

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 201

Offshore Geophysical Site Investigation

10	12/2018	General review
09	05/2015	Organisation change - January 2015
08	09/2014	General review
07	09/2013	General review
00	10/2000	First issue
Rev.	Date	Purpose of the revision

Owning entity: DSO/IP/TEC	Managing entity: DSO/IP/TEC/GEO
Other Approving entity(ies):	

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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 Services require more detailed investigation, Company reserves the right to apply further Particular Technical Specifications.

All Equipment and Materials necessary to complete the site investigation in accordance with the 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 Services shall include the following phases:

- **Data acquisition phase:** Site investigation implementing any offshore geophysical and/or hydrographical equipment
- **Data processing phase:** This phase is to be carried out during data acquisition including navigation, hydrographical and geophysical data processing
- **Interpretation phase:** This phase shall provide comprehensive interpretation and integrate all aforementioned data including any existing data provided by Company
- **Reporting phase:** Preparation of comprehensive Reports and Charts in English language as per the objectives of the required Services. **The final product shall be an Expert Report**
- **GIS:** Presentation of site investigation results in a GIS format.

2. Reference documents

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

The order of precedence of the applicable documents shall be:

- The Particular Technical Specifications
- The present General Specifications
- 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.

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External Documents

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

Reference	Title
IAGC	Marine Geophysical Operations Safety Manual 7 th edition, 1991
IMCA	International Marine Contractor's Association, Guidelines for the use of MBES echo-sounders for offshore survey, 2015
ISO 9000	Quality Management and Quality Assurance Standards
OGP 462	Guidelines for the use of the Seabed Survey Data Model
OGP Report 213 6.38	Service Vessel Marine Safety Guidelines
OGP Report 343	Managing Health for field operations in oil & gas activities
OGP Report 373-18-1	Guidelines for the conduct of offshore drilling site surveys
OGP Report 432	Managing HSE in a geophysical contract

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP GEO 101	Offshore Geotechnical Survey
GS EP GEO 110	Requirements for Offshore Survey Vessels
GS EP GEO 202	ROV Survey Work for the Installation and/or the Inspection of Offshore Structures and Flowlines
GS EP GEO 203	Geophysical survey for offshore pipeline inspection
GS EP GEO 204	Geophysical debris survey
GS EP GEO 206	Seabed Sampling for geochemical, heat flow and biostratigraphic analysis - SGE
GS EP GEO 401	GIS requirements for engineering site surveys and studies
GS EP GEO 501	Meteorological and Oceanographic survey
GS EP GEO 505	Monitoring of Metocean Conditions for Offshore Units
GS EP GIN 122	Deliverables and Delivery Procedure for Surface Seismic Acquisition and Processing Data
GS EP LSO 202	Personnel transfer between watercrafts and between watercrafts and offshore structures
GS EP LSO 207	Notices to mariners and restricted navigation zone

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Reference	Title
GS EP LSO 306	Selection and Operation of Dynamically Positioned Vessels
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works
GS EP POS 004	The use of Differential Global Navigation Satellite System

3. Offshore geophysical site investigation objectives and methodology

3.1 Site investigation objectives

The objective of offshore geophysical site investigations is to identify and delineate any possible constraints and hazards from man-made, natural and geological features which may affect the integrity of any exploration site or development area. This objective relies upon the interpretation of the geophysical site investigation results, including:

- Charting of water depths (bathymetric map) and slope gradient (gradient map)
- Mapping of bathy-morphology showing geological features, local reliefs or any man made obstacles (seabed features map)
- Definition of the near surface lithology to nominal 100 m depth below seabed (shallow geological sections, isopach and structural maps).

In case of a Drilling Hazard site survey, Contractor shall refer to [OGP Report 373-18-1](#), Guidelines for the conduct of offshore drilling site surveys.

In addition to the above, the following is requested:

- Definition of the deep lithology to nominal **1000/2000 m depth** below seabed (geological sections, isopach and structural maps)
- Mapping of any drilling geohazard (e.g. **shallow gas...**).

Data interpretation shall allow Contractor to issue an expert report including favourability / exclusion map for subsea installations or drilling location.

