



Exploration & Production

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 203

Geophysical survey for offshore pipeline inspection

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1. Scope

The aim of the General Specification for an annual geophysical inspection is:

- To check the thickness of clay/sand/gravel cover (in both horizontal and vertical planes) on all pipelines
- To check the integrity of the pipelines, to locate any unusual situation (exposure, free span) and to follow the evolution in time of the already known specific features.

This annual inspection shall be carried out from a dedicated survey vessel by means of Echo Sounder (ES), Side Scan Sonar (SSS), and Sub-Bottom Profiler (SBP).

The work program defined in this General specification is tentative and some complementary investigations may be required in the course of the survey. They shall be defined in the Particular Specification.

Note that particular care shall be given:

- To the various calibrations and offsets determination
- To the presentation in the final report of the results of the quality control.

Recording parameters and vessel's speed shall be adjusted in order to obtain the best possible data quality, especially for the detection of the pipelines, which have been recently buried.

2. Reference documents

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.

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.

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

Reference	Title
E&P Forum	Service Vessel Marine Safety Guidelines, Report N° 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
ISO 13623	Petroleum and Natural Gas Industries – Pipeline Transportation Systems
Nederlands Normalisatie Instituut	Requirements for steel pipeline transportation systems
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

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 201	Offshore geophysical surveys
GS EP GEO 202	Geophysical Survey for the Installation and/or the Inspection of Offshore Structures and Pipelines
GS EP POS 001	Offshore surface positioning works
GS EP POS 002	Subsea positioning works

3. Pipeline network description

The pipe line network description is supplied in the Particular Specification.

3.1 Platforms coordinates

Platform co-ordinates are given in the Particular Specification.

3.2 Pipeline corridors

Pipeline corridors are defined in the Particular Specification.

3.3 Coverage

All pipelines of the network are protected. The majority of the pipelines are buried, of which some with artificial back filling. Some pipelines laid at an early stage were only protected by sand.

The thickness of the sand coverage over the pipelines is ranging from a few centimetres up to 2 metres in some places.

3.4 Natural Seabed (NSB)

Natural seabed is defined as the seabed level, which has not been disturbed by pipeline laying, dumping, and trenching operations or other.

Natural seabed level at pipe location is the average of the seabed level taken at least 80 m either side of the pipeline.

Natural seabed shall be taken as the relative vertical reference level for the mapping of the pipeline position when required.

3.5 Line crossings

They include subsea lines from other gas/oil fields and telephone cables.

3.6 Specific features

Some of the specific features detailed in the Particular Specification shall be checked during the annual inspection.

3.7 Chainage

Corridor data (lengths, KP's, key points) shall be referenced to the kilometric chainage (and associated UTM co-ordinates) established from a reference survey.

3.8 Water depth

The water depths shall be reduced to the LAT datum.

4. Survey procedures

Basic procedure applied over the entire length of each corridor. The programme shall be:

- Either a "detailed programme" run yearly until pipeline position and cover thickness stability has been established for three (3) years. The "detailed programme" shall then be performed every ten (10) years
- Or a "light programme" carried out in between the "every 10 years" detailed programme.

Specific procedure which consists of a more detailed inspection, over limited sections, where particular or unusual features have been observed during previous survey or may be detected during the year campaign.

Subsidence survey which consists of two cross profiles of 2 km long each run close to some platforms over the same place. This survey is performed on a five (5) year basis.

From the survey results of the above programmes (basic and specific), additional works may be required.

4.1 Basic inspection procedure

4.1.1 Detailed programme

It shall consist of:

- Two longitudinal profiles shall be run in opposite directions either side of the pipelines, additional longitudinal profiles shall be run to survey other lines when they are out of the coverage performed during the first survey.
- A series of cross lines at following spacing at each end of the corridors:
 - First cross line at 20 m from the platform
 - Second cross line at 50 m from the platform, then 50 m spacing up to 200 m away from the platform
 - Series of cross lines at 200 m spacing on the remaining corridor.

4.1.2 Light programme

It shall consist of:

- Two longitudinal profiles that shall be run in opposite directions either side of the pipelines
- A series of cross lines at following spacing at each end of the corridors:
 - First cross line at 20 m from the platform
 - Second cross line at 50 m from the platform, then 50 m spacing up to 200 m away from the platform.

4.1.3 Profile description

The two longitudinal profiles shall be run as straight as possible (therefore, manoeuvrability of the vessel shall be of prime importance), at a distance to be kept between 75 m and 125 m from the pipelines. Fixing shall be done every 100 m, or reduced to 50 m if straight navigation can not be achieved.

