Base Load Power Hub (BLPH)

OIM V3 - HLV Positioning Procedure

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Positioning Services during Crosswind HKN Offshore Wind Farm BLPH Topside Installation

Preliminary Survey Procedure | North Sea, Offshore The Netherlands

Survey and Positioning Services Procedure Issue 4 | 14 November 2024

For Review

Scaldis N.V.

Document Control

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TJP	Thijs Prins	Service Line Director Marine Asset Integrity

Report Amendment

Frontispiece



Contents

1.	**Summary of Project Details**	**1**
1.1	Contractor Contact Details	1
1.2	Project Brief	2
1.3	Purpose	2
1.4	Fugro Scope of Work	2
1.5	Personnel	3
1.6	Equipment	3
2.	**References**	**6**
2.1	Installation Subcontractor Provided Documents	6
2.2	FSBV Documents	6
3.	**Responsibilities**	**7**
4.	**Datums and Tolerances**	**9**
4.1	Horizontal Control	9
4.2	Vertical Datum	10
4.3	Tolerances and System Accuracies	10
4.4	Contingency Planning	10
5.	**Yard Surveys and Preparations**	**11**
5.1	Dimensional Control Survey General Notes	11
5.2	Yard Survey Report Requirements	13
5.3	Gyro Plate/Gyro Box Installation	13
5.4	Dimensional Control Survey	14
5.5	Topside Reference Frame	15
5.6	Yard Survey Report Requirements	18
6.	**Preparations, Mobilisation and Calibrations**	**20**
6.1	Preparations	20
6.2	Mobilisation	21
6.3	Calibrations	21
	6.3.1 Onshore calibrations	22
	6.3.2 Offshore calibrations	25
7.	**BLPH Position**	**27**
8.	**Field Procedures**	**28**
8.1	HLV Positioning	28
	8.1.1 Anchoring	28
8.2	ROV Survey	29
8.3	Transition Piece Installation	30
8.4	Caisson Installation	30

8.5 Topside Installation 30
8.5.1 Pre-Lift Preparation 31
8.5.2 Topside Lift from Barge 31
8.5.3 Topside Set Down 31
8.5.4 As-Installed Survey of Topside 32
8.5.5 ROV Post-Installation Survey 32

10. Onboard Administration 35

11. Demobilisation and Debrief 38

12. QA and HSE Procedures 39
12.1 Quality Policy Statement 39
12.2 Standard Procedures 40
12.3 General Safety Operations 40

Figures in the Main Text

Figure 1.1: Work site location 1
Figure 1.2: HLV Rambiz hardware diagram 5
Figure 1.3: Project specific equipment 5
Figure 5.1: Standard Reference Frame for offshore survey 12
Figure 5.2: Example of permanent marking for resection 12
Figure 5.3: Example of EDM Prism mounted on handrail 12
Figure 5.4: General set up of Gyro Assembly 14
Figure 5.5: Topside Horizontal Reference Frame Determination 16
Figure 5.6: Topside Vertical Reference Frame Determination 17
Figure 5.7: Topside Equipment Installation Overview 18
Figure 7.1: Schematic overview BLHP topside, transition piece and monopile 27

Tables in the Main Text

Table 1.1: Contact details 1
Table 1.2: Equipment list 3
Table 2.1: Installation Subcontractor provided documents 6
Table 2.2: FSBV documents 6
Table 4.1: Project geodetic parameters 9
Table 4.2: Test coordinate 10
Table 4.3: System performances as per specification 10
Table 4.4: Contingency planning 10
Table 6.1: Position comparison setup requirements 25
Table 6.2: Position comparison performance standards 25
Table 7.1: BLPH monopile as-built coordinates 27
Table 8.1 HLV Positions 28

Table 8.2: Anchor Positions 29

Abbreviations

Company	Crosswind
Contractor	DEME
Installation Subcontractor	Scaldis N.V.
Survey Subcontractor	Fugro
AHT	Anchor Handling Tug
BLPH	Base Load Power Hub
C-O	Computed Minus Observed
CRP	Common Reference Point
DDPR	Digital Daily Progress Report
DGPS	Differential Global Positioning System
DP	Dynamic Positioning
FSBV	Fugro Survey B.V.
GNSS	Global Navigation Satellite System
HKN	Hollandse Kust Noord
HLV	Heavy Lifting Vessel
HSE	Health Safety and Environment
LAT	Lowest Astronomical Tide
MP	Monopile
PPE	Personal Protective Equipment
QC	Quality Control
ROV	Remotely Operated Vehicle
TMS	Tug Management System
TP	Transition Piece
TRA	Task Risk Assessment
USBL	Ultra-Short Base Line
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1. Summary of Project Details

Fugro acts as survey subcontractor to Scaldis N.V. to provide positioning services in association with the installation of the Base Load Power Hub (BLPH), located at the Hollandse Kust Noord (HKN) wind farm, 18.5 km off the coast of The Netherlands, as depicted in Figure 1.1.

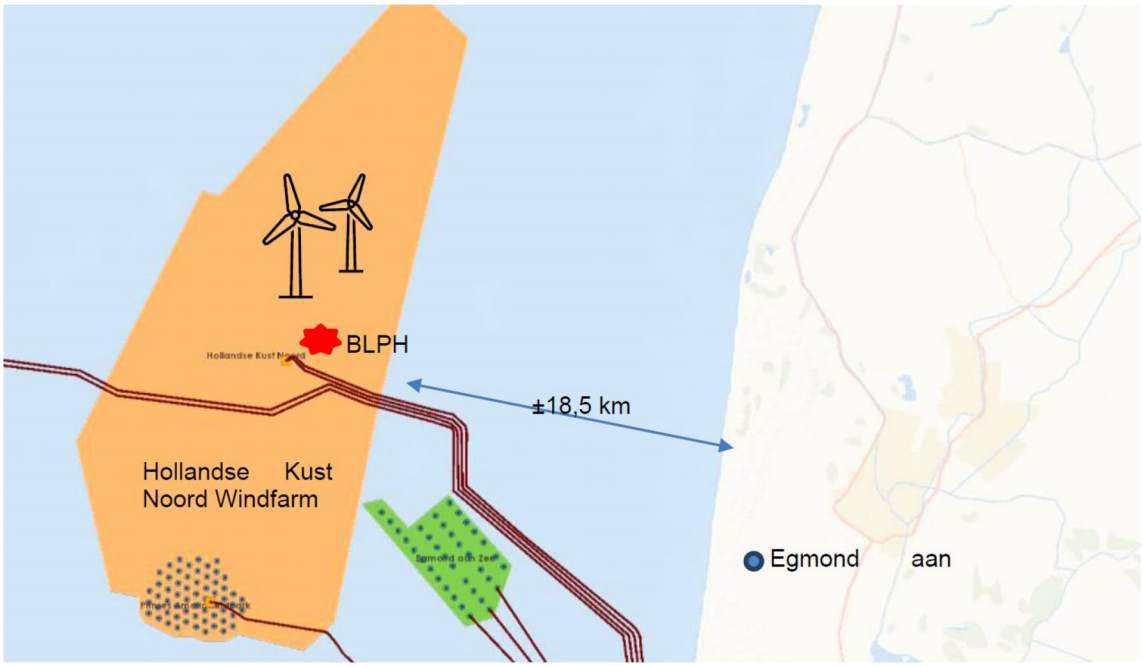


Figure 1.1: Work site location

Fugro project number CH139 is to be used on all documents pertaining to the BLPH installation.

1.1 Contractor Contact Details

Table 1.1: Contact details

Contractor		Survey Subcontractor	
Pieter-Jan Peeters – Project Manager		Liam Moroney – Project Manager	
Scaldis N.V.		**Fugro**	
North Trade Building		Prismastraat 4	
Noordelaan 133, Bus 31		2631 RT, Nootdorp	
B-2030, Antwerp		The Netherlands	
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Mobile:	+32 495 82 40 10		

1.2 Project Brief

The HKN offshore wind farm is located 18.5 km off the coast of The Netherlands, near the town of Egmond aan Zee. Water depth at the area of BLPH monopile is approximately 21 m.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub will ensure a continuous power supply regardless of the wind situation.

The BLPH is designed to integrate with one of the wind turbine generators in the Hollandse Kust Noord wind farm thereby delivering a baseload of at least 20 % of the average electricity production of a Wind Turbine Generator (WTG) (i.e., 1 MW) 99 % of the time independent of wind conditions, demonstrating time-shifting flexibility on hours-to-days resulting in reduction of the intermittent power output.

It is emphasized that this preliminary execution plan is to be regarded as a general operational plan, based on execution of the works by HLV Rambiz, on anchors. In case Installation Subcontractor chooses to perform the operations by HLV Gulliver on DP, no AHT will be mobilized.

1.3 Purpose

The purpose of this document is to define the survey procedures to be carried out by Fugro during the Crosswind HKN base load power hub project. This to ensure the specified survey scope of work is executed in accordance with Installation Subcontractor's requirements.

1.4 Fugro Scope of Work

Fugro will provide survey support during positioning and installation of the BLPH transition piece and topside.

The survey scope of work will be as follows:

Preparation and mobilisation phase:

- Review Installation Subcontractor supplied survey data related to the planned HLV activities;
- Confirm/finalise survey methodology and equipment requirements in liaison with Installation Subcontractor;
- Install positioning equipment on to the Topside and test;
- Conduct dimensional control survey of the Topside;
- Issue dimensional control report;

- Mobilise personnel and survey equipment to the HLV;
- Set up, test and calibrate positioning equipment onboard HLV;
- Mobilise AHT equipment;
- Assist in HLV anchoring positioning.

Transition Piece (TP) phase:

- Assist with ROV pre-installation survey;
- Test and provide video telemetry from TM to the HLV bridge;
- Provide heading and position of the HLV and TP ghost shape during installation.