Depending on the project type, the present document may be associated to [GS EP GEO 202](#), [GS EP GEO 203](#) and [GS EP GEO 204](#).

3.2 Methodology according to water depth

The location of the offshore geophysical site investigation will involve operations in variable water depths, which define three types of site investigation methodologies.

- **Shore approach** refers to the zone between the shore line and 10 m water depth, involving the use of shallow-draft vessel, mini-AUV or ASV.

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- **Shallow Water site investigation** takes place on the continental shelf, between 10 m and 300 m water depths. This site investigation is normally carried out by a single vessel using towed and/or hull mounted sensors.
- **Deep-water site investigation** takes place in water depth greater than 300 m. The methodology to be used shall be adapted to Company's project-specific needs and accuracy requirements implementing either AUV with 1 vessel or deep-tow with 2 vessels. However, Company's preference is for the use of AUV over surface towed or hull mounted equipment.

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

ADCP	Acoustic Doppler Current Profiler
AUV/UUV	Autonomous Underwater Vehicle / Unmanned Underwater Vehicle
ASV	Autonomous Surface Vehicle
AHTS	Anchor Handling Tug Supply
AVO	Amplitude Versus Offset
BSR	Bottom Simulating Reflector
CD	Chart Datum
CDP/CMP	Common Depth Point / Common Mid-Point (seismic data element)
CTD	Conductivity, Temperature, Density
DAC/DCC	Distance Across Course / Distance Cross Course
DTM	Digital Terrain Model (MBES product)
DVL	Doppler Velocity Log
DGPS/GPS	Differential Global Positioning System/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
INS	Inertial Navigation System
LARS	Launch and recovery system

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LAT	Lowest Astronomical Tide
LBL	Long Base Line System
LCT	Landing craft (type of inshore vessel)
MASW	Multichannel Analysis of Surface Waves
MBES	MBES (or swathe) echo-sounder
Metocean	Meteorology and Oceanography
MMO	Marine Mammal Observer
MRU	Motion Reference Unit
MSL	Mean Sea Level
NMO	Normal Move Out
PSV	Platform Support Vessel
QC	Quality Control
RIB	Rubber Inflatable Boat
ROV	Remote Operated Vehicle
RPM	Revolutions Per Minute (motor, propeller)
RMS	Root Mean Square
RTK	Real Time Kinematic
SBES	Single Beam Echo-Sounder
SBP	Sub Bottom Profiler
SEGD	Society Exploration Geophysicists format D
SEGY	Society Exploration Geophysicists format Y
SSS	Side Scan Sonar
SV	Sound Velocity
TVG	Time Variant Gain
USBL	Ultra Short Baseline System
VHF	Very High Frequency
VHR	Very High-resolution
WCI	Water Column Imaging
WGS 84	World Geodetic System 1984

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5. Vessel(s) used by Contractor

The vessel(s) to be used by Contractor shall conform to **GS EP GEO 110**, **GS EP LSO 202**, **GS EP LSO 207** and **GS EP LSO 306**.

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 areas required under the terms of the Contract.

In addition Contractor shall comply with the following points:

1) Marine Operation Control

In order to enhance safety of marine operations, Company applies a strict marine operations control system. This system is fully described in Company's rules and procedures.

Contractor will have to comply with this system, and particularly with the following control steps:

1.1) Contractor qualification for marine services

Company selects Contractors that are entitled to provide marine services through a pre qualification system.

Marine services for Offshore Geophysical Site investigations are those performed using dedicated Site investigation Vessel(s) or eventually opportunity vessel(s) as supply boats....

The qualification evaluation is based on a documentary review, linked with a standard questionnaire. It includes 3 parts: Technical/HSEQ, Financial situation, Compliance.

The Technical/HSEQ part is mainly based on IMO's ISM code, technical and personnel management evaluation.

As part of the execution of this contract, all contractors operating marine units (contract holder or sub-contractor as applicable) will have to be qualified by Company for marine services.

Should a marine operator fail to be qualified, even for the contract holder, Contractor will have to nominate an alternate qualified operator for the related marine operation.

Potential marine operators therefore need to be nominated in due time so that their actual status can be confirmed, and to launch a qualification process if necessary.

