
 PETROBRAS	TECHNICAL SPECIFICATION		Nº: I-ET-0000.00-0000-970-P9U-002			
	CLIENT:	-	SHEET:			1 de 30
	JOB:	-				-
	AREA:	GENERAL				
-	TITLE:	MINIMUM REQUIREMENTS FOR POST-LAY SURVEY			EDD/EDR	
					-	
INDEX OF REVISIONS						
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1 INTRODUCTION


1.1 General

This Technical Specification establishes the scope of work and minimum requirements for the Engineering and Construction related to the ROV post-installation surveys of offshore pipelines, risers and related equipment.

This Technical Specification is applicable to post-lay surveys such as as-laid surveys and as-built surveys. As-laid surveys are performed during installation. As-built surveys are performed after the pre-commissioning activities are concluded, pipeline is not pressurized and no other movement on pipeline is envisaged. As-built surveys can be performed prior to the jumpers or spools being installed. The minimum requirements of these surveys are established in DNV-ST-F101.

The minimum scope of work for the engineering design activity includes:

- Offshore survey of entire pipeline and riser lengths, including sections that are not possible to survey with ROV (very shallow water, shore approach, splash zone, etc.). In these cases, appropriated or indirect methods shall be used;
- Offshore survey of entire route of the pipeline and its equipment (PLEM, PLET, SDV, IL equipment, etc.);
- Crossing verification and survey of the areas pre-installed aids, final position of pipeline on supports and gaps (profile);
- Identification of debris and obstructions along the pipeline route and riser TDZ on seabed (that were not identified and treated by pre-lay survey);
- Identification of damaged section of pipeline and riser (coating, field-joints, anodes, VIV suppressor (e.g. strakes), polymeric buoyancy elements, etc.);
- Identification of riser embedment at TDZ on seabed;
- Identification of pipeline embedment along the route and equipment embedment;

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- Identification of free-spans along the pipeline route (profile);
- Identification of lateral displacements along the pipeline route, as well as longitudinal displacements of pipeline ends and equipment.

Acquisition of any data or information necessary to perform the objective of this document and not supplied on contractual documents.

1.2 Abbreviations

The following abbreviations are applied in this document:

ASCII	American Standard Code for Information Interchange
AUTR	Automatic position keeping system with redundancy in technical design
AUV	Autonomous Underwater Vehicle
BOP	Bottom of Pipe
CV	Curriculum Vitae
DCC	Distance Cross Course
DGPS	Differential Global Positioning System
DNV	Det Norske Veritas
DP	Dynamic Positioning
DYNPOS	Dynamic Positioning System
DTM	Digital Terrain Model
GIS	Geographical Information System
IL	In-line
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
ISO	International Standards Organization
KP	Kilometer Point


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OBR	On-Bottom Roughness
PDF	Portable Document Format
PDOP	Percent Dilution of Position
PLEM	Pipeline End Manifold
PLET	Pipeline End Termination
ROV	Remotely Operated Vehicle
RTK GPS	Real Time Kinematic Global Positioning System
SDV	Shutdown Valve
SGO	Sistema de Gerenciamento de Obstáculos
SIRGAS	Sistema de Referência Geocêntrico para as Américas
SIT	Silicon Intensifier Target
TDZ	Touchdown Zone
TMS	Tether Management System
TOP	Top of Pipe
USBL	Ultra Short Base Line System
UTM	Universal Transverse Mercator
VIV	Vortex Induced Vibrations
VRU	Vertical Reference Unit
WD	Water Depth
WGS	World Geodetic System
XREF	External Reference File

1.3 Definitions

The following definitions are used for the purpose of this technical specification:

CONTRACTOR	The group or organization responsible for the design, manufacture, testing and delivery of the specified equipment and supply of services
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to perform the duties specified within the scope of this specification. This is used interchangeably with "Supplier" or "Manufacturer" or "Vendor".

- SHALL Indicates a mandatory requirement for CONTRACTOR
- SHOULD Indicates a preferred course of action for CONTRACTOR
- MAY Indicates an optional course of action for CONTRACTOR
- WORK The entire project requirements as stated in the Purchase Order

1.4 Deviations

All deviations to this Specification, and other referenced specifications or attachments listed in the contract, shall require written approval by PETROBRAS prior to execution of the work.