Caisson phase:

- Provide heading and position of the HLV and caisson ghost shape during installation.

Topside installation phase:

- Provide heading and position of the HLV and Topside ghost shape during installation;
- Base case vessel positioned on anchors; back-up with DP.
- Assist with ROV post-installation survey

Demobilisation and reporting phase:

- Personnel will demobilise, whereas equipment (permanent spread) will remain mobilised for next project.
- If time allows, a compilation of field memos shall be produced on board the HLV before demobilisation, however in the event that this is not possible, a final survey report will be issued by the Fugro office reporting team following completion of the project;
- Lessons learned for the project will be formalised during personnel debriefings following demobilisation. Lessons learned will be shared with oncoming crew.

1.5 Personnel

Following survey personnel is to be mobilised onboard HLV Rambiz for this project:

- 1x Party Chief;
- 1x Surveyor;
- 2 x Survey Engineers

1.6 Equipment

The HLV Rambiz is equipped with a permanent survey spread and consists of following equipment (including spares):

Table 1.2: Equipment list

Surface Positioning	
Primary positioning (DGNSS)	Access to Starfix.G2+ signal
	1x StarPack GNSS receiver

Secondary Positioning (DGNSS)	Access to Starfix.XP2 signal
	1x StarPack GNSS receiver
Navigation Q/C	2x PC c/w Starfix Navigation Suite (Starfix.NG)
	1x GNSS Heading
	1x Access/Interface to Vessel Gyro (vessel system)
	3x Configurable remote display
	2x Configurable remote PC
	1x Network Hub with cabling
	1x Total Station (with dark eye piece)
Other (Crane Tip Monitoring)	Access to Starfix.XP2 signal
	2x StarPack GNSS receiver
Subsea positioning	GAPS USBL Head
	3x GAPS USBL transponder
Contingency TMS	2x Tug Management System StarPod (HLV)
	1x Tug Management System StarPod (AHT)

Equipment is subject to change.

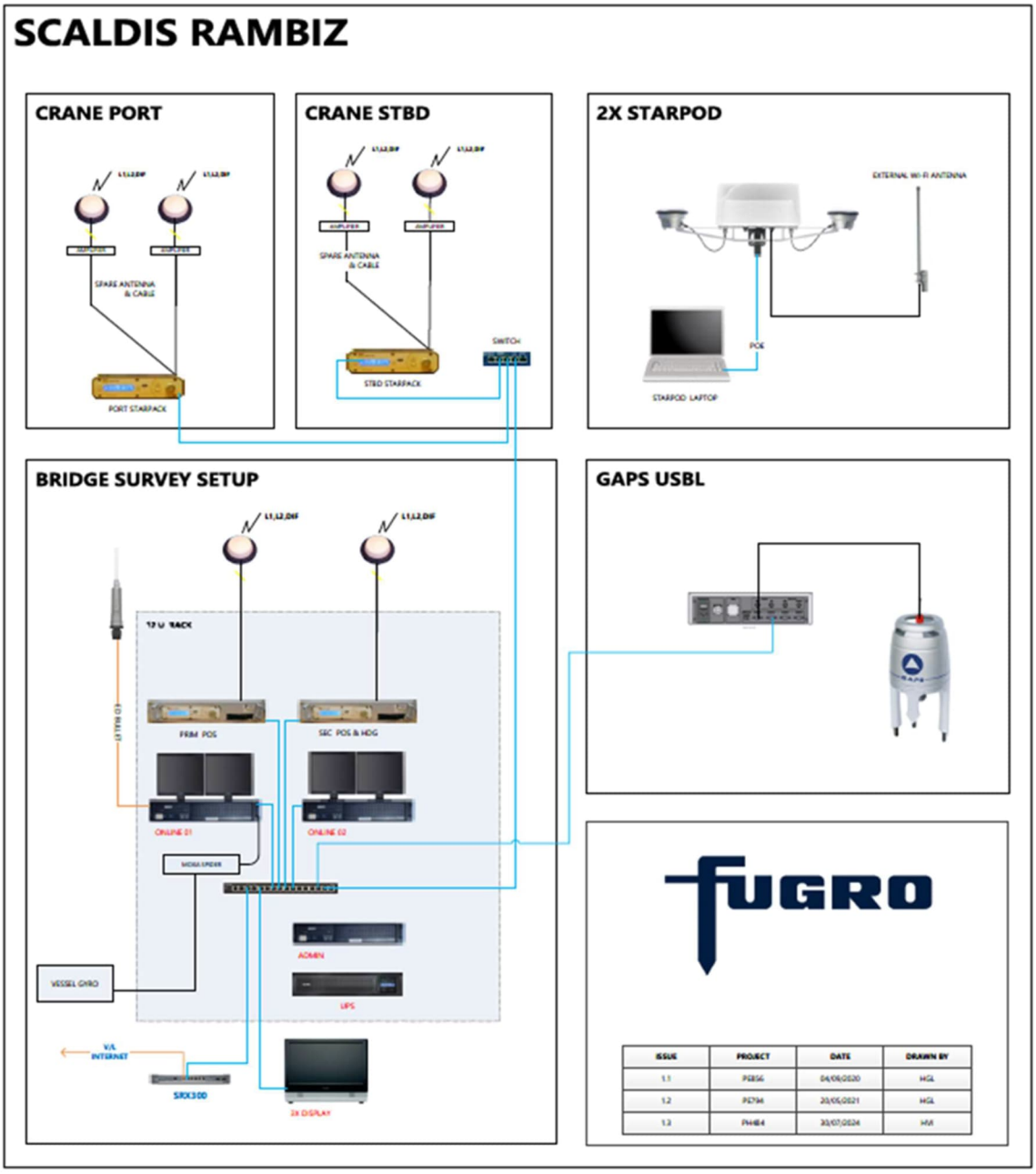


Figure 1.2: HLV Rambiz hardware diagram

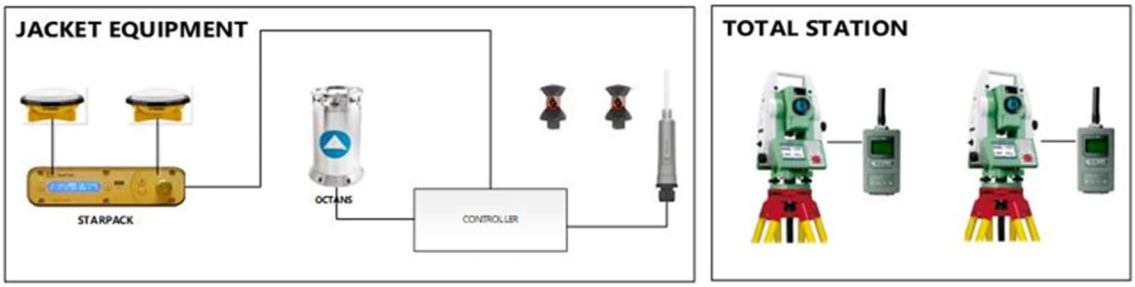


Figure 1.3: Project specific equipment

2. References

2.1 Installation Subcontractor Provided Documents

Table 2.1: Installation Subcontractor provided documents

Ref	Document No.	Title/Description
[1]	23-RE006-MST-QUO-002	Crosswind HKN Base Load Power Hub Project Preliminary Execution Plan – Offshore Installation
[2]	23-RE006-DWG-MRG-001-A2	HLV Mooring Layout – Anchor Layout

Installation Subcontractor shall ensure that the latest revision of all applicable procedures and or drawings shall be available at mobilisation.

2.2 FSBV Documents

Table 2.2: FSBV documents

Ref	Document No.	Title/Description
[3]	FSBV Management System	
[4]	FSBV HSE Guidelines	
[5]	FSBV Survey Guides	Survey work practices
[6]	FSBV Survey Forms	Equipment work practices
[7]	FSBV Technical Guides	HSE responsibilities
[8]	FSBV Work Instructions	Hazard Register

FSBV shall ensure that the latest revisions of relevant FSBV controlled documentation are available at mobilisation.

3. Responsibilities

The Manager Offshore Projects of Fugro Survey B.V. has the overall responsibility for the successful completion of the project. The Manager Offshore Projects has appointed a dedicated Project Manager to this project.

The Project Manager has the following responsibilities:

- Advise Workshop Manager of contractual project equipment requirements;
- Ensure the correct equipment is prepared and functional to meet the Installation Subcontractor 's specifications;
- Ensure that the equipment mobilisation and timing thereof are in line with contractual requirements;
- Confirm that all personnel working offshore have the necessary safety training, medical and PPE;
- Ensure that field staff is fully aware of Company and Installation Subcontractor (local) policies in respect to working safely, drugs and alcohol;
- Prepare and issue to Installation Subcontractor all necessary procedures, and other documentation as required;
- Brief the personnel and ensure that they receive the correct data/information and understand the scope of work (for this purpose, a briefing will be held prior to the field staff mobilising to site);
- Monitor the progress & status of the project and communicate with Installation Subcontractor and field staff ensuring that project requirements are met;
- Communicate with Installation Subcontractor on progress and contractual issues;
- Relay any relevant information to the survey team in the field during operations;
- Debrief field staff on completion and action outstanding issues.

The survey team leader has the following responsibilities:

- Ensure that the mobilisation, operations and de-mobilisation are conducted in accordance with the specifications and procedures outlined in this document and in Installation Subcontractor specifications;
- Issuing and QC-ing of survey data and survey related information to the Installation Subcontractor's Representative onboard, by means of field memos and field charts as applicable;
- Prepare TRA's for operations involving a risk to the survey team (such as for example back deck operations and antenna installations);
- Check that field staff properly keep the log book;
- Prepare Daily Operations Reports;
- Address HSE within the survey team, including attending HSE meetings and preparation of TRAs and Tool Box Talks;

- General communication with the Installation Subcontractor 's Representative and master onboard on positioning requirements;
- Reporting on the project status and/or progress to the Project Manager.

