



Exploration & Production

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 201

Offshore geophysical surveys

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1. Scope

The contents of these General Technical Specifications indicate the minimum standards required by COMPANY. However, should COMPANY consider that any aspects of the work requires more detailed investigation, COMPANY reserves the right to apply further Particular Technical Specifications.

All Equipment and Materials necessary to complete the survey in accordance with this Contract shall be supplied by CONTRACTOR. Such Equipment and Materials shall include all spare parts and spare Equipment units as may be necessary to provide normal and continuous operations, and shall be in good operating condition prior to the award of Contract.

Such Equipment shall be properly maintained in such a way as to assure accuracy within the tolerances set by the MANUFACTURERS for such Equipment. CONTRACTOR undertakes to provide a statement of the surveying accuracy of this Equipment.

The Work defined in these Specifications shall be performed in accordance with the Agreement.

The Work shall include the following phases:

- **Data acquisition phase:** Survey implementing multibeam echo-sounder system, side scan sonar, sub bottom profiling (pinger, boomer / sparker), digital multi-channel seismic, and piston-coring.
- **Data processing phase:** This phase is to be carried out while data acquisition in order to be sure that surveyed area is acceptable and concerns:
 1. Final navigation data for all sensors
 2. Offshore acquisition of multi-beam echo-sounding, side scan sonar, analogue seismic and soil samples; onshore: laboratory tests on soil samples if any
 3. High-resolution digital multi-channel processing, to be carried out on-board seismic vessel while data acquisition is underway or further onshore.
- **Interpretation phase:** Preparation of comprehensive Reports in English language integrating all above data and all previous available data (previous site survey results as well as geotechnical data if available and required).

Reports shall include bathymetric, seabed feature, lithological, geophysical charts and interpreted cross-sections, as well as hazard chart(s) in order to recommend:

- Suitable drilling location(s) - sites surveys
- Suitable re-routing of the pipeline - pipeline route surveys
- As per objectives of the Particular Specification

The final product shall be an Expert Report.

The programme of the Work is included in the Particular Technical Specifications.

2. Reference documents

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

The order of precedence of the applicable documents shall be:

- i) The Particular Technical Specifications
- ii) The present General Specifications
- iii) 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.

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

Standards

Reference	Title
IAGC	Marine Geophysical Operations Safety Manual 7 th edition, 1991
BS 8010, Part 3	Pipelines Subsea: Design, Construction and Installation
DNV	Rules for Submarine Pipeline Systems, December 1996
IMCA	International Marine CONTRACTOR's Association, Guidelines for the use of multibeam echo-sounders for offshore survey, 2000
ISO 9000	Quality Management and Quality Assurance Standards
ISO 13623	Petroleum and Natural Gas Industries - Pipeline Transportation Systems
OGP	Service Vessel Marine Safety Guidelines, Report No. 6.38/213 - December 1994
	Health, Safety and Environmental Schedules for Marine Geophysical Operations, July 1995
	Guidelines on the use of Small Boats in Marine Geophysical Operations, July 1995
UKOOA guidelines	Guidelines for the Conduct of site Surveys for Mobile Drilling Rigs - 1995 and subsequent updates
	Guidelines on the use of differential global systems in offshore surveying, 1994

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 GEO 101	Offshore geotechnical soil survey
GS EP GEO 110	Requirements for offshore survey vessels
GS EP GEO 202	Geophysical survey for the installation and/or the inspection of offshore structures and pipelines
GS EP GEO 203	Geophysical survey for offshore pipeline inspection
GS EP GEO 204	Geophysical debris survey
GS EP LSO 202	Personnel transfer between ships to ships and offshore structure
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works
GS EP POS 004	The use of differential global positioning system

3. Survey objectives and methodology

3.1 Survey objectives

The object of this General Specification is to define the Work concerning:

- **Site surveys** at the locations specified in the Particular Technical Specifications
- **Pipeline corridor surveys**, on a route specified in the Particular Technical Specifications.

If the pipeline is planned to reach an onshore landing, the survey shall be divided into two specific operations:

- An **offshore pipe route survey**, that is from the offshore location(s) towards the coast until a water depth of 6 m (or safe manoeuvring depth based on proposed vessel draft)

- A **shore approach** survey, from nominal 6 m water depth as above, to the landfall (defined as 0.0-m depth contour after reduction to LAT).