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2 REFERENCES

2.1 Documents & Specifications


- | | | |
|-----|------------------------|---|
| [1] | PROJECT DESIGN REPORTS | PIPELINE AND RISER DATASHEETS |
| | | PIPELINE DESIGN BASIS |
| | | RISER DESIGN BASIS |
| | | PIPELINE DESIGN ROUTE (OR AS-LAID IF AVAILABLE) |
| | | PIPELINE GEOPHYSICAL DATA |
| | | PIPELINE GEOTECHNICAL DATA |
| | | PIPELINE ALIGNMENT SHEET |
| | | PIPELINE PRE-LAY SURVEY REPORTS |
| | | PIPELINE OBR AND FREE-SPAN ANALYSIS |
| | | PIPELINE CROSSING DESIGN |
| | | PIPELINE GLOBAL BUCKLING DESIGN |
| | | PIPELINE STABILITY ANALYSIS |
| [2] | LOCAL AREA INFORMATION | PETROBRAS SGO |

2.2 Industry Standards

- | | | |
|-----|---------------|---|
| [3] | DNV-ST-F101 | SUBMARINE PIPELINE SYSTEMS |
| [4] | ISO-9000 | QUALITY MANAGEMENT SYSTEM |
| [5] | IMCA S 017 | GUIDANCE ON VESSEL USBL SYSTEMS FOR USE IN OFFSHORE SURVEY AND POSITIONING OPERATIONS |
| [6] | N-1487 | INSPEÇÃO EXTERNA – DUTOS SUBMARINOS |
| [7] | ABNT-NBR16244 | ENSAIOS NÃO DESTRUTIVOS – ENSAIO VISUAL – INSPEÇÃO SUBAQUÁTICA |

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|------|------------|---|
| [8] | IMCA S 008 | DIGITAL VIDEO OFFSHORE: A REVIEW OF CURRENT AND FUTURE TECHNOLOGIES |
| [9] | IMCA S 013 | DEEP WATER ACOUSTIC POSITIONING |
| [10] | IMCA R 004 | CODE OF PRACTICE FOR THE SAFE & EFFICIENT OPERATION OF REMOTELY OPERATED VEHICLES |
| [11] | N-2698 | ELABORAÇÃO DE SERVIÇOS GEORREFERENCIADOS |
| [12] | N-381 | EXECUÇÃO DE DESENHO E OUTROS DOCUMENTOS TÉCNICOS EM GERAL |
| [13] | N-1710 | CODIFICAÇÃO DE DOCUMENTOS TÉCNICOS DE ENGENHARIA |
| [14] | N-2064 | EMISSÃO E REVISÃO DE DOCUMENTOS DE PROJETO |


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3 POSITIONING SYSTEMS

3.1 Local Datum

All records shall be based on local datum to be supplied by Petrobras. This shall be clearly presented at CONTRACTOR Documents. Information about datum shall include following information:

- Local Datum
- Spheroid;
- Major Axis;
- Semi-Minor Axis;
- Inverse Flattening;
- First Eccentricity;
- Projection;
- Central Meridian;
- Origin Latitude;
- Origin Longitude;
- False X;
- False Y;
- Scale Factor;
- Grid Unit.

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Trial Transformation Calculation:

For means of verification of the coordinate transformation procedure, CONTRACTOR shall submit to PETROBRAS an example of coordinate transformation executed with the navigation program to be used for survey vessel positioning. The chosen reference coordinate shall be within the limits of the working area. The example shall demonstrate the following transformation steps:


- ✓ GEODETIC IN WGS 84 → GEODETIC SIRGAS 2000;
- ✓ GEODETIC IN WGS 84 → UTM SIRGAS 2000;
- ✓ UTM IN WGS 84 → UTM SIRGAS 2000.

Transformation will be checked by PETROBRAS and differences shall be at the order of centesimal (0.01) second for geodetic coordinates and 50 cm for UTM coordinates.

