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	JOB:	-					-
	AREA:	GENERAL					-
-	TITLE:	<b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>			EDD/EDR		-
<b>INDEX OF REVISIONS</b>							
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**TABLE OF CONTENTS**

<b>1</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	GENERAL .....	3
1.2	ABBREVIATIONS .....	4
1.3	DEFINITIONS.....	5
1.4	DEVIATIONS.....	5
<b>2</b>	<b>REFERENCES.....</b>	<b>6</b>
2.1	DOCUMENTS & SPECIFICATIONS .....	6
2.2	INDUSTRY STANDARDS .....	6
<b>3</b>	<b>POSITIONING SYSTEMS.....</b>	<b>8</b>
3.1	LOCAL DATUM.....	8
3.2	MARINE VESSEL.....	9
3.3	CALIBRATION .....	12
3.4	EQUIPMENT TESTING AND SURVEYS.....	13
<b>4</b>	<b>TECHNICAL REQUIREMENTS.....</b>	<b>14</b>
4.1	GENERAL .....	14
4.2	OFFSHORE SURVEYS .....	14
4.3	EQUIPMENT .....	16
4.4	VESSELS .....	19
4.5	SURVEY PERSONNEL .....	20
<b>5</b>	<b>SYSTEM ACCEPTANCE, CONTINGENCY AND SAFETY .....</b>	<b>22</b>
5.1	SURVEY PROCEDURES.....	22
5.2	MOBILIZATION.....	22
5.3	DEMOBILIZATION.....	23
5.4	CONTINGENCY .....	23
<b>6</b>	<b>REPORTING .....</b>	<b>24</b>
6.1	SURVEY PROCEDURES.....	24
6.2	ONBOARD REPORTING .....	25
6.3	REPORTING MEDIA .....	26
6.4	SURVEY DATA BASE.....	26
6.5	GEOGRAPHICAL INFORMATION SYSTEM (GIS).....	27

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: <b>3 de 29</b>	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

## 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 pre-installation surveys of offshore pipelines, risers and related equipment.

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

- Offshore survey of entire design route of the pipeline (nominally +/- 20 meters centered on route centerline) and its equipment (PLEM, PLET, SDV, IL Equipment, etc.);
- Offshore survey of dead man anchor and wire rope of the dead man anchor (initiations), or with the wire rope of the abandonment and recovery winch (laydown operations);
- Offshore survey of area of influence of the mooring patterns;
- Crossing verification between the pipeline or riser to be laid and previously installed lines to establish the location of pre-installed aids;
- Identification of any obstructions along the pipeline design route and riser TDZ on seabed forecast in design and define area of influence on pipeline route;
- Identification of possible interferences;
- Identification of targets located along the pipelay corridor;


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

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-		SHEET: 4 de 29
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY		EDD/EDR

## 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
CV	Curriculum Vitae
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
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

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: <b>5 de 29</b>	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	

SIRGAS	Sistema de Referência Geocêntrico para as Américas
SIT	Silicon Intensifier Target
TDZ	Touchdown Zone
TMS	Tether Management System
USBL	Ultra Short Base Line System
UTM	Universal Transverse Mercator
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 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: <b>6 de 29</b>	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	


## 2 REFERENCES

### 2.1 Documents & Specifications


- |     |                        |                                     |
|-----|------------------------|-------------------------------------|
| [1] | PROJECT DESIGN REPORTS | PIPELINE AND RISER DATASHEETS       |
|     |                        | PIPELINE DESIGN BASIS               |
|     |                        | RISER DESIGN BASIS                  |
|     |                        | PIPELINE DESIGN ROUTE               |
|     |                        | PIPELINE GEOPHYSICAL DATA           |
|     |                        | PIPELINE GEOTECHNICAL DATA          |
|     |                        | PIPELINE ALIGNMENT SHEET            |
|     |                        | 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] | ABNT-NBR16244 | ENSAIOS NÃO DESTRUTIVOS – ENSAIO VISUAL – INSPEÇÃO SUBAQUÁTICA                        |
| [7] | IOGP 373-19   | GUIDELINES FOR GNSS POSITIONING IN THE OIL & GAS INDUSTRY                             |

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: <b>7 de 29</b>	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

- |      |            |   |
|------|------------|---|
| [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  |

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: <b>8 de 29</b>	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	


### 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.



 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 9 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

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.

The vessel shall be capable of locating any obstruction, been able to holding station over the work site for the duration of the operation.