3.2 Survey purpose

Interpretation of the data shall enable CONTRACTOR to report results of the **site surveys**, in order to:

- Chart water depths (bathymetric map)
- Delineate the steep and potentially unstable slopes of 5 degrees and more, if any
- Delineate irregular topography showing features and local relief (seabed feature map)
- Assess any obstacles to structure emplacement on the seafloor
- Define the nature of the soils (lithological map of surficial and mid-depth sediments, to nominal **75-m depth** sub seabed)
- Identify and delineate any potential geohazards over the survey area
- Delineate active faults, modern and ancient landslides
- Map **shallow gas** or gas hydrate **occurrences**, and their horizontal extent as well as vertical height (structure and fluid column height)
- Recommend the safest drilling locations, with regard to drilling units; or sub-sea emplacements, development structures, relating to purposes of the Particular Technical Specification
- Prepare comprehensive reports and charts, written in English language.

The results of **pipeline route surveys** shall enable CONTRACTOR to:

- Chart water depths (bathymetric map)
- Assess any obstacles to pipe-laying on or below the seafloor
- Define the nature of the soils (e.g. lithological map of surficial sediments) with regard to pipeline lay
- Recommend pipeline route alternative(s), to avoid pipe laying obstacles at or below seabed, identified by interpretation of survey data. This shall be done offshore, in consultation with COMPANY, before de-mobilisation, to ensure sufficient coverage acquisition by survey
- Prepare comprehensive report written in English language, including maps and profiles presented on "**Alignment Sheets**".

3.3 Survey methods according to water depth

The location of survey will entail operation in a particular water depth range, which this general specification addresses by differentiating three types of survey.

- **Shore approaches** refer to the zone between 6-m (shallowest approach of a survey vessel) and the surf zone, calling for the use of shallow-draft vessel, or mini AUV, maybe in conjunction with the survey vessel

- **Conventional survey** typically takes place on the continental shelf, between 6-m near-shore depths and about 300 m offshore depths. This survey is normally carried out by a single survey vessel.
- **Deep-water survey** presents challenges due to sensor positioning. The methodology to be used should be adapted to COMPANY's project-specific needs and accuracy requirements. Deep-water is defined, for this purpose, as depths exceeding about 300 metres for site or pipeline surveys.

CONTRACTOR shall propose one or more of the below deployments, according to COMPANY's call for tender. The final choice of method will rest with COMPANY. The different methods vary by the deployments of sensors (relative resolutions/positioning accuracies) and are listed below in general order of preference.

- a) Autonomous Underwater Vehicle
 - b) Deep-tow specification, 2 vessels
 - c) Deep-tow specification, 1 vessel
- Projects are awarded on the basis of one of these methods, or a combination in case of wide depth variations over the survey area. Any departures from these requirements shall be agreed by COMPANY.

4. Units and abbreviations

4.1 Units

Measurement system: The **International System** of Units shall be used in all relevant measurements, processing and reporting.

4.2 Abbreviations

AUV/UUV	Autonomous Underwater Vehicle/Unmanned Underwater Vehicle
ASV	Autonomous Surface Vehicle
AVO	Amplitude Versus Offset
BSR	Bottom Simulating Reflector
CD	Chart Datum
CDP/CMP	Common Depth Point / Common Mid-Point (seismic data element)
DAC/DCC	Distance Across Course
DTM	Digital Terrain Model (multi-beam product)
DGPS / GPS	Differential Global Positioning System
ERP	Emergency Response Plan
FPSO	Floating Production Storage Offloading
FRC	Fast Rescue Craft
GIS	Geographical Information System (chart database)
HPR	Hydro-acoustic Positioning System

2DHR	2D High-resolution,
LAT	Lowest Astronomical Tide
LBL	Long Base Line System
LCT	Landing craft (type of inshore vessel)
MBES	Multi-beam (or swathe) echo-sounder
MSL	Mean Sea Level
NMO	Normal Move Out
QC	Quality Control
ROV	Remote Operated Vehicle
RPM	Revolutions Per Minute (motor, propeller)
RMS	Root Mean Square
SEGD	Society Exploration Geophysicists format D
SEG Y	Society Exploration Geophysicists format Y
TDS	Temperature Depth Salinity (sounder calibration)
TVG	Time Variant Gain
USBL	Ultra Short Baseline System
VHF	Very High Frequency
VHR	Very High-resolution
WGS 84	World Geodetic System 1984

5. Vessel(s) used by CONTRACTOR

The vessel(s) to be used by CONTRACTOR shall conform to COMPANY General Specification **GS EP GEO 110**.