3.2 Marine Vessel

3.2.1 General

CONTRACTOR shall provide an operational marine vessel capable of successfully performing the Work in accordance with the requirements of the Contract. All vessels shall have valid class with a recognized classification society. The valid class shall cover all systems of importance for the safety of the operation. CONTRACTOR shall supply vessel details to PETROBRAS including the spread required to perform the work. CONTRACTOR shall provide details of previous experience with the methods and installation equipment to PETROBRAS for review prior to selection of the appropriate method.

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The vessel and its equipment shall be capable of locating the freespans as well as any other obstruction, been able to holding station over the work site for the duration of the operation.

The vessel operations shall be designed to prevent damage to the pipeline, riser and subsea equipment.

Further requirements for the vessels shall be as defined in DNV-ST-F101.

3.2.2 Positioning Equipment and Accuracies


The surface positioning system shall be provided using two different systems. A primary system shall be the DGPS (with 100% redundancy), while the secondary system shall be proposed by the CONTRACTOR for PETROBRAS approval. For underwater positioning, the USBL system shall be used.

Differential Global Positioning System (DGPS):

The CONTRACTOR shall operate two DGPS providing 100% back-up in the event of system failure, as the method of establishing surface position. Preference shall be given to systems that receive differential corrections via satellite link and provide a multi-reference station capability with weighting given to the nearest station. The positioning accuracy shall be at least ± 0.5 meters.

In order to achieve this accuracy, the following DGPS parameters shall be monitored in real time and operated within the ranges below (95% of the time):

- ✓ PDOP < 4;
- ✓ Number of satellites above elevation mask > 6;
- ✓ Arrival interval for differential corrections < 3 seconds.

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Acoustic – Ultra Short Base Line System (USBL):


For the post-laid survey, an USBL subsea positioning system with tracking transducer shall be used. This system shall be interfaced with the on-line electronic survey manager system and the surface positioning systems.

The CONTRACTOR shall supply all necessary equipment in order to have a fully operational USBL system interfaced to the on-line electronic survey manager system and the surface positioning systems. The installation of equipment shall comply with supplier's recommended requirements, and special attention shall be given to the following:

- The hull mounted USBL transducers shall be located as to minimize disturbances from thrusters and machinery noise and/or air bubbles in the transmission channel or other acoustic transmitters;
- The USBL equipment shall be supplied with its own computer display unit and shall be capable of operating as a stand-alone system;
- The USBL transducer array shall be mounted on a long stem;
- The VRU shall be of a type recommended by the USBL system supplier;
- The system shall be capable of positioning at least nine transponders and/or responders;
- The system shall be supplied complete with, as a minimum, the supplier's recommended spares and replacement components.

The USBL equipment shall be subject to PETROBRAS approval.

The installation and calibration of the system shall provide an accuracy of better or equal than 0.50% of water depth for normal pipeline installation conditions. However, if necessary in specific locations along the pipeline route, such as: equipment, crossings, buckle initiators, etc., CONTRACTOR shall reevaluate this accuracy or consider a more accurate positioning system.

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The CONTRACTOR shall present prior mobilization the list of equipment with the technical specification and calculation of the overall accuracy of the USBL system for PETROBRAS approval. The CONTRACTOR shall advise PETROBRAS of the capability of the proposed positioning systems for the WORK with respect to accuracy and repeatability.

3.3 Calibration


The CONTRACTOR shall ensure all calibration procedures are approved by PETROBRAS prior to the calibration being carried out.

All equipment shall be tested and calibrated to the satisfaction of the PETROBRAS representative prior to departure. All calibrations, verifications and tests shall be earlier agreed between CONTRACTOR and PETROBRAS based on to previously determined standards and values.

Prior to any survey work being performed, the approved calibration procedure shall have been carried out together with acceptance trials. The calibration shall be performed again should any discrepancy occur during operations.

The location of the trials shall be mutually agreed between PETROBRAS and the CONTRACTOR. The trials shall be performed close to the work location at similar water depth to the scope of work. The trials shall be conducted in accordance with procedures submitted by the CONTRACTOR and approved by PETROBRAS, and shall be witnessed and approved by PETROBRAS prior to the commencement of any of the WORK.