The survey team onboard the HLV Rambiz has the following responsibilities:

- Ensure that the positioning operations are conducted in accordance with the specifications and procedures outlined in this document;
- Communication with the team leader on progress;
- Keep the e-logbook, and ensure this addresses as a minimum:
- Work carried out and project progress;
- Situations encountered;
- Survey/project status;
- Survey results;
- Equipment status;
- Changes in personnel and / or equipment;
- Installation (as required), maintenance and, when necessary, the repair of all survey and positioning equipment onboard the HLV and AHT;
- Marking of broken equipment (if any) and preparation of paperwork (fault reports) as well as the appropriate packing of equipment for return transport.
- To conduct all operations in a safe manner and in accordance with the HSE rules laid down by the various parties;
- Attend HSE meetings.

Installation Subcontractor Representative onboard has the following responsibilities:

- Verify and confirm geodesy in use;
- Verify other survey parameters in use;
- Confirm the latest revision of survey related information, layout and/or design drawings, coordinates and database background files;
- Confirm restricted areas or safety corridors to be used;
- Sign off:
- Mobilisation completion form;
- Daily Operations Reports;
- Field memos and field reports.

4. Datums and Tolerances

4.1 Horizontal Control

The following geodetic parameters must be used:

Table 4.1: Project geodetic parameters

ED50/UTM zone 31N [UKOOA-CO]							
EPSG Code:	23031						
Global Navigation Satellite System (GNSS) Geodetic Parameters*							
Datum:	World Geodetic System 1984				EPSG Code: 6326		
Ellipsoid:	WGS 84						
Semi major axis:	a = 6 378 137.00 m						
Inverse Flattening:	1/f = 298.257 223 563						
Local Datum Geodetic Parameters†							
Datum:	European Datum 1950				EPSG Code: 6230		
Ellipsoid:	International 1924						
Semi major axis:	a = 6 378 388.00 m						
Inverse Flattening:	1/f = 297						
Datum Transformation Parameters‡ from WGS 84 to ED50							
Shift dX:	+89.500	m	Rotation rX:	+0.000	arcsec	Scale Factor:	-1.200 ppm
Shift dY:	+93.800	m	Rotation rY:	+0.000	arcsec	Coordinate Frame rotation	
Shift dZ:	+123.100	m	Rotation rZ:	-0.156	arcsec	EPSG Code: 1311	
Project Projection Parameters							
Map Projection:	Transverse Mercator						
Grid system:	UTM zone 31N				EPSG Code: 16031		
Latitude of Origin:	00° 00′ 00″ North						
Central Meridian:	003° 00′ 00″ East						
False Easting:	500 000 m						
False Northing:	0 m						
Scale factor on Central Meridian:	0.9996						
Units:	Metre						

Notes:
* = Fugro Starfix navigation software always uses WGS 84 geodetic parameters as a primary datum for any geodetic calculations
† = Source: Client
‡ = Fugro Starfix navigation software uses the right-handed coordinate frame rotation convention for reporting project coordinate reference system

Table 4.2: Test coordinate

WGS84	Test Point	Computed Point
Latitude	52° 42′ 53.35700″ N	52° 42′ 53.35700″ N
Longitude	004° 20′ 29.83900″ E	004° 20′ 29.83900″ E
ED50		
Latitude	52° 42′ 56.14200″ N	52° 42′ 56.14213″ N
Longitude	004° 20′ 34.61700″ E	004° 20′ 34.61645″ E
UTM zone 31N		
Easting	590 719.100 m	590 719.096 m
Northing	5 841 602.300 m	5 841 602.314 m
Convergence	1.06857°	1.06857°

Note: Once the parameters are entered in Starfix.NG, test calculations shall be performed using the Geodetic Parameters sheet. These parameters shall be confirmed by the Contractor and Installation Subcontractor prior to starting the project.

4.2 Vertical Datum

Vertical datum has been specified to be LAT.

4.3 Tolerances and System Accuracies

The topside will be placed on a monopile that will already be installed. As a consequence, there are no positioning tolerances specified by Contractor.

Table 4.3: System performances as per specification

System	Accuracy
Starfix.G2 surface positioning (HLV)	± 0.15 m
StarPack ProTrack heading (Primary Heading)	± 0.1° (95 % @10 m baseline between antennas)
Starfix.HP surface positioning (Crane Tip)	± 0.15m
Gyrocompass – vessel system (Secondary Heading)	± 0.5° in dynamic environment
Tape Measure	< ± 0.5 mm/5m (typically)

4.4 Contingency Planning

Table 4.4: Contingency planning

Equipment	Level 1	Level 2
HLV Positioning primary	StarPack 1	StarPack 2
HLV Positioning secondary	StarPack 2	StarPack 1
Topside Positioning primary	Visually	HLV Crane tip GNSS
Online navigation	Operational	Spare onboard
HLV Heading	StarPack ProTrack	Vessel gyro

5. Yard Surveys and Preparations

5.1 Dimensional Control Survey General Notes

Reporting

- For each structure/vessel a comprehensive field memo describing the dimensional control survey methodology, drawings, results, etc is required;
- A results summary table should be included for quick reference.

Procedures

- The following Work Instruction for Dimensional Control Surveys should be consulted:
  - FSBV-TD-WI-010.

Accuracies

- Dimensional control survey measurements shall be measured with the tolerances stated in Table 5.1 below;

Table 5.1: Dimensional control survey accuracies

Dimensional control survey accuracies		
Items	**Accuracies (at 95 %)**	**Remarks**
CRP Determination	< 5 mm	
X, Y and Z Axis	< 0.01°	
Reference points and positioning supports	< 5 mm	From CRP along X, Y & Z axis
Gyrobox plate misalignment	< 0.10°	Misalignment between gyro foundation plate and topside reference frame

Best-Fit Centres

- A minimum of 6 points equally distributed around the cylindrical structure should be measured;
- Best-fit centre utility in COGO is to be used to calculate centre position.

Reference Frame

- The reference frame shown in Figure 5.1 will be used.

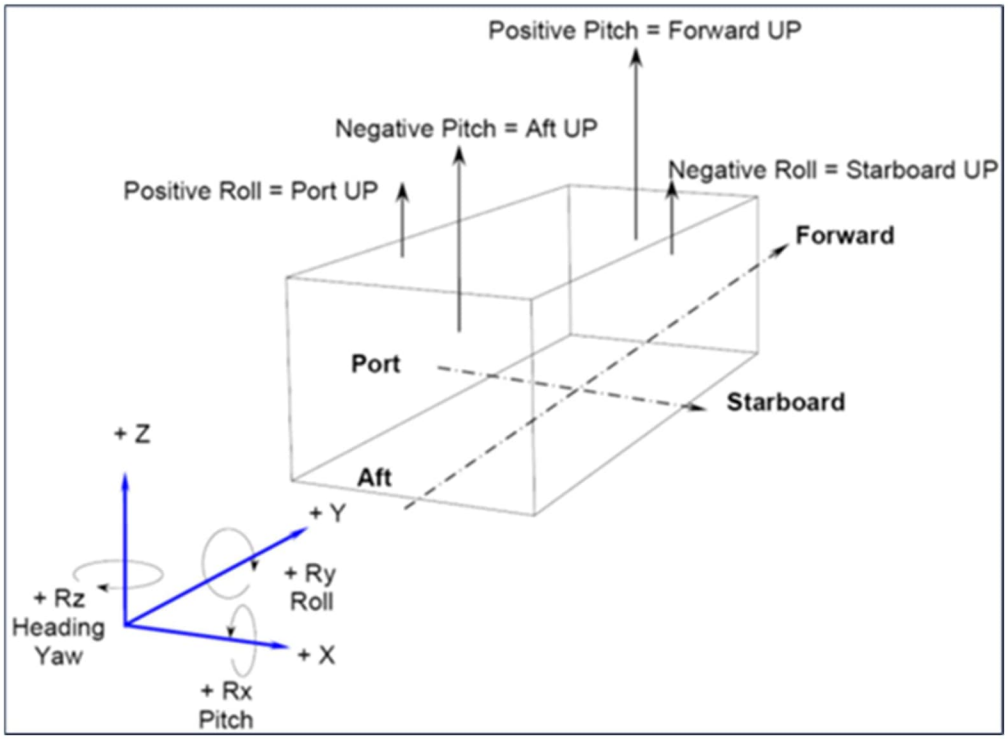


Figure 5.1: Standard Reference Frame for offshore survey

Typical Markings



Figure 5.2: Example of permanent marking for resection



Figure 5.3: Example of EDM Prism mounted on handrail

5.2 Yard Survey Report Requirements

The yard survey report shall describe as a minimum:

- Locations relative to (C)RP of all positioning aids and other relevant items;
  - Gyro Plate/Gyro Box;
  - Antennas;
- Misalignment of gyro base plate relative to topside reference plane;
- C-O for all heading, pitch and roll sensors, for each possible installation configuration on the platform;
- Flatness checks completed and results for base plates;
- (Digital) photography of (C)RPs and all installation aids;
- All raw data in order to recalculate the results and proof of measurements redundancy;
- Relevant drawings and sketches;
- Operation summary;
- Calibration certificates of used equipment, where applicable;
- Photographs detailing potential locations for cameras mounted around the docking cones.

Reports should make use of photographs and sketches to detail the yard survey results.

5.3 Gyro Plate/Gyro Box Installation

The gyro assembly design consists of a standard DIN 2527 DN 150 PN 6 blind flange, a manufactured female flange which will be bolted onto the blind flange for the entirety of the project and an Octans Gyro fixed to a male flange which has been calibrated in the Fugro Workshop. The arrangement is shown in Figure 5.4.