CONTRACTOR shall ensure that any vessel(s) used or chartered for the performance of the work hereunder shall be free from any legal, contractual or other restriction preventing it from operation in those areas required under the terms of this Contract.

In addition CONTRACTOR shall comply with the following points:

5.1 Vessel main characteristics

- COMPANY reserves the right to not accept any vessel older than **twenty-five (25) years**. In any case, such vessels would be subject to audit from Company's authorised personnel.
- The vessel(s) to be used by CONTRACTOR will consist of one or more of the following:
 - For shore approach survey, an **inshore vessel** (shallow draft boat, which may be of LCT type). The minimum length acceptable to COMPANY for such a vessel is **6-m**, and an air-conditioned cabin is mandatory for work in tropical climates.

- A **SURVEY VESSEL** for work to be performed in open sea where water depth is usually greater than 6 metres. The **minimum length** acceptable to COMPANY for such a vessel is **50-m**.
- The SURVEY VESSEL used by CONTRACTOR for the performance of the work shall conform to the following requirements:
 - For work in open waters: twin-engine, single or dual screw, and bow thrusters
 - For work within 500-m of coastline, or offshore installations (rig or platform): twin-engine, dual screw, and bow thrusters.
 - The vessel shall be capable of good manoeuvrability as well as constant speed while surveying: nominally a cruising speed of 10 knots down to 2 knots (4 m/s) for surveying (vessel speed to be compatible with 6.25-metres shot interval, when 2DHR seismic is performed).
- The SURVEY VESSEL shall be equipped with **auto pilot**, primary and spare **radars** (ARPA type) and gyro-compass (with digital output if interfaced with survey computer).
- The SURVEY VESSEL shall be fully compliant with **GS EP LSO 202**.
- On any type of VESSEL, fully operative radio Equipment including HF and VHF radio telephone shall be provided by CONTRACTOR to allow uninterrupted contact with the shore network and other vessels. The radio shall be equipped with frequencies used in the country of work.

On SURVEY VESSEL, **SATCOM facilities (phone/fax, e-mail and Internet)** shall be installed on-board. The SATCOM transceivers shall be linked to the gyro-compass.

- The autonomy of the SURVEY VESSEL (fuel, lubricants, food, fresh water and all consumables) shall be sufficient to ensure the complete performance of the survey or at least continuous operations during twenty-eight (28) days of nominal duration.

5.2 Vessel arrangement and manning

- Master and First Officer of SURVEY VESSEL shall be specifically trained or experienced with survey work at sea. They **shall be fluent in English** language and shall have proper **acknowledged diploma** for safely operating survey vessels. Master shall be experienced for staying alongside petroleum offshore facilities. C.V. of Master, Mate together with other key personnel shall be provided by CONTRACTOR
- The SURVEY VESSEL shall be equipped with a **clean galley** (sanitary standards) and **comfortable living quarters**. For surveys of duration greater than 1 week, SURVEY VESSEL is expected to be equipped with a dedicated recreation room, for use by survey crew and COMPANY REPRESENTATIVE.
- Catering shall be of a good European/Asian standard. Soft drinks shall be available for the whole party. **Alcohol and drugs are not allowed on-board**. The fresh water on-board shall be filtered and drinkable. COMPANY reserves the right to request independent analysis of drinking water stored on-board for human consumption.
- The SURVEY VESSEL shall have an independent **interpretation room** (at least 6 m²) where desk work and charting can be performed. A portable cabin installed on the deck is acceptable. The interpretation room shall be fitted with a large table, a light table and a photocopier.

- THE SURVEY VESSEL shall have a dedicated room (at least 6 m²) for working on soil samples in adequate conditions (including large tables, chairs, water supply, laboratory equipment...).
- On SURVEY VESSEL, a **separate cabin** with a desk and full communication facilities (Sat phone, ADSL internet connection) shall be available for the COMPANY REPRESENTATIVE. A second, separate cabin shall be available for Liaison Officers or any additional COMPANY personnel.
- Office equipments, such as **photocopier**, light table, **an extra computer** (PC), stationery and interpretation tools (compass, 10-point dividers, etc.) shall be available on-board the vessel.