The CONTRACTOR's positioning system shall be adjusted in accordance with the provided subsea co-ordinates.

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The CONTRACTOR shall take into consideration the presence of other vessels or rigs close to the location where the works will be carried out. The CONTRACTOR shall make prior arrangements with the representatives of the other units in order to avoid interruption of such works.

The equipment calibration shall be performed before starting any activity and is valid up to one year in accordance with IMCA S017 (Guidance on vessel USBL systems for use in offshore survey and positioning operations). The reports described in section 8 of IMCA S017 shall be supplied. In case of previous calibration, within a valid calibration period, CONTRACTOR shall verify the equipment calibration by transit and/or spin and demonstrate a valid calibration.

3.4 Equipment Testing and Surveys

All test programs, surveys, etc. carried out by CONTRACTOR to comply with this Specification shall be witnessed by PETROBRAS at PETROBRAS'S discretion. If any equipment is deemed to be in unsatisfactory condition, it shall be repaired and submitted for re-inspection prior to mobilization. Any repairs required as a result of failing a test or survey shall be CONTRACTOR'S responsibility.

Any vessels used for the post-lay work shall fully comply with the relevant statutory and PETROBRAS requirements.

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4 TECHNICAL REQUIREMENTS

4.1 General

CONTRACTOR is required to utilize industry 'best practice' survey and testing techniques with reporting systems and methods to fulfill the project objectives to the standard outlined in this Specification.

No WORK will be carried out until all equipment is safely installed, tested and calibrated and PETROBRAS has accepted the vessel and survey spread as operational and ready for the designated tasks. WORK will cease when sea state/weather condition results in impaired data quality or unsafe operation due to excessive vessel motion. CONTRACTOR shall inform PETROBRAS when data quality is being degraded and propose actions to mitigate.

In the event that a task is aborted or fails for whatever reason, CONTRACTOR will resume the task with appropriate overlapping data or repeat a failed test where data cannot be recovered.

It is CONTRACTOR's responsibility to demonstrate that the gathered data complies with the specified accuracy, density and resolution for that data.

The following sections are intended to specify minimum requirements, and do not provide exhaustive description of vessels, equipment or procedures required.

4.2 Offshore Surveys

4.2.1 Post-lay Survey

After carrying out pipe lay operation CONTRACTOR shall perform post-lay surveys of the entire route of the pipeline (nominally +/- 10 metres centred on route centreline).


In case of as-laid surveys, CONTRACTOR shall perform all ROV based post-laid surveys after the pipeline and riser have been installed at final planned design

position and before any trench backfilling, rock dumping, free span correction and pipeline flooding. CONTRACTOR may perform the as-laid surveys during installation, but only in sections of pipeline and riser that will not have any additional interference of vessel laying process.

In case of as-built surveys, CONTRACTOR shall perform all ROV based post-laid surveys after the pre-commissioning activities to verify that the completed installation work meets the specified requirements, and to document deviations from the original design, if any. As-built surveys to be performed after ceased all interferences in the pipeline and the internal pressure is in accordance with the final pipeline delivery pressure defined in design basis.

Requirements for the as-laid survey are:

- Continuous video coverage of exposed pipeline (top and either side);
- Pipeline and riser XYZ position (exposed and buried) (plan and longitudinal profile), including its equipment, and seabed profile adjacent to pipeline/equipment contact / burial. At least, the following data shall be provided: KP, DCC, TOP Easting coordinate, TOP Northing coordinate, TOP depth, BOP depth, adjacent left depth near pipe/seabed intersection, adjacent right depth near pipe/seabed intersection, mean seabed left depth at about 3 m of pipe and mean seabed right depth at about 3 m of pipe;
- Detection and recording of any damage (location and clock position) of pipeline and riser (coating, field-joints, anodes, VIV suppressor (e.g. strakes), polymeric buoyancy elements, buckle arrestors etc.). Photos and dimensions of the damages are to be taken;
- Location and commentary on condition of anodes and field joints;
- Location and recording of any non-expected debris or obstacle within the pipeline route and riser TDZ on seabed;
- Location and recording of the post-laid survey (crossing supports, free span corrections, seabed rectification, thermo-mechanical behavior mitigation devices etc.);
- Location and recording of all free spans in pipeline route before pre-commissioning activities, with information of span length, seabed clearance