1.2) Vessels selection

All vessels that will be nominated within the contract's Marine Support Services will have to be inspected and accepted by Company.

Inspections will be based on the OCIMF's OVID system. Vessel owner/operator will be responsible of registering his vessel(s) into the OVID electronic database, to fill in and update the online particulars questionnaire, and to review/comment on-line the inspection report after the inspection.

Should a vessel not be accepted after inspection evaluation, Contractor will have to nominate an alternate vessel.

Company also applies a vessel's age limit policy. All vessels above 20 years old before the end of the contract will be submitted to an extensive evaluation (mainly related to vessel's

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history, maintenance records and modifications) before acceptance. For some vessels type (including but not limited to AHTS and PSV), the vessel's age limit policy is strict: vessels above 20 years old will not be accepted.

1.3) Procedure control

All marine operation procedures (including but not limited to towing, moving, mooring...) will have to be submitted to Company for approval before being implemented. Any rejected procedure will have to be re issued and re submitted to Company.

The full compliance with the approved procedures will be checked by Company by any appropriate way, including the attendance of Company man onboard vessels during the operations. Company will be entitled to stop the operations if the procedure is not fully applied or if vessels condition or environment conditions justifies it.

1.4) Complementary measures

In addition to the above, Contractor agrees that Company proceeds to formal and/or informal inspections on board chartered vessels upon request.

Contractor also agrees that Headquarters or Affiliates of nominated marine operators (contract holder or sub-contractor) are audited by Company's marine specialists upon request.

5.1 Vessel main characteristics

- The vessel(s) to be used by Contractor will consist of one or more of the following:
 - For shore approach site investigation, 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 **Site investigation 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 Site investigation 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 Site investigation 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 autonomy of the Site investigation Vessel (fuel, lubricants, food, fresh water and all consumables) shall be sufficient to ensure the complete performance of the site

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investigation or at least continuous operations during twenty-eight (28) days of nominal duration.

5.2 Vessel arrangement and manning

- Master and First Officer of Site investigation Vessel shall be specifically trained or experienced with site investigation work at sea. They **shall be fluent in English** language and shall have proper **acknowledged diploma** for safely operating Site investigation 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 Site investigation Vessel shall be equipped with a **clean galley** (sanitary standards) and **comfortable living quarters**. For site investigations of duration greater than 1 week, Site investigation 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 Site investigation 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 Site investigation 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 Site investigation 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 Site investigation 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.
- In case Site investigation Vessel is equipped with metocean sensors (wind sensors, ADCP, marine radar, etc.) all raw and processed data recorded during Site investigation shall be provided to Company at the end of the work at sea.

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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 P2/11 format for the navigation.

UKOOA P1/11 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 Offshore Geophysical Site investigations. **An absolute accuracy of better than ± 1 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 USBL positioning

This system shall be integrated in the primary positioning system in order to locate continuously any underwater equipments.

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 Tide gauge and other metocean sensors

In case the Site investigation area is considered to potentially sustain harsh metocean conditions, or on the opposite, to be subjected to unknown metocean conditions, and in agreement with Company, metocean sensors should be deployed prior to the Site investigation for real-time monitoring purposes during operations. Metocean data thus recorded shall be transmitted in real-time to the Site investigation Vessel and to the forecast contractor to help ensure safe and optimum operations. Contractor shall comply with [GS EP GEO 501](#) and [GS EP GEO 505](#).

7.1.2 Shore approach

The site investigation will be performed **during daylight** only for safety reasons. 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 in a **single pass operation** and downloaded daily to the main Site investigation Vessel or to the shore base.

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Any vessel used during a shore approach site investigation is expected to be sufficiently spacious for the staff to work comfortably in a safe, sheltered and air-conditioned cabin. Company Representative shall have full access to the vessel at any time.

If the shore approach site investigation is performed using mini-AUV or ASV deployed directly from the shore, a support vessel, such as RIB, shall be available.

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

- Positioning
- Bathymetry (MBES and single-beam echo-sounders)
- Imagery (SSS and backscatter)
- Shallow geology (sub bottom profiler, seismic refraction, MASW)
- Buried objects (magnetometer)
- Seabed sampling.

