shall be sufficient to supply all the required power and control to the ROV and to transmit all Video and sensor signals, with no interference.

3.6.1.2 ROV Gyro-compass

The ROV shall be equipped with a Gyro-Compass; its calibration shall be checked at regular intervals against the vessel's gyro-compass.

3.6.1.3 Bathymetric survey suite

In order to provide highly accurate depth measurements, the ROV shall be equipped with a Bathy-System combining information from ROV altimeter with a high-precision pressure sensor (0.1% of the water depth).

Both sensors will need to have a recent bench calibration sheet (less than a year old).

Depth information shall be computed in real-time, displayed and logged for later integration into the reports.

Sound velocity in the water column is to be recorded with a CTD profiler.

Atmospheric pressure and tidal corrections shall be applied.

3.6.1.4 Trench profiler

A trench profiler shall be provided in order to obtain vertical cross sections showing sealine position relative to the undisturbed seabed.

All profiles shall be logged, together with the ROV pitch/roll measurements and high accuracy depth data, for later processing.

3.6.1.5 Pipe and cable tracking system

When buried, the sealine position shall be obtained from a pipe and cable tracking system. This equipment shall be mounted on the ROV, and in the field of vision of the cameras.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 16 of 32

Position, heading, pitch and roll, altitude of the ROV shall be used in order to calculate the depth of burial and offset position.

Target representations, offsets and depth of burial shall be calculated in real-time, displayed and if required, included on the video overlay.

All data shall be logged for later processing.

3.6.1.6 Out of straightness measuring system

In the event of high pressure, high temperature fluid being carried through a small diameter pipeline (< 16 inch), it may be necessary to accurately measure the vertical/ horizontal post-lay undulations, in order to detect potential risk of heaving/lateral buckling and anticipate the nature of remedial action to be taken.

The system should comprise two elements: High-accuracy pressure sensor and High-accuracy odometer.

Tide and atmospheric pressure corrections shall be applied.

All data shall be logged for later processing.

3.6.2 Positioning

3.6.2.1 Real time DGPS

In all cases, Contractor shall supply as a minimum, 2 fully independent positioning systems providing sufficient redundancy and quality control output in order to insure that positioning is made within the required accuracy.

At least, one system shall be a dual frequency DGPS System. During period of high solar activity, dual frequency shall be a standard requirement as well as HF corrections options.

The primary DGPS system absolute accuracy shall be better than ± 1 m (95% confidence)

The secondary DGPS system absolute accuracy shall be better than ± 3 m (95% confidence). Refer to **GS EP POS 001** for technical details concerning equipment and procedures.

3.6.2.2 Ultra Short Base Line (USBL) and Long Base Line (LBL) acoustic positioning

USBL system shall be permanently integrated to the primary positioning system in order to continuously track towed fishes or ROV.

LBL system shall be interfaced to the primary positioning system for Box-in operation only.

Refer to **GS EP POS 002** for technical details concerning equipment and operational procedures.

3.6.2.3 Complementary survey sensors

Survey gyro-compass and VRU with full back-up shall be interfaced to the Integrated Navigation system.

SV and CTD profiler with full back-up shall be required for calibration and high accuracy positioning purpose.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 17 of 32

Refer to **GS EP POS 002** for technical details concerning equipment and operational procedures.

3.6.3 Integrated navigation system

Integrated Navigation System shall be interfaced to all positioning systems, complementary sensors such as VRU, Gyro-compass, ROV system including ROV Gyro-compass, VRU, Bathy-System, dual-head scanning sonar (DHSS), multi-beam echo sounder, SV sensors, Pipetracker and CP sensors. It shall be able to acquire, calculate, display and store the various parameters required for survey operations. It shall be able to display video overlay message.

It will display Real time Navigation Graphic information to ROV Control room, client office and Bridge.

Integrated Navigation Software features and performance shall be submitted to Company approval.