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(gap height), soil support conditions (buried or not), partial and spans mitigation actual situation and location. The effectiveness of each span support shall be inspected and documented;

- Photos of the equipment installed within the pipeline including its position in seabed, inclinations (roll and pitch) and settlement (equipment embedment) on seabed;
- Recording of the following pipeline conditions during performing of post-laid survey: profile of content density, profiles of internal pressure and temperature along the pipeline and/or riser, making reference to the proper project documents.

As-laid survey operations may take place in conjunction with pipe laying activities, with priority given to lay vessel assistance as required. Moreover, CONTRACTOR shall assure the TDZ (touchdown zone) monitoring continuously during pipe laying process.


Specific requirements for the as-built survey are the following in addition to the requirements for as-laid survey shall be also fulfilled:

- Location and recording of any pipeline lateral displacement observed after pre-commissioning activities and identified by soil berms in either sides of pipeline. These displacements shall consider as initial reference the as-laid survey information;
- Location and recording of longitudinal displacements of the pipeline ends and equipment observed after pre-commissioning activities. These displacements shall consider as initial reference the as-laid survey information;
- Location and recording differences on free span and crossings (length, gap height and supports) when comparing to as-laid data.

4.3 Equipment

4.3.1 ROV Systems

CONTRACTOR shall propose an ROV system(s) capable of carrying out all aspects of underwater monitoring, inspection and intervention as required in support of pipeline

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and riser construction activities to full project water depth. The ROV system shall include, as a minimum:

- High capacity work class, TMS based, ROV system(s) for survey, monitoring and construction support to full water depth range;
- Inspection class ROV / video system in support of trenching and nearshore post-lay / pipeline and riser installation activity.

Optical and acoustic sensors, required as a minimum (certified and rated to full project water depth):

- High resolution colour video;
- High resolution colour cameras;
- High resolution laser survey equipment;
- Multibeam system;
- Sonar (Sound Navigation and Ranging);
- Dual head scanning profiler system;
- High resolution collision avoidance sonar;
- High resolution altimeter and pressure compensation system;
- Pipe tracker;
- Multi-function manipulator and cable cutting device.

Continuous online display and recording (2 copies) of colour video, views of centre, right side and left side, are required as a minimum and shall be obtained through the use of boom cameras of centre, starboard and portside, respectively.

4.3.2 Very Shallow Water Depth System

CONTRACTOR shall consider a multi beam, sonar, pipe tracker or similar equipment to perform the post-lay survey on very shallow water depth. If necessary, dives may be employed.

4.3.3 Bathymetry System

Bathymetric survey equipment shall meet the following requirements:

- Multibeam system (or similar area scanning system) - Discrete beam formed or proven interferometric system fully compensated for roll, pitch and heave.

Systems shall include full quality control and data processing facilities capable of providing data binning statistics, final sounding density, geo-referenced ASCII XYZ data in digital format, contour maps and profiles.

Soundings shall be corrected and compensated for variations in sound velocity, tide, ray bending and other environmental/atmospheric effects and referenced to the survey vertical datum.

The minimum levels of fidelity are required from the near seabed deployed swath bathymetry data, refer to Table 4-1.

Table 4-1- Fidelity from Near Seabed Data


Survey Stage	Vertical Resolution (m)	Horizontal Resolution (m)	Vertical Accuracy	Final Gridded Density
Main Pipeline Corridor Survey	0.01	0.1	0.1% WD	1 node at 0.10x0.10 meter interval (*)

(*) Final gridded requirements are just a guidance. Multibeam system (or similar area scanning system) shall be able to identify the pipeline and adjacent soil in order to measure free-span clearance.

Vessel speed, acoustic beam width, beam spacing, swath angle update rate and line configuration shall be such that the above final sounding density is normally achieved.