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-		SHEET: 10 de 29
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY		EDD/EDR

The vessel operations shall be designed to prevent damage to the pre-laid 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  $\pm 0.5$  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.

#### Acoustic – Ultra Short Base Line System (USBL):

For the pre-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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 11 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	


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.

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

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-	SHEET: 12 de 29	
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY	EDD/EDR	
		-	

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.

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.


 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 13 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

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 pre-lay work shall fully comply with the relevant statutory and PETROBRAS requirements.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 14 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

## 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 Pre-lay Survey

Prior to carrying out any pipe lay operation; CONTRACTOR shall perform pre-lay survey of the entire pipeline construction corridor (nominally +/- 20 metres centered on route centerline) in order to verify:

- The construction corridor is clear of obstructions that could impede the safe and proper installation of the pipeline.

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-	SHEET: 15 de 29	
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY	EDD/EDR	
		-	

- The status and position of existing natural and anthropogenic seabed features are confirmed and reported.
- The status and position of previously installed pipelines, flexible lines, umbilicals and cables to be crossed by the pipeline or riser section on seabed. In case of crossings the survey is to be extended as much as necessary to permit the proper evaluation of the crossing;
- The status of any installed sections of the pipeline to be verified prior to recommencement of pipelay operations.

CONTRACTOR shall also perform detailed bathymetric surveys at the proposed subsea equipment (PLEM, PLET, SDV, IL structures, etc.) locations in order to verify seabed slope.

CONTRACTOR shall also perform detailed bathymetric surveys at the crossing areas in order to allow adequate positioning of pre-installed aids.

The reference to be used shall be the same as the one specified for the pipelay works (same KP 0).

Detailed seabed characteristics shall be surveyed to allow adjustment of installation equipment, if necessary.

Visual and sonar pre-lay survey shall be undertaken prior to the laying of the pipeline or riser to ensure that it is clear of any debris and natural or man-made hazard. All debris/obstructions will be removed by ROV, when possible and placed well clear of the route. Large unmovable items will be listed and position shown on the display. Should the route need to be adjusted to avoid debris, this will be conducted only in accordance with the supplied specifications referenced in this document.

Should results of the pre-lay survey reveal actual or potential conflicts with the CONTRACTOR obligations under the terms of the WORK or obstacles along the route, these shall be brought to PETROBRAS attention so that remedial actions can be

determined and implemented (e.g., route deviation within the corridor or removal of obstructions), and in this case the extension of the change are to be defined by the pre-lay survey.

### **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 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 pre-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 are required as a minimum.

#### 4.3.2 Very Shallow Water Depth System

CONTRACTOR shall consider a multi beam, sonar, pipe tracker or similar equipment to perform the pre-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.

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-		SHEET: 18 de 29
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY		EDD/EDR

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 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 19 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

#### 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.

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;

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-		SHEET: 20 de 29
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY		EDD/EDR


- 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.

	TECHNICAL SPECIFICATION	Nº: I-ET-0000.00-0000-970-P9U-001	REV. C
	-		SHEET: 21 de 29
	TITLE: MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY		EDD/EDR

**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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 22 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

## 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 23 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

### 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 24 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

## 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.



 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 25 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	

## 6.2 Onboard Reporting


### 6.2.1 Pre-lay Survey

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

- PETROBRAS access to properly labeled and stored records and/or digital data via workstation;
- Ongoing processing and reporting of data to include newly acquired information;
- Timely provision of trackplots, plan and bathymetric profile for ongoing analysis, based on “paper-free office” approach and in digital form;
- Computation and delivery of digital bathymetry profile data of proposed subsea pipeline/equipment locations; comma delimited XYZ distance, easting, northing, depth; at constant 10 cm distance interval. The bathymetric profile shall be provided as a ASCII format, preferentially in Microsoft Excel file;
- Limited provision of preliminary processed and raw digital ASCII XYZ bathymetry data of the corridor; in format and media requested by PETROBRAS;
- Final report on inclinations at subsea equipment locations;
- Final report on bathymetric and sonar data along the surveyed areas;
- Geo-referenced targets detected during the pre-lay survey;
- Sonar and bathymetric images, in GEOTIFFS formats, detected during the pre-lay survey.

### 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 26 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

### 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.

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.

The pre-lay 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 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 28 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

### 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.

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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-0000.00-0000-970-P9U-001</b>	REV. <b>C</b>
	-	SHEET: 29 de 29	
	TITLE: <b>MINIMUM REQUIREMENTS FOR PRE-LAY SURVEY</b>	EDD/EDR	
		-	

### 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.

### 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.