3.6.4 LBL Positioning and Calibration system

This module for Calibration and navigation shall be either included in the support vessel Navigation system or included in a stand-alone system.

LBL Software features and performance shall be submitted to Company for approval

In addition, an array adjustment QC software (Geomatrix, move3...) shall be used to verify online software adjustments and calculations.

3.6.5 Survey equipment

3.6.5.1 Echo sounder and side scan sonar (shallow water)

Refer to **GS EP GEO 201** for technical details concerning equipment and operational procedures.

3.6.5.2 Magnetometer (shallow water)

A magnetometer with a sensitivity of 0.01 gamma should normally be used to locate a buried pipeline or communication cable. Locating a decommissioned power cable or out of use telephone cable may require the use of a 3-axis magnetometer, as well as in some cases low-frequency AC signal injection in the cable.

The proposed system shall include graphic recorders, sensors, winch and tow cable long enough to tow the sensor outside the vessel's magnetic field.

Typically, the magnetometer is towed a couple of metres above the seabed. A depth sensor is therefore mandatory.

If available at the time of the pre-lay survey, the ROV pipe/cable tracker may also be used.

3.7 Quality control

3.7.1 Equipment quality control

As part of the QC plan, all equipment must be installed and operated in accordance with the Manufacturer's specifications and the Contractor standard procedures.

Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines

Rev.: 05

Effective date: 10/2012

Page: 18 of 32

All items of equipment must be tested and calibrated in accordance with the operator's and Manufacturer's procedures, as often as required, in order to ensure that the equipment is providing consistent, reliable data during the course of the survey.

Bench calibration certificates must be available on board. Results of field calibrations shall be submitted to Company representative's approval.

Copies of laboratory and field calibrations shall be included in the mobilization report and in the final report.

3.7.2 Equipment documentation and Spare parts

All key equipment shall be provided with full back-up and all necessary spare parts supplied to avoid down time during the survey. A detailed list of the back-up equipment and of spare parts shall be documented in the tender documents, listed in the survey procedure and submitted to the Company representative at vessel mobilization stage.

Maintenance and operation manuals of each equipment shall be available on board Vessel.

4. Data Processing and Mapping System

In addition to the real-time acquisition system, the following software package shall be mobilized, when required:

- DVL post-processing
- USBL calibration software
- DHSS data processing - free span analysis
- Tide prediction/tide correction
- LBL array adjustment
- Box-in calculation
- Reporting and Mapping system, Autocad or Microstation
- A3 printers and A0/A1 plotters.

5. Onboard Reporting

5.1 Daily Progress report

Standard Survey progress report shall be issued to Company using an approved Company form.

5.2 Weekly report

Weekly report shall include all relevant information concerning the progress of the survey operation and results agreed by Company.

Two documents are required: Weekly progress status drawing and Position & results database update.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 19 of 32

5.3 Field report

Every Positioning and Survey activity shall require a Field report. It includes: mobilization, calibrations, pre-survey, Interim survey, as-laid survey, structure installation, permanent surface structure installation.

In addition, for subsea structure positioning, a data sheet with main results and QC information shall be issued by Contractor, reviewed by Company Representative and dispatched to project.

In addition to the above documents, copy of raw data and results files, in ASCII format, shall be provided to Company.

All field reports shall be reviewed, commented and approved by Company for integration in the final report.

5.4 Final report

The Final report shall include all information and results obtained during the operations and shall be submitted to the Company for approval not later than 4 (four) weeks after completion of the survey.

The report shall include a specific section detailing all Quality Control activities carried during the course of the survey.

It shall be entitled:

Company name, Block reference and location name Type of sea line, diameter, start and end of line location Contractor's name Start/end dates of offshore works As laid Survey report or "as-trenched" or "as-built"
--

The first page of the report must specify the date of issue, the name and signature of issuing authority, Party Chief in charge of field works and all personnel involved in its preparation.