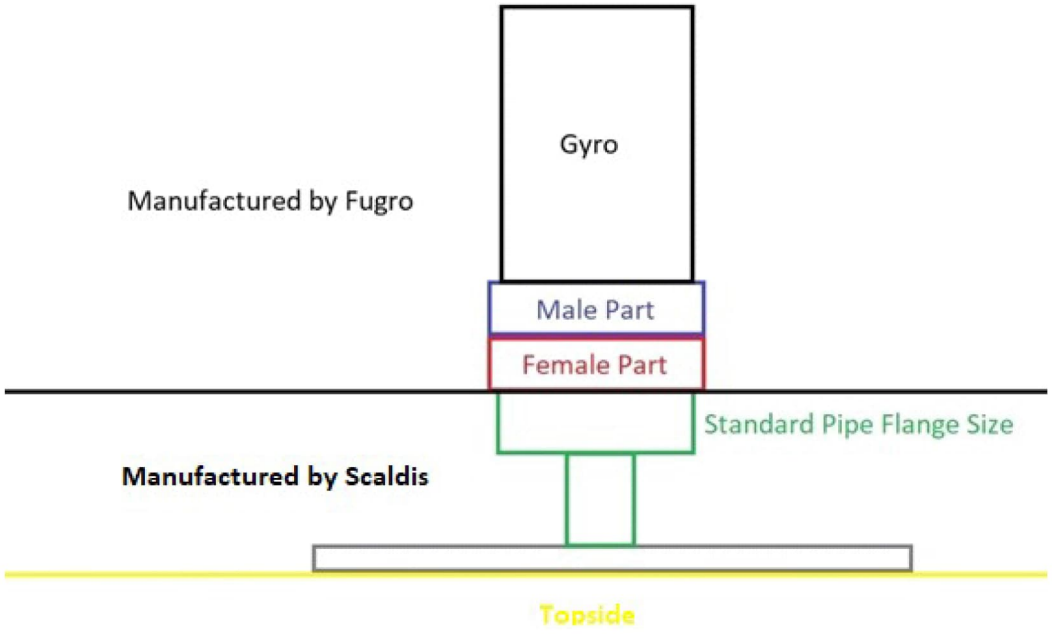


Figure 5.4: General set up of Gyro Assembly

On arrival in the yard, the female flange/Gyro Box will be attached to the mounting point on the Topside by the DC Surveyor. Before starting any measurements, the DC Surveyor will ensure that there is no movement in the female flange/Gyro Box.

5.4 Dimensional Control Survey

The dimensional control survey of the topside will be conducted prior to the start of the offshore campaign. Unrestricted access to the platform is required to complete the survey. The survey will consist of the following tasks;

- Establishing the respective reference frames with respect to the chosen CRP;
- Establishing the position aids within the reference frame;
  - EDM Prisms should be measured to the phase centre of the prism;
  - GNSS Antennas should be measured to the phase centre of the antenna;
  - **N.B. If it is not possible to measure to the phase centres of the antenna or prism this should be clearly noted within the dimensional control report.**
- Determining the pitch, roll and heading misalignment of the gyro flange with respect to the topside reference frame;
- Establishing and clearly marking multiple permanent reference points for future resections;
- Establishing and clearly marking multiple permanent reference points for future levelling;
- Points should be easily accessible for levelling and provide good rectangular geometry.
- Establishing the best fit centre of the top of each receptacle within the topside reference frame;

- Establishing the best fit centre of the bottom of each receptacle within the topside reference frame;
- Establishing any other position as may be requested by CONTRACTOR during the dimensional control survey.

5.5 Topside Reference Frame

The Topside reference frame is defined as follows:

The **CRP** of the Topside will be the Geometric Centre, defined as the intersection of the Diagonals between C2/A2 and Receptacles C4/A4 at the level of the lowest steel brace. Please note, the conventions given, refer to Fugro's own, platform design conventions may differ.

The X, Y and Z is a right-handed orthogonal frame, as shown in Figure 5.5.

The **X-axis** will be determined as shown in Figure 5.5 and as explained below:

- +ve X Axis is in the direction towards Row 3;
- Measure the best fit centre of the vertical receptacles at the bottom of topside level;
- Compute X1-axis using the C2 to A2;
- Compute X2-axis using the C4 to A4;
- Average X1 and X2 to determine the X-axis;
- Shift X origin to the CRP.

The **Y-axis** will be determined as shown in Figure 5.5 and as explained below:

- +ve Y Axis is in the direction towards Row D;
- Measure the best fit centre of the vertical receptacles at the bottom of topside level;
- Compute Y1-axis using the A2 to A4;
- Compute Y2-axis using the C2 to C4 receptacles;
- Average Y1, and Y2 to determine the Y-axis;
- Shift Y origin to the CRP.

The **Z-axis** will be determined as shown in Figure 5.6 and explained below:

- Measure the best fit centre of the receptacles at each bracing level;
- Compute the best fit centre of each bracing level;
- Compute the Z-axis using a best fit approach through the computed centres of each level;
- Shift Z origin to the CRP at the level of the lowest steel brace.