The cross lines shall extend up to 100 m minimum either side of the pipelines in order to reach areas where it is believed that the Natural Seabed has not been modified by the sand dumping or the trenching operations. Fixing shall be done every 50 m.

The cross lines must be **perpendicular** to the pipelines, except in the platform approaches (up to 200 m) where profile network described in the Particular Specification shall be applied.

For obvious soil assessment the same theoretical track shall be used each year.

4.1.4 Platform inspection

In addition to the cross lines run over the pipelines at platform approach, one profile 200 m long at 50 m from the platform shall be run.

4.2 Specific inspection procedure

This survey mainly concerns the detailed inspection of the specific features and those that will arise during the year inspection. It is expected that the basic inspection procedure shall yield the necessary information on the expansion loops close to the platforms, but additional profiles may also be necessary.

The specific inspection shall consist of a series of cross lines at 50 m spacing or less if necessary.

4.3 Subsidence survey

Two cross lines 2 km long, one north/south line and one east/west line shall be run on a five year basis.

4.4 Share-out of survey equipment

4.4.1 Echo sounder

The echo sounder shall be used on each profile (longitudinal and cross lines).

4.4.2 Side scan sonar

The side scan sonar shall be used:

- On the longitudinal profiles
- For feature detection in closest vicinity of the platform legs:
 - On the first two cross lines at each corridor ends
 - On the additional profiles as defined in chapter 4.1.4.

4.4.3 Sub-bottom Profiler

The sub-bottom profiler shall only be used on the cross lines.

Note: Distance between sub-bottom profiler lines without any recorded or interpretable hyperbolae shall not exceed 400 m. At least 90% of the cross lines must show the position of the buried pipelines.

5. Survey equipment

5.1 Vessel specifications

The vessel shall be "in class" for survey operations. It shall be in compliance with all relevant regulations for the safety of life at sea and shall be able to operate and carry out survey works all year around.

The vessel shall be fitted for seismic profiling works and capable of working at sea for a minimum period of 15 days without port calls. It shall be properly equipped and manned for the operations on a 24 hours per day basis.

She shall be fitted with adequate power supplies for site surveying and have a low noise level. She shall also be fitted with handling facilities capable of safely deploying and recovering the outboard survey equipment. A copy machine shall be onboard for use by the technical team and COMPANY Representative. A mobile telephone would be appreciated.

The vessel shall have a good manoeuvrability at speeds as low as two knots in order to optimise the hyperbola shape.

5.2 Positioning and navigation system

5.2.1 Geodetic parameters

Shall be defined in the particular specifications.

5.2.2 Positioning equipment

5.2.2.1 Real time DGPS

5.2.2.1.1 General

The use of differential GPS for site investigation as a stand-alone positioning system is requested. An absolute accuracy of less than ± 5 m is normally obtained. A secondary positioning system (an independent DGPS system) must be provided in case the primary positioning system uses only one reference station, in order to check reliability and minimise downtime.

5.2.2.1.2 Minimum requirements

Minimum requirements shall be in accordance with **GS EP POS 001**.

5.2.2.1.3 Shore calibration

The shore calibration shall be done in accordance with **GS EP POS 001**.

5.2.2.1.4 Offshore calibration

The offshore calibration shall be done in accordance with **GS EP POS 001**.

5.2.2.2 Positioning Quality Control

Comparison between primary and secondary positioning systems shall be continuously monitored.

5.2.3 Acoustic positioning

The acoustic positioning shall be in accordance with **GS EP POS 002**.

5.2.3.1 In harbour

Check of the transducer alignment (discrepancies between measured and calculated bearing shall not exceed $\pm 0.5^\circ$).

Check of range accuracy (which shall be better than 0.4% of the range).

5.2.3.2 At sea

Velocity of sound in water determination (accuracy of ± 1.5 m/s).

Calibration and check of the overall accuracy over known subsea structure or by running cross lines in opposite directions.

5.2.4 Gyro compass

The gyrocompass interfaced with the navigation software shall be very well calibrated in the harbour prior and after survey works.

5.2.5 Peripherals

The positioning systems shall be interfaced with peripherals in order to follow pre-plotted tracks. The on line positions shall be logged on magnetic discs.

The peripheral set shall be used for calibrations of the positioning systems.

Standard peripherals will consist of desktop computer, track plotter, data logger printer, video display units annotator as well as necessary interfaces.

5.2.6 Software

The navigation software will be adapted for the purpose of this work. The drawings of all existing structures (platform, pipes, etc.), as well as theoretical route axis will be displayed on the screen of monitors.

The software shall accept the inputs from all items of equipment (positioning systems, ES, SSS, etc.).