Date, relevant names and signatures should also be indicated on each chart.

The final report shall be written according to (but not limited to) the following guidelines:

Section 1: Introduction

It gives a brief description of the operation, date of survey, location plan with existing structures, obstructions, etc. and the theoretical sealine route.

Section 2: Results

This section shall provide an extensive description of the sealine field joint or data at 10- to 20-metre spacing (for a cable or a flexible), and event logs already presented in the preliminary report. It should also comprise the following:

- The undisturbed seabed level is the reference for any vertical measurement of the sealine top after laying, trenching or material dumping
- The burial depth is the depth of sealine top relative to the natural seabed level

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 20 of 32

- The coverage is the vertical distance from the top of the sealine to the surface of the overlaying material
- After trenching or dumping, the lateral range of the trench profiler must allow unambiguous reading of the seabed level, outside the area affected by excavated soils or spreading of dumped material
- The profiles performed after laying, trenching or material dumping, selected for reporting shall have the same KP's for comparison purposes
- Any measurement related to the undisturbed seabed level must be corrected for tide.

Section 3: Procedures and statistics

This section reviews the work definition and technical specification and provides an extensive description of the resources used to perform the whole survey:

- Vessel and survey equipment including: side scan sonar, echo sounder, gyro-compasses, etc.
- Surface positioning systems
- Acoustic positioning systems
- Navigation system
- ROV and ROV survey sensors
- ROV video equipment
- Video recording and display system
- Reporting suite.

Section 4: Quality control of results

This section provides an extensive description of the performances of the positioning and survey sensors used, together with all port and offshore calibration results, further checks and controls performed during the course of the operation, during the processing of data, Array adjustments, etc.

Section 5: Cross profile catalogue

This section includes the profiles obtained from the trench profiler.

Each profile (typical spacing 5-10 meters) shall be displayed with horizontal/vertical scale of 1 cm = 1 meter. The following information should be included:

- ROV dive number
- Profile number
- Date
- Time
- KP
- UTM co-ordinates

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 21 of 32

- Tide value at time of profile
- ROV depth, including trench profiler offset
- Natural seabed level left/right
- Natural seabed level mean
- Depth of sealine top
- Burial depth (positive value if above, negative value if buried)
- Depth of trench (or residual trench if sealine covered)
- Thickness of overlaying material (cover).

Section 6: Appendices

- Appendix 1: Reduction of all charts to A3 standard size
- Appendix 2: Summarized tidal data, SV, CTD profile
- Appendix 3: Personnel involved
- Appendix 4: Diary of events
- Appendix 5: Survey station co-ordinates and description
- Appendix 6: Offset diagrams
- Appendix 7: Video tape/ DVD index (ROV)
- Appendix 8: Video print-out log (ROV)
- Appendix 9: ROV Dive and Survey Logs (ROV)
- Appendix 10: Log of original records.
- Appendix 11: Log of Field reports.
- Etc.
- Appendix XX: DVD including all reports, charts and results.

Section 7: Maps

Because of the reduction of all charts to A3 standard size, special attention must be paid to the printing quality.

All maps should show the geographical and grid co-ordinates, as well as the survey grid (in filigree) and a true North arrow.

All symbols used must be explained in the legend.

The key map must be located on a situation plan.

Each map should have an overlap of 10 cm approximately.

The match line must be clearly shown.

The personnel in charge, date of issue and revision number must be indicated on each map.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 22 of 32

The scale of all alignment sheets and the horizontal scale of the cross-sections shall be as follows:

- 1/2,500 for a corridor length < 10,000 m
- 1/5,000 for a corridor length < 20,000 m
- 1/10,000 for a corridor length > 20,000 m.

The following maps are required:

General situation map

It shows the intended sealine route, the existing platforms, cables, pipelines and, in general, all place names used in the report. This map must also appear in the text.