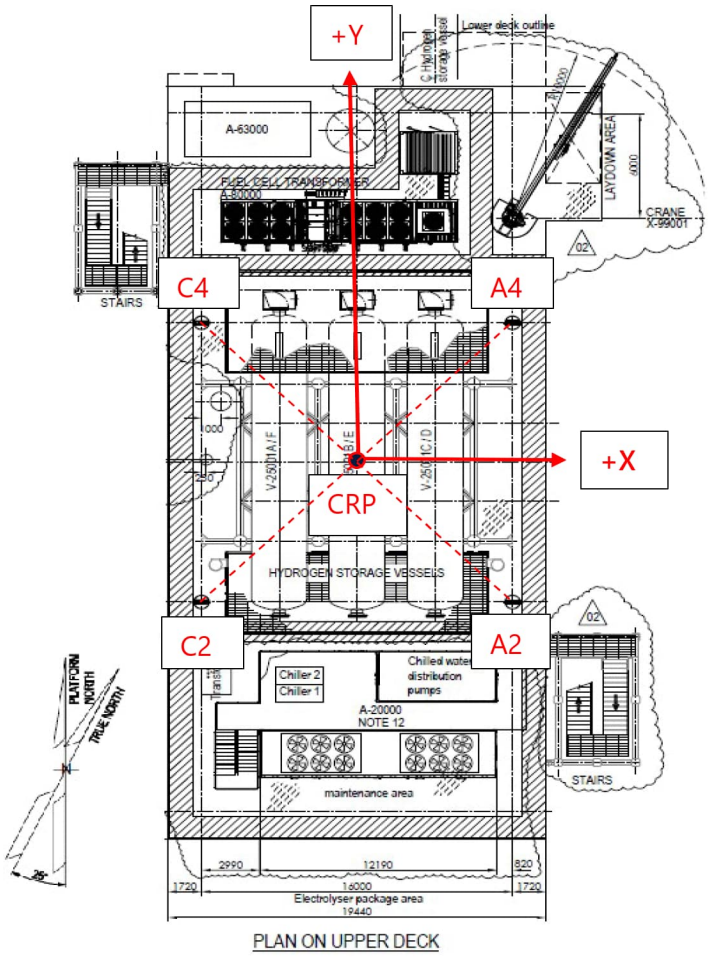


Figure 5.5: Topside Horizontal Reference Frame Determination

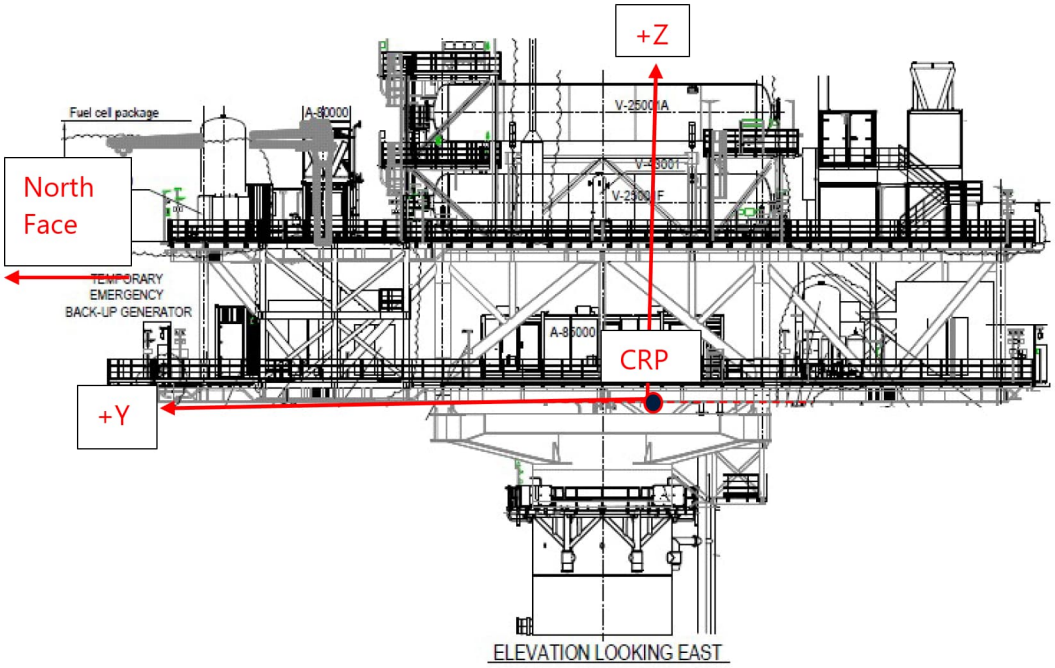


Figure 5.6: Topside Vertical Reference Frame Determination

please show the inromations included in Fig, 5.7 in a dedicated drawing

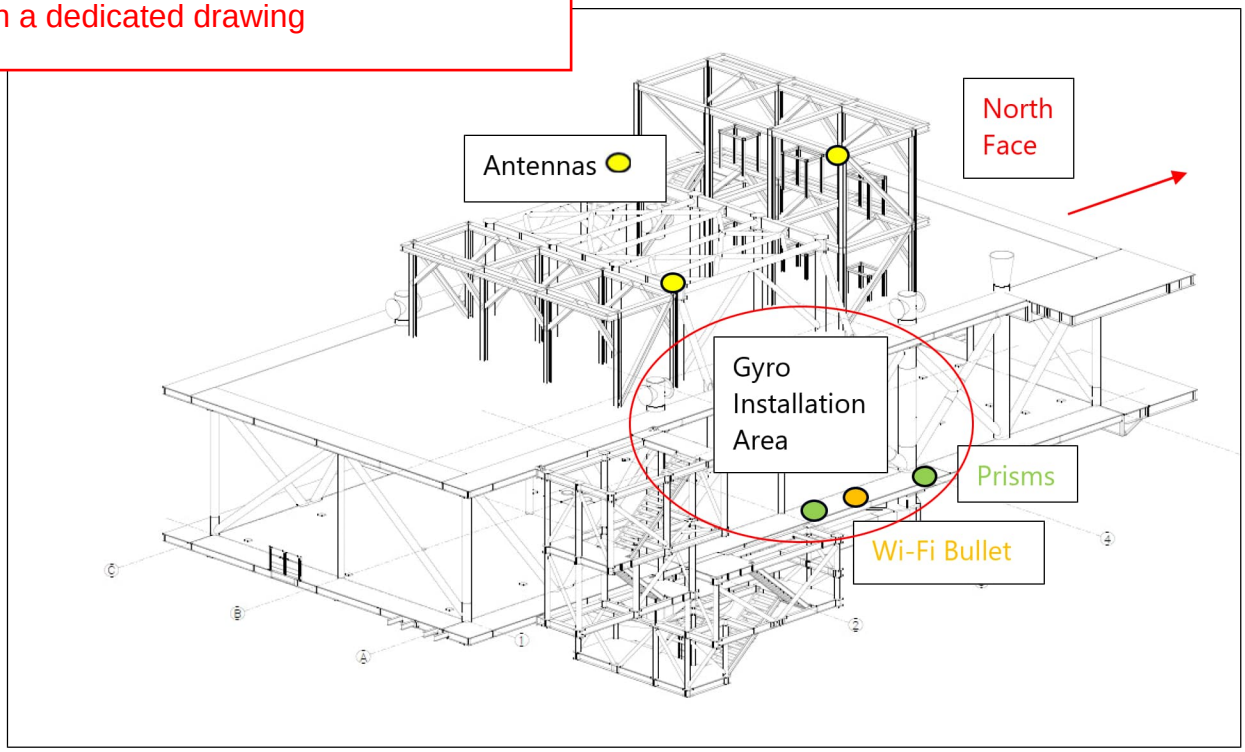


Figure 5.7: Topside Equipment Installation Overview

The positions shown in Figure 5.7 for the positioning aids for the Topside are indicative and final positions will be determined in the yard.

5.6 Yard Survey Report Requirements

The yard survey report shall describe as a minimum:

- Location of topside CRP and description of how it has been physically identified;
- Location of the geometric topside centre.
- Locations relative to CRP of all positioning aids and other relevant items;
  a. Gyro assembly flange;
  b. EDM Prisms and phase centre (if possible);
  c. GNSS antennas and phase centre (if possible);
  d. Top & Bottom centres of receptacles;
  e. Intersection of the bottom of the four receptacles (provided as an installation reference point).
- Misalignment of gyro flange relative to topside reference plane;
- C-O for all heading, pitch and roll sensors, for each possible installation configuration on the platform;
- Clear (Digital) photography of CRPs and all installation aids;
- All raw data in order to recalculate the results and proof of measurements redundancy;
- Relevant drawings and sketches;
- Operation summary;
- Calibration certificates of used equipment, where applicable;

- Reports should make use of photographs and sketches to detail the yard survey results.

6. Preparations, Mobilisation and Calibrations

6.1 Preparations

The preparations involve the following activities:

Project Manager

- Examine project details, documentation and summarise survey and positioning requirements;
- Verify latest Contractor and Installation Subcontractor requirements and specifications;
- Obtain relevant data from the Installation Subcontractor and Contractor (such as latest field layout, vessel layout and specs and specific requirements);
- Prepare listing of equipment requirements and inform workshop of equipment requirements (as applicable);
- Purchase and/or hire necessary equipment and consumables and organise shipments as required;
- Verify project specifications against specifications of survey and positioning equipment to be used on the project;
- Prepare survey procedure;
- Prepare the project field data pack with all the necessary field data in digital format. The disk contains project specific information with as a minimum target coordinates, field information (background displays for navigation computer), vessel file (if available), hardware diagrams, equipment listings, copy of project specs and documents as issued by Installation Subcontractor and Company, procedures, safety information, travel instructions and (D)GNSS information;
- Briefing of the nominated personnel on all technical, commercial and HSE aspects of the project;
- Monitor logistic requirements and arrangements for personnel and equipment.
- Workshop
- Test equipment as individual units (as applicable);
- Ensure that latest firmware and software versions are installed on equipment and that this is also available onboard;
- Set up equipment as it will be used in the field;
- Test system functionalities; all equipment shall be tested in the configuration in which it will be utilised onboard;
- Pack equipment and prepare (customs) paperwork;
- Arrange transportation to the vessel.

Survey team leader

- Familiarise with work scope, project details, field layout, survey specifications, equipment (specifications) and survey procedure;

- Prepare data files and forms to be used during operations;
- Identify calibration requirements and prepare (data) for calibration activities;
- Identify and prepare for mobilisation activities and paperwork;
- Identify field memo/report/chart requirements and prepare template(s);
- Identify initial hazards requiring a Task Risk Safety Assessment (TRA).

6.2 Mobilisation

The permanent spread survey equipment is already installed on the HLV prior to the project mobilisation. Any additional project equipment will be mobilised at the time advised by the Installation Subcontractor. Personnel will mobilise to the HLV at a port in The Netherlands. After arrival onboard HLV personnel will undergo the Installation Subcontractor and if applicable Company site induction. Personnel will be onboard during the transit from port to the worksite offshore.

Installation Subcontractor shall ensure that the latest revisions of all applicable locations, headings and drawings shall be available at mobilisation. The Team Leader shall confirm with Installation Subcontractor 's Project Engineer prior to operations that he has the latest information.

The following summarises the activities part of the mobilisation:

- Induction of all Fugro personnel with regards to safety, HSE, emergency procedures and escape routes before starting any other mobilisation activity;
- Mobilise and install additional survey equipment onboard;
- Test all equipment interfaces;
- Set up the navigation software and enter project details (geodesy, vessel file, offsets, background file(s), target coordinates);
- On completion of software setup perform a test transformation using the test point;
- Prepare print of the result; get this signed by project parties and archive on the network;
- Perform offset measurements and in-port calibrations and verifications (refer to Section 6.3);
- Prepare calibration documentation; have this signed by project parties and archive on the network;

6.3 Calibrations

A dynamic calibration will be carried out in Q1 2025. Derived values are deemed valid for this project, since GNSS antennas should not have changed position since then.

6.3.1 Onshore calibrations

6.3.1.1 Test transformation

- Prior to any other calibration activity and as soon as the survey computer has been set up, a test transformation shall be carried out using the test point provided in Section 4.1 of this procedure;
- The results, proving that the entered Geodetic and transformation parameters are entered and applied correctly in the software, shall be documented, and signed for by Contractor and thereafter filed on the network.

6.3.1.2 Offset measurements

Dimensional control of vessel previously performed.

6.3.1.3 Crane tip positions

Compare position derived from the Crane Information System with the GNSS position this should be better than 10 meters.

6.3.1.4 Dynamic Calibration

Dynamic calibration allows for calibration of vessels MRU and heading sensor equipment. The principle is based on the presence of at least three GNSS receivers plus antennas from which motion and heading are calculated and compared to vessels MRU and Gyrocompasses. Data can be used to calculate new calibrations for MRU and gyro equipment.

GNSS, heading and motion sensor data will be logged and sent to Subcontractor office for processing. Real Time Kinematic processing is used to derive the vectors for calibration of heading, pitch and roll sensors. Then, Precise Point Positioning Processing is used to derive the vessel's DGNSS positions.

The results of the GNSS processing and the logged vessel sensor data are combined in Subcontractor software to produce the deliverables:

- Heading sensor corrections;
- Motion sensor corrections;
- DGNSS system verifications;
- Full calibration report;
- Description of methodology;
- Data QC information.

Subcontractor prefers to use its dynamic calibration methodology to calibrate HLV's heading and motion sensors. This methodology can be applied when alongside or offshore. In case this cannot be followed, below separate calibration activities shall be performed which will take more time and tend to be less accurate.

6.3.1.5 Gyro calibration

- Prior to the gyro calibration, check Latitude and Speed and let the gyro settle for at least two hours.
- Leave C-Os in Online system as per last dynamic calibration. Don't set to 0 (zero) before calibrations. The aim is to find differences from previous calibrations and verifications, not new C-O values.
- Use one of the three methods mentioned below to calibrate the gyro.

Using two known points:

- Setup two total stations at a position on the quay at approximately right angles to the prisms onboard. The position of the total stations should be determined using provided reference points or in situ made post processed precise point positioning (PPP);
- Perform, at least 20, simultaneous observations of the prism positions and heading devices. The observations should be evenly spread over a period of at least half an hour to confirm the stability of the heading sources;
- The observations can be used for the GNSS verification.