The expected vertical accuracy, data density and error budget shall be demonstrated to PETROBRAS and included in CONTRACTOR's Survey Procedures.

The swath bathymetry system shall be calibrated to obtain corrections for heading, roll and pitch. Cross checks shall be performed at a known seabed feature in the

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deepest water for the survey program. A detailed method and procedure for system calibration and validation shall be included as part of CONTRACTOR's survey procedures.

Swath bathymetry calibrations and validation shall be conducted during mobilization and must be accepted by PETROBRAS representative prior to the WORK commencing.

Dual Head Scanning Profiler (DHSS) system can replace the use of the Multibeam system since all requirements of this Item 4.3.3 are fulfilled and all deliverables this Technical Specification are provided.

4.3.4 Tidal Reduction


Tidal heights shall be computed from observed tides where predicted over 0.5m mean range. These shall either be derived from a tidal model utilizing nearshore stations or tide gauge deployment at the worksite for the duration of the survey work. Tide gauge deployment can be installed during offshore survey. CONTRACTOR's Survey Procedures shall fully document the method of establishing the tidal model reduction. The method accuracy shall be to centimetre level.

On-board bathymetric analysis may utilize reduction of tidal component based on tidal predictions for the local area or RTK GPS nearshore. However, final presentation of bathymetric data and DTM generation shall utilize the observed tidal data set.

4.3.5 Sonar

The sonar shall be considered by CONTRACTOR only when specified by PETROBRAS. Otherwise, this item shall be disregarded; but, if it is desire of CONTRACTOR to use a faster method to access free-spans, pipeline and equipment displacements, debris etc., CONTRACTOR sonar shall fulfill requirements bellow.

Sonar data shall be acquired concurrently with bathymetry data for all survey areas, preferably as co-located data from deployment on a common sensor platform.

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Sonar imagery from reprocessed swath bathymetric system is not acceptable as primary sonar system but will be considered to supplement swathe bathymetry based reconnaissance work.

The system shall be configured and operated to provide optimum acoustic beam geometry at the seabed for target resolution and seabed characterization.

Sonar resolution shall be less or equal to 10 cm for all survey corridors.

All data shall be displayed and printed online, with digital recording for optional further processing and production of geo-referenced mosaics.

4.4 Vessels

CONTRACTOR is anticipated to mobilize a number of different vessels to perform the WORK. All vessels used for survey tasks shall have a proven efficient capability and be of a class designed for the proposed task.

All vessels shall be maintained and operated to current industry standards, as a minimum providing the following:

- Capable of maintaining steerage and station keeping in sea states of up to and including Beaufort scale force-4;
- DP vessel classification to be minimum IMO Equipment Class 2 DYNPOS-AUTR (DNV Rules for Classification of Ships);
- Efficient, safe and certified lifting, handling and deployment facilities for all 'in water' equipment;
- Online operations area(s) with sufficient room, good access and communication for all survey instruments and recorders, including navigation monitors;

- Offline processing area(s) with sufficient comfortable and well-ventilated space, for the handling, interpretation and organized storage of acquired geophysical, and environmental monitoring data.

4.5 Survey Personnel

CONTRACTOR shall supply properly trained experienced personnel in sufficient numbers to complete the WORK.


During mobilization and at any survey crew changes throughout the WORK, CONTRACTOR shall provide Curriculum Vitae (CV's), comprising details of project responsibilities and past experience of all survey personnel proposed. To maintain continuity, a maximum of fifty percent (50%) of the survey personnel should be changed at any time. The Party Chief is responsible for ensuring a suitable and effective hand-over between key personnel. The Party Chief, Senior Geophysicist and Senior Data Processor shall not be change at the same crew change.

Minimum survey manning levels expected are indicated in Table 4-2.

Table 4-2- Survey Personnel Requirements

Survey	Survey Personnel	Number
All	Project Surveyor	1
Offshore	Party Chief	1
	Senior Surveyor	2
	Processing / Reporting	1
	Survey Technician/ Operator	2

CONTRACTOR may to consider data processing to be automated or performed remotely. However, the processing results shall be delivered onboard the vessel and, if any error or information lack is identified, CONTRACTOR shall assure the revision and/or data complementation still onboard the vessel.