Separate drawings of initiation and lay-down or crossing areas

Scale 1/1000 with position of existing sea lines, LBL array, LBL beacons on sealine, theoretical target, final position of initiation or lay-down head, existing structures (theoretical and "as-found" co-ordinates), theoretical and final heading, etc.

Alignment sheet

The results on the sealine route shall be presented under the form of alignment sheets having 4 (four) thematic "Blocks" or "boxes" in the following order:

Bloc 1: Plan view of the sealine

The actual sealine position overlays the information obtained from the geophysical/geotechnical survey and from the pre-lay survey:

- Bathymetric contours (0.5 m contour interval), LAT (unless otherwise specified)
- Kilometric indications along the sealine showing KP (kilometer posts), with co-ordinates and ticks every 100 meters
- Theoretical sealine route, in filigree, together with the main geodetic points along the sealine (turning point, tangent point, curvature radius, etc.)
- Existing structures
- Debris within the side scan sonar range (detected during the pre-lay survey or the as-built survey).

The information obtained from the ROV survey shall be added:

- Anomaly
- Free span
- Video tape change
- Damage
- Picture number.

All the above events shall be documented with corresponding KP and UTM co-ordinates.

Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines

Rev.: 05

Effective date: 10/2012

Page: 23 of 32

Bloc 2: Longitudinal profile of sealine and seabed

With representation of the top and bottom of the sealine relative to the natural seabed level.

The KP indications (ticks every 100 m) must also be drawn and the main events listed above reported in same manner as in Box 1.

If the longitudinal profile follows a material dumping operation, the top of overlaying material must also be indicated.

Bloc 3: Cross profiles

This must provide the most convenient representation (spacing 50-100 meters) of the cross profile extensively presented in the catalogue.

Selected profiles must illustrate, as far as practical, significant events such as free span, self lowering, exposures, etc.

Bloc 4: Engineering information

This window should provide information not appropriate to the previous window(s) i.e.:

- KP with ticks every 100 meters
- Video tape index
- Video print index
- Joint
- Anode
- Free span
- Self lowering
- Damage
- Debris
- Other.

In the event of bundle laying, the following should also be included:

- Joint and anode of the attached sealine
- Saddle-block or clamp
- Damage to the sealine
- Clock face position when different from vertical.

6. Document delivery**6.1 Final report**

When the final version of the survey report has been amended/corrected according to Company comments and approved by Company, it shall be issued and dispatched, together with a PC-compatible CD ROM copy of the full report in Word for Windows format and in Adobe Acrobat PDF format, according to the distribution list included in the project specification.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 24 of 32

In addition, all charts shall be digitized and stored on DVD in a standard agreed format (dgn and dwg as a minimum, dxf optional).

Position database for sea lines, umbilicals and structures shall be provided in ASCII format compatible with Excel.

As a separate deliverable, the data acquired shall be provided in a format fully compatible with Total GIS (Geographical Information System, or survey database).

6.2 ROV Video tapes/ DVD

All Tapes/DVD must be labeled, referenced and sent when and where required in the project specification.

When dual boom cameras were used, video recording may include in the same view, all top, left and right camera records.

6.3 Field records from analogue Survey

All original records shall be sent after the report has been delivered and must comply with following requirements:

- Each file and roll shall be assigned a number and recorded on the same listing. The detailed listing of original records, including the common reference numbers, shall be included in Appendix 10 (see section 6 of chapter 5.1.4). It will indicate, for each file roll:
 - The file or roll number
 - Profile numbers with, for each, the first and last fix numbers
 - The date of the recording
 - The location name.
- Data disclosure to any person/Company not specified in the contractual documents is not allowed without Company written approval.

6.4 Field Positioning data base & reports

- Final release of the complete Positioning database shall be included in the report DVD.
- Positioning Quick sheet issued onboard and all Field reports shall be added.