Using Sun shot:

- When making sun azimuth observations make use of a total station with sun filter in front of the lens. Do not use eye pieces to darken the objective of the total station; Setup the total station on one of the predefined offsets onboard the vessel, aligned with the vessels reference grid;
- Perform, at least 15, simultaneous observations of the sun and heading devices. The observations should be evenly spread over a period of at least half an hour to confirm the stability of the heading sources.

Back to back (comparison):

In case there is no opportunity to perform heading calibration using the above-mentioned ways, use values from the previous project and check heading observations against the heading as calculated by the StarPack

- Check speed and latitude of gyro(s) as applicable;
- Vessel to remain on steady heading for two hours to allow gyro to settle;
- Perform gyro calibration (for all gyros in use) by comparing gyro reading against known heading on the quayside or against sun azimuth observation (thus creating a known heading on the vessel);
- When making sun azimuth observations make use of Total Station with sun filter;
- When the vessel is alongside, use "taped offset" or Total Station methodology.
- Perform a minimum of 10 measurements;
- Prepare gyro calibration documentation (use "Gyro Calibrations") and calculate C-O for each gyro;

- Enter C-O in software and document “C-O in use” in the e-logbook.

6.3.1.6 HLV position verification

- Should it be possible, then set up the Total Station on one of the available known points on the quayside;
- Orientate the Total Station;
- Observe and record the position of the CRP or positioning antenna by Total Station (minimum of ten times) whilst simultaneously recording the vessel primary and secondary surface position in the Starfix navigation software, CRP and positioning antenna;
- Use the ‘DGPS Verification Tool’, available in Starfix.NG
- The discrepancy between the two sets of coordinates for the HLV shall be less than 0.5 m to be acceptable.

6.3.1.7 HLV positioning system comparison

- Perform a positioning system check by comparing the CRP position as calculated from both the primary and secondary positioning systems. Use the navigation software module “Position Comparison” or the “Positioning System Comparison” form;
- Record at least 50 simultaneous positions at an interval of minimum 5 s;
- The discrepancy between the primary and secondary system shall be less than 0.5 m to be acceptable.

6.3.1.8 USBL function test

Perform a USBL system check by hanging a USBL transponder over the side of the vessel from a known offset. Compare the position provided by the USBL system to the offset. Summarize the results in a field memo and sign off the memo.

6.3.1.9 AHT Settings (in case contingency scenario is executed)

- Using tape measure or laser distance meter to determine the offset of StarPod antenna to centre stern;
- Update vessel shape accordingly;
- Compare StarPod heading to vessel heading;
- Enter heading offset in Starfix, if necessary;
- Select correct communication protocol.

6.3.1.10 Bi-Weekly comparisons for position and heading

With the ‘Position Comparison’ report in Starfix make a comparison for the position solution and heading.

Table 6.1: Position comparison setup requirements

Item	Value
GNSS Solutions in project	For all StarPacks G4+ and XP2
Log duration	4 hours
Log interval	3 minutes

The results of the position and heading comparison should fall in the following

Table 6.2: Position comparison performance standards

Item	Value
Position differences at CRP	0.20 m
Heading deviation	0.2°

6.3.2 Offshore calibrations

6.3.2.1 HLV and AHT Geodetic Datum Check

As check that the correct geodetic datum system is in use, the radar range and bearing from the HLV's to a known point (platform) near the work site shall be observed and checked against the HLV's position in the background file. This check shall be performed after arrival in the field and prior to anchoring operations.

- Compare the HLV's position relative to the platform as shown on the Radar's display against the relative position as shown on the survey screen
- In case there is a significant discrepancy (order of magnitude: 200 m +), then change the geodetic datum in the Starfix navigation software to WGS84 and repeat the steps above;
- In case the discrepancy remains significant, then further investigate and rectify the erroneous cause
- Present results to Contractor representative.

Alternatively, the following steps could be followed (if supported by the AHT's own navigation equipment):

- Verify coordinates of the platform with the Contractor representative on board;
- Confirm that the AHT's position is displayed and logged in the navigational software on board the HLV;
- On board AHT, display on the Radar screen and/or ECDIS screen a circle with a radius > 500 m centred at the platform;
- Navigate the AHT to the circle and let her circumference the platform by sailing the circle displayed on the Radar and or ECDIS screen;
- At completion of circumnavigation the platform, calculate the mean AHT position;
- Compare the calculated mean AHT coordinates against the given platform coordinates;
- In case there is a significant discrepancy (order of magnitude: > 200 m), then change the geodetic datum in the Starfix navigation software to WGS84 and repeat the steps above;

- In case the discrepancy remains significant, then further investigate and rectify the erroneous cause;
- Present results to the Contractor representative.

6.3.2.2 HLV positioning system comparison

- Perform a positioning system comparison between the primary and secondary positioning systems making use of the Starfix Positioning Comparison Report;
- Record at least 50 simultaneous positions at an interval of minimum 5 seconds;
- When using L1 service the discrepancy between the primary and secondary system shall be less than 3 m to be acceptable, when using L1/L2 service (HP, XP2, G2 or G2+) then the difference shall be less than 0.2 m to be acceptable;
- Prepare Positioning Comparison Report for Contractor representative to sign and archive on the online computer and survey network;
- Make a note of results and details in the e-logbook and update vessel set up document with latest details.

6.3.2.3 USBL Check

Given the restricted manoeuvrability of the HLV's, a USBL calibration is realistically not achievable. Moreover, as per the Contractor's requirements, the USBL system will not be used for survey related positioning, only for ROV position indication. Therefore, no calibration shall be executed. To prevent gross errors, position verification shall be carried out by manoeuvring the USBL beacon under a known point.

- Lower a USBL beacon at a known offset location o/b the HLV. The larger the offset the more accurate the correction values can be determined;
- Display the beacon's USBL position in the navigation software;
- By adjusting correction system values for heading/pitch/roll minimise the distance between observed USBL position and actual position;
- Enter correction values document in the e-logbook;
- Prepare print out of values entered and archive on the survey network;
- Gross error check results by comparing the ROV position to a known point on the seabed (if available).

7. BLPH Position

The BLPH topside will be installed on top of the monopile, caisson and transition piece. The monopile as-built position as specified by Installation Subcontractor is listed in Table 7.1.

Table 7.1: BLPH monopile as-built coordinates

Location	ED50/UTM 31N		WGS 84		Heading	Orientation Transition piece
	Easting [m]	Northing [m]	Latitude [North]	Longitude [East]	[°T]	[°T]
BLHP MP	590 719.10	5 841 602.30	52° 42′ 53.357″	004° 20′ 29.839"	335°	335°
Notes: Convergence (world) at BLPH location: 1.06857° (Grid heading = True Heading - Convergence)						

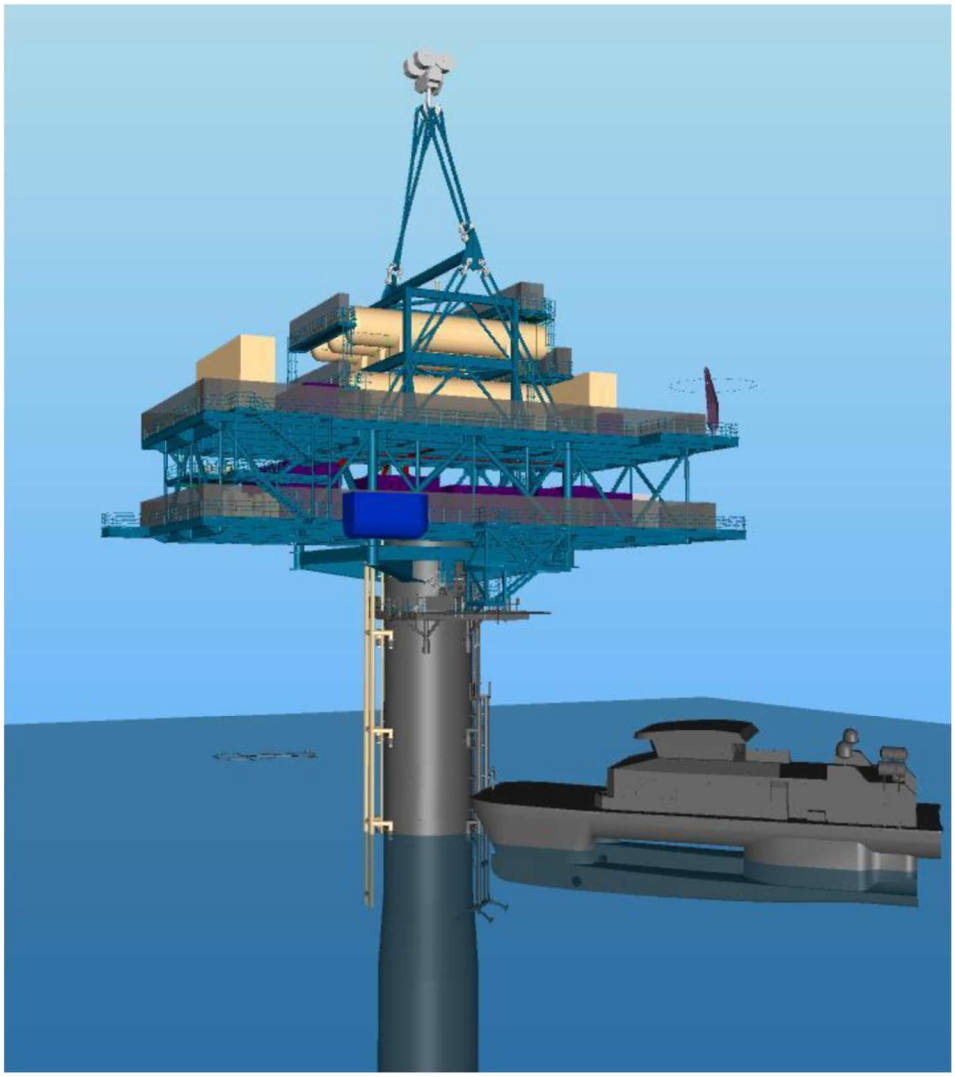


Figure 7.1: Schematic overview BLHP topside, transition piece and monopile

8. Field Procedures

8.1 HLV Positioning

On arrival at site, the HLV will be positioned at the intended location. The HLV position will be provided by two StarPack GNSS receivers. The HLV primary heading will be obtained from the StarPack GNSS receivers. Secondary heading will come from the vessel's gyro. Base case is to perform the installation with vessel on anchors (refer to section 8.1.1). Contingency is for the vessel to be in Dynamic Positioning mode.