The software shall be capable of recording and displaying of data of both positioning systems simultaneously.

The software shall be familiar to the surveyors so that eventual adjustment can be done on board.

In addition, an integrated navigation-survey data handling and processing package shall be used for automatic acquisition and off-line drawing, etc.

5.3 Bathymetry

5.3.1 Echo Sounder (ES)

The survey vessel shall be preferably equipped with a hull-mounted echo sounder with dual frequency transducer (typically 30 and 200 kHz). As examples of equipment, SIMRAD, ATLAS DESO 20 or equivalent can be proposed. CONTRACTOR shall furnish a detailed drawing of the vessel giving location (x, y, z) of the ES transducers. Integrated heave compensator shall be supplied. The data shall be recorded on dry paper but the digital readout shall be recorded on the on-line data logger system.

5.3.2 Calibration

A velocity meter or TDS gauge shall be supplied to allow sound speed calibration with a steel grating (catwalk) for direct calibration (shape and dimension of the grating shall be chosen carefully).

Calibration of the echo sounder shall be performed using the following methods:

- Steel grating immersed to known depths below the transducer in 10 metre-steps down to seabed. Same operation during retrieval of the grating
- Using data collected with the velocity meter (or TDS gauge) at the same levels as above.

Note: The cable for both the equipment shall be at least long enough to reach the seabed.

Immersion of the transducer shall be carefully measured in port prior and after the offshore works.

Water sound velocity shall be measured at the beginning and at the end of the echo sounder works and each time when operational conditions (climatic - breakdown, etc.) are changing.

5.3.3 Tidal data

In order to determine the required time shifts and factor to be applied from the tidal curve measured on site during the survey works (to ensure accurate vertical positioning relative to L.A.T.) CONTRACTOR shall install a tide recorder (Aanderaa WLR7 or equivalent) in the vicinity of the work areas.

CONTRACTOR shall make sure that he shall have access to the information from other tide gauges installed by any other user in the area either in real time or immediately after the survey.

5.4 Side scan sonar

A dual channel side scan sonar with a dual frequency of about 100/500 kHz is requested (range used shall be preferably 125-150 m).

This equipment shall have the capability of image correction in order to get records fully corrected for slant range and vessel's speed.

Equipment such as EGG 260 or KLEIN 595, or equivalent is requested.

A hydraulic/electric winch with slip rings shall be provided in order to adjust the length of cable out during the runs. A minimum length of cable (typically 200 metres) shall be supplied in order to work with the specified water depth. A "length of cable out" measuring device shall be supplied with direct read-out in the instrument room. The height of the towfish above the seabed (typically 10% of the selected range) and the speed of the vessel shall be adjusted to ensure

the optimal performance of the system. Accurate lay back of the fish relative to the antenna shall be established by opposite runs on same line over characteristic features.

5.5 Sub-bottom profiler

CONTRACTOR shall use a high definition dedicated pipeliner, equipped with heave compensator.

Frequency range between 3 and 12 kHz.

Pulse repetition rate over 20 per second.

Available transmitting power not less than 5 kW.

CONTRACTOR shall mention in his offer maximum firing rate of the proposed pinger.

A thermal paper recorder with high sweeping rate shall be used to record the entire length of cross profile.

5.6 Survey equipment requirement

All equipment shall be installed and operated according to the MANUFACTURER's specifications.

All items of equipment shall be tested and calibrated according to MANUFACTURER's procedures which will be applied as often as recommended by MANUFACTURERS in order to ensure that the equipment is providing consistent and reliable data during the course of the survey. Equipment provided shall be of recent make and in any case not older than five years.

All key equipment must be duplicated and all necessary spare parts to avoid breakdown during the survey shall be supplied. A detailed list of the back-up equipment and of all spare parts shall be documented in the tender documents by CONTRACTOR and shall be checked by COMPANY representative at the mobilisation.

The detailed technical manual of each item of equipment shall be available on board.

6. Report

6.1 Preliminary report

This report shall be supplied within eight days after survey completion and shall mainly present all necessary information on the specific features, which may need the setting up of remedial works, such as:

- Exposures
- Loss of coverage
- Free-spans
- Obstructions, etc.

All events or anomalies detected in the course of the survey shall be listed and documented (description, KP, co-ordinates, pictures). If same event is detected on different records, all the relevant pictures shall also be presented.

6.2 Draft of final report

A draft of the final report shall be submitted within six weeks after survey completion to:

Subsidiary name

Attention to Mr xxxxxxxx

Defined in the particular specification

Another copy shall be sent to:

COMPANY

Attention to Mr xxxxxxxx

Defined in the particular specification

This copy shall include the data listing of Section 2 (see 6.3.1) on CD ROM in Excel format.