7. Quality Assurance - Quality Control

7.1 Quality System

The Contractor and its Survey Sub-Contractor shall be managed by an effective Quality System that ensures the conformity with the agreed requirements of the project. The system shall provide verified and traceable documentation showing compliance with the project requirements

The requirements of [ISO 9001](#) shall be met. The Quality System shall comprise the:

- Quality Assurance Procedure Manual
- Project Quality plan

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 25 of 32

- Work Instructions and Standard Procedures
- Records, Reference and Support Documentation. These shall be in the English language and available for audit by Company.

7.2 Quality Audits

The Company shall reserve the right to assess the technical capacity of and review the effectiveness of Quality Systems implemented by the Contractor and its Sub-Contractors. This may be affected by means of surveillance, review and audit methods at the discretion of the Company.

The Contractor shall maintain similar methods to assess and review their Sub-Contractors. These records should be available to the Company.

7.3 Project Quality plan

The Contractor shall propose a comprehensive Quality Plan covering all aspects of the Scope of work and which satisfactorily relates the Quality System of the Company. Where mandated by Company, or Contractor's own Quality systems, or statutory requirements, the Quality Plan should comply with good practice, as required by published authorities:

- [ISO 9001](#) : Quality management requirements
- [ISO 9000](#) : Quality management certifications

The Project Quality Plan shall set out the specific Quality practices, resources and sequence of activities relevant to the Contract. It should follow the practices detailed in the [UKOOA Guidelines](#):

- Guidelines for the Measurement of Quality and Basic Quality Control of Offshore Positioning Data, UKOOA (Survey & Positioning Committee), June 1992
- UKOOA Guidelines on the use of differential global systems in offshore surveying, 1994
- *where relevant*, UKOOA Guidelines for the Conduct of site Surveys for Mobile Drilling Rigs, 1995.

As a minimum the Project Quality Plan shall contain the following:

- A description of the Contractor's organization which specifies those individuals responsible for achieving compliance with the technical and quality requirements of the Work
- A description of the Contractor's team responsibility
- The Work Instructions list to be used for standard survey activity
- A detailed list of documents: procedure, method statement and charts, to be produced in order to allow a proper operation mobilization, performance and reporting
- QC Activity plan (ITP) detailing each survey & positioning activity
- A list of the objective documentation and reports to be produced as proof of achievement of the requirements
- The criteria used to measure the acceptance of acquired data including algorithms where applicable

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 26 of 32

- Table of tolerances required, means and methods proposed, accuracy of the method, contingency method for each main step of the operation
- Description of the methods used by Contractor to assess and control sub-contracted services.

7.4 Quality Control Activity Plan

The Quality Control Activity Plan shall outline the activities in relation to Survey and positioning services and shall have been designed such that all required activities form systematic categories. By adopting this format, it shall be easy to trace and control each process and individuals responsible for support and execution of each task as described in the company specifications.

Column of the QC Plan table shall allow to specify the following:

Task number, process description, responsible person, process control document to be used (procedure/ Work Instruction), verifying document ref, inclusion in final report (as-built), level of inspection (H/W/M/V/A, etc.) and controlling authority signature Contractor, Company.

The QC Activity Plan, also called Inspection and Test Plan (ITP), shall be include in the Positioning & Survey procedure, which an integral part of the Project Quality System.

7.5 Documentation

A copy of Project Quality System documentation shall be available onboard the surface unit for review by the Company Representative.

It shall include:

- Contractor quality System, Project Quality Plan, Survey Sub-Contractor (if applicable), QC system including Work Instruction and Standard procedures, Procedures in the "Approved For Construction" status, QC Activity Plan
- User and maintenance manual for all Software, equipment and systems
- Company Geodetic System data sheet including transformation example
- A copy of the Guidelines for the Use of DGPS in Offshore Surveying, published by the UKOOA (Surveying & Positioning Committee) in September 1994
- A copy of Guidelines for the Measurement of quality and basic quality control of offshore positioning data, published by the UKOOA (Surveying & Positioning Committee) in June 1992.