The following data will be displayed on the HLV helmsman monitor and remote displays:

- HLV outline on the real-time position and heading;
- HLV outline on the target position and heading (ghost shape);
- Any provided background data such as existing pipelines, well-heads and (subsea) structures.

Survey personnel will assist the vessel crew during final positioning of the vessel by displaying the required offset position as requested by the vessel / installation crew. The vessel outline and the offset position(s) will be displayed relative to the target location. In addition, the distance and bearing to go to the target will be digitally indicated on the navigation display to aid the vessel crew in manoeuvring the vessel over the target location.

During the manoeuvring of the vessel, the surveyor on duty shall monitor the quality of the positioning. Should the positioning not meet the specifications in this period then the surveyor shall immediately inform the Installation Subcontractor 's Representative accordingly.

Table 8.1 HLV Positions

HLV Position	Heading	WGS84		ED50/UTM Zone 31N	
		Latitude [North]	Longitude [East]	Easting [m]	Northing [m]
Installation	245°	52° 42' 53.619"	004° 20' 30.814"	590 737.23	5 841 610.75
Standby	245°	52° 42' 54.931"	004° 20' 35.685"	590 827.87	5 841 652.99

8.1.1 Anchoring

In the case, anchoring is used for station keeping of the HLV, the following tasks shall be performed by the survey team on board:

- Install a StarPod unit on AHT;
- Establish data link between HLV and AHT;
- Set navigation display to show the following, in consultation with AHT Master and survey team:

- HLV position and heading;
- AHT position and heading;
- Monopile;
- Anchor target positions;
- Existing and relevant future assets;
- Anchor positions and fairleads;
- Assist HLV and AHT with anchoring operations;
- Record anchor dropped position, AHT Centre stern offset.

Table 8.2: Anchor Positions

Anchors	WGS84		ED50/UTM Zone 31N	
	Latitude [North]	Longitude [East]	Easting [m]	Northing [m]
Port Bow	52° 42′ 30.576"	004° 20′ 28.141"	590 700.35	5 840 897.85
Starboard Bow	52° 43′ 09.902"	004° 19′ 56.391"	590 082.04	5 842 101.85
Starboard Stern	52° 43′ 12.253"	004° 20′ 55.713"	591 193.63	5 842 195.21
Port Bow	52° 42′ 52.315"	004° 21′ 10.269"	591 478.29	5 841 584.30

8.2 ROV Survey

Prior to start of the installation and post installation, one of the HLV's ROVs shall perform a visual inspection of the monopile. Survey tasks during this operation include but are not limited to:

- Set navigation screen to display:
- HLV position and heading;
- ROV position and heading;
- Provide ROV USBL position to ROV for overlay.
- Monopile position;
- Existing and relevant future assets;
- Record any contacts or unusual observations, as requested by the Installation Contractor Project Engineer and investigate these separately by ROV video;
- Report all debris found with description and logged position;
- If any targets are deemed too obtrusive to the installation they shall be removed, provided the ROV is capable to do so;
- Record results of the survey for comparison with post-installation survey results;
- Prepare field memo detailing the pre-installation survey results and issue in timely manner to installation subcontractor representative.
- Anchor positions and fairleads;

Video recording, commentary, video overlay and reporting of this operation are responsibilities of the ROV Team.

8.3 Transition Piece Installation

Magnetic mount Wi-Fi cameras will be installed and positioned on the TP structure, in consultation with the installation subcontractor, and tested back to the installation screens on the HLV bridge.

The TP will be lifted from the transport barge, which is moored to the HLV's stern. After barge unmooring the HLV will shift to the intended installation position, which will be displayed as a TP outline (ghost shape) on the navigation display as an approximation of the TP location.

The TP's position will be determined relative to the crane tip position (derived from the GNSS receiver mounted on the crane tip) and displayed (visualised) on the navigation screen. The TP will be lifted by the crane and lowered over the proposed location. The TP heading will be aligned with respect to the HLV heading.

Survey is responsible for providing positioning data of the HLV. The final positioning and alignment of the TP during installation will be done visually by Installation Subcontractor 's representative(s). For reference, north mark on monopile should align with north mark on the TP.

No final position or heading check is required by Installation Subcontractor.

8.4 Caisson Installation

The caisson will be lifted from the transport barge, which is moored to the HLV's stern. After barge unmooring the HLV will shift to the intended installation position, which will be displayed as a caisson outline (ghost shape) on the navigation display as an approximation of the caisson location.

The caisson's position will be determined relative to the crane tip position (derived from the GNSS receiver mounted on the crane tip) and displayed (visualized) on the navigation screen. The transition piece will be lifted by the crane and lowered over the proposed location. The caisson heading will be aligned with respect to the HLV heading.

Survey is responsible for providing positioning data of the HLV. The final positioning and alignment of the caisson during installation will be done visually by eye and camera assistance by the Installation Subcontractor 's representative(s). For reference, north mark on monopile should align with north mark on the caisson.

No final position or heading check is required by Installation Subcontractor.

8.5 Topside Installation

we do not have stabbing cones on topside but stabbing guides from TP

Magnetic mount Wi-Fi cameras will be installed and positi
consultation with the installation subcontractor, and tested back to the installation screens on the HLV bridge.

The topside will be lifted from the transport barge, which is moored to the HLV's stern. After barge unmooring the HLV will shift to the intended installation position, which will be displayed as a topside outline (ghost shape) on the navigation display as an approximation of the topside location.

8.5.1 Pre-Lift Preparation

- Confirm Gyro Assembly is operational;
- Ensure that the tracking total stations are set up and referenced into the vessel frame.

8.5.2 Topside Lift from Barge

During all the topside installation duration, survey will assist with the following tasks:

- Transfer to the Topside prior to lift off to install all remaining position aid equipment;
- Prior to the Topside installation, the positioning aid systems will be tested and confirmed within the survey system. Upon verification that all survey systems are operational, the topside shall be installed by the HLV.
- Display:
    - Any obstructions in the (vicinity of) the installation area as a result of the debris survey;
    - HLV outline at actual position;
    - Topside position, heading, attitude and elevation;
    - Field layout;
    - Topside outline on the target position and heading (ghost shape);
- Monitor Survey Systems for Topside position, heading, attitude and elevation;
- Monitor HLV surface positioning solutions;
- Assist installation subcontractor with additional requirements.

As a backup, the topside's position will be determined relative to the crane tip position (derived from the GNSS receiver mounted on the crane tip) and displayed (visualized) on the navigation screen. The topside will be lifted by the crane and lowered over the proposed location. The topside heading will be aligned with respect to the HLV heading.

Survey is responsible for providing positioning data of the HLV. The final positioning and alignment of the topside during installation will be done visually by Installation Subcontractor's representative(s).

8.5.3 Topside Set Down

During the set down, primary positioning of the Topside shall be conducted using the position output derived from the GNSS Antennas.

During Set down, survey additional tasks will include but are not limited to:

- Display:

- Distance and bearing to-go-to design position;
- A circle around the design location which represents the installation tolerance;
- Topside heading and the difference to the design heading;
- Topside inclination;
- Differences between primary and secondary positioning and heading solutions.

- Provide preliminary report at the end of topside set down including Topside heading, position, attitude, and distance from design;

8.5.4 As-Installed Survey of Topside

After set-down of the topside in the intended installation position, Surveyors will be required to perform an as-installed survey of Topside. Survey tasks include but are not limited to:

- Log Octans Pitch/Roll data. 1 hour recommended: Duration to be adjusted depending on operational constraints and at the discretion of the Installation Subcontractor;
- Simultaneously log Total Station derived position, elevation and heading for comparison
- Verify that all data has been collected for the as-installed report;
- Demobilise sensitive equipment from the topside before piling operations.
- Survey to issue topside as-installed field memo.

8.5.5 ROV Post-Installation Survey

A post-installation survey shall be carried out upon completion of the installation of the Topside.

Upon completion of all installation activities, and upon instruction by the HLV Management Team, the survey team shall assist with the post-installation survey. The post-installation survey will nominally follow the same procedure and area as the pre-installation survey as detailed in Section 8.2.

Upon completion of the post-installation survey a field memo will be issued detailing the survey results.

9. Project Reporting

9.1 General Notes

General instructions from Contractor for all documentation:

All reports/memos should contain the following information:

- Project name, number (Fugro and Scaldis), and date;
- Reference to relevant section in survey and positioning task plan;
- Summary of operations (start of dive, end of dive, relevant operations);
- Results;

- Signature boxes for SUBCONTRACTOR, CONTRACTOR and CLIENT;
- Photographic records of installations, reference points, etc.

The following documentation will be prepared as a minimum during the project:

Table 8.3: Reporting Documents and Timelines

Name of Document	Type of Document	Operation	Issue Timeframe
Dimensional Control Survey	Report	After yard survey is complete and results are verified	Within 14 days from end of measurements
Vessel Mobilisation and Calibration	Report	After completion of all mobilisation and calibration tasks	Within 72 hours of completion of tasks
ROV Pre-Installation Debris Survey	Field Memo	After completion of ROV debris survey	Within 12 hours of completion
As-Installed Report	Field Memo	Upon disconnection of rigging and crane slewing clear	Within 12 hours of completion of logging
As-Built Report	Field Memo	On instruction from Project Team	Within 12 hours of completion of logging
ROV Post-Installation Debris Survey	Field Memo	After completion of ROV Debris Survey	Within 12 hours of completion
Final Survey Report	Report	After completion of all operations	Within 14 days of end of project

Any other field memos that may be required during the project and which are not listed above will be issued within a time frame discussed between the Party Chief and the Project Engineer.