7.1.3 Shallow water site investigation

Data will be acquired on a **24 hour basis**. All data will be acquired preferably in a **single pass operation**. **Particular attention shall be paid to the following points:**

- In the case of over-the-side deployments, Contractor shall submit to Company's approval, the installation arrangement planned during mobilisation, including a technical case for the robustness of proposed mounts at site investigation and transit speeds.
- 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 shall be submitted by Contractor.
- Survey Plan to determine ability of the spread to deal with slopes, currents and other acquisition difficulties shall be submitted by Contractor.

7.1.4 Deep water site investigation

7.1.4.1 Two-vessel operation, deep-tow surveys

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

The tracking vessel shall be positioned by DGPS 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 compatible with site water depth condition (as detailed in the Particular Specification) and expected layback.

In the case of over-the-side deployments, Contractor shall submit to Company's approval, 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

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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 Site investigation 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).

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 Site investigation Vessel. **Particular attention shall be paid to:**

- Actual performance of deployments for over-the-side sensors, such as offset and depth of sonar and profiler cables, speed of winches for CTD 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.

7.1.4.2 AUV operations

Generalities

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 shall be acquired by simultaneous (1 pass) operation of the vehicle, on a 24 hour basis.

The system selection shall rely upon:

- Vehicle endurance and deck servicing times, empirical
- Effective MBES swath width, for determination of line spacing
- Planned manning, for deck operation, acquisition monitoring, and processing
- Vehicle deployment/recovery method, and its weather constraints (LARS)
- Horizontal and vertical accuracies for the combined sensor sequence (DGPS, USBL, DVL, INS), at the stated depths of operation and altitude, with nominal error budget.

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

- Real-time positions can be tracked from Site investigation Vessel; final positions are generated on Site investigation Vessel **within 12 hours of AUV recovery**
- The range will be sufficient for operation at the required water depths of the site investigation area. 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 SSS, MBES, SBP, still camera.

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Deployments

The Contractor shall provide the AUV LARS procedures including:

- 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.

QC and monitoring

Contractor shall specify the real-time Monitoring and Quality Control procedures 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) shall be maintained on the Site investigation Vessel, logged throughout the AUV in-sea period, and made available to Company Representative at all times.

Data logging and management

Contractor shall specify the data transfer rates between AUV and main Site investigation Vessel, in terms of hours of AUV on-deck time required to download a given data volume, namely the anticipated AUV dive mission time.

7.2 Acquisition trials and confidence checks

7.2.1 Shore approach site investigations

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 Shallow water site investigations

Pre-acquisition MBES activities

The first phase of MBES operations shall consist of **calibrations**, as per section 7.3.4.1 **Corrections and Calibrations**.

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

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Survey planning

The survey programme, submitted by Contractor to Company's approval, must specifically state the **planned line spacing**, in particular MBES swath width, overlap between MBES bathymetry and SSS passes that will be achieved.

The effective MBES swath width achievable will be determined in the field by the pre-acquisition trials, to finalise the optimal **actual line spacing** used on the site investigation area.

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" shall 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 route 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 MBES 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 MBES calibration.
- Positioning reliability and line-keeping, for which 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.

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- MBES calibration shall be performed during the test dive; 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% MBES overlap.

7.3 Data acquisition

7.3.1 Acquisition speed

Recommended acquisition speed (relative to seabed) is four (4) knots for seabed survey (SSS, MBES, SBP) and three and a half (3,5) knots for 2DHR seismic. In any case, acquisition speed shall be adapted to the required data sampling frequency, in order to guarantee the quality of the gathered data (not affected by ship noise) and the same density of records for all the swathes or passes.

7.3.2 Data storage

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

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

- Accessible on-line to processors
- Backed-up as the site investigation progresses, on two different secured media and accessible on-board.

All data volume and 100% back-ups shall be transported separately to the Contractor's nominated reporting centre.

7.3.3 Navigation and annotation of records

A dedicated software shall be used for on-board navigation processing. It shall integrate all surface and sub-surface navigation and positioning data. It shall automatically log fix marks and label all records, including:

- 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.

A visual display unit shall work in real-time in order to QC the navigation.