8. Survey & Positioning Procedures

Survey and positioning procedures are an essential part of the Project Quality Plan.

Contractor shall issue at least 2 months prior to the start of the operation, a Positioning & Survey procedure, for review and comment. After all comments have been addressed, this document shall be approved "for Construction", issued as an IFC procedure and signed by Company.

Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines

Rev.: 05

Effective date: 10/2012

Page: 27 of 32

No deviation from his procedure shall be made without prior formal approval of the Company (deviation request). Any operation, performed in violation of the procedure, shall require a Non-Conformance Report.

8.1 Procedure Summary

Positioning & Survey Procedure shall include as a minimum the following sections:

- Introduction with scope of the document, definitions, abbreviations, document & references, contacts
- Responsibility
- Scope of work
- HSE
- Quality System
- Survey parameters
- Preparation, Mobilization and Calibrations
- Field Operations including Method statement and details of tasks for each operation
- Charting & reporting
- Resources: Personnel, Equipment, ROV, Vessels
- QC Activity Plan (or ITP)
- Project Database and Drawings
- Appendix and Annexes including all required information and additional documents.

Health and Safety issues shall be given due consideration according to the relevant Contract Exhibits, industry practices, and published guidelines. Refer: [IAGC Safety Manual](#), 1991; E&P Forum, Safety Guidelines, 1994, 1995; if relevant, use of Small Boats, 1995.

8.2 Survey Procedures Content

The procedure shall describe Contractor means and methods by which it shall ensure conformance to requirements and positioning tolerances. With close reference to the Contractor standard procedures and work instructions, the procedure shall detail Contractor positioning systems, survey sensors, methods, techniques and general configuration by which the positioning objectives will be met. The Contractor shall ensure that all specified navigation and positioning equipment including computer hardware and software are installed, calibrated and operational.

These shall include at the very minimum the following:

- Comprehensive descriptions of all proposed sub-surface positioning equipment and systems. Where the systems are sub-contracted, then performance figures shall be provided as well as details of Contractor's audits on the Sub-Contractor. Monitoring systems shall be described as well as any other relevant information. Types of acoustic equipment shall be itemized.

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 28 of 32

- Line listing and pre-plots together with the agreed geodetic parameters.
- List of calibrations to be carried out as well as the methodology and procedures to be used. Historical data from previous calibrations will be provided where applicable.
- An analytical appraisal of the positioning configuration. This shall comprise as absolute minimum a description and analysis of all nominal offsets, geometry, redundancy, nodes, a priori standard deviations of all of the observations and where applicable the correlation coefficients between the observations. Any other relevant information must be included. The analysis shall be applied to the survey networks and the results supplied to Company on CD/DVD. Any tracking nodes shall be identified. Scenarios of realistic equipment breakdown shall be included. A hard copy shall be supplied by fax or courier. A block diagram of the structure of data acquisition and processing including the individual systems shall be supplied.
- Description of all real time and off-line data processing methods. The methodology of the computations shall be described as well as the statistical output and testing involved to ensure that all significant errors are readily detected. Any proposed changes to existing onboard systems or software shall be detailed. Any filtering methods shall be fully documented and made available to Company prior to the commencement of the survey. Contractor shall clearly indicate whether processed data is Kalman filtered or computed by Least Squares for each point.
- All other quality controls and measures that concern processing of positioning data shall be described and in context with the processing set up.
- Percentage of and type of spare equipment and contingency for the replacement or repair of defective material.
- The magnetic declination for the survey area.
- Details of the survey team, including names and brief CV.

The Contractor shall prove to Company that the proposed configuration of positioning systems and sensors is capable of achieving the required precision and that sufficient redundancy exists to ensure valid statistical results and to maintain the required precision in case of certain levels of equipment failure.

Company reserves the right to request changes and to add further specified procedures if considered necessary.