5.3 Others

- **A noise test** of the SURVEY VESSEL shall be provided to COMPANY prior the start of the operation.
- Detailed specifications of the proposed vessel and its equipment shall be provided by CONTRACTOR.

6. Positioning

6.1 General

All raw data from the vessel(s) survey sensors shall be logged and made available to COMPANY REPRESENTATIVE in the [UKOOA P2/91](#) format for the navigation.

[UKOOA P1/90](#) data format will be used for processed data, and will be available to COMPANY REPRESENTATIVE in case of on-board processing. The logging procedure shall ensure that all survey sensor data are time-tagged to one common accurate clock reference.

6.2 Real-time DGPS

The use of differential GPS, as a stand-alone positioning system, is required for site investigation. **An absolute accuracy of ± 5 m** is required for survey operations.

Positioning data shall be finalised on-board and provided as track plots to enable interpretation of data from all sensors.

Refer to [GS EP POS 001](#) for technical details on equipment and operational procedures.

6.3 RTK positioning

Refer to [GS EP POS 004](#) for technical details on equipment and operational procedures.

6.4 Ultra short base line acoustic positioning

This system shall be integrated in the primary positioning system in order to locate continuously the side scan sonar fish, the ROV or the AUV if requested.

Refer to [GS EP POS 002](#) for technical details concerning equipment and operational procedures.

7. Work specifications

7.1 Sensors deployment specifications

7.1.1 Shore approach

Shore approach area is located between a nominal 6-m water depth (minimum safe operation of the main survey vessel) and the landfall. It will be surveyed by shallow-draft boat or mini AUV.

This shallow-draft boat is expected to work **by daylight** for reasons of safety. Longer working hours if safely practicable, or shorter hours, if required by local conditions, will be at the discretion of COMPANY REPRESENTATIVE.

Data will be acquired by **simultaneous (1-pass) operation** of the sensors and downloaded daily to the main survey vessel or shore base.

The shallow-draft boat is expected to be sufficiently spacious for the staff to work comfortably in a sheltered and air-conditioned cabin for the duration of daily operations. COMPANY REPRESENTATIVE will have full access to the shallow-draft boat during operations and any other time during the project.

The objective of the shore approach survey is to provide a dataset fully consistent with the **offshore** and **onshore survey data** (if any) including:

- Positioning
- Bathymetry (Multi-beam and single-beam echo-sounders)
- Imagery (side scan sonar and backscatter)
- Shallow geology (sub bottom profiler)
- Buried objects (magnetometer)
- Seabed sampling.

7.1.2 One-vessel operation, conventional or deep-tow surveys

The towed sensor approach to survey is conventional to continental shelf operations, and detailed in below specifications for various equipments. Data will be acquired on a **24-hour basis**.

In the case of deep-tow surveys, CONTRACTOR is requested to detail, the main characteristics of the equipment for the depths of intervention, particularly:

- Optimal configuration of ship-borne and over-the-side sensors, in order to effectively anticipate the achievable data quality, in terms of resolution and accuracy of final mapped results
- Effective capability of acoustic positioning for sensors: range, precision and the impact on the reliability and repeatability of acquisition
- Actual performance of deployments (speed of all winches) for over-the-side sensors, (such as sonar and profiler cables, probes and sampling devices), planned offset and depths, and estimates of deployment times at the required water depth
- Survey Plan to determine ability of the spread to deal with slopes, currents and other acquisition difficulties.

7.1.3 Two-vessel operation, deep-tow surveys

This deployment calls for a second vessel, to track the position of sensors deployed by the main survey vessel. Data will be acquired on a **24-hour basis**.

Survey operations making use of a tracking vessel will adhere to the following specifics.

The tracking vessel shall be positioned by GPS and carry out monitoring of the Towfish position by means of acoustic positioning (USBL) fully motion-compensated and suitably calibrated. Deployment of such acoustic systems may be over-the-side or permanent mounting (hull-mount or pole through gate valve). The directionality of the beacons, together with their effective range, shall be stated by CONTRACTOR prior to acceptance.