Two weeks after approval:

- 10 (ten) neatly bound copies shall be sent to Subsidiary:
 - Only one copy shall include a cross-section booklet (if any) and one set of A1 drawings
 - Another copy shall be delivered with only one set of A1 drawing.
- 1 (one) neatly bound copy shall be sent to COMPANY, it shall include a cross-sections booklet (if any), and a set of A1 drawings + one copy of the report in PDF ACROBAT format (version 3). The charts on Microstation format (version 95 extension ".DGN") on CD ROM.

6.3 Final report

Final report shall be entitled as follow:

Subsidiary name

Offshore Fields

Sea lines network

Annual inspection

* 1

* 2

Study report

Note:

*1 CONTRACTOR name

*2 Start/end date of offshore works

The final report should be written according to the following guidelines:

6.3.1 Text

Section 1: Introduction

Giving a brief description of the aim of the survey, the intended scope of work and main operational features (date of survey, location surveyed with situation plan).

Section 2: Results

In which the following abstracts shall be extensively presented for each pipeline corridor in the following order:

- A situation plan titled "Corridor NR" where the corridor is seen relative to the subsidiary's pipeline field and where crossing lines or specific features are mentioned
- A brief chapter describing:
 - Inspection programme performed over the corridor
 - Status of the whole corridor at time of survey inspection (mean buried levels, exposures, specific features).
- A chapter of comments of the results recorded in this corridor
- A graph which gives a schematic view of the cover evolution from last survey
- Separate data listing (see example in the Particular Specification) for each pipeline, crossing pipelines and telephone cables (defined previously in the particular specification), including KP numbers, co-ordinates, distance of top of pipe relative to natural seabed (Burial Depth), thickness of sand cover (Cover), water depth (to LAT) over natural seabed at pipe location and cover height difference with the last inspection (KP and co-ordinate point shall be clearly defined). In front of the listing, KP zero must be referenced (name or description and co-ordinates), distance of pipe to natural seabed and thickness of sand cover must be clearly defined by a terse sentence or a small sketch:
 - In view of automatic processing by specialised software, all here above data shall be copied on CD ROM. The data shall be recorded in Excel format. These floppy disks shall be supplied with the draft of final report (see 6.2).
- A reduced copy of the considered alignment sheets.

Section 3: Specific features

For each specific feature pointed out during this campaign a description as complete as possible shall include:

- Location (corridor NR, KP NR, type of pipeline)
- Kind of feature (exposure, free-span, obstruction, etc.)
- Characteristics (size, length, height, thickness, etc.)
- Comments.

All recordings of any specific feature must be reported in this chapter with a very well duplicated and labelled copy (photocopy or picture if necessary).

Section 4: Platform Inspection

For each platform the abstract shall be presented as follows:

- A situation plan where the platform and the side scan sonar runs are seen relative to the pipeline network. References of that platform shall be clearly labelled in legend
- A very well duplicated and labelled copy (photocopy or picture if necessary) of each side scan sonar record done on the platform
- A chapter of comments (field works and results) on that specific platform inspection.

Section 5: Field Work

Implementation, giving a brief description of the amount of work, type of equipment, positioning, vessel used, acquisition procedures, calibration procedures, configuration, etc.

Section 6: Quality control of results

Positioning system:

- Referenced data of positioning system
- Onshore and offshore calibration results
- Accuracy control of fixing
- Horizontal positioning offsets, sketch of the equipment lay out on the survey vessel
- Sample records.

Sounding survey:

- Referenced data used for sounding computations
- Port and offshore calibrations
- Tidal results and curve
- Sounding computation
- Statistics of depth discrepancies at line crossings
- Sample records.

Scanning sonar survey:

- Horizontal positioning offset computations
- Sample records.

Sub-bottom profiling survey:

- Accuracy control of vertical and horizontal position of sea lines
- Sample records.

Results interpretation:

- Description of method used for results interpretation
- Statistic analysis of pipeline position (horizontal and vertical) with last survey.

Section 7: Appendices

- Appendix A: Personnel involved during the survey, the processing and the interpretation of report
- Appendix B: Diary of events
- Appendix C: Extensive documentation of equipment (vessel + survey and processing equipment)
- Appendix D: Radio-positioning station descriptions
- Appendix E: Listing of profiles and original records as defined in chapter 6
- Appendix F: Listing of UTM co-ordinates of the map corners as defined in chapter 6.3.2.