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5 SYSTEM ACCEPTANCE, CONTINGENCY AND SAFETY

5.1 Survey Procedures

CONTRACTOR shall submit comprehensive survey procedures to PETROBRAS for review and approval.

The survey procedures shall fully document all survey activities, methodology (including calibration checklists), testing, contingency and reporting. These should include project specific personnel, equipment (including level of spares) and techniques.


Where CONTRACTOR uses a standard set of work procedures, these may be used in conjunction with a bridging document to modify CONTRACTOR standard procedures to the specific requirements of this WORK.

5.2 Mobilization

Mobilization commences with the installation of equipment, through the performance of harbour and offshore trials, and culminates with the completion of equipment calibrations.

CONTRACTOR shall collate a concise Mobilization Report, which shall document the following:

- Equipment mobilized on board and any deviation from PETROBRAS reviewed, CONTRACTOR's procedures;
- Equipment trials and calibrations, datum transformations and error budgets specific to this WORK;
- Equipment calibration certificates;
- Any non-critical defects.

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5.2.1 Harbour Installation and Trials

Harbour trials shall be conducted when alongside at port of mobilization as agreed with PETROBRAS. These trials shall include the functional testing and demonstration that all acquisition and processing systems are operational to the acceptance of PETROBRAS.

All 'in water' equipment shall be 'wet' tested.

The positioning systems shall be calibrated using the appropriate datum reference and system integrity and calibration verified in writing to PETROBRAS.

5.2.2 Offshore Calibration and Trials

Calibration results will be included in the mobilization report. Any defects or system deficiencies shall be rectified to PETROBRAS satisfaction prior to commencement or continuation of work.


5.3 Demobilization

CONTRACTOR shall be responsible for the removal of all equipment, instrumentation and materials from the WORK area at the conclusion of all survey work.

5.4 Contingency

All the equipment on-board and at the work site shall be supplied with adequate spare parts and/or back up units for ordinary maintenance and repair on site with no / minimal delay to operations.

CONTRACTOR shall submit a complete inventory of equipment, back-up systems, and spares. CONTRACTOR shall identify all equipment that is critical to maintaining full survey support and uninterrupted construction activity and define contingency actions in event of failure.

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6 REPORTING

All documents to be issued shall include, but shall not be limited to the following initial items in an introduction:

- Field description (if a Design Basis will not be issued by CONTRACTOR);
- Objective;
- Local Datum;
- Executive Summary.


All documents (final or partial reports) to be issued shall be in accordance with the last revision of Petrobras standards below:

- N-381 - Execução de Desenho e outros Documentos Técnicos em Geral;
- N-1710 - Codificação de Documentos Técnicos de Engenharia;
- N-2064 – Emissão e Revisão de Documentos de Projeto.

6.1 Survey Procedures

CONTRACTOR shall submit comprehensive Survey Procedures to PETROBRAS for review and approval. These procedures shall be submitted at least four weeks prior to any mobilization.

Survey procedures shall fully document all survey activities, methods (including calibration checklists), contingency and reporting.

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6.2 Onboard Reporting

6.2.1 Post-lay Survey

Minimum onboard reporting in post-lay survey are defined as follow:

- ROV inspection logs;
- Summary data for pipeline XYZ position and GIS data in an interchange format (e.g. shapefile);
- Record of as-laid/as-built pipeline condition;
- Environmental monitoring results as may be acquired and processed by third party specialists, and as required under permit condition;
- CAD files plus field memos may be delivered during as-laid and as-built surveys for incorporation into Petrobras database in a regular basis.

6.2.2 Data Access


CONTRACTOR shall allow and plan for PETROBRAS access to online display of vessel position, geophysical records, current touchdown position and ROV inspection data of pipeline and riser.

6.2.3 Data Processing and Onboard Reporting

Any specific PETROBRAS charting and data requirements will be agreed during mobilization.

6.3 Reporting Media

The approved final reports including, drawings, figures, plots, GIS deliverables and videos shall be provided in electronic format. The media and precise format will be confirmed during reporting, but is anticipated to be browse-capable Hard Drive Disks or NAS Drives.