In the case of over-the-side deployments, CONTRACTOR shall submit to COMPANY's approval, at tender stage, the installation arrangement planned during mobilisation, including a technical case for the robustness of proposed mounts at survey and transit speeds. Any deployment requiring to be recovered above water, for the vessel to transit at a nominal 10-knots, will need to be re-calibrated before the next period of acquisition.

The positioning solution is required to include real-time telemetry of the position data for sensor(s) obtained by positioning vessel, to the main survey vessel. Surveyors on-board the latter will process such absolute or relative positions, such that final track plots are obtained offshore in near real-time (hours), and are used for interpretation of sonar/profiler data and processing of multibeam data, where acquired.

Other duties may be carried out by this tracking vessel, as per CONTRACTOR's planning and subject to approval by COMPANY REPRESENTATIVE; these may include sounder calibrations (velocity profiling), seabed sampling or any task which may be effectively and safely carried out to support the main survey vessel.

CONTRACTOR is requested to detail, in his proposal, the specifics of the equipment for the depths of intervention, particularly:

- Effective capability of acoustic positioning for sensors: range, precision and impact on the reliability and repeatability of acquisition
- Optimal configuration of ship-borne and over-the-side sensors, in order to effectively anticipate the achievable data quality, in terms of resolution and accuracy of final mapped results
- Actual performance of deployments for over-the-side sensors, such as offset and depth of sonar and profiler cables, speed of winches for TDS probe and sampling devices, and estimates of deployment times for required water depth
- Planned acquisition grid to determine ability of the spread to deal with slopes, currents and other acquisition difficulties.

7.1.4 General specification for AUV

7.1.4.1 AUV Positioning and Acquisition

CONTRACTOR will specify the equipments deployed from the AUV, and the separate sensors (if any) planned for vessel deployment (e.g. deep profiler, sampling etc.). AUV data will be acquired by simultaneous (1-pass) operation of the vehicle, on a 24-hour basis.

The choice of the system shall be explicit regarding:

- Vehicle endurance and deck turn-around times, empirical
- Effective multibeam footprint, for determination of line spacing
- Planned manning, for deck operation, acquisition monitoring, and processing
- Vehicle deployment/recovery method, and its weather constraints
- Horizontal and vertical accuracies for the combined sensor sequence, at the stated depths of operation and altitude, with nominal error cube.

The location of the AUV will be provided by acoustic positioning, optimised such that:

- Real-time positions can be tracked from survey vessel; final positions are generated on survey vessel **within 12 hours of AUV recovery**
- The range will be sufficient for operation at the water depths of survey, as advised by COMPANY before mobilisation
- The directionality of beacons shall be maximised, such that the vessel can track the vehicle anywhere within a 45° cone pointing upwards above the vehicle
- The power supply of beacons shall be sufficient as to not constrain vehicle endurance, e.g. beacon operation will out-last the power supply of the vehicle itself.

The AUV payload shall comprise side scan sonar, sub bottom profiler and multibeam echosounder system, for which the proposal will detail acquisition parameters in the planned mode(s) of operation:

- Configuration and options of coverage
- Minimum and maximum operating depths, and operating AUV altitude (above seabed)
- Horizontal and vertical resolutions for stated configuration.

7.1.4.2 AUV deployments

CONTRACTOR will specify the systems pertaining to AUV deployments, control, and safety aspects:

- Launch procedure, including roles and responsibilities, communication between bridge and back deck, from pre-dive checks to start of data logging
- Position control of AUV in-sea, and failsafe systems in case of control loss, for instrument location and tracking on the surface, such as lights, radar reflector, independent GPS/radio link
- Recovery procedure and fall-back measures in case of failure of primary procedure, including case of weather hampering recovery; emergency measures, safety issues of any workboat/Fast Rescue Craft involved in recovery
- Data downloading procedure, from AUV on deck to CONTRACTOR's survey computer on the survey vessel, by means of network connection.

7.1.4.3 QC and monitoring

CONTRACTOR will specify the real-time Monitoring and Quality Control system proposed for the AUV operation, e.g. acoustic link(s) to enable:

- Monitoring of AUV attitude, battery status and other relevant indicators to provide sufficient control for effective operations
- Quality Control to track a sub-set of the data transmitted by acoustics from AUV to the vessel, to verify actual logging of the data, and extent of line coverage on a grid basis (multi-line).