9.2 Field Memos

Field Memo templates will be prepared and used for this project to minimise the time impact of reporting, and to expedite the prompt delivery of information to the Project Team.

9.3 Final Survey Report

Final report should contain as a minimum:

- Introduction;
- Brief narrative describing operations;
- Results;
- Appendices (field reports, memos, charts, drawings, etc);
  All drawings and charts will be made available in their native format upon request.
- Mobilisation & Calibration reports;
- Copies of software set-up;
- Field memos.

Final survey report should be issued to Contractor within 14 days of demobilisation.

10. Onboard Administration

General

For the duration of the project, keep detailed records of operations in the e-logbook. Prepare Daily Progress Reports as per Fugro standards and get these signed by Installation Subcontractor 's Representative.

E-logbook

The survey personnel shall keep an accurate e-logbook of the sequence of events. The e-logbook shall further contain offset diagram(s), interim and final results, anchor positions etc. A separate note shall be made as to which time basis is used for the e-logbook and the various computers.

To ensure that all relevant information is recorded in the e-logbook, please follow the instructions listed below:

a. Start each day on a new page with the day and date listed;
b. A margin must be drawn on the left for the Time entry. List the time used and if Local time is used, the difference between UTC;
c. Should the work covered carry onto the next page, add the following, (continued), behind the day and date;
d. Start the day's entry with 00:00 and carry over the description listed at the end of the previous day;
e. When the entries are completed for a day, end off with 24:00 and give a brief description of what the project status is;
f. Two parallel lines are to be drawn under the last entry for the day to signify the end of the recording for that day;
g. The left side of the book is to be used for all drawings, notes, changes in system settings, calculations, offset drawings, etc;
h. When logging data, list the file names and locations;
i. Clearly note anything to do with all calibrations and the values entered into the navigation system. Should these be altered during the project, highlight the new values as well as the reason for the change;
j. Avoid writing important information on separate pieces of paper. Log everything in the e-logbook and copy relevant information from the e-logbook;
k. List all correspondence to / from Contractor;
l. When completing the e-logbook, bear in mind that this is the primary project document that will be used by the field and office personnel. Every effort should therefore be attempted to ensure that it is as detailed as possible as well as presentable.

Daily reporting

Digital Daily Progress Reports (DDPR) shall be prepared using the DOME web interface. The daily reports shall cover the period from the moment of equipment or personnel mobilisation (whichever is first) until the moment personnel leaves the vessel. The information in this daily report is usually a short summary of the e-logbook and shall be signed by the Installation Subcontractor 's representative onboard. All relevant events described in an unambiguous manner. Results shall be clearly mentioned and recorded as such and marked preliminary as applicable.

- Specify the personnel's function in the DDPR e.g. Party Chief [Name]/Senior Sur [Name]/Senior Acoustic Sur [Name]/Sur [Name]/Eng [Name];
- Ensure that the Installation Subcontractor Representative onboard the HLV signs the DDPR;
- Clearly indicate in the relevant DDPR when any memo's / field reports were issued to the Installation Subcontractor ;
- Clearly indicate in the relevant DDPR when any operation information changes and by whom it was issued;
- Comply with the HSE section of the DDPR;
- Ensure that the scanned copy is clear and readable;
- Construction Support Vessel DDPR will always have the relevant project as the project number / code;
- Submit the original signed DDPR back to the office.

Equipment fault reports

It is of vital importance that fault reports are prepared in case of equipment failures. When fault reports are prepared these shall be included with the faulty equipment. Boxes containing such equipment shall be clearly marked as such on the outside. Fault descriptions shall be as detailed as possible and where required and/or possible provide details of the circumstances under which the fault appeared. A copy of the fault report shall be issued to the project manager lately during the debriefing session.

General data handling

- Setup survey computer network in accordance with the hardware diagram;
- Instruct staff not to connect survey network to other equipment then provided by FSBV;
- Setup file structure and instruct staff in using it (refer to F-SU06 Project Data Directory Structure);
- Make sure only relevant data from office provided project field data pack is copied into the file structure;
- Instruct staff regarding mp3 files/ movies etc (NOT to be found on any of the Starfix computers!);
- Schedule backing up of project data and setup backup software;
- Make regular backups during the project;
- Organise and clean data for final back up;

- Make two copies of final backup preferably on different media;
- Label backups and other data properly using the delivered means. Minimum information
- All data recorded, be it in digital or analogue form, shall be recorded on the data overview form(s);
- Remarks on data, such as “do not process” or a description of the activity, shall be made as necessary;
- Proper data tracking is mandatory in order to enable processing and reporting personnel to easily find their way through all recorded data.

HSE reporting

An accident/incident report is included in the Management System Field Operations. The form shall be properly dated and signed as soon as reasonably possible after the incident. The Installation Subcontractor ’s representative shall receive a copy and the original shall be submitted to the office for administration and follow-up purposes. Should it be necessary to provide additional information for the base office, then this shall be attached on a separate sheet.

Project Documentation

Following documentation is prepared as a minimum during the project:

- Mobilisation report;
- Report of test point conversion by program in final set up;
- Calibration results (including sound velocity profiles if any);
- Offset diagrams;
- Mobilisation completion/acceptance;

Following HSE related documentation is also produced during the project:

- Task risk assessments;
- Toolbox and Safety meeting documentation;
- STOP/HOC cards.

11. Demobilisation and Debrief

Upon completion of the installation operations, Fugro personnel will be demobilised via a port in The Netherlands. The permanent equipment spread will be left mobilised onboard.

Personnel shall return to shore. The Project Manager shall be advised of the estimated time of arrival of personnel.

Upon arrival back in the office, the field staff will be de-briefed as part of the demobilisation. Feedback from the debrief will be forwarded to the Installation Subcontractor, as necessary.

12. QA and HSE Procedures

12.1 Quality Policy Statement

Fugro supplies services of the highest possible standards in a challenging environment. The company provides solutions by means of professional, highly flexible, pro-active and dedicated staff. Fugro aims to become the preferred supplier to Clients and the favoured employer for staff.

It is the policy of Fugro to supply services to agreed customer requirements and within agreed time scales in the most efficient way practical and to provide a safe and healthy workplace and working environment contributing to the well-being of its employees. Health, safety and environment have equal status with other primary business objectives.

The Management System has been implemented to achieve the following aims:

1. Provide an organisation structure that ensures the continuity of company business activities and perform essential activities under controlled conditions;
2. Increase of efficiency and effectiveness of key processes and continually improve the product / services supplied;
3. Clarification of key activities to Clients and new employees. Transfer of existing Company knowledge and workmanship skills;
4. To avoid harm to its employees, (sub)contractors and all others who might be affected directly or indirectly, and to avoid material and environmental damage;
5. Commitment of management to and continual improvement of reasonably practicable achievable standards of safety, occupational health and environmental protection.

The Fugro Management System has been established to ISO-9001:2000 standards and Safety Checklist Contractors (SCC**) requirements, and is maintained to provide assurance that the services fulfil contractual obligations and provide staff with adequate training and supporting resources.

It is recognised that everyone within Fugro plays a vital role in ensuring that the product / services provided to the Company is up to the required standards. All employees are responsible for the quality of their own work carried out under safe conditions. The Management System is mandatory for all employees. The responsibility for the implementation of the Management System is a line management responsibility and ultimate responsibility for the maintenance of the Management System rests with the Managing Director.

12.2 Standard Procedures

An electronic copy of all the standard procedures, and the complete Fugro Survey Management System, will be available onboard for review and consultation by FSBV and Installation Subcontractor personnel throughout the project. They will form the basis of the setting up, calibrations, operations and presentation of the work scope described in the preceding sections of this procedure.

12.3 General Safety Operations

Upon arrival onboard all Fugro personnel will undergo an induction briefing that shall address the primary safety issues surrounding the HLV, vessels and general offshore operations. If one is available, the induction video will be shown and other visual aids utilised. Personnel shall be made aware of the following issues:

- Hot Work and Cold Work Permit Procedure;
- Life Boat drills/Fire Drills Procedure;
- Escape Routes;
- Protective Clothing Requirement;
- Risk Assessments Procedure.

All operations will be carried out in a safe and responsible manner and will not compromise Fugro, Installation Subcontractor or other personnel. Safety policies and safe working practices shall be considered at any time. All new personnel to the vessel will be given a tour of the vessel and shown all the safety features. Fire and Lifeboat drills will be held at frequent intervals, regular safety meetings will be held, and minutes kept onboard throughout the duration of the work.

Personnel will be required to actively participate in schemes designed to enhance theirs and everybody else's health and safety onboard the vessel, including muster drills.

Prior to certain operations a toolbox talk will be convened. This will be attended by all personnel concerned with the operation and will assess whether all the factors required from the operation risk assessment are in place and if the circumstances offshore at the time of the operation will require any amendments or additions to these.

Toolbox talks will also take place at the end of shift. This will effectively be an operational handover that will highlight any ongoing or new factors that are affecting the safe continuance of work.

Where appropriate, a TRA will be carried out for all operations not usually undertaken as part of the "normal" survey operations. The TRA will involve all personnel involved with the particular task.

A record shall be kept of all safety related issues (toolbox talks and risk assessment) during the project by means of:

- Safety Meeting/ Audit form for safety meetings, toolbox meetings;
- Incident Report for reporting of any incident [Ref.8];
- A note in the survey e-logbook and DDPR will record that toolbox talks and risk assessment took place.