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All charts and maps are to be provided in digital format (files type .DWG), preferentially built and issued in AutoDesk software.

All logged data are to be provided in EXCEL spreadsheet files.

PETROBRAS as part of the final deliverables may request all raw and processed data on appropriate media and format.

Regarding the bathymetric data from as-laid and as-built surveys, CONTRACTOR shall have these data available. If PETROBRAS requires the bathymetric data for any pipeline section, CONTRACTOR shall provide these data even if they are required before the issue of the Survey Management System. In this case, the ASCII XYZ files with all collected points without applying any grid shall be provided. This file shall already consider the corrections for tide reduction and removal of spikes on data. Filters may be applied to this data but the precision and accuracy shall not be compromised.


The as-laid or as-built report shall contain all data required on item 4.

6.4 Survey Data Base

CONTRACTOR shall maintain survey charts and the associated electronic data base for use by the survey SUBCONTRACTOR at the various stages of the construction and installation activities.

CONTRACTOR shall be responsible for providing and maintaining throughout the duration of construction and installation activities all necessary nautical aids, navigational warnings and signs, temporary moorings, amongst others required to properly perform the WORKS, and the survey data base shall be updated with the relevant location and detailed information.

Interpretation and Engineering Assessment - CONTRACTOR shall provide experienced personnel offshore to carry out thorough quality control and preliminary

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assessment/interpretation of all data as acquired, reporting directly to CONTRACTOR engineering team.

6.5 Geographical Information System (GIS)

All pipeline and charted seabed information will be required as input to a company GIS. CONTRACTOR is required to ensure data is fully compatible and available for input as defined in the following guidelines (Applies to .DWG files preferentially built and issued in AutoDesk software).

6.5.1 Drawing Structure

Drawings should be complete, and not be required to make reference to the following features, or any items that are path dependent:


- External file references (XREFs);
- External blocks;
- External images;
- Line types and fonts not supported by .DWG files, preferentially built and issued in AutoDesk software.

The drawing should not contain any surface rendering.

All blocks inserted into a drawing should have been exploded back to constituent feature types prior to final saving. Ideally, a layer should only contain one type of 2-dimensional feature (points, lines or polygons) and one thematic type per layer. Layer names should be descriptive to reflect contents of layer.

6.5.2 Coordinate Space

All data must be presented in the real world coordinates within which the mapping work is being undertaken. The use of paper and model space view ports to combine presentation layout and real world coordinates is acceptable.

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If model space and paper space views ports are used an explanatory text file should accompany each drawing.

6.5.3 Stacked Alignment Charts

Where stacked alignment charts are produced which show the different features for the same section of seabed, a separate drawing for each block in real world coordinates should also be produced. For example, a chart which has three panels of bathymetry, seafloor geology and depth to reflector should also have an accompanying drawing in real world coordinates with these features placed on separate layers.

6.5.4 Splines

The reading of spline lines is not fully supported in all GIS packages and it is preferable that drawings do not contain splines. Where linear features are to have curves added to them, this should be undertaken by applying a curve to a polyline, rather than turning the polyline into a spline.

6.5.5 Hatching


All hatching will be removed prior to incorporation of data into the GIS.

Hatching should, therefore, be placed on a separate layer to the features to which it is associated.

Where hatching is used to define a polygon feature, closed polylines / polygon features must also exist for the boundaries of the feature. This enables the represented feature to be reproduced without the need for hatching.

6.5.6 Linear Contours

Contours should be placed at an elevation equal to the attribute that they are representing. Contours should be provided as continuous lines with no breaks for text labels.

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6.5.7 Polygons

Polygons should be represented as either .DWG files, preferentially built and issued in AutoDesk software, polygon shapes (e.g. circle, rectangle, etc.) or as closed polylines. Internal boundaries of polygons must match exactly with no slivers.

6.5.8 Daily Report

CONTRACTOR shall maintain a Daily Operations log that records timing and description of all significant events during the survey task. This log shall be made available to PETROBRAS on request, and will form input to the CONTRACTORS Daily Progress Report.