These display(s) will be maintained on the survey vessel, logged throughout the AUV in-sea period, and made available to COMPANY REPRESENTATIVE at all times.

7.1.4.4 Data logging and management

CONTRACTOR shall provide the survey plan according to the Particular Specification, and anticipate mass storage requirements for a commensurate volume of data, including a contingency of **50% extra**.

Processor(s) on the survey vessel will be equipped with **state of the art computer(s)**, characterized by sufficient live memory, speed and connectivity to carry out the processing effectively.

CONTRACTOR's proposal shall specify the data transfer rates between AUV and main survey vessel, in terms of hours of AUV on-deck time required to download a given data volume, namely the anticipated AUV dive mission time.

Storage will be such as to provide for the entire raw and processed datasets for all deployed sensors. The raw data for the entire survey shall be:

- Accessible on-line to processors
- Backed-up as the survey progresses, to secure medium (to be specified by CONTRACTOR) and accessible on-board.

7.2 Acquisition trials and confidence checks

7.2.1 Shore approach surveys, trials

Trials shall be used to optimize the survey plan as proposed by CONTRACTOR.

COMPANY reserves the right to revise the programme or mode of operation if the effectiveness of the operation is significantly less productive than CONTRACTOR's estimation of the acquisition rate.

7.2.2 Conventional surveys, trials

Pre-acquisition Multi-beam activities

The first phase of multibeam operations shall consist of **calibrations**, as per section **Corrections and Calibrations**.

Trials, before start of acquisition, will test the acquisition parameters of the MBES, in water depths similar to those of the survey. Tests of comparative parameters shall determine the optimal instrument settings: ping rate and range settings to produce a **square ping footprint**, **power** and **gain settings** most appropriate to the seabed under study.

The final **acceptance** of the MBES calibration will be subject to the successful acquisition and processing of 4 test lines with acquisition parameters determined by trials, as follows:

- a) 2 lines crossing orthogonally over a distinctive location (feature or listed well)
- b) 2 lines run over the same track, in opposite directions

The lines will be fully processed separately, and a **difference map** will be produced of the two resulting DTM's. The map will be plotted at high resolution, submitted to COMPANY REPRESENTATIVE for acceptance, and included in the final report.

Survey planning

COMPANY expects the multibeam system to have a real-time bathymetric display providing a **minimum** swathe width (seabed coverage) of **4 times the water depth**.

The survey programme, submitted by CONTRACTOR to COMPANY's approval, must specifically state the **planned line spacing**, MBES swath width, and overlap between MBES bathymetry and side-scan passes that will be achieved.

The effective multibeam swathe width achievable will be determined in the field by the pre-acquisition trials, to finalise the optimal **actual line spacing** used on the survey.

Any data set will be surveyed inclusive of cross-lines for quality control, at a nominal interval to be agreed with COMPANY REPRESENTATIVE. Additional sounding lines may be necessary to map out any significant feature/seabed obstacles identified.

For operations utilising a hull-mounted MBES, the "run-in" and "run-out" are to be such that the vessel is running along the projected survey line for a minimum of 300 metres before start and after end of lines. Where a towed system is used, the run-in and run-out lengths are to be agreed with COMPANY REPRESENTATIVE on-board the vessel, and will be dependent on offsets, water depth and ship's speed.

Pipeline surveys

The nominal corridor widths, for pipeline surveys, are at a **minimum**:

- Shoreline to 6 m depth 0.5 km
- 6 m to 300 m depth 1.0 km
- 300 m and deeper 1.0 km

The corridor width shall be centred on the proposed route, and each survey line shall provide a minimum of 20% overlap with adjacent survey lines in respect of multibeam data, i.e. 2 lines 100-m apart will have a common 20-m of coverage after nominal clipping of outer beams.

In the case of vessel-mounted MBES transducers, adjacent lines will be run in opposite directions, enabling CONTRACTOR to verify accuracy by means of matching features or contours between tracks.

Corridors will be surveyed with an odd number of lines, and the centreline is to be used for profile of the nominal route (depth and shallow geology). Where a corridor crosses existing coverage, a minimum of one centreline shall be acquired over the area, to ensure continuity of data with new coverage.