General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 29 of 32

9. Bibliography

Reference

E&P Forum

Title of the publication

Service Vessel Marine Safety Guidelines, Report no. 6.38/213 - December 1994

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 30 of 32

Appendix 1 Definitions

1. General

ISO 9001

International Standards Organization 9001: 1994 which is part of the ISO 9000 series and addresses Quality Systems - Model for Quality Assurance in design, development, production, installation and servicing.

Company

Total, its Subsidiaries or Associates

Contractor

Main Contractor and its Survey Sub-Contractor or Survey Contractor, contracted by Company to carry out Survey/positioning services offshore

Representative

Positioning Representative acting on behalf of Company

Scope of Work

Document produced by Company which details the particular requirements for a particular project

Sub-Contractor

Company providing services to Contractor as part of project Contract

Technical Specification

Specification written by Company

UKOOA Guidelines

Guidelines published by UKOOA (Surveying & Positioning Committee), Use of DGPS for Offshore Positioning, 1994

UKOOA

United Kingdom Offshore Operators Association

2. Quality system

Authority

Inspection, approval personnel acting on behalf Sub-Contractor, Contractor of Company or entitled to signed QC Activity plans

Organization

Juridical entity representing, Company, Contractor and any Sub-Contractor

ITP

Inspection & Test Plan. Table listing phase by phase, task per task, the detail of the quality Control task to be performed, the person responsible, the procedure used, the inspection authority for Sub-Contractor, Contractor of Company, the approval authorities Each individual QC task shall be signed by authorities

QC

Quality Control

Quality Audit

A systematic and independent examination to determine whether Quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 31 of 32

Appendix 1

Quality System	Rules, Procedures, Method and Document implemented as part of the Quality Policy of an Organization
Quality Manual	A document stating the Quality Policy, and describing the quality system of an Organization
Project Quality Plan	Document setting out the specific Quality practices, resources and sequence of activities relevant to the particular project
QC Activity Plan	Same definition as ITP above

3. Positioning & Survey

AHT	Anchor Handling Tug
CD	Chart Datum
C-O	Calculated minus Observed correction
DCC	Distance Cross Course
DGPS	Differential Global Positioning System, which uses corrections from known reference stations
DP System	Dynamic Positioning System
GcGPS	Globally corrected GPS based on high accuracy clock, trajectory and propagation delay corrections
HF	High Frequency
ITRF	International Terrestrial Reference Frame
KP	Kilometer Post
LAT	Lowest Astronomical Tide
MDE	Marginally Detectable Error
MSL	Mean Sea Level
PDOP	Position Dilution of Precision (satellite geometry indicator)
RGPS	Relative Global Positioning System
RINEX	Receiver Independent Exchange Format
RTCM SC-104	Radio Technical Commission for Maritime Resource Special Committee 104
RTCM SC-104 Format	Recommended format for GPS in differential mode. Differential corrections are often referred to as simply RTCM corrections
TMS	Tug Management System
UTC	Universal Time Co-ordinates
UTM	Universal Transverse Mercator

General Specification		GS EP GEO 202
Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines		
Rev.: 05	Effective date: 10/2012	Page: 32 of 32

Appendix 1

VHF Very High Frequency
WGS 84 World Geodetic System 1984

4. Acoustic

CTD Conductivity Temperature Depth sensor
EF Extra High Frequency
MF Medium Frequency
LF Low Frequency
LBL Long Base Line System
SBL Short Base Line System
SV Sound Velocity
USBL Ultra Short Baseline System

5. ROV

ROV Remote Operated Vehicle
DVL Doppler Velocity Log
INS Inertial Navigation System
TMS Tether Management System
DHSS Dual Head Scanning Sonar
OAS Obstacle Avoidance Sonar
SSS Side Scan Sonar to be mounted on ROV
BATHY-SYSTEM ROV System coupling Digiquartz pressure sensor and sounder
MBES Multi-Beam Echo-sounder to be mounted on ROV