6.3.2 Charting

In order to facilitate the monitoring of the pipelines behaviour with the aid of an appropriate data handling software, dedicated mapping is required.

The charting shall comprise three sets of maps for which the following general requirements shall apply:

- Very good quality of drafting is necessary for future microfilming of the maps
- Map sheet assembly (KEY MAP) in front of each sheet
- Both, the geographical and UTM lattices shall be drawn, including north arrows
- The over view maps shall bear the UTM co-ordinates corresponding to each corner of the map (or window)
- Adjacent maps with 200 m overlap and match lines
- All data (positioning, sounding, KP, etc.) and specific symbols (free-spans, obstructions, exposures, existing platforms, etc.) shall be clearly referenced or annotated in legend
- Chainage: on each pipeline route (plan view and section)
- Scales:
 - Horizontal:
 - . 1/1000 on platform area map
 - . 1/5000 on alignment sheet.
 - Vertical:
 - . 1/50 on alignment sheet.

Section 8: Platform area maps

Plan view at scale 1/1000 of each platform surrounding within about 300 m, showing pipelines arrival/departure, expansion loop, exposures, free-spans, etc.

A separate numbering shall be used for the platform area maps. It will be done as follows: NR PA1, PA2, PA3, and so on, etc.

Section 9: Alignment sheets along pipeline routes

In view of charting, the whole corridors shall be divided in areas, numbered according to the KEY map defined in the Particular Specification:

- Each alignment sheet shall bear the entire length of the horizontal and vertical profiles. For corridors where "light programme" survey applied this year, the alignment sheets of the last "detailed programme" survey in date shall support the amendments (if any) evidenced on the side scan sonar and bathymetric profiles or by the close inspection at line crossings on specific locations. The areas where amendments are done this year shall be made unmistakable by symbols or different style of drawing.
- Each alignment sheet shall cover 3 km of corridor and bear three thematic windows:
 - Upper window: pipeline position and navigation chart showing the pipeline routes in the corridor, the survey tracks with line number and fixes
 - Each pipeline route will bear a kilometric chainage

- Middle window: soundings and features map showing soundings reduced to LAT, pipeline routes, track chart in filigree and all features of interest such as obstructions, exposures, free spans, scours, depressions
- Lower windows: longitudinal profile
- The longitudinal profile of each pipeline in the corridor shall be presented in separate windows
- In each window the longitudinal profile of top of pipeline, natural seabed reference level and seabed at pipe shall be referenced to the LAT (zero line)
- Bottom longitudinal profile of pipeline shall be drawn up only at exposure areas to evaluate characteristics of possible free-spans
- Distance from top of pipeline to natural seabed level (natural seabed profile) and thickness of sand cover (profile of sand cover at pipeline) shall be drawn as dotted lines and clearly labelled
- Lower part of the longitudinal section below profile of sand cover shall be screened in order to easily point out exposures and coverage thickness of pipeline
- Within each window, figure of the minimum and maximum distances from top of pipe to natural seabed level and sand cover thickness shall be reported.

Section 10: Cross-sections

All cross lines recorded with the sub-bottom profiler during the survey **must be reported** in this section.

A cross-section, showing actual seabed profile, the NSB level and buried pipeline positions shall be drawn for each cross-profile (profile to be centred on the gas pipeline).

All depths shall be referred to LAT.

Tentative scales are 1/1000 (horizontal) and 1/50 (vertical). Each 200 m long cross-section shall be drawn on A4 format and identified by its theoretical position along the chainage (KP numbers). The cross-sections for each corridor shall be presented in form of a neatly bound booklet, with indication on the front page of key plan, corridor number and type of pipelines involved.

Computer aided drawing of these cross-profiles, by means of an appropriate software is required.

Section 11: Subsidence Area Maps

One sounding map at scale 1/5000 for each area, showing the platform(s) and the soundings (typically every 50 m). Longitudinal profiles shall also be plotted on these maps at horizontal scale 1/5000 and vertical scale 1/100.

As the survey is performed every five years, the report shall only include the charts of the subsidence survey carried out during this annual inspection.

A separate numbering shall be used for the subsidence area maps.

6.3.3 GIS requirements

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

7. Documents delivery

7.1 Final report

Once the final version of the report has been approved and amended accordingly, it is edited and dispatched according to the distribution list given in 6.2.

7.2 Field data

All original records must be sent to **COMPANY** and comply with following requirements:

- The whole original records are folded or rolled in the most compact possible manner i.e. in a minimum number of file and/or roll
- In case where records are folded flat, the folded page does not exceed the A4 standard size.

7.3 Data disposal

CONTRACTOR is not allowed to dispose of data without prior approval of COMPANY.