In all places where the line curvature exceeds 10° it will be necessary to run each line individually and not steer the vessel around the alter course. This procedure is to ensure

complete and full data collection, and will mean that "loops" will have to be steered at the Turning Points.

7.2.3 Deep-water/AUV trials

The **VEHICLE** will be run on one or more sets of trial lines, in order to provide:

- Vehicle positioning accuracy, by comparative positions of a known feature (e.g. a wellhead) imaged by at least 2 lines run in opposite directions. This verification is additional to lines of multibeam calibration
- Positioning reliability and line-keeping, the suggested procedure is to run the Vehicle in a straight line at constant speed, and drive the vessel in a circle above the vehicle, to test the repeatability of directionality of acoustic positions
- Multibeam calibration, serving also as test of logging; the calibration report shall be given to COMPANY REPRESENTATIVE and included in the survey report Vol. 2
- Trial of acquisition parameters: effective range and resolution for a range of practical vehicle altitudes, and hence optimal line spacing for full coverage with reliable 20% multibeam overlap.

7.3 Data acquisition

7.3.1 Vessel speed

CONTRACTOR shall state the operating speeds of the proposed vessel, for all aspects of the operation, and the consequent resolution of the instruments.

The ship's speed shall be reduced to a survey speed such that the quality of the data gathered is not affected by ship noise, and generates the same density of records for all the swaths or passes.

Survey records shall not be acquired at survey speeds (relative to seabed) exceeding five (5) knots for seabed survey (sounder/sonar/profilers), or three (3) knots for high-resolution 2D seismic.

Records shall be acquired continuously at constant speed, using acceptable chart advance rate, and depth or range scale, to be agreed with COMPANY REPRESENTATIVE.

7.3.2 Navigation and annotation of records

A dedicated computer shall be used for on-board navigation. It shall integrate navigation data, gyrocompass, echo-sounder input and logging functions. This computer shall drive trigger(s), annotator (fix-mark and its text label) and speed input to the side scan sonar recorder.

An annotator shall be interfaced with the navigation computer and shall automatically log fix marks and label all records.

A visual display unit and track plotter shall be used for navigation. The track plotter shall work in real-time in order to visualise immediately the quality of the navigation.

At the beginning and end of all records along a line or portion of line, the following annotations shall be noted on the records (multi-beam echo-sounder, side scan sonar, pinger and/or other analogue seismic):

- COMPANY affiliate and country
- Survey name
- Vessel name
- Location name or number
- Line number
- Date and times of recording
- First and last fix number
- Scale, range, significant parameters.

7.3.3 Multi-beam bathymetric survey

MultiBeam Echo-Sounder (MBES), or swathe, technology is considered as the standard survey tool, to be used on all projects, unless advised otherwise by COMPANY. This applies equally to:

- Shore approach survey
- Conventional survey
- Deep-water survey

The vessel has to be fitted with a MBES system capable of accurate depth measurements over the **whole range of expected depths + 25%**. This MBES can be hull-mounted, side-mounted or fitted in a towed fish or other deployment, providing the deployment's depth and position can be accurately determined.

All survey grids carried out with MBES will include, at the very minimum, one cross-line orthogonal to the main lines, in order to provide quality control during processing, in respect of tide corrections, offsets and other acquisition parameters.

A single-beam echo sounder shall be provided to generate a **QC dataset**, and operated on the most appropriate depth scale range for greatest accuracy in the depths being surveyed.

7.3.3.1 System considerations

System specifications from the MANUFACTURER will be respected, in terms of depth range, recommended attitude corrections, etc.

For non-permanent deployments, CONTRACTOR needs additionally to make a case for the robustness of the deployment. Pole-mounted systems need to be sufficiently sturdy for sustained work, rapid recovery or transit at the ship's usual transit speed. Towfish based systems require a detailed technical case for accuracy and repeatability.

All soundings shall be motion-corrected, recorded in metres, corrected for draft and tides variation, and reduced to CD. Requirement is for a minimum depth resolution of 0.5%, and accuracy of 1%, both relative to water depth.

Amplitude data (backscatter) shall be made available by CONTRACTOR in conjunction with other seabed